Scientific Sessions
Contrast-enhanced spectral mammography (CESM) is an advanced application of digital mammography that uses contrast agent. But little is known about its efficacy in Egyptian patients. In this work, we aimed to share our experience in evaluating a large sector of female patients with different breast diseases using CESM.

**METHOD AND MATERIALS**
CESM was carried for 3000 patients during their daily visit to our institute from 2012–2014. Examinations were performed for staging of proved malignancy in 27% cases and to clarify nature of indeterminate lesions in another 30%. Post operative cases and follow-up cases post neoadjuvant chemotherapy were 23% and 20%, respectively. Medio-lateral oblique and cranio-caudal views were taken in low (22-33 kVp) and high (44-49 kVp) energy exposures after IV injection of non-ionic iodinated contrast agent. The diagnostic performance of the contrast enhanced mammography was evaluated and pathology from surgical specimen or ultrasound-guided core biopsy were the gold standard of reference in all cases.

**RESULTS**
CESM presented sensitivity of 88% and specificity of 86% to differentiate benign and malignant masses. For post operative cases, sensitivity was 85% and specificity was 60%. In cases on chemotherapy, sensitivity was 87% and specificity was 77%. Contrast uptake was noted in 2040/3000 (68%) lesions. Intense uptake and heterogeneous enhancement were more frequent in malignant pathology (p value ≤ 0.001). Uniform ring enhancement noted in cavity benign masses as abscess cavities and infected cysts noted in 664 cases (22.1%). Multicentric and multifocal carcinomas were detected in 42.2% (n=1266) of proved malignant masses. Statistical analysis yielded a sensitivity, specificity and accuracy of 71.4%, 37.5% and 53.3% for conventional mammograms compared to 87.5%, 75% and 80% for contrast enhanced mammograms respectively.

**CONCLUSION**
Contrast-enhanced spectral digital mammogram enhances the specificity of the standard mammogram. It presents an easy, simple and rapid contrast based method for discrimination between different breast pathologies and for follow up of chemotherapy and post operative cases.

**CLINICAL RELEVANCE/APPLICATION**
CESM represents a new era of imaging. It provides better diagnostic performance than the standard mammogram, perform proper screening for high risk patients and follow up response to different lines of management.
The purposes of this study were to examine the extent of background parenchymal enhancement (BPE) on contrast-enhanced spectral mammography (CESM) and to compare the level of BPE on CESM and breast magnetic resonance imaging (MRI).

This is a retrospective, IRB-approved and HIPAA-compliant study performed on women with or at increased risk for breast cancer who underwent screening CESM and MRI at our institution between 2010 and 2014. Need for informed consent was waived. Three readers independently rated the BPE level on each imaging modality using a categorical scale: minimal, mild, moderate, or marked.

To assess pairwise agreement between BPE levels on CESM and MRI as well as among readers, a weighted kappa (k) coefficient with quadratic weights was calculated. For overall agreement, the mean kappa and bootstrapped 95% confidence intervals (CI) were calculated with N=1000 bootstrap samples.

A total of 278 women underwent both CESM and MRI within a median time interval of 0 days (range: 0-28 days). Of these women, the BPE level determined by the three readers was minimal in 41-43%, mild in 24-34%, moderate in 17-20%, and marked in 4-16% on CESM compared to 36-46% minimal, 24-38% mild, 16-23% moderate, and 5-14% marked on MRI. The majority of women had minimal or mild BPE both on CESM (68-76%) and MRI (69-76%). Between CESM and MRI, the agreement ranged from moderate for reader 3 (k=0.55, 95% CI: 0.47-0.63) to substantial for reader 1 (k=0.66, 95% CI: 0.57-0.75) and reader 2 (k=0.67, 95% CI: 0.60-0.75).

Within CESM, the agreement for the readers was substantial at k=0.68 (95% CI: 0.62-0.73) with the pairwise agreement all being substantial (range: k=0.62-0.71). Within MRI, the agreement for the readers was substantial at k=0.75 (95% CI: 0.70-0.80) with the pairwise agreement all being substantial (range: k=0.72-0.79). Overall agreement on BPE levels between CESM and MRI and among the readers was substantial at k=0.66 (95% CI: 0.61-0.70).

The level of BPE detected on CESM is in substantial agreement with that on MRI. While increased BPE on MRI has been demonstrated to be associated with increased odds of breast cancer, additional studies will be needed to evaluate the role of BPE on CESM as a predictor of breast cancer risk.

The level of BPE detected on CESM is in substantial agreement with that on MRI and may serve as an additional marker of breast cancer risk.

The purpose of this study is to assess the correlation between the mammographic breast density and the intensity of background parenchymal enhancement (BPE) on Contrast Enhanced Spectral Mammography (CESM).

The study is a retrospective study that included 410 patients who underwent CESM. The mammographic breast density was assessed on the low-energy images and was scored on a 4-point scale on the basis of the ACR MRI BI-RADS criteria, which included the fatty (a) and the scattered fibroglandular tissue (b) breast densities and group 2 which included the heterogeneously dense (c) and the extremely dense (d) breast densities. The intensity of BPE was assessed on the subtraction high-energy images and was graded on the basis of the ACR BI-RADS breast density categories from a to d. These were further grouped into: group 1 which included the fatty (a) and the scattered fibroglandular tissue (b) breast densities and group 2 which included the heterogeneously dense (c) and the extremely dense (d) breast densities. The intensity of BPE was assessed on the subtraction high-energy images and was scored on a 4-point scale on the basis of the ACR MRI BI-RADS criteria, as minimal, mild, moderate, or marked. Statistical correlation was calculated using the Pearson correlation coefficient.

Group 1 (breast densities a and b) included 207/410 (50.5%) cases out of which 138/ 207 (66.6%) cases showed minimal and 66/207 (31.9%) cases showed mild BPE. Only 2/ 207 (1%) and 1/ 207 (0.5%) cases showed moderate and marked BPE respectively. Group 2 (breast densities c and d) included 203/410 (49.5%) cases out of which 91/ 203 (44.8%) cases showed minimal, 81/203 (39.9%) cases showed mild, 24/203 (11.8%) cases showed moderate and only 7/ 203 (3.4%) cases showed marked BPE. The intensity of the BPE showed weak positive correlation with the corresponding breast density grade (r: 0.2824) were 376/410 (39.9%) cases showed mild, 24/203 (11.8%) cases showed moderate and only 7/ 203 (3.4%) cases showed marked BPE.

CONCLUSION

Mammographic breast density shows a weak positive correlation with the intensity of BPE on CESM. While increased BPE on MRI has been demonstrated to be associated with increased odds of breast cancer, additional studies will be needed to evaluate the role of BPE on CESM as a predictor of breast cancer risk.

The level of BPE detected on CESM is in substantial agreement with that on MRI. While increased BPE on MRI has been demonstrated to be associated with increased odds of breast cancer, additional studies will be needed to evaluate the role of BPE on CESM as a predictor of breast cancer risk.

The purpose of this study is to assess the correlation between the mammographic breast density and the intensity of background parenchymal enhancement (BPE) on Contrast Enhanced Spectral Mammography (CESM).

The study is a retrospective study that included 410 patients who underwent CESM. The mammographic breast density was assessed on the low-energy images and was scored on a 4-point scale on the basis of the ACR MRI BI-RADS criteria, which included the fatty (a) and the scattered fibroglandular tissue (b) breast densities and group 2 which included the heterogeneously dense (c) and the extremely dense (d) breast densities. The intensity of BPE was assessed on the subtraction high-energy images and was graded on the basis of the ACR BI-RADS breast density categories from a to d. These were further grouped into: group 1 which included the fatty (a) and the scattered fibroglandular tissue (b) breast densities and group 2 which included the heterogeneously dense (c) and the extremely dense (d) breast densities. The intensity of BPE was assessed on the subtraction high-energy images and was scored on a 4-point scale on the basis of the ACR MRI BI-RADS criteria, as minimal, mild, moderate, or marked. Statistical correlation was calculated using the Pearson correlation coefficient.

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CONCLUSION

Mammographic breast density shows a weak positive correlation with the BPE on CESM. While increased BPE on MRI has been demonstrated to be associated with increased odds of breast cancer, additional studies will be needed to evaluate the role of BPE on CESM as a predictor of breast cancer risk.

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Participants
Chen-Pin Chou, MD, Kaohsiung, Taiwan (Presentor) Nothing to Disclose
Tsung-Lung Yang, MD,MD, Kaohsiung, Taiwan (Abstract Co-Author) Nothing to Disclose
Huay-Ben Pan, MD, Kaohsiung, Taiwan (Abstract Co-Author) Support, Hologic, Inc

PURPOSE
To assess the enhancement patterns of benign and malignant lesions on contrast-enhanced breast tomosynthesis (CEBT)

METHOD AND MATERIALS
Institutional review board approved the study. Written informed consent was obtained from all patients. A total of 140 consecutive women suspected of having architectural distortion on digital mammogram between March 2012 and April 2014 were reviewed. All women had both CEBT before biopsy. For the dual-energy CEBT, a modified Selenia Dimensions (Hologic, Inc.) machine was used. Simultaneously 2D mammogram and 3D tomosynthesis were taken after injection with iodine contrast agent. Post-contrast images were taken at 2 minutes (MLO view) and 4 minutes (CC view). The enhancement patterns were divided early enhancement in 2 minutes (type1), equal enhancement in 2 and 4 minutes (type2), late enhancement in 4 minutes (type3). The enhancement patterns were determined by consensus of two radiologists.

RESULTS
Total 151 histological results of breast lesions were available in 140 women (mean age 52 years, range 31-70 years). The pathology revealed 78 benign lesions and 73 breast malignancies (36 non-invasive and 37 invasive cancers). The enhancement patterns included 28 type 1, 65 type 2 and 58 type 3. Type 1 enhancement was found in 23 malignant lesions and 5 benign lesions, type 2 enhancement in 23 malignant lesions and 42 benign lesions, and type 3 enhancement in 27 malignant lesions and 31 benign lesions. Among 23 cancers with type 1 enhancement, 21 were invasive and 2 were non-invasive. Type 1 enhancement was highly associated with breast malignancy (p<0.01) and invasive breast cancer histology (p<0.01).

CONCLUSION
CEBT enhancement patterns in 2 and 4 minutes may predict the nature of breast lesions.

CLINICAL RELEVANCE/APPLICATION
Enhancement pattern of CEBT may pay a role for differentiating breast lesions..

Participants
Norran H. Said, MD, FRCR, Cairo, Egypt (Presentor) Nothing to Disclose
Naglaa Abdel Razek, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Engy I. Ali, MSc, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
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Ashraf Selim, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the added value of Contrast Enhanced Spectral Mammography (CESM) and Breast Tomosynthesis (BT) in the confirmation or exclusion of breast cancer after their referral from the national screening program

METHOD AND MATERIALS
After Ethics committee approval, and patients' consent, 75 women who underwent screening Digital Mammography, and were recalled by two independent breast radiologists were enrolled in the study. All patients underwent both BT and CESM, and an independent BIRADS score was given for each modality. Results were compared to pathology and follow up of negative/ typically benign findings.

RESULTS
Out of the 75 patients; 39 were recalled due to detection of a mass, 19 due to focal asymmetry, 11 due to microcalcifications, and 6 due to architectural distortion. Sensitivity, Specificity, PPV, NPV, LR positive, LR negative of CESM were 91.1, 96.7, 97.6, 87.8, 27.3, 0.09 respectively, and in BT were 86.6, 76.6, 84.7, 79.3, 3.71, 0.17. Agreement by Kappa was 0.104. CESM and BT both agreed on TP in 36 cases out of 45 proved cancers. With CESM there were 4 FN cases, from which BT could detect 3 cancers (micro calcifications). With BT there were 6 FN cases from which CESM could detect 5 cancers. There was 1 FP by CESM, and 7 by BT. Biopsy was avoided by CESM in 29 cases, and by BT in 23 cases.

CONCLUSION
CESM was able to avoid/ confirm biopsy with diagnostic certainty apart from cases with only microcalcifications as the dominant finding, where BT has shown better diagnostic capabilities.

CLINICAL RELEVANCE/APPLICATION
Both CESM and BT are now valuable tools in the recall unit of a national screening program and have proven good clinical
CEBT and DCE-MRI showed similar diagnostic performance for architectural distortion lesions on screening mammogram.

CONCLUSION
the ROC curve (AUCs) for diagnosis of malignancy were not significantly different between CEBT and DCE-MRI (all p >0.05).

for diagnosing breast cancers were 100%/38%/53% and 100%/58%/68%, respectively (all p>0.05). For all readers, the areas under pathology revealed 24 benign lesions and 8 breast malignancies. The sensitivity/specificity/accuracy between CEBT and DCE-MRI

Total 32 histological results of architectural distortion were available in 32 women (mean age 54 years, range 45-63 years). The

methodology.

Participants
Miriam Sklar-Levy, MD, Tel -Hashomer, Israel (Presenter) Nothing to Disclose
Yitzi Pfeffer, BS, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Anat Shalom, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Yael Servadio, MD, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Arie Rudnstein, MD, TelHashomer, Israel (Abstract Co-Author) Nothing to Disclose
Michael Gottlieb, MD, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Amaldo Mayer, PhD, Ramat Gan, Israel (Abstract Co-Author) Co-founder, RadLogics Inc; Officer, RadLogics Inc

PURPOSE
To assess feasibility of automatic breast lesion classification algorithm in dual-energy contrast enhanced spectral mammography and evaluate its potential for biopsy sparing in benign breast lesions.

METHOD AND MATERIALS
A retrospective study, a set of 93 breast lesions in dual-energy contrast mammography, 41 benign,52 malignant lesions. Each lesion was manually contoured using standard PACS viewer drawing tools. Based on the data set a supervised learning algorithm was developed to tell benign and malignant lesions. The algorithm automatically extracts numerical descriptors from the pixels located inside and outside the lesion. The descriptors characterizes visual patterns that appear in benign and malignant lesion. The set of numerical descriptors is appended into a feature vector characterizing the lesion. In a training phase, a linear support vector machine classifier is trained to tell apart benign and malignant lesions using a subset of the lesions represented by their feature vectors and the corresponding label (benign/malignant) provided by pathology. In a testing phase, the remaining subset of lesions is fed to the trained classifier that returns a classification score. The higher the score, the higher the probability that the considered lesion is malignant. Eventually, the score is thresholded to provide the final classification with the desired balance between sensitivity and specificity. In the performed experiments, 92 lesions were used for training and 1 for testing phases. In this leave-one-out approach training and testing were repeated 93 times, each one for a different test lesion, so that each lesion was classified exactly 1 time without contributing to the training of its classifier.

RESULTS
Setting the classification score threshold (TH) to 0.5: sensitivity=0.90, specificity=0.76, NPV=0.86. Reducing TH to 0:
sensitivity=0.98, specificity=0.54, NPV=0.96. Only 1 malignant lesion was classified as benign. Reducing TH to -0.5: sensitivity=1,
specificity=0.37, NPV=1. It provides a reduction on 37% in biopsies without affecting sensitivity

CONCLUSION
This research showed the feasibility of automatic lesion classification in dual-energy CESM with a significant potential to reduce the number of benign breast biopsies.

CLINICAL RELEVANCE/APPLICATION
Automatic lesion classification in dual-energy CESM has the potential to reduce the number of benign breast biopsies, therefore to reduce the anxiety of patients. And reduce the cost

SSA01-06 Automatic Classification of Breast Lesions in Contrast Enhanced Spectral Mammography
Sunday, Nov. 29 11:35AM - 11:45AM Location: Arie Crown Theater

Participants
Chen-Pin Chou, MD, Kaohsiung, Taiwan (Presenter) Nothing to Disclose
Tsung-Lung Yang, MD, MD, Kaohsiung, Taiwan (Abstract Co-Author) Nothing to Disclose
Huay-Ben Pan, MD, Kaohsiung, Taiwan (Abstract Co-Author) Support, Hologic, Inc

PURPOSE
To compare the diagnostic accuracy of contrast-enhanced breast tomosynthesis (CEBT) and dynamic contrast-enhanced breast MRI (DCE-MRI) for architectural distortion lesions detected on digital mammogram.

METHOD AND MATERIALS
Institutional review board approved the study. Written informed consent was obtained from all patients. A total of 32 consecutive women suspected of having architectural distortion on digital mammogram between March 2012 and April 2014 were reviewed. All women had both CEBT and DCE-MRI before biopsy. For the dual-energy CEBT, a modified Selenia Dimensions (Hologic, Inc.) machine was used. Simultaneously 2D mammogram and 3D tomosynthesis were taken after injection with iodine contrast agent and imaged between 2 and 4 minutes after injection. The BI-RADS classifications on CEBT were finally determined based on findings on combinations of 2D mammogram, 3D tomosynthesis and post-contrast subtraction 2D and 3D images. Women were also evaluated at 1.5T (GE) or 3T MRI (Siemens) with dedicated breast coil. Receiver operating characteristic (ROC) analysis was used to evaluate the performance of CEBT and DCE-MRI. Different radiologists interpreted CEBT and DCE-MRI.

RESULTS
Total 32 histological results of architectural distortion were available in 32 women (mean age 54 years, range 45-63 years). The pathology revealed 24 benign lesions and 8 breast malignancies. The sensitivity/specificity/accuracy between CEBT and DCE-MRI for diagnosing breast cancers were 100%/38%/53% and 100%/58%/68%, respectively (all p>0.05). For all readers, the areas under the ROC curve (AUCs) for diagnosis of malignancy were not significantly different between CEBT and DCE-MRI (all p >0.05).

CONCLUSION
CEBT and DCE-MRI showed similar diagnostic performance for architectural distortion lesions on screening mammogram.
CLINICAL RELEVANCE/APPLICATION

CEBT is a flexible imaging tool for differentiating architectural distortion lesions on screening mammograms.

SSA01-08  The Comparative Role of Contrast Enhanced Spectral Mammography versus Sono-Mammography in the Assessment of Patients Following Breast Surgery

Sunday, Nov. 29 11:55AM - 12:05PM Location: Arie Crown Theater

Participants
Marwa M. El Sayad, MBCh, Giza, Egypt (Presenter) Nothing to Disclose
Rasha M. Kamel, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Ayda A. Youssef, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this study is to evaluate the diagnostic accuracy of Contrast Enhanced Spectral Mammography as an adjunct to Sono-mammography versus Sono-mammography alone in the assessment of patients following breast surgery.

METHOD AND MATERIALS

The study was a prospective study that was approved by the research ethical committee of the Radiology Department. It included 38 patients (with 52 breast lesions) with history of breast surgery and indeterminate sono-mammographic findings. Patients with mastectomy bed lesions who could not perform mammography were excluded from the study. They were all scheduled for Contrast Enhanced Spectral Mammography (CESM). The identified lesions were classified into lesions at the site of the operative bed, lesions in the ipsilateral breast, yet, away from the operative bed and lesions in the contra-lateral breast. These lesions were further classified into benign or malignant by biopsy and histopathology. The sensitivity, specificity, positive and negative predictive values and likelihood ratios of sono-mammography and CESM were calculated and compared when using sono-mammography or CESM alone and when adding the three modalities together in diagnosis.

RESULTS

Out of the 52 identified breast lesions, 30/52, 57.7% were benign and 22/52, 42.3% were malignant. Eighteen out of 52 lesions, 34.6% were identified at the operative bed, 7/52, 13.5% in the ipsilateral breast, and 27/52, 51.9% in the contra-lateral breast. The calculated sensitivity, specificity, positive and negative predictive values and positive and negative likelihood ratios of sono-mammography were 81.8%, 23.3%, 43.9%, 63.6%, 1.067 and 0.779 respectively as compared to 86.4%, 90%, 86.4%, 90%, 8.636 and 0.152 for CESM. When adding CESM to sono-mammography the calculated diagnostic indices were raised to 95.5%, 96.7%, 95.5%, 96.7%, 28.636 and 0.047 respectively.

CONCLUSION

Adding CESM in the post-operative breast assessment improved the diagnostic performance of sono-mammography.

CLINICAL RELEVANCE/APPLICATION

The follow up of patients who had undergone breast surgery, especially the interpretation of findings of the postsurgical breast, represents a diagnostic dilemma. Many findings can be mistaken for cancer. CESM is a promising time saving and lower cost technique than Magnetic Resonance Imaging (MRI). It has the potential to replace MRI as an adjunct to sono-mammography in this field.

SSA01-09  Clinical Performance of Dedicated Breast Computed Tomography in Comparison to Diagnostic Digital Mammography

Sunday, Nov. 29 12:05PM - 12:15PM Location: Arie Crown Theater

Participants
Elodia B. Cole, MS, Charleston, SC (Presenter) Consultant, FUJIFILM Holdings Corporation; Consultant, Koninklijke Philips NV; Consultant, Alan Penn & Associates, Inc
Amy S. Campbell, MD, Washington, DC (Abstract Co-Author) Nothing to Disclose
Srinivasan Vedantham, PhD, Worcester, MA (Abstract Co-Author) Research Grant, Koning Corporation
Etta D. Pisano, MD, Charleston, SC (Abstract Co-Author) Founder, NextRay, Inc CEO, NextRay, Inc Research Grant, Koning Corporation Research Grant, Koninklijke Philips NV Research Grant, Zumatec, Inc Research Grant, FUJIFILM Holdings Corporation Equipment support, Siemens AG Research Grant, Siemens AG Equipment support, Koninklijke Philips NV Research Grant, Koninklijke Philips NV
Andrew Karellas, PhD, Worcester, MA (Abstract Co-Author) Research collaboration, Koning Corporation

PURPOSE

To compare the clinical performance of a three-dimensional dedicated breast computed tomography system requiring no breast compression alone (dBCT), dBCT as adjunct to two-dimensional standard view screening mammography (SM), and two-dimensional diagnostic mammography (DxM).

METHOD AND MATERIALS

Eighteen radiologists interpreted 235 cases (52 negative, 104 benign, 79 cancer; 93/235 calcifications) that were randomly selected from 478 cases enrolled under 3 different clinical trial protocols, all in diagnostic population. Each case consisted of unilateral SM, DxM and dBCT images. Each case was randomized to 3 sessions and interpreted under 3 conditions: dBCT alone, dBCT plus SM, and DxM alone with at least a 4-week washout period. Each interpretation included an overall BIRADS score and continuous probability of malignancy (POM) score. For each case, any identified lesions assigned BI-RADS category 3 or greater had its location, type, BI-RADS and POM reported. Sensitivity, specificity and area under the ROC curve (AUC) were determined with either pathology or 1-year follow-up as truth.

RESULTS

All reported performance metrics were averaged across all readers. Results are reported from analysis using BIRADS score after
dichotomizing at BIRADS 4. The sensitivity for dBCT alone was 81.78%, 87.93% for dBCT plus SM, and 84.07% for DxM. dBCT plus SM had significantly higher sensitivity than DxM (p=0.0081), and dBCT alone (p<0.0001). DxM and dBCT alone did not differ in sensitivity (p=0.1753). The specificity for dBCT alone was 49.67%, 39.65% for dBCT plus SM, and 44.84% for DxM. Neither dBCT alone (p=0.1148) nor dBCT plus SM (p=0.0745) statistically differed from DxM. dBCT alone had a significantly higher specificity than dBCT plus SM (p<0.0001). The AUC based on BIRADS (POM) were 0.716 (0.770) for dBCT, 0.723 (0.791) for dBCT plus SM, and 0.724 (0.792) for DxM. There were no statistically significant differences between the modalities based on POM (p=0.3311) or BIRADS (p=0.8569) score analyses.

**CONCLUSION**

The most effective use of dBCT for diagnostic imaging is as adjunct to standard view mammography.

**CLINICAL RELEVANCE/APPLICATION**

Dedicated Breast Computed Tomography has potential for use as a diagnostic breast imaging tool.
**SSA02**

**Cardiac (Dual-energy Cardiac CT)**

Sunday, Nov. 29 10:45AM - 12:15PM Location: S502AB

**CA CT**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

**FDA** Discussions may include off-label uses.

**Participants**

Gautham P. Reddy, MD, Seattle, WA (*Moderator*) Nothing to Disclose

Harold I. Litt, MD, PhD, Philadelphia, PA (*Moderator*) Research Grant, Siemens AG; Research Grant, Heartflow, Inc;

Johan H. Reiber, PhD, Leiden, Netherlands (*Moderator*) Stockholder, Medis Medical Imaging Systems bv

**Sub-Events**

**SSA02-01 One-Stop-Shop Cardiac Dual-Energy CT: A Gatekeeper for Invasive Coronary Angiography Early after Acute Myocardial Infarction?**

Sunday, Nov. 29 10:45AM - 10:55AM Location: S502AB

**Participants**

Wenhuan Li, MD, Beijing, China (*Presenter*) Nothing to Disclose

Kuncheng Li, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

Xiaolian Zhu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

Nan Chen, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

Qi Yang, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To assess the gatekeeper function of one-stop-shop cardiac dual-energy CT (DECT) in acute myocardial infarction (AMI) patients to avoid unnecessary invasive coronary angiography (ICA), by evaluating its diagnostic performance to detect coronary stenoses, myocardial perfusion defects, and myocardial infarction, using ICA plus 13N-ammonia/18F-deoxyglucose (FDG) PET as the gold standard.

**METHOD AND MATERIALS**

Consecutive AMI patients scheduled for ICA who have not undergone primary or rescue angioplasty were prospectively recruited. One-stop-shop DECT and 13N-ammonia/18F-FDG PET were underwent before ICA. The one-stop-shop DECT needed a dual-phase scan. First phase was scanned in arterial phase, used to reconstruct images of DECT angiography (DE-CTA) and DECT myocardial perfusion (DE-CTP). Second phase was delayed phase DECT which was scanned 10 seconds after first phase scan, used to detect myocardial infarction. Image analysis was as follow: firstly, identify the area of myocardial perfusion defects and myocardial infarction by DE-CTP and delayed phase DECT using 13N-ammonia/18F-FDG PET as the gold standard. A concordant reduction in 13N-ammonia perfusion PET and 18F-FDG metabolic PET (matching defects) indicates myocardial infarction. Then assess the presence or severity of stenoses on coronary artery supplying area of myocardial perfusion defects or myocardial infarction by DE-CTA, using ICA as the gold standard. If there were multiple plaques in coronary, the lesion with larger plaque area was considered as the culprit lesion. Significant stenosis was defined as a luminal diameter reduction of ≥50% on coronary artery.

**RESULTS**

A total of 25 patients were successfully completed one-stop-shop DECT, 13N-ammonia/18F-FDG PET and ICA. Intervals between examinations were no more than 1 week. ICA plus 13N-ammonia/18F-FDG PET showed 20 AMI patients with significant stenoses on infarct-related artery (IRA) and 5 AMI patients without significant stenoses on IRA. One-stop-shop DECT correctly identified 20 AMI patients with significant stenoses on IRA (sensitivity 100%) and correctly ruled out 5 patients AMI (specificity 100%).

**CONCLUSION**

One-stop-shop cardiac DECT has a gatekeeper function to avoid unnecessary ICA in patients early after AMI without significant stenosis.

**CLINICAL RELEVANCE/APPLICATION**

One-stop-shop cardiac DECT has a gatekeeper function to avoid unnecessary ICA in patients early after AMI without significant stenosis.

**SSA02-02 Extracellular Volume Fraction from Iodine Density Image Using Single Source Dual-energy CT: Comparison with Manual Measurement and Non-rigid Registration Approach**

Sunday, Nov. 29 10:55AM - 11:05AM Location: S502AB

**Participants**

Yasutoshi Ohta, MD, Yonago, Japan (*Presenter*) Nothing to Disclose

Shinichiro Kitao, Yonago, Japan (*Abstract Co-Author*) Nothing to Disclose

Junichi Kishimoto, Yonago, Japan (*Abstract Co-Author*) Nothing to Disclose

Tomomi Watanabe, MD, Yonago, Japan (*Abstract Co-Author*) Nothing to Disclose

Natsuko Mukai, MD, Yonago, Japan (*Abstract Co-Author*) Nothing to Disclose

Kazuhiro Yamamoto, Yonago, Japan (*Abstract Co-Author*) Nothing to Disclose

Toshihide Ogawa, MD, Yonago, Japan (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The purpose of this study was to evaluate the usefulness of myocardial extracellular volume fraction (ECV) from iodine density...
METHOD AND MATERIALS

SsDECT image was collected from patients suspected of coronary artery disease or further evaluation of reducing resection fraction. All subjects were performed non-contrast and equilibrium contrast-enhanced CT using ssDECT. Manually-measured ECV (mECV), automatically-subtracted ECV using non-rigid deformation (aECV) and equilibrium-iodine density derived ECV (iECV) using iodine density image without subtraction were calculated on the mid-left ventricular level. mECV, aECV and iECV were compared by using Pearson correlation. Agreements among three methods were assessed by using Bland-Altman comparison.

RESULTS

Twenty-two patients were evaluated. iECV was calculated without plain CT. The correlations of each ECV measurement approach were as follows: (mECV and iECV; r=0.754, p<0.001), (mECV and aECV; r=0.623, p=0.002). ECV was higher in patients with heart failure than healthy control subjects for mECV (30.73 vs. 24.45, p=0.012), nECV (30.60 vs. 24.95, p=0.027) and iECV (29.79 vs. 24.68, p=0.007). Mean radiation dose was 3.5±0.2mSv for each CT acquisition.

CONCLUSION

ECV using iodine density image correlates with ECV calculated by subtraction, which allows for the noninvasive technique quantification of the diffuse fibrosis burden in myocardial diseases with less radiation dose and without plain CT.

CLINICAL RELEVANCE/APPLICATION

ECV derived from iodine density image using ssDECT enables measurement of ECV without non-enhanced CT and discriminate patient increased ECV as well as subtraction derived ECV. This approach leads to reduction of X-ray exposure.

SSA02-03 Underestimation of Atherosclerotic Burden by Invasive Coronary Angiography Compared to Dual Energy Computed Tomography

Sunday, Nov. 29 11:05AM - 11:15AM Location: S502AB

Participants

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PURPOSE

Dual energy (DE) CTCA has emerged as a novel approach that aims to convey a more accurate assessment of atherosclerotic coronary plaques since it attenuates some of the limitations related to the polychromatic nature of x-rays, by means of synthesized monochromatic evaluation. We sought to explore the differences between atherosclerotic burden with invasive coronary angiography (ICA) and DE-CTCA in symptomatic patients.

METHOD AND MATERIALS

The present prospective study involved patients with suspected coronary artery disease (CAD) referred for invasive coronary angiography (ICA). Patients were categorized according to the atherosclerotic burden extent using the modified Duke prognostic CAD index, the CAD extension score, and the segment stenosis score (SSS), which reflect the extension and severity of the atherosclerotic burden; and the segment involvement score (SIS), which only reflects the extent of the atherosclerotic burden.

RESULTS

Eighty patients were prospectively included in the study protocol. The mean age was 62±10.9 years, and 59 (74 %) patients were male. The mean SIS (8.2±3.9 vs. 6.0±4.7, p<0.0001), modified Duke index (4.33±1.6 vs. 4.0±1.7, p=0.003), the CAD extension score (4.8±1.8 vs. 4.4±2.1, p=0.005), and the median SSS (13.5 (9.0-18.0) vs. 9.5 (5.0-15.0), p<0.0001) were significantly higher at DE-CTCA compared to ICA. DE-CTCA showed a significantly higher number of patients with any left main coronary artery lesion (46 (58 %) vs. 18 (23 %), p<0.0001) and with severe proximal lesions (0.28±0.03 vs. 0.26±0.03, p<0.0001) than ICA. Overall, DE-CTCA identified a larger extent of disease at proximal and mid coronary segments compared to ICA, particularly higher at the left main coronary artery (DE-CTCA 0.69±0.7 vs. ICA 0.29±0.6, p<0.0001).

CONCLUSION

In this study, CTCA using dual energy imaging identified a significantly larger atherosclerotic burden compared to ICA, particularly involving the proximal segments. Our findings provide further insights into the limitations of ICA and the concept of normal or near normal coronary arteries, although the potential clinical implications should be explored in further prospective natural history studies.

CLINICAL RELEVANCE/APPLICATION

Dual energy (DE) CTCA has emerged as a novel approach that aims to convey a more accurate assessment of atherosclerotic coronary plaques since it attenuates some of the limitations related to the polychromatic nature of x-rays.

SSA02-04 Dual Energy Computed Tomography Coronary Angiography. Diagnostic Performance in Patients with Intermediate to High Likelihood of Coronary Artery Disease

Sunday, Nov. 29 11:15AM - 11:25AM Location: S502AB

Participants

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Dual energy (DE) CTCA has emerged as a novel approach that shows promise to attenuate some of the limitations related to the polychromatic nature of x-rays. We sought to explore the diagnostic performance of DE-CTCA in patients with intermediate to high likelihood of CAD referred to ICA, and the influence of different energy levels and the extent of coronary calcification.

**METHOD AND MATERIALS**

Between May 2014 and January 2015, consecutive symptomatic patients with suspected CAD referred to ICA who accepted to undergo DE-CTCA and a coronary artery calcium (CAC) scoring. 45, 65 and 85 keV datasets were randomly assigned for analysis by consensus of two observers blinded to the clinical data and to energy level applied. Quantitative image quality assessment and luminal attenuation and signal noise was evaluated at the aortic root. Coronary artery calcium (CAC) scores were calculated by a forth independent observer. Each coronary segment was assigned a vessel territory and categorized into tertiles according to the individual vessel CAC score.

**RESULTS**

Sixty-seven patients were prospectively included. The mean effective radiation dose of DECT was 4.1±1.0 mSv and of CAC 0.9±0.3 mSv. The median CAC scoring was 597 (interquartile range 184-1095). Ten segments (1.0%) were deemed non-assessable among 45 keV reconstructions, compared to 5 (0.5%) among both 65 keV and 85 keV reconstructions (p=0.07, Friedman test). Image quality was significantly lower at 45 keV reconstructions. No significant differences were observed between groups regarding the diagnostic performance either on a per patient or per segment basis. Patients with moderate calcification showed a modest decrease in the positive predictive value among mid and high energy levels compared to reconstructions at 45 keV, modest improvement in likelihood ratios, and a trend towards a significant improvement in diagnostic performance with 65 keV versus 45 keV reconstructions ([45 keV, AUC 0.92 vs. 65 keV, AUC 0.96, p=0.06]. The diagnostic performance of DE-CTCA was significantly lower in segments with severe calcification, independently of the energy level applied.

**CONCLUSION**

DE-CTCA had a good diagnostic performance, with a high specificity even in patients with diffuse calcification.

**Clinical Relevance/Application**

Dual energy (DE) CTCA has emerged as a novel approach that shows promise to attenuate some of the limitations related to the polychromatic nature of x-rays.
DE-CTMPI datasets may be routinely reconstructed with a BHC algorithm to decrease beam-hardening artefacts and improve assessment of the myocardium.

SSA02-06 Diagnostic Value of Spectral CT Combined with Serum Biomarkers in Determining Coronary Artery Plaque Characteristics-A Preliminary Study

Sunday, Nov. 29 11:35AM - 11:45AM Location: S502AB

Participants
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Purpose
The aim of the present study was to evaluate the value of spectral computed tomography (CT) in determining coronary plaque composition and in reflecting coronary plaque vulnerability which were compared with CT values and the findings of serum biomarkers as the reference standard.

Method and Materials
107 consecutive patients (65 males and 42 females) underwent coronary CTA on a GSI capable 64-slice CT scanner. Plaques were divided into 5 groups according to MSCT criteria (plaque density expressed by Hounsfield units [HU]) and the size of calcification in mixed plaques. Spectral curve and effective atomic number and two-material decomposition (FAT and HAP) technique were used to analyze coronary plaques. The vulnerability of plaques was determined by serum biomarkers including soluble OX40 ligand (sOX40L) and matrix metalloproteinases (MMP-9) and lipoprotein associated phospholipase A2 (Lp-PLA2). The concentration of serum biomarkers were measured by ELISA.

Results
159 coronary artery plaques were analyzed. 90 cases of blood samples were obtained, and 42 cases were negative on CT. By measuring CT values, the plaques were classified as fibrous (group 1, n=29), which had a density of 61-129 HU (75±20 HU), soft (group 2, n=35), which had a density of 61-129 HU (75±20 HU), mixed plaques with larger (group 4, n=40.465±196 HU) or spotty (group 5, n=31, 53±32 HU) calcification were also analyzed. Except the value of FAT between group 1 and group 5 and between group 2 and group 5, there were statistically significant differences of four spectral results among the 4 groups (p<0.05). Levels of three serum biomarkers were significantly higher in positive patients (p<0.05). There were significant differences of MMP-9 levels between group 2 and group 3 (p<0.05). Negative correlations were found between serum MMP-9 levels and CT density (r=-0.501, p<0.05) and effective atomic number (r=-0.372, p<0.05) and slope of spectral curves (r=-0.378, p<0.05) and value of HAP (r=-0.411, p<0.05).

Conclusion
Our results indicate that spectral CT might be used to differentiate atherosclerotic plaques. Serum levels of sOX40L and MMP-9 and Lp-PLA2 correlate with the coronary atherosclerosis, and the elevated levels of MMP-9 might be associated with coronary plaque vulnerability.

Clinical Relevance/Application
Spectral CT might be used to differentiate atherosclerotic plaques and indicate coronary plaque vulnerability.

SSA02-07 Interobserver Agreement of Stress Rest Dual Energy CT Myocardial Perfusion

Sunday, Nov. 29 11:45AM - 11:55AM Location: S502AB

Participants
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Purpose
The objectives of this paper are to determine the interobserver variability in the evaluation of myocardial perfusion defects by Stress-Rest DECT myocardial perfusion and to assess the Sensitivity (S), Specificity (Sp), Positive predictive value (PPV) and Negative predictive value (NPV) of two observers in correlation with SPECT findings.

Method and Materials
We evaluated 20 patients with known or suspected coronary disease who had a positive exercise test for ischemia or had an indication of SPECT. Prospective ECG-triggered cardiac DECT was performed with a 128 slice CT scanner (Discovery CT750 HD; GE Medical Systems). First a stress CT scan was carried out and 30 minutes later a rest CT scan was complemented. Dipyridamole was used for stress myocardial perfusion imaging in both CT and SPECT studies. The protocol was approved by an Institutional Ethics Committee and all patients signed an informed consent. A 17 segmental model analysis was done using the DECT monochromatic data at 70 kev by two independent observers. SPECT analysis was done and compared with DECT. Statistical analysis: The 95% confidence interval of the proportions was calculated by the exact binomial method to determine the presence of myocardial perfusion defects for both observers (O1; O2). Interobserver agreement between both observers was measured by the kappa coefficient.

Results
There were 680 myocardial segments for analysis. For the detection of myocardial perfusion defects for O1 and O2: S, Sp, PPV and
NPV were 82.1%, 96.74%, 85.48%, 96.04% and 83.3%, respectively. The correlation between O1 and O2 was k= 0.79 (0.71 to 0.86). The mean radiation dose for each patient was 7.1 +/- 1.2 mSv.

CONCLUSION
There was good interobserver agreement of Stress-Rest DECT for the detection of myocardial perfusion defects as well as adequate sensitivity and specificity with SPECT findings, with similar radiation dose than single energy CT scans.

CLINICAL RELEVANCE/APPLICATION
Stress-Rest DECT for the detection of myocardial perfusion defects is feasible and shows a good performance compared to SPECT scans.

SSA02-08 Improvement of Image Quality Using Adaptive Statistical Iterative Reconstruction in the Evaluation of Chronic Myocardial Infarction Using Iodine Density Image with Spectral CT

Sunday, Nov. 29 11:55AM - 12:05PM Location: S502AB

Participants
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PURPOSE
The aim of this study was to evaluate the effect and determine the optimal blend percentages of adaptive statistical iterative reconstruction (ASiR) for iodine density imaging (IDI) of myocardial late iodine enhancement (LIE) in the evaluation of chronic myocardial infarction (CMI) with spectral CT.

METHOD AND MATERIALS
A total of 28 patients underwent cardiac LIE using single source dual-energy CT scanner (DiscoveryCT 750HD, Freedom Edition: GE). IDI between 0% and 100% of contributions of ASiR in 10% increments were reconstructed. The signal-to-noise ratio (SNR) of remote myocardium and the contrast-to-noise ratio (CNR) of infarcted myocardium were measured. Transmural extent of infarction was graded by using a 5-point scale (0 = no late enhancement, 1 = late enhancement with 1-24% of transmural extent, 2 = 25-49%, 3 = 50-74%, 4 = 75-100%). The SNR, CNR, and transmural extent were assessed in a contribution ratio of each ASiR. The transmural extents were compared with MRI as a reference standard.

RESULTS
In comparison with 0% ASiR, the use of 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100% ASiR resulted in reduction of image noise between groups (-5.4%, -12.9%, -20.3%, -26.9%, -34.0%, -41.3%, -47.6%, -54.0%, -60.1% and -64.8%, respectively; p<0.01) without difference in signal (p=NS). Compared with 0% ASiR images, reconstruction with 100% ASiR image demonstrated the highest improvement in SNR (229%; p<0.001) and CNR (199%; p<0.001). 80%-100% ASiR demonstrated the highest ratio (73.7%) of accurate transmural extent classification in comparison to MRI.

CONCLUSION
ASiR intensity of 80% to 100% improves image quality without changes in signal and maximizes the accuracy of transmural extent in infarcted myocardium.

CLINICAL RELEVANCE/APPLICATION
Use of ASiR improves the image quality of LIE on iodine density image and leads to accurate diagnosis of transmural extent.

SSA02-09 Reduction of Coronary Motion Artifact in Monochromatic Imaging at Various Energy Levels Using a Motion Correction Algorithm in ECG-gated Single-source Dual-Energy Coronary CT Angiography with Rapid Switching of the Tube Voltage: Clinical Impact

Sunday, Nov. 29 12:05PM - 12:15PM Location: S502AB

Participants
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PURPOSE
To investigate the clinical impact of reduction of coronary motion artifact in monochromatic imaging (MI) at various energy levels obtained using a motion correction algorithm (MCA) in electrocardiography-gated single-source dual-energy coronary computed tomography angiography with rapid switching of the tube voltage (DECTCA)

METHOD AND MATERIALS
We retrospectively assessed 134 consecutive patients (73 men; mean age 68 ± 11 years; mean heart rate 53.7 ± 5.0 bpm) who underwent DECTCA. On 65-keV MI reconstructed at the optimal cardiac phase without the MCA using the detail kernel, adaptive statistical iterative reconstruction algorithm (50% blending ratio), and 20-cm field of view, 3 readers independently graded per-vessel coronary motion artifact from one (poor) to 5 (excellent) (3 to 5, interpretable) for the right (#one to 3) and left coronary arteries (#5 to 8) and left circumflex artery (#11, 13). For 30 uninterpretable vessels in 24 of 134 patients, MI was reconstructed...
at 45 to 105 keV at 20-keV intervals with the MCA; the readers regraded per-vessel coronary motion artifact on the MI; and the percentage of interpretable vessels achieved with the MCA was calculated at each energy level. We compared grades between images obtained with and without the MCA using Wilcoxon signed-rank test and for each energy level with the MCA using Kruskal-Wallis test.

RESULTS
For the 30 vessels in 24 patients that were uninterpretable without the MCA, 26 (87%) at 45 and 65 keV, 21 (70%) at 85 keV; and 16 (53%) at 105 keV were interpretable with the MCA. Grades of coronary motion artifact were 1.6 ± 0.5 at 65 keV without the MCA and 3.7 ± 1.0 at 45 keV, 3.6 ± 1.0 at 65 keV, 3.1 ± 1.1 at 85 keV, and 2.8 ± 1.2 at 105 keV with the MCA. Grades were significantly better with the MCA than without at any energy level (P < 0.01 for all), and the grade with the MCA between any 2 energy levels (P > 0.05) differed significantly only between 45 and 105 keV.

CONCLUSION
Use of the MCA on MI at 45 to 65 keV is clinically useful for reducing coronary motion artifact in DECTTA.

CLINICAL RELEVANCE/APPLICATION
Use of the MCA for MI at a lower keV is clinically useful to reduce coronary motion artifact and improve image interpretability and diagnostic accuracy in DECTTA.
Cardiac (Anatomy and Function)

Sunday, Nov. 29 10:45AM - 12:15PM Location: S504AB

CA CT MR

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants
Gregory W. Gladish, MD, Houston, TX (Moderator) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Cleveland, OH (Moderator) Institutional Research Grant, Koninklijke Philips NV

Sub-Events
SSA03-01 Utility of Ungated Free-breathing Through-time Radial GRAPPA in Pediatric Cardiac MRI- Preliminary Results

Sunday, Nov. 29 10:45AM - 10:55AM Location: S504AB

Participants
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PURPOSE
Cardiac MRI (CMR) sequences require ECG gating and multiple breath holds, which may be difficult in children and often require general anesthesia. We sought to compare the image quality and quantitative ventricular parameters with ungated free breathing through-time radial GRAPPA to gold-standard breath-hold cine sequences.

METHOD AND MATERIALS
The study included 9 patients, 7 on 1.5 T and 2 on 3 T scanners. Both gold-standard breathheld SSFP scans with ECG gating and free breathing ungated highly under sampled radial bSSFP scans were acquired. Radial data was reconstructed using through-time radial GRAPPA. ESV, EDV, EF and mass were assessed for both scans and compared using two-sided t-tests. Images were evaluated by two independent cardiac imagers for several features including endocardial border detection, blood pool, myocardium, mitral and tricuspid valve, global and regional cardiac wall motion abnormalities on a 5 point scale (1- worst, 5- best). Artifacts were graded on a 5 point scale (1- no artifacts, 5- extensive artifacts).

RESULTS
There was excellent correlation of quantitative measurements between the two MRI techniques (EF R=0.89, EDV R=0.99, ESV R=0.93, mass R=0.98). The differences in EF, EDV, ESV and mass between gold-standard and real-time methods were not statistically significant. For the Bland-Altman plot, the mean difference of the measurements between the gold-standard and real-time methods was -0.35% (1.57% and -2.27%) and 95% limits of agreement contained 100% of the difference scores. On qualitative assessment, mitral valve was seen well (p=0.01) in SSFP but all the other features were comparable in both sequences. The mean artifact score was significantly lower in the real-time images (1.1 vs 2.8, p < 0.005). The mean scan time was also shorter with real-time real-time method (4.1 mins vs 6.5 mins, p < 0.001)

CONCLUSION
Real-time functional CMR with through-time radial GRAPPA performed without ECG-gating under free-breathing can be considered as an alternative to gold-standard breath hold cine imaging for the evaluation of quantitative and qualitative parameters in pediatric patients with comparable results, fewer artifacts and shorter scan times.

CLINICAL RELEVANCE/APPLICATION
This novel sequence is useful in cardiac MRI of children, who often are not compliant with breath holding instructions and may thus obviate the need for general anesthesia in these children.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator

SSA03-02 Accuracy, Precision, and Inter-Observer Variability of Left Ventricular Mass Quantification with 4D Flow MRI

Sunday, Nov. 29 10:55AM - 11:05AM Location: S504AB

Awards
CONCLUSION

Compared to FT analysis, DRA demonstrates superiority in repeated measurements (intra-observer agreement) for DRA (0.9903; 95% CI: 0.9815 to 0.9950) as significant correlation (r=0.34; P=0.049). DRA demonstrated significantly lower intra-observer variability in comparison to FT analysis. While GLS data based on FT analysis did not significantly correlate to STE (r=0.09; P=0.61) DRA derived GLS showed significant correlation (r=0.34; P=0.049). DRA derived GLS was significantly different from STE (-23.2±3.9%; P<0.0001) and DRA (-16.0±1.7%; P<0.0001) was significantly different from STE (-21.8±1.6%) and SSFP (ED ICC 0.989 (95% CI 0.980, 0.993); ES ICC 0.989 (95% CI 0.980, 0.994)).

RESULTS

In this prospective study, 28 patients with thalassemia major and 10 healthy volunteers underwent cardiac MRI at 1.5T (Avanto fit, Siemens, Germany). LV peak systolic global longitudinal (GLS) based on 3 long axis SSFP cine images was measured using MR feature tracking (2D Cardiac Performance Analysis MR, Tomtec, Germany) and a prototype automatic contouring tool with integrated inverse deformable registration analysis (DRA) (TrufiStrain, Siemens CT, Princeton, US) based on material coordinates. Complete ventricular coverage was obtained with both axial 4D flow and standard two-dimensional short-axis multi-slice SSFP sequences. Two blinded cardiovascular imagers independently segmented the images for LV myocardium on end systolic (ES) and end diastolic (ED) images, thus yielding four blinded measurements of LV mass by each imager in each subject. Linear regression, ANOVA, Bland-Altman analysis, and intra-class correlation (ICC) were used to assess the hypothesis that the accuracy, precision and inter-observer variability of LV mass measurements are not significantly different between 4D flow and cine SSFP acquisitions.

CONCLUSION

Ferumoxytol-enhanced 4D flow MRI determines LV mass with comparable precision, accuracy and inter-observer agreement relative to cine SSFP.

CLINICAL RELEVANCE/APPLICATION

4D flow imaging allows for accurate and reliable assessment of LV mass, potentially reducing costs and increasing patient comfort due to shortened data acquisition times.

SSA03-03 Deformable Registration Based Analysis of Cine MR for Quantification of Regional Myocardial Function: Comparison to MR Feature Tracking and Speckle-Tracking Echocardiography

Sunday, Nov. 29 11:05AM - 11:15AM Location: S504AB

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Bernd J. Wintersperger, MD, Toronto, ON (Abstract Co-Author) Speakers Bureau, Siemens AG; Research support, Siemens AG

METHOD AND MATERIALS

In this prospective study, 28 patients with thalassemia major and 10 healthy volunteers underwent cardiac MRI at 1.5T (Avanto fit, Siemens, Germany). LV peak systolic global longitudinal (GLS) based on 3 long axis SSFP cine images was measured using MR feature tracking (2D Cardiac Performance Analysis MR, Tomtec, Germany) and a prototype automatic contouring tool with integrated inverse deformable registration analysis (DRA) (TrufiStrain, Siemens CT, Princeton, US) based on material coordinates assessment (Lagrangian strain). Repeated analysis was performed for both MR approaches to assess for measurement variability. 2D speckle-tracking echocardiography (STE) (EchoPAC, GE, UK) was performed within 2h of the MR examination.

RESULTS

STE based longitudinal strain analysis was feasible in 89% of subjects while both MR approaches successfully analyzed all data sets (100%). GLS measured by FT (-23.2±4.3%; P < 0.0001) and DRA (-16.0±1.7%; P < 0.0001) was significantly different from STE (-19.9±1.6%). While GLS data based on FT analysis did not significantly correlate to STE (r = 0.09; P = 0.61) DRA derived GLS showed significant correlation (r = 0.34; P = 0.049). DRA demonstrated significantly lower intra-observer variability in comparison to FT analysis (COV (%): 1.63 vs. 6.22, F = 14.43, p < 0.001) with also low inter-observer variability (COV 3.179%). Assessment of ICC also demonstrates superiority in repeated measurements (intra-observer agreement) for DRA (0.9903; 95% CI: 0.9815 to 0.9950) as compared to FT analysis 0.9659 (95% CI: 0.8479 to 0.9874).

CONCLUSION

The aim of this study is to assess deformable registration algorithms using cine SSFP data for analysis of myocardial strain in comparison to cine SSFP feature tracking (FT) and speckle-tracking echocardiography (STE).
Deformable registration based analysis of cine SSFP data is a novel semi-automated method that allows assessment of longitudinal deformation with superior reproducibility in comparison to MR feature tracking approach. Although DRA derived GLS values differed from those obtained by STE and FT MR methods, the values were still within the published normal values.

**CLINICAL RELEVANCE/APPLICATION**

Strain analysis is an important measure of regional ventricular function and subclinical myocardial dysfunction. Automated, accurate and reproducible assessment of strain using standard Cine SSFP data can promote routine use in clinical practice.

**SSA03-04 Feature Tracking Cardiac MRI Reveals Abnormalities in Ventricular Function in Patients with Bicuspid Aortic Valve and Normal Ejection Fraction**

Sunday, Nov. 29 11:15AM - 11:25AM Location: S504AB

Participants
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**PURPOSE**

Prior echocardiographic studies of congenital bicuspid aortic valve (BAV) have found evidence of subclinical systolic and diastolic dysfunction. Patients with BAV commonly undergo cardiac magnetic resonance imaging (CMR) for evaluation of valvular function and aortic dimensions. Feature tracking CMR (FT-CMR) is a technique that allows for assessment of myocardial strain using standard 2D cine sequences. The purpose of this study was to investigate differences in myocardial strain between BAV patients with preserved ejection fraction and healthy controls using FT-CMR.

**METHOD AND MATERIALS**

Patients with isolated BAV and normal ejection fraction (EF), who had previously undergone CMR (n=36), were compared to an age- and sex-matched sample of healthy control subjects (n=10). FT-CMR strain analysis software (Circle Cardiovascular Imaging, Inc.) was used to measure LV mass, EF and 2D ventricular strain parameters. Comparison of means was performed with student's t-test assuming unequal variance.

**RESULTS**

Average age was 30.4 ± 10.7 for the BAV group and 29.4 ± 8.7 for healthy controls (p=0.8). Gender distribution was similar between groups (BAV: 47% F, Control: 50% F). The majority of BAV patients had mild or no valve dysfunction by echocardiography (stenosis: 64%, insufficiency: 72%). There was a trend towards higher global peak circumferential and radial strain in BAV patients compared to controls [(19.8 ± 1.8 vs. -18.8 ± 1.2%, p=0.07) and (40.3± 6.4% vs. 36.8 ± 4.3, p=0.08) respectively], but these differences did not reach statistical significance. Compared to controls, myocardial mass index was higher in BAV patients (61.3 ± 13.5 vs. 46.1 ± 8.7 g/m2, p<0.001). Peak diastolic circumferential and radial strain rates were lower in BAV patients compared to controls [(0.83 ± 0.21 vs. 1.1 ± 0.21 s^-1, p=0.01) and (-2.0 ± 0.66 vs. -2.8 ± 0.50 s^-1, p=0.02) respectively]. Longitudinal strain and strain rate were not different between groups.

**CONCLUSION**

Feature-tracking CMR can identify abnormalities of left ventricular strain in a clinical cohort of BAV patients with normal EF. Differences in diastolic strain rate between BAV and control groups may indicate evidence of early diastolic dysfunction.

**SSA03-05 Is CMR Reproducible Enough for the Follow-up of RVEF? Comparison with Gated Blood Pool SPECT in Various Subgroups of Heart Disease**

Sunday, Nov. 29 11:25AM - 11:35AM Location: S504AB

Participants
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Herve P. Rousseau, MD, Toulouse, France (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The estimation of right ventricular ejection fraction (RVEF) is crucial in order to establish the diagnosis, the risk stratification, the prognosis, and the response to treatment in a wide range of heart disease. Cardiac Magnetic Resonance Imaging (CMR) is the reference-standard for the evaluation of RV volumes but the manual delineation of endocardial border leads to a significant operator-dependency. This report investigates if new MRI techniques are reproducible enough to be considered as the reference-standard for the follow-up of RVEF (in 12 subgroups of heart disease), in comparison with the most reproducible technique: gated blood pool single photon emission computed tomography (GBPS).

**METHOD AND MATERIALS**

94 CMR and 99 GBPS were measured by two physicians. GBPS was performed using 2 automatic algorithms: BP-SPECT and QBS and a semi-automatic algorithm: TOMPOOL. Relative Inter-Observer Variability (IOV) was defined as the absolute difference between the two calculated measurements normalized to their average and expressed as a percentage.

**RESULTS**

The overall IOV (%) was greater using semi-automatic GBPS procedure (TOMPOOL: 16±20%) than CMR (12±14%) or automatic
GBPS algorithm (QRS: 8±12%, BP-SPECT: 6±6%). The IOV of CMR challenged GBPS in 2 subgroups of heart disease treated arrhythmia (6±4%) and hyperdynamic cardiomyopathy / cirrhosis (4±3%). Overall, the factors that most influenced the IOV were right valve regurgitation (20±18%; n=27), dilated cardiomyopathy (20±20%; n=24), RVEF<45% (20±18%; n=32), end-systolic diameter of the left ventricle>41mm (17±19%; n=30) and left valve regurgitation (17±20%; n=27).

CONCLUSION
The most reproducible procedure is automatic GBPS. Changes occurring during the follow-up should be interpreted cautiously on CMR (IOV: 12%) or semi-automatic GBPS (IOV: 16%). The parameters responsible for increased IOV on CMR are: valve regurgitation, altered ejection fraction and enlargement of the left ventricle. The reproducibility of CMR challenged GBPS in treated arrhythmia and hyperdynamic heart disease.

CLINICAL RELEVANCE/APPLICATION
The estimation of RVEF is crucial in a wide range of heart disease. A reproducible technique is necessary for an optimal follow-up of RV dysfunction.

SSA03-06  Left Ventricular Function Can Be Adequately Assessed Using Compressed Sensing Cine Imaging with High Spatial and Temporal Resolution

Sunday, Nov. 29 11:35AM - 11:45AM Location: S504AB

Participants
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Harald H. Quick, PhD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
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PURPOSE
Cardiac magnetic resonance cine imaging currently bases on time consuming cine SSFP sequences with limited spatial and temporal resolution. Here we assessed whether two compressed sensing cine sequences with high spatial or high temporal resolution can reliably quantify left ventricular volumes and mass.

RESULTS
Small differences were observed between standard SSFP and sparse 1 for end-diastolic volume (EDV, median difference 4ml, p=0.044), stroke volume (SV, mean difference, 7±10ml, p=0.013), ejection fraction (EF, 1%, p=0.029), and myocardial mass (-8±7g, p=0.001), but no significant difference was found for end-systolic volume (ESV, p=0.135). No significant differences were observed between standard SSFP and sparse 2 regarding EDV (-1±5ml, p=0.528), ESV (-3±5ml, p=0.058), SV (2±5ml, p=0.139), and EF (1±3%, p=0.105), except for myocardial mass (-648g, p=0.017). Intraclass correlation coefficients comparing standard SSFP with both sparse sequences were at least 0.95. Bland-Altman analysis and Passing-Bablok regression showed good agreement between all sequences. Intraobserver agreement was good to excellent (kappa: 0.76-0.90).

CONCLUSION
Compressed sensing cine sequences with improved spatial or temporal resolution enable reliable assessment of LV volumes and mass.

CLINICAL RELEVANCE/APPLICATION
Compressed sensing cine imaging allows an adequate assessment of the left ventricular function and an improved spatial and temporal resolution.

SSA03-07  CMR-derived TAPSE Is a Useful Marker for Detection of RV Function Changes in Patients with Chronic Thromboembolic Pulmonary Hypertension

Sunday, Nov. 29 11:45AM - 11:55AM Location: S504AB

Participants
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Zhanhong Ma, Beijing, China (Abstract Co-Author) Nothing to Disclose
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Shuang Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Tianjing Zhang, Beijing, China (Abstract Co-Author) Employee, Siemens AG

PURPOSE
The aim of this study is to determine whether CMR-derived right ventricular fractional shortening (RVFS), tricuspid annular plane systolic excursion with a reference point within the right ventricular apex (TAPSEin) and with one outside the ventricle (TAPSEout) : (1) can predict pulmonary hypertension ,(2)correlates with pulmonary vascular resistance index (PVR) and main pulmonary artery flow in patients with CTEPH.

METHOD AND MATERIALS
37 patients (age, 50.1 ± 11.7 years; male,22) with chronic thromboembolic pulmonary hypertension (CTEPH) and 15 healthy subjects (age,47.4 ± 13.6 years; male, 9) underwent CMR imaging at 3T. The four-chamber Cine images were acquired to get the distance between the cutting edge of the tricuspid annulus with the RV free wall and the RV apex or a reference point outside the RV apex in end-diastole (end-diastolic length (EDL) in or EDLout) and end-systole (end systolic length (ESL) in or ESLout). All patients underwent right heart catheterization to get PVR. The parameters between different group were compared by an
independent t- test. The ROC curve analysis was used to evaluate the diagnosis value of TAPSE derived by CMRI. TAPSE obtained by CMRI were correlated with PVR and MPA mean velocity by Spearman or Pearson correlation analysis.

RESULTS
TAPSEout (t=5.69, p<0.001), TAPSEin (t=5.83, p<0.001) and RVFS (t=6.05, p<0.001) revealed a significant difference between patients with CTEPH and the healthy group. ROC curve analysis showed that TAPSEout had a high predictive value for CTEPH (Auc = 0.92 for TAPSEout, 0.89 for TAPSEin, 0.88 for RVFS, p<0.01). The diagnostic threshold for TAPSEout was 15.7 mm for CTEPH patients. In patients with CTEPH, PVR showed a significant but weak correlation with TAPSEout (r = 0.31, p = 0.04) and no correlation with TAPSEin (r = 0.09, p = 0.61) and RVFS (r = 0.08, p = 0.64). There was a moderate correlation between MPA mean velocity and TAPSEout (r = 0.54, p<0.03) and no correlation with TAPSEin (r = 0.13, p = 0.62) and RVFS (r = 0.06, p = 0.83).

CONCLUSION
CMR-derived TAPSEout is a useful marker to predict CTEPH. TAPSEout shows a good correlation with PVR and MPA mean velocity in CTEPH patients. TAPSEout might be a potential indicator for detection of RV function changes.

CLINICAL RELEVANCE/APPLICATION
CMR - determined TAPSE measurement is a quick screening method to identify patients with potential RV dysfunction and to select patients in whom a more detailed analysis would be used.

SSA03-08 Body Mass Index-Based Reduction of Radiation Exposure in Coronary CT Angiography Using a 3rd Generation Dual-Source CT Scanner

Sunday, Nov. 29 11:55AM - 12:05PM Location: S504AB

Participants
Stefanie Mangold, MD, Charleston, SC (Presenter) Nothing to Disclose
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Giuseppe Muscogiuri, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
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Akos Varga-Szemes, MD, PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose

PURPOSE
To retrospectively investigate the potential of further dose reduction at coronary computed tomography angiography (CCTA) based on body mass index (BMI) using a 3rd generation dual-source CT (DSCT) scanner and automated tube voltage selection.

METHOD AND MATERIALS
We evaluated 231 patients who underwent CCTA with a 3rd-generation DSCT. Prospectively ECG-triggered adaptive sequential acquisition at 70, 80, 90, 100 and 120kV (pulsing window 30-90%, full dose at 70% of the cardiac cycle) was performed with automated attenuation-based selection of tube current and voltage and advanced modeled iterative reconstruction. Patients were divided in three classes: 1, 70-80kV (n=44); 2, 90-100kV (n=59) and 3, 120kV (n=118). BMI and effective dose (ED) was recorded. Vascular attenuation in proximal and distal coronary arteries was measured. Contrast-to-noise ratio (CNR) was calculated. To subjectively evaluate vessel enhancement and image noise five-point scales were used.

RESULTS
Image quality was diagnostic in 98.7% of the examinations. BMI between the groups was significantly different with 24.2 kg/m² in group 1, 27.5 kg/m² in group 2 and 34.3 kg/m² in group 3 (p=0.006 and p<0.0001, respectively). Proximal and distal CNR was significantly lower in group 1 compared to group 2 (14.5 ± 16.8 and 11.4 ± 14.0, p=0.049 and 0.007) and in group 3 compared to group 2 (13.6 ± 10.9; p=0.002 and 0.001). However, no significant differences between the groups were shown by subjective image quality analysis (p>0.5). Intragroup comparison in group 1 and 2 revealed no significant differences regarding the BMI and objective image quality parameters between 70 and 80kV (mean BMI: 24.0 ± 3.0 vs 25.1 ± 3.4, p=0.370 and 0.001). However, mean BMI and effective dose (ED) was recorded. Vascular attenuation in proximal and distal coronary arteries was measured. Contrast-to-noise ratio (CNR) was calculated. To subjectively evaluate vessel enhancement and image noise five-point scales were used.

CONCLUSION
For CCTA with 3rd generation DSCT automated tube voltage selection is effective in reducing the ED according to patient size.

CLINICAL RELEVANCE/APPLICATION
Automated tube voltage selection can be used to achieve significant reduction of radiation dose in CCTA in patients with a wide range of body types.

SSA03-09 The Impact of Dipper Status in Hypertension on Cardiac Structure, Global Function and Regional Myocardial Strain: Insights from Cardiac Magnetic Resonance (CMR)

Sunday, Nov. 29 12:05PM - 12:15PM Location: S504AB

Participants
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PURPOSE

The loss of normal nocturnal dip in blood pressure in hypertension has adverse prognostic implications. We investigated the impact of dipper status on cardiac structure and function using cardiac magnetic resonance (CMR).

METHOD AND MATERIALS

24 hour ambulatory blood pressure monitoring (ABPM) and comprehensive CMR including late gadolinium enhancement (LGE) for myocardial scar assessment (1.5T Avanto, Siemens) were performed in 72 hypertensive patients referred from our tertiary hypertension clinic. Dipper status (n=33) was defined as >10% drop and non-dipper (n=39) as 0-10% drop in nocturnal systolic BP (SBP) versus diurnal SBP. Left ventricular mass (LVM) and volumes indexed to body surface area. Regional myocardial strain was estimated from the global mid LV from a 3D model generated from 4-chamber, 2-chamber and short axis cines (cvi42, Circle Cardiovascular Solutions Inc.). Fishers exact or unpaired student T tests were used as appropriate.

RESULTS

The results are show in Table 1. Non-dippers were significantly older than dippers (54±14 vs 46±15 years p<0.05). There was no difference in overall SBP and DBP between dippers and non-dippers but the latter had significantly higher nocturnal SBP (152±23 vs 129±13 mmHg p<0.0001) and DBP (82±14 vs 76±12 mmHg p<0.05). There were non-significant trends towards higher indexed LVM (90±25 vs 84±18g/m2) and prevalence of subendocardial LGE suggesting previous subclinical myocardial infarction (11% vs 3%) in non-dippers compared to dippers. Time to peak longitudinal strain was significantly higher in non-dippers compared to dippers (346±68 vs 316±54ms p<0.05) despite no significant difference in BP. A similar trend was observed for time to peak radial strain (332±68 vs 306±68ms p=0.07).

CONCLUSION

Significantly higher nocturnal SBP and DBP occur in non-dippers versus dippers. Trends towards increased indexed LVM, prevalence of subendocardial MI and prolonged time to peak strain. The latter suggests increased peripheral vascular resistance in non-dippers. These findings may help explain the adverse cardiovascular risk conferred by non-dipper status.

CLINICAL RELEVANCE/APPLICATION

CMR provides insights into different structural and function differences in non-dippers versus dippers and has potential to aid risk stratification in patients with hypertension.
To determine the association of COPD and COPD phenotypes (emphysema, airway and mixed) with lung cancer (LC) in patients with indeterminate lung nodules in the National Lung Screening Trial (NLST).

METHOD AND MATERIALS

We conducted a retrospective, case-control study of 817 participants (200 LC, 617 controls) in the CT-trial arm with 6-19 mm indeterminate lung nodules. 8 readers performed a visual analysis for centrilobular emphysema (CLE), bronchial wall thickening, centrilobular nodularity and interstitial fibrosis. Readers were asked to classify each scan as normal, emphysema-predominant COPD, airway-predominant COPD or mixed pattern COPD. Spirometry results (FEV1/FVC, FEV1) were used to classify each participant as normal or mild, moderate, severe or very severe COPD.

RESULTS

In a univariate analysis for LC diagnosis, emphysema-predominant COPD phenotype had an odds ratio (OR) of 1.530 (95% confidence interval (CI): 0.994, 2.354), airway-predominant COPD an OR of 1.004 (95% CI: 0.619, 1.629) and the mixed pattern an OR of 0.764 (95% CI: 0.427, 1.367) (reference = normal). Increasing CLE severity was associated with LC diagnosis for trace (OR 1.378, 95% CI: 0.879, 2.160), mild (OR 1.704, 95% CI: 1.073, 2.706) and moderate (OR 2.133, 95% CI: 1.326, 3.431). The number of patients with severe CLE was small with inconclusive results (; OR 1.105, 95% CI: 0.580, 2.103). Increasing airflow limitation was not strongly associated with increasing odds ratios for LC [mild OR 0.917 (95% CI: 0.533, 1.577), moderate OR 1.278 (95% CI: 0.865, 1.889), severe OR 0.939 (95% CI: 0.525, 1.681), very severe OR 2.040 (95% CI: 0.653, 6.374), reference normal].

CONCLUSION

Both an emphysema-predominant COPD phenotype by CT and increasing severity of CLE were associated with an increased LC risk in patients with indeterminate lung nodules on CT screening, while airflow limitation had a less strong relationship. The latter may be due to the lack of specificity of COPD phenotype available from spirometry. The NLST received funding from the National Cancer Institute through the grants U01 CA079778 and U01CA 080098

CLINICAL RELEVANCE/APPLICATION

Risk calculation for indeterminate nodules incorporates COPD history. CT information on both emphysema-predominant COPD phenotype and severity may perform better in risk prediction than spirometry.
SSA04-02  Lung Nodule Consistency and Relative Risk of Future Lung Cancer Diagnosis: Does Sex Matter?

Sunday, Nov. 29 10:55AM - 11:05AM Location: S404CD

Participants
Philip M. Boiselle, MD, Boston, MA (Presenter) Nothing to Disclose
Fenghai Duan, PhD, Providence, RI (Abstract Co-Author) Nothing to Disclose
Stavroula Chrysanthopoulou, Providence, RI (Abstract Co-Author) Nothing to Disclose
Sarah DeMello, Providence, RI (Abstract Co-Author) Nothing to Disclose
Denise R. Aberle, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Caroline Chiles, MD, Winston-Salem, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare differences in the relative risk (RR) of lung cancer (LC) by nodule consistency and sex in the CT arm of the NLST.

METHOD AND MATERIALS
By study design, all CT-detected nodules measuring 4-30 mm were characterized by consistency (solid=SN, nonsolid/ground glass=GGN, and part-solid=PSN). For each nodule consistency, the following were calculated: sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for LC for both men (M) and women (W). For each nodule consistency, RR was calculated as the ratio of the probability of LC given a reported nodule consistency to the probability of LC given no nodule of the same consistency.

RESULTS
Of 26,455 participants in the CT arm of the NLST, 9994 (37.8%) had a positive screen at ≥ 1 time point. 8062 (81%) had 1 nodule consistency and 1932 (19%) had >1 nodule consistency. The RR of LC was significantly higher for women than men for GGNs (2.68 W vs.1.68 M, p=0.0026), and a similar trend was observed for PSNs (4.45 W vs. 3.19 M, p=0.0556). In contrast, SNs were associated with a comparable RR for both sexes (4.48 vs. 3.77, p =0.1970), along with nearly equivalent sensitivity and specificity for LC (sensitivity = 69.6% W, 68.5%M; specificity = 69.6% W, 68.5% M). Women demonstrated a higher sensitivity than men for subsolid nodules, including GGNs (26.7% W, 12.6% M) and PSNs (16.2% W, 10.2% M). PSNs had the highest PPV in both sexes (15.3% W, 12.3%, M), whereas SNs had the lowest PPV in women (7.9%) and GGNs had the lowest PPV in men (6.6%).

CONCLUSION
Rates of lung cancer are influenced by both nodule consistency and sex. Subsolid nodules are associated with a higher risk of lung cancer for women than men.

CLINICAL RELEVANCE/APPLICATION
Radiologists should be aware of sex-related differences in risk of lung cancer for subsolid nodules when interpreting CT screening studies.

Honored Educators
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Philip M. Boiselle, MD - 2012 Honored Educator

SSA04-03  Comparing Lung-RADS and the McWilliams Nodule Malignancy Score: Which Approach Works Best to Select Screen Detected Pulmonary Nodules for More Aggressive Follow-up?

Sunday, Nov. 29 11:05AM - 11:15AM Location: S404CD

Participants
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PURPOSE
In 2014 Lung-RADS was published to standardize CT lung screening reporting and management, based on nodule type, size, and growth. In 2013 the McWilliams model was published providing a nodule malignancy probability based on nodule size, type, morphology and subject characteristics. Threshold of the McWilliams score provides an alternative over Lung-RADS categories to determine work-up for screen-detected nodules. We compare both approaches on an independent data set.

METHOD AND MATERIALS
All 60 cancers were selected from the Danish Lung Cancer Screening Trial, in the first scan where they were visible, and 120 randomly selected benign nodules from baseline scans were added, all from different participants. Data had been acquired using a low-dose (16x0.75mm, 120kVp, 40mA) protocol, and 1mm section thickness reconstruction. For each nodule, the malignancy probability was calculated using McWilliams model 2b. Parameters were available from the screening database or scored by an
expert radiologist. Completely calcified nodules and perifissural nodules were given a score of 0, in accordance with the McWilliams model. All nodules were categorized into their Lung-RADS category based on nodule type and diameter. Perifissural nodules were treated as regular solid nodules, in accordance with Lung-RADS guidelines. Sensitivity and specificity were calculated, for each Lung-RADS category cut-off. For each specificity level, corresponding sensitivity of the McWilliams model was determined.

RESULTS

McWilliams performed substantially better than Lung-RADS in selecting malignant nodules for more aggressive follow-up. Defining Lung-RADS category 2/3/4A/4B and up as a positive screening result, nodule malignancy specificity was 21%/65%/86%/99% and sensitivity was 100%/85%/58%/32%. At the same specificities, McWilliams's sensitivity was higher with 100%/96%/86%/45%.

CONCLUSION

For every cut-off level in Lung-RADS, the McWilliams model operating at the same specificity has superior sensitivity to differentiate malignant from benign nodules.

CLINICAL RELEVANCE/APPLICATION

The McWilliams model seems to be a better tool than Lung-RADS to provide a malignancy risk and help radiologists determine which subgroup of nodules detected in a screening setting need more invasive work-up.

SSA04-04  Sex- and Gender-linked Differences in Baseline Characteristics of the National Lung Screening Trial

Sunday, Nov. 29 11:15AM - 11:25AM Location: S404CD

Participants
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Phillip M. Boiselle, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Evaluate baseline characteristics of male and female participants in the National Lung Screening Trial (NLST) to determine sex- and gender-linked differences at enrollment that could influence trial results in terms of lung cancer (LC) risk.

METHOD AND MATERIALS

The NLST enrolled men (M) and women (W) aged 55 -74, current or former smokers with > 30 pack-year smoking history. At registration, all participants completed questionnaires regarding demographics, personal/family history of cancer, and smoking history. Demographic characteristics of these participants were stratified by sex and compared with LC risk as determined by the Prostate Lung Colon Ovarian (PLCO) screening trial logistic-regression model for lung cancer prediction (PLCOM2012). Using this model, the mean 6-yr risk of LC was calculated for M and W participants.

RESULTS

Baseline characteristics that increase LC risk in female NLST participants included their lower educational level [13.62 years ± 2.28 (W), 14.05 years ± 2.49 (M)], lower BMI [28.0 (W), 29.0 (M)], higher self-reported history of COPD [6.44% (W), 4.08% (M)], and higher family history of LC [23.78% (W), 20.32% (M)], p=0.001 for all comparisons. Baseline characteristics that decrease their LC risk included younger age [61.2 (W), 61.6 years (M)], decreased smoking intensity [26.64 cigarettes per day (W), 29.69 (M), p<0.001], and shorter smoking duration [39.24 yrs (W), 40.27 (M), p<0.001 for all comparisons. Based on the PLCOM2012 model for lung cancer prediction, the mean calculated 6-yr LC risks were similar for both sexes [0.0319 ± 0.0274 (W), 0.0323 ± 0.0283 (M), p=0.07].

CONCLUSION

Despite significant differences in a variety of individual LC predictors between men and women, the mean calculated 6-yr risk of LC was similar for male and female NLST participants. These findings are consistent with reported similar lung cancer incidence rates between men and women within each trial arm of the NLST.

CLINICAL RELEVANCE/APPLICATION

Risk factors for LC may vary according to sex characteristics. Including these in risk modeling may improve selection of individual patients for screening.

Honored Educators

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Phillip M. Boiselle, MD - 2012 Honored Educator

SSA04-05  Radiologic Findings In Patients with a Previous History Of Malignancy Undergoing Lung Cancer Screening

Sunday, Nov. 29 11:25AM - 11:35AM Location: S404CD

Participants
Darragh Halpenny, MBChB, MRCPI, New York, NY (Presenter) Nothing to Disclose
Jane D. Cunningham, FFRRCSI, New York, NY (Abstract Co-Author) Nothing to Disclose
Lung cancer screening with computed tomography (CT) reduces mortality in high-risk patients with a smoking history. The rate of lung cancers detected based on positive screening CT in the National Lung Screening Trial (NLST) was 2.4%. The aim of this study was to assess the radiological findings in a cohort of patients with a previous history of malignancy, who underwent CT screening for lung cancer.

**METHOD AND MATERIALS**

The IRB approved this study. Patients with a previous history of a malignancy, either cured from that disease or with a life expectancy of at least 5 years, were referred for low dose CT lung cancer screening between 5/2/2011 and 9/24/2014. Initial CTs and all available follow up CTs were retrospectively reviewed by 2 radiologists in consensus. CT features assessed included nodule size, morphology and number. Clinical features recorded included pack year smoking history, type of previous cancer and previous cancer therapy. The Lung-RADS™ scoring system was retrospectively applied to all studies.

**RESULTS**

140 patients were studied. 61 (43%) male, 79 (56%) female, mean age 66 (40-80). 139 patients (99%) had a smoking history [mean pack years 57 (0-120)]. All had a previous history of cancer: 58 (41%) breast, 21 (15%) head and neck and 17(12%) lung. All patients had at least 1 chest CT, 42 had 2 CTs, 30 had 3 CTs and 9 had at least 4 CTs.8 (6%) patients were diagnosed with cancer on screening CT (7 lung carcinoma, 1 chest wall sarcoma). 2 (1%) patients had a biopsy or surgery for lesions identified on screening CT (1 atypical pneumocyte hyperplasia, 1 nodular scar). 49 (35%) patients were considered to have a positive screening CT (recalled for repeat chest CT earlier than 330 days), 33 (23%) after the 1st screen, 16 (20%) after the 2nd screen, and 6 (15%) after the 3rd screen. After the 1st screen, the Lung-RADS™ categories were: 4 - 6%, 3 - 9% and < 2- 84%. The most common incidental findings were emphysema 26%, post-surgical change 8% and post-radiation change 16%.

**CONCLUSION**

Patients with a previous history of a malignancy undergoing screening chest CT have a higher rate of screen detected neoplasm as compared to the incidence reported in a non oncologic group such as the NLST.

**CLINICAL RELEVANCE/APPLICATION**

Patients with a prior cancer history have a higher rate of screen detected lung cancer than reported in the NLST. Larger studies are needed in this group who may benefit from lung cancer screening.
To investigate the association of pulmonary multi-nodularity with lung cancer probability in baseline computed tomography (CT) lung cancer screening.

METHOD AND MATERIALS
In a low-dose CT lung cancer screening trial, participants were selected with at least one non-calcified nodule at baseline. The trial was approved by the Ministry of Health. All participants gave informed consent. The per-participant number of baseline nodules was determined. The probability of lung cancer was compared for categories based on the number of baseline nodules using chi-square testing. Lung cancer diagnosis was confirmed by histology. Nodules were classified as benign if they did not show significant growth for up to six years after baseline.

RESULTS
3,392 participants with 7,258 nodules were included. 1,746/3392 participants (51.5%) had one nodule, 800/3392 (23.6%) had two nodules, 354/3392 (10.4%) had three nodules, 191/3392 (5.6%) had four nodules, and 301/3392 (8.9%) had over four nodules at baseline. Lung cancer was diagnosed in these nodules during baseline in 62 participants, and during later rounds in another 75 participants (cancer rate 4.0%). Mean nodule count in subjects with only benign nodules was 2.1±1.8, compared to 2.3±2.2 (p=NS) in screenees with lung cancer. The probability of lung cancer was 61/1746 (3.5%) in case a participant had one nodule, 37/800 (4.6%) for two nodules, 17/191 (8.8%) for three nodules, and 10/301 (3.3%) when a participant had four nodules (p=NS). Lung cancer diagnosis during baseline screening was made in the largest nodule in 60/62 (96.8%) cases.

CONCLUSION
Multi-nodularity is common in baseline CT lung cancer screening. The relationship between nodule count and lung cancer probability is complex, with a possible peak in probability of malignancy in subjects with four nodules. Lung cancer was detected most frequently in the nodule with the largest volume.

CLINICAL RELEVANCE/APPLICATION
Malignancy probability does not change with the increase of the number of lung nodules in a patient. Each nodule found in lung cancer screening subjects should be assessed separately, with recommendation for nodule management based on the nodule with the largest volume.

SSA04-08 Occurrence and Lung Cancer Probability of Newly Detected Solid Nodules at Incidence CT Lung Cancer Screening

Participants
Robin Peters, MD, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose
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Geertruida H. De Bock, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose
Matthijs Oudkerk, MD, PhD, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the occurrence of new solid nodules and their respective lung cancer rate at the incidence screening rounds of a large randomized low-dose computed tomography (LDCT) lung screening trial.

METHOD AND MATERIALS
This trial was approved by the Ministry of Health. All participants gave informed consent. In total, 7,557 individuals underwent baseline LDCT screening. Following baseline, incidence-screenings took place after 1, 3 and 5.5 years. For this study, participants were selected with solid non-calcified nodules, newly detected after baseline and also in retrospect not present on any previous screening. Lung cancer diagnosis was based on histology, and benignity was based on either histology or a stable volume for at least two years.

RESULTS
At incidence screenings, in total 1,484 new solid nodules were identified in 949 participants. The median age of participants with new solid nodules was 59 years (interquartile-range 55-63 years), and 77% (735/949) were male. After one year, at least one new solid nodule was present in 4.7% (344/7295) of participants, and after two more years additional new nodules were found in 7.1% (491/6922) of participants. Eventually, in 7.9% (75/949) of participants with new solid nodules, a new solid nodule was proven to be lung cancer (in total 77 cancers). Most of the detected lung cancers were adenocarcinoma (30/77 [39.0%]), squamous cell carcinoma (20/77 [26.0%]) or small cell lung cancer (9/77 [11.7%]), and a majority (48/77 [62.3%]) was diagnosed at stage I.

CONCLUSION
New solid nodules are common findings in CT lung cancer screening and carry a substantial risk of malignancy. More research concerning new nodules is necessary to determine a sufficient follow-up strategy and evaluate distinguishing nodule features of.
benign and malignant new nodules.

**CLINICAL RELEVANCE/APPLICATION**

During LDCT lung cancer screening, in almost 8% of participants with new solid nodules, one of these nodules is malignant and guidelines may need to consider a more stringent follow-up for new nodules.

**SSA04-09 Comparing Inter-reader Variability of Manual Diameter and Semi-automated Volumetric Measurements for Pulmonary Nodules in Lung Cancer Screening**

Sunday, Nov. 29 12:05PM - 12:15PM Location: S404CD

**Participants**

Arjun Nair, MD, FRCR, London, United Kingdom (Presenter) Nothing to Disclose
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Anand Devaraj, MBBS, London, United Kingdom (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Guidelines propose that solid nodules with baseline diameter<6mm return to annual lung cancer screening. However, the accepted range of inter-reader variability (IRV) in manual diameter measurements derives from a single study. We aimed to (1) quantify IRV for both manual diameter and semi-automated volumetric measurements (Vol), and (2) assess inter-reader agreement for diameter-based categorisation, for solid nodules that may potentially require CT follow-up based on their volumes.

**METHOD AND MATERIALS**

Solid nodules between 50-300mm³ that had been measured by two trial radiologists at baseline CT in a national lung screening trial were reviewed. Two radiologists also independently measured diameters using electronic callipers. Diameter measurements were used to categorise nodules according to Lung-RADS for each reader. IRV was calculated using Bland-Altman analysis for diameter and volume measurements in all nodules, and for nodules ≥6mm. Inter-reader agreement for Lung-RADS categorisation was compared using the weighted kappa statistic (multirater K). The percentage of nodules where readers would have disagreed on the need for CT follow-up, using diameters according to Lung-RADS, was calculated.

**RESULTS**

286 nodules (mean diameter 5.0 ± 1.2mm, mean volume 99.5 ± 51.8mm³) in 200 subjects were studied. Absolute and percentage mean (and 95% confidence intervals, CIs) difference between readers were 0.2 (-1.2,1.6) mm and 4.5% (-22.7%, 31.6%) respectively for diameter, and 4.6(-101.6, 110.8) mm³ and 1.3% (-19.9%, 22.6%) respectively for volume. Percentage mean (and 95% CIs) differences between readers for diameter and volume in the 54/286 nodules measuring ≥6mm were 3.0% (-27.2%, 33.3%) and 0.1% (-1.1%, 1.4%). Multirater K for Lung-RADS categorisation was 0.67. Radiologists would have disagreed on the need for CT follow-up using diameter in Lung-RADS in 18/286 nodules (10.9%).

**CONCLUSION**

IRV in diameter is slightly higher than in semi-automated volumetry, for solid nodules with volumes 50-300mm³, but substantially lower using volumetry for nodules measuring ≥6mm in this volume range. However, inter-reader agreement for categorisation according to diameter remains good.

**CLINICAL RELEVANCE/APPLICATION**

Diameter measurement provides good overall agreement for nodule categorisation, but size reproducibility could substantially be improved using semi-automated volumetry for nodules deemed positive.
PURPOSE
A recent study from a single large teaching hospital in 2014 suggested that the use of imaging in the emergency department (ED) may be decreasing. Our purpose was to study this issue on a nationwide basis.

METHOD AND MATERIALS
The national Medicare Part B Physician/Supplier Procedure Summary Master Files from 2001-2013 were evaluated. These files cover all patients in traditional Medicare fee-for-service (37.3 million in 2013). Volumes of radiography, CT, and noncardiac ultrasound (US) - the 3 major types of ED imaging - were determined by aggregating all CPT codes within each modality. Exams performed in EDs were determined by using Medicare's place-of-service codes. Utilization rates per 1000 Medicare beneficiaries were calculated. Medicare specialty codes were used to determine the specialty of the interpreting physicians.

RESULTS
The ED utilization rate per 1000 of radiography increased every year from 238 in 2001 to 323 in 2013 (+36%). In ED CT, the rate increased every year from 48 in 2001 to 158 in 2013 (+229%). The CT increase would have been even greater except for code bundling of CT scans of the abdomen and pelvis in 2011. In ED noncardiac US, the rate also increased every year from 8.6 in 2001 to 22.2 in 2013 (+158%). In 2013, radiologists interpreted 98% of ED radiographs and 99% of CT scans. They interpreted 88% of noncardiac US studies. The remaining US exams were interpreted by vascular surgeons (5%), ED physicians (3%), general surgeons (2%), or cardiologists (1%).

CONCLUSION
There has been a steady increase in the utilization rates of the 3 major types of imaging that are performed in ED patients. The increase has been quite sharp in CT and noncardiac US. Despite the recent report, there is no evidence that ED imaging use is declining. Radiologists strongly predominate in interpretation of all types of imaging in EDs, despite persistent efforts by some other specialties to gain a foothold.

CLINICAL RELEVANCE/APPLICATION
NA
of CT following emergent laparotomy in the setting of trauma.

METHOD AND MATERIALS

The trauma databases of two urban level 1 trauma centers were queried over a 5 year 8 month period for patients who underwent abdominopelvic CT imaging within 48 hours of emergent exploratory laparotomy. CT reports and images were retrospectively reviewed to identify all injuries diagnosed by post-laparotomy CT. All injuries diagnosed at laparotomy were identified by reviewing the operative records. Comparisons were made between operative and CT findings.

RESULTS

92 patients met inclusion criteria. 64 patients (69.6%) had additional injuries not identified during laparotomy. There were 20 unidentified solid organ injuries, including 4 splenic, 4 hepatic, and 7 renal injuries. CT upgraded severity of 4 liver injuries that were diagnosed at initial surgery. Of 16 patients with suspected renal injury at surgery, there were 12 renal injuries confirmed by CT. 11 patients (12.0%) had CT injuries severe enough to prompt further intervention, including 5 angiography/embolizations and 6 re-operations. Fractures were found in 59 (64%) patients.

CONCLUSION

Overall there was high concordance between injuries identified on CT and those which could reasonably be expected to be identified at surgery. In total, 70% of patients had undiagnosed injuries; however, some of these injuries, such as fractures, would not be expected to be diagnosed at surgery. 12% of patients had injuries on CT severe enough to require further intervention. Post laparotomy CT adds value in trauma patients who initially require emergent exploratory laparotomy.

CLINICAL RELEVANCE/APPLICATION

Post laparotomy CT identifies clinically important injuries in a small but significant percentage of trauma patients who require initial emergent exploratory laparotomy and is recommended for complete evaluation of traumatic injuries.

SSA05-04 Duplicate Cardiothoracic Imaging in the ED: Is there Room for Improvement?

Sunday, Nov. 29 11:15AM - 11:25AM Location: N228

Participants
Tarek N. Hanna, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Waqas Shuaib, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
James Matthew Kerchberger, BS, Atlanta, GA (Presenter) Nothing to Disclose
Jamil-Omar Johnson, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Faisal Khosa, FFR(RCSI), FRCPC, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Examine Emergency Department (ED) ordering practices in patients receiving both chest radiography (CXR) and chest computed tomography (CCT).

METHOD AND MATERIALS

Consecutive ED patients receiving both CXR and CCT in a single ED visit from 6/2009-3/2013 were included. For each exam, time of order entry (TOE), time of study completion (TSC), and time of final interpretation (TOI) was recorded and analyzed. TOE was the time of electronic order entry by the ED provider. TSC was when images were uploaded to PACS. TOI was the time of final radiology report availability. Cases with incomplete data were excluded.

RESULTS

3627 patients (66.5% male, average age 49.2 ±36 years) met inclusion criteria. In 3437 (94.8%) patients the CXR was ordered first, in 43 (1.2%) the CCT was ordered first, and in 91 (2.5%) the CCT and the CXR were ordered simultaneously. Of the 91 patients with simultaneous CCT and CXR orders, the CXR was completed first in 78 cases (85.7%); none of the 91 patients had chart documentation to explain the simultaneous orders. In only 50.6% (1740/3437) of exams where CXR was ordered first, was the final CXR report available prior to CCT order placement. Of the 43 patients in whom CCT was ordered first, only 2 (4.6%) had the final CCT report available prior to the CXR order. In 47.8% (1735/3627) of all cases, the second imaging modality (whether CT or CXR) was ordered prior to final report availability of the first exam. In 7.3% (n=263/3627) of all cases, the second imaging modality (whether CT or CXR) was ordered prior to the image availability of the first exam.

CONCLUSION

Making secondary cardiothoracic imaging decisions without having the final radiology report for the primary exam (47.8% of all cases) or ordering a secondary cardiothoracic imaging study prior to image availability for the first exam (7.3%) may be appropriate in certain situations, but further investigation of these trends is needed to identify possible inappropriate resource utilization. In 2.5% of cases, CCT and CXR were ordered simultaneously, which may occur secondary to perceived wait times for CCT. Targeted technology solutions may alleviate some of this redundancy.

CLINICAL RELEVANCE/APPLICATION

Primary imaging results should influence secondary imaging decisions. Efficient imaging in the ED helps arrive at an accurate diagnosis while minimizing cost, radiation, and patient turn around time.

SSA05-05 Radiological Workflow in Mass Casualty Incidents: Evaluation of Two Level 1 Trauma Sites in a Large-scale Exercise

Sunday, Nov. 29 11:25AM - 11:35AM Location: N228

Participants
Fabian Mueck, Munich, Germany (Presenter) Nothing to Disclose
Maximilian Muggenthaler, Munich, Germany (Abstract Co-Author) Nothing to Disclose
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Stefan Wirth, MD, MSc, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

Aim of study was to compare the in-house workflow of two level 1 trauma sites in the case of a mass casualty incident (MCI) with a particular focus on CT management.

METHOD AND MATERIALS

A MCI of 70 patients was simulated by actors. According to a local MCI patient distribution matrix, the on-site triage assigned 7 cases to trauma site A (long in-house distances) and 5 patients to the completely independent second trauma site B (short in-house distances) of the same hospital. Within a most realistic simulation of in-house treatment several time points were measured and compared (e. g. with respect to arrival: time to triage, time to trauma room, time to CT and time to one of the two possible ending points which were arrival at the intensive care unit or at the operating theatre).

RESULTS

Site A needed more time (minutes) from arrival to ending point (A:31.84; B:21.60; P=0.059). According to the distances the times were longer to both trauma room (A:8.46; B:2.73, P = 0.008), and CT room (A:1.81; B:0.06, P=0.008). The observed shorter stay on the CT table did not compensate these effects. (A:6.42; B:7.31, P=0.705).

CONCLUSION

Facility design has a major influence on the time needed for in-house treatment. Short distances allow reaching end-points within 22 min. Considering CT it is possible to serve up to 6 patients per scanner-hour by using a standard protocol and up to a theoretical maximum of 13 patients by using a CT triage procedure.

CLINICAL RELEVANCE/APPLICATION

Considering polytrauma patients in CT, optimized facility design with short distances allows to serve up to 6 patients/h using a standard protocol, and up to a theoretical maximum of 13 patients/h by using a more simple triage procedure.

SSA05-06 Time to Write an Obituary? Sacrum and Coccyx Radiographs have Limited Clinical Impact in the Emergency Department

Sunday, Nov. 29 11:35AM - 11:45AM Location: N228

Participants

Mahniya Sadiq, BS, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
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Marc D. Benayoun, MD, PhD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Determine the yield and clinical impact of sacrum and coccyx radiographs (SC-XR) in the Emergency Department (ED).

METHOD AND MATERIALS

Consecutive SC-XR obtained in the EDs of 4 hospitals over a 5 year period were categorized as positive for acute fracture or dislocation, negative, or other. Other documented incidental findings that may have clinical relevance. Five follow-up metrics were analyzed: follow-up imaging in the same ED visit, follow-up imaging within 30 days, new pain medication prescriptions at discharge, clinic follow-up recommended at discharge, and surgical intervention within 60 days.

RESULTS

687 patients met inclusion criteria (48.1 years, 61.6% female). 91.3% were negative, 8.4% (n=58/687) were positive, and 0.3% (n=2/687) had other findings (lytic metastatic disease, Pagets). Regarding follow-up: 5.7% (n=39) had CT or MRI in the same ED visit, 4.3% (n=29) had advanced imaging within 30 days, 65.8% of patients received recommendations for clinical follow-up, and 47.9% of patients were prescribed new pain medications. Due to inherent practice differences, the level 1 trauma center was analyzed separately. At the level 1 trauma center (n=335, 44.8 years, 53.4% female), when comparing positive and negative SCXRs, there was no significant difference in follow-up ED imaging (p=0.19), 30 day imaging follow-up (p=0.77), medication administration (0.06), or clinical follow-up (p=0.14). At the level 2 trauma centers (n=352, 51.3 years, 69.4% female) there was a significant difference in same day (p=0.04) and 30-day follow-up imaging (p=0.001), but no difference in pain medication (p=0.94) or clinic follow-up (p=0.09). 0% (0/58) of the positive cases had surgical intervention. At our institution, the average global charge for SC-XRs over the study period was $230 ($201-263), $24 professional and $206 technical, for a total cost over the study period of $158,010.

CONCLUSION

ED SC-XRs have costs and ionizing radiation, and in some EDs result in more advanced imaging. However, the results of SC-XR did not affect pain medication administration or clinic follow-up. No positive SC-XRs resulted in surgical intervention.

CLINICAL RELEVANCE/APPLICATION

As ED SC-XRs do not affect clinical management, their use can be curtailed, and patients treated conservatively. This will result in radiation and cost savings, and may decrease ED length of stay.

SSA05-07 Incidental Findings in Patients with Multiple Injuries: How to Proceed?

Sunday, Nov. 29 11:45AM - 11:55AM Location: N228

Participants

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Faisal Khosa, FFR(RCSI), FRCP, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Marc D. Benayoun, MD, PhD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Determine the yield and clinical impact of sacrum and coccyx radiographs (SC-XR) in the Emergency Department (ED).

METHOD AND MATERIALS

Consecutive SC-XR obtained in the EDs of 4 hospitals over a 5 year period were categorized as positive for acute fracture or dislocation, negative, or other. Other documented incidental findings that may have clinical relevance. Five follow-up metrics were analyzed: follow-up imaging in the same ED visit, follow-up imaging within 30 days, new pain medication prescriptions at discharge, clinic follow-up recommended at discharge, and surgical intervention within 60 days.

RESULTS

687 patients met inclusion criteria (48.1 years, 61.6% female). 91.3% were negative, 8.4% (n=58/687) were positive, and 0.3% (n=2/687) had other findings (lytic metastatic disease, Pagets). Regarding follow-up: 5.7% (n=39) had CT or MRI in the same ED visit, 4.3% (n=29) had advanced imaging within 30 days, 65.8% of patients received recommendations for clinical follow-up, and 47.9% of patients were prescribed new pain medications. Due to inherent practice differences, the level 1 trauma center was analyzed separately. At the level 1 trauma center (n=335, 44.8 years, 53.4% female), when comparing positive and negative SCXRs, there was no significant difference in follow-up ED imaging (p=0.19), 30 day imaging follow-up (p=0.77), medication administration (0.06), or clinical follow-up (p=0.14). At the level 2 trauma centers (n=352, 51.3 years, 69.4% female) there was a significant difference in same day (p=0.04) and 30-day follow-up imaging (p=0.001), but no difference in pain medication (p=0.94) or clinic follow-up (p=0.09). 0% (0/58) of the positive cases had surgical intervention. At our institution, the average global charge for SC-XRs over the study period was $230 ($201-263), $24 professional and $206 technical, for a total cost over the study period of $158,010.

CONCLUSION

ED SC-XRs have costs and ionizing radiation, and in some EDs result in more advanced imaging. However, the results of SC-XR did not affect pain medication administration or clinic follow-up. No positive SC-XRs resulted in surgical intervention.

CLINICAL RELEVANCE/APPLICATION

As ED SC-XRs do not affect clinical management, their use can be curtailed, and patients treated conservatively. This will result in radiation and cost savings, and may decrease ED length of stay.
PURPOSE

Multislice computed tomography (MSCT) is the diagnostic criterion standard for the initial evaluation of patients with suspected multiple injuries. Besides scanning for injuries directly related to the initial trauma, MSCT scans can reveal pathologies unrelated to the trauma of clinical relevance. The aim of the present study was to determine the frequency and follow-up course of incidental findings in patients with multiple injuries.

METHOD AND MATERIALS

This is a retrospective analysis of prospectively collected data on 2,242 patients with suspected multiple injuries at a Level I trauma center from 2006 to 2010. The MSCT reports were retrospectively reviewed regarding abnormal findings not related to trauma. These incidental findings were classified on a four-point level scoring system with respect to clinical importance and urgency for further diagnostic and therapeutic procedures.

RESULTS

During initial trauma center evaluation in the emergency department, 2,246 patients met our inclusion criteria. A total of 2,036 patients (90.7%) underwent MSCT; 1,142 (50.9%) of the patients had one or more incidental findings. A total of 2,844 incidental findings were detected. Overall, 349 tumor findings were noted (12.3% of all incidental findings); 113 findings were suspicious for malignant processes or metastasis. According to our classification, 168 (5.9%) of the incidental findings required urgent follow-up (Level 4), and 527 (18.5%) of the incidental findings required a follow-up before discharge (Level 3).

CONCLUSION

MSCT in patients with multiple injuries reveals one or more incidental findings in more than one of two patients. A scoring system classifying for relevance of incidental findings was introduced and could be applied in routine trauma care in the future.

CLINICAL RELEVANCE/APPLICATION

The consequent handling of incidental findings may add an extra burden for trauma surgeons and emergency physicians but should lead to improvements in health care for the patients. Especially in trauma patients, the reviewing radiologist should pay attention to both the presence of traumatic injuries and the incidental findings and communicate both to the ordering physician.

SSA05-08 Completion CT Chest Abdomen Pelvis after Acute Head and Neck Trauma: Incidence of Acute Traumatic Pathology

Sunday, Nov. 29 11:55AM - 12:05PM Location: N228

Participants

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Michael F. Rolen, MD, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Syed A. Bokhari, MD, New Haven, CT (Abstract Co-Author) Nothing to Disclose

PURPOSE

At our institution, patients found to have acute head or neck trauma will receive a CT chest abdomen pelvis (CT CAP) even in the absence of signs or symptoms to suggest bodily trauma. The purpose of our study was to determine the incidence of acute traumatic pathology on these CT CAP exams.

METHOD AND MATERIALS

After receiving IRB approval, a retrospective chart review was performed. Patients who presented to our institution's emergency department over a one-year period (8/1/2013-7/31/2014) with findings of acute head and neck trauma who subsequently went on to have a CT CAP were identified. Exclusion criteria were as follows: proximal extremity/rib fractures identified on plain film prior to CT CAP, chest pain, abdominal pain, CPR after the traumatic event, soft tissue hematomas identified on physical exam and hypotension. We then analyzed the clinical course and imaging results of each patient meeting study criteria. Specifically, for the head/neck CTs, type of injury was divided into five broad categories: intra-axial bleed, extra-axial bleed, facial bone fracture, skull fracture, and cervical spine fracture. Mechanism of injury was categorized as follows: fall from standing, fall from height (greater than 6 feet), motor vehicle collision, and assault. The frequency and percentage of each of these categories were calculated. For this CT CAP exam, acute traumatic injuries were recorded, and the incidence of acute traumatic injury was calculated.

RESULTS

101 (8.6%) CT CAP studies performed in our ED during the one-year period met study criteria. The most frequent mechanism of injury in this group was a fall from standing (76.2%). The most common traumatic head/neck injury in this group was an extra-axial hemorrhage (49.5%). Of all CT CAP studies, only one study demonstrated an acute traumatic injury (non-displaced 5th and 6th rib fractures). This finding was of no significant clinical consequence.

CONCLUSION

In the setting of low-velocity trauma, patients with acute head/neck injury without signs or symptoms of bodily injury should not receive a CT CAP. This data can be used to restructure trauma algorithms, which will reduce financial costs and better utilize radiological resources in the emergency department setting.

CLINICAL RELEVANCE/APPLICATION

CT CAP is an unnecessary exam for low-velocity trauma patients with acute head/neck injury in the absence of signs or symptoms to suggest bodily injury.
Effect of Timing of Request on Imaging Approach to the Diagnosis of Acute Appendicitis in a Group of Teaching Hospitals with 24/7 Availability of Ultrasound Technologist

Sunday, Nov. 29 12:05PM - 12:15PM Location: N228

Participants
Mostafa Atri, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Hassan A. Alzahrani JR, MD, Dammam, Saudi Arabia (Presenter) Nothing to Disclose
Ravi Menezes, PhD, Toronto, ON (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine if time of the day and day of the week influence the type of imaging request to evaluate for acute appendicitis and the performance of different modalities during and after regular hours.

METHOD AND MATERIALS
This is an REB approved retrospective study of consecutive patients operated with pre-operative diagnosis of acute appendicitis between Feb 2013 and August 2014 in three teaching hospitals with 24/7 US technologist coverage. Acquisition of consent was waived. Data collected included: a) the rate of US only, CT only and US followed by CT performed between 8AM and 5PM during the regular hours and after this period during the week, and weekend and holidays, and b) performance of each imaging approach. US examinations were all initiated by a technologist and reviewed by a staff/fellow during regular hours and by a resident/fellow after hour.

RESULTS
Three hundred and thirty seven patients were operated during this period. They included 152 women and 185 men, ranging in age from 18 to 85 (mean 36±15) years old. One hundred thirteen (33.5%) of patients were imaged before and 224 (66.5%) after regular hour (p=0.001). Eighteen (5.3%) had negative appendectomy, 5 (4.4%) during regular hour and 13 (5.8%) after hour (p>0.05), and 319 patients had appendicitis or a condition of appendix requiring surgery. Regular hour imaging included 59 (52%) US only, 32 (28%) CT only, and 22 (20%) US followed by CT. The corresponding numbers for after-hour examinations were 109 (48%), 98 (44%), and 17 (8%) (p =0.006). Sensitivity of US during regular hour was 72% (56/78), and CT was 76% (40/53). The corresponding sensitivities for after hour examinations were 86% (101/118) (p=0.018) and 95% (106/111) (p<0.001).

CONCLUSION
In spite of comparable sensitivity of US to CT, significantly higher number of CTs was requested after regular hour to evaluate for acute appendicitis.

CLINICAL RELEVANCE/APPLICATION
There are more CTs performed after regular hour to evaluate for acute appendicitis because of the wrong perception of lower accuracy of US being performed after regular hour.
**SSA06**

**Gastrointestinal (Pancreas Solid Masses)**

*Sunday, Nov. 29 10:45AM - 12:15PM Location: E353A*

**Gi CT MR**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

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**Participants**

Michael A. Blake, MBChB, Boston, MA (*Moderator*) Editor with royalties, Springer Science+Business Media Deutschland GmbH
Desiree E. Morgan, MD, Birmingham, AL (*Moderator*) Research support, General Electric Company

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**Sub-Events**

**SSA06-01**

**Diagnostic Performance of 18F-FDG PET/MRI for the Preoperative Assessment of Resectability and Staging of Pancreatic Cancer: Comparison with 18F-FDG PET/CT Plus Contrast-enhanced MDCT - A Prospective Preliminary Study**

*Sunday, Nov. 29 10:45AM - 10:55AM Location: E353A*

**Participants**

Ijin Joo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jeong Min Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Grant, Guerbet SA; Support, Siemens AG; Support, Koninklijke Philips NV; Grant, Bayer AG; Consultant, Bayer AG; Grant, General Electric Company; Support General Electric Company; Grant, STARmed Co, Ltd; Grant, RF Medical Co, Ltd; Grant, Toshiba Corporation; Grant, Dong-So Medical Industrial Col, Ltd
Dong Ho Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Joon Koo Han, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the diagnostic performance of 18F-FDG PET/MRI in the assessment of local resectability, N staging, and M staging in patients with pancreatic cancer compared with 18F-FDG PET/CT plus contrast-enhanced MDCT.

**METHOD AND MATERIALS**

In this prospective study, a total of 37 patients with 39 pancreatic cancers were enrolled and underwent 18F-FDG PET/MRI, 18F-FDG PET/CT, and contrast-enhanced MDCT within 2 weeks of each other. Mean and maximum standardized uptake values (SUVs) in PET/MRI and PET/CT of pancreatic cancers were measured. Two independent radiologists retrospectively reviewed two imaging sets (set 1: PET/MRI, set 2: PET/CT plus MDCT) to evaluate tumor conspicuity and local resectability using a 5-point scale, and to determine preoperative N staging (N- or N+) and M staging (M0 or M1). Diagnostic performances two imaging sets were compared using paired t-test, ROC analysis, and McNemar test.

**RESULTS**

Both mean and maximum SUVs of the pancreatic cancer showed strong correlations between PET/MRI and PET/CT ($r=0.89$ and $0.90$, $P<0.0001$). Tumor conspicuity was slightly higher in PET/MRI set than PET/CT plus MDCT set ($3.64$ vs. $3.36$, and $3.49$ vs. $3.23$ in reviewers 1 and 2, respectively; $P>0.05$). Diagnostic performance of PET/MRI in assessing local resectability was equivalent to PET/CT plus MDCT (Az values of $0.857$ vs. $0.725$, and $0.875$ vs. $0.754$ in reviewers 1 and 2, respectively; $P>0.05$). There were no statistically significant difference in the diagnostic accuracies for N- and M-staging between two imaging sets (N-staging: $52.6\%$ vs. $42.1\%$, and $57.9\%$ vs. $42.1\%$; M-staging: $75.0\%$ vs. $79.2\%$, and $79.2\%$ vs. $83.3\%$, in reviewers 1 and 2, respectively; $P>0.05$).

**CONCLUSION**

In this preliminary study in patients with pancreatic cancer, diagnostic performance of 18F-FDG PET/MRI is comparable to that of 18F-FDG PET/CT plus contrast-enhanced MDCT in the preoperative assessment of local resectability, N-staging, and M-staging.

**CLINICAL RELEVANCE/APPLICATION**

In the preoperative assessment of resectability and staging of pancreatic cancer, 18F-FDG PET/MRI, as an one-step whole-body imaging tool, may serve as an alternative to PET/CT plus MDCT.

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**SSA06-02**

**Prospective Histopathological Correlation of IVIM Derived Quantitative MR Parameters in Pancreatic Adenocarcinoma**

*Sunday, Nov. 29 10:55AM - 11:05AM Location: E353A*

**Participants**

Elizabeth M. Hecht, MD, New York, NY (*Presenter*) Nothing to Disclose
Michael Z. Liu, MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Sachin Jambawalkikar, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Helen R. Remotti, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
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Martin R. Prince, MD, PhD, New York, NY (*Abstract Co-Author*) Patent agreement, General Electric Company; Patent agreement, Hitachi, Ltd; Patent agreement, Siemens AG; Patent agreement, Toshiba Corporation; Patent agreement, Koninklijke Philips NV; Patent agreement, Nemoto Kyorindo Co, Ltd; Patent agreement, Bayer AG; Patent agreement, Lantheus Medical Imaging, Inc; Patent agreement, Bracco Group; Patent agreement, Medtronic, Inc; Patent agreement, Topspins, Inc; Stockholder, Topspins, Inc
Donald Garmon, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Yanghee Woo, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Michael D. Kluger, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
John Chabot, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To assess agreement between IVIM derived parameters and histopathology in participants with suspected pancreatic ductal adenocarcinoma (PDA) undergoing surgical resection.

**METHOD AND MATERIALS**

18 patients (9M:9F, mean 68y) were prospectively enrolled in this IRB approved, HIPAA compliant study with informed consent. All underwent respiratory-triggered axial EPI DWI with 11b values from 0 to 800 within 1 month of surgery (mean, 6d). Two experienced radiologists (>10y each) independently drew 2 ROIs over tumor and surrounding non-tumoral tissue when present and individual results were averaged. Mono (ADC0-800, ADCtotal) and bi-exponential (true diffusion (D), "pseudo" diffusion (D*) and perfusion fraction (f)) fitting were derived using open source MITK software (MITK.org). DWI metrics were compared with quantitative histopathology including % fibrosis, tumor cell density, and mean vascular density (MVD). Statistical analysis included intra-class correlation, Pearson correction and student t-test.

**RESULTS**

16 patients had PDA (Grade 2 (n=7), 2-3 (n=4), 3 (n=5), 1 cholangiocarcinoma and 1 metastatic renal cell carcinoma (mRCC). Non-tumoral pancreas tissue was available in 14/18 patients specimens. Mean reader ROI size for tumor and non-tumoral tissue was not significantly different (p>0.05). Reader agreement was moderate-high (0.68-0.98) for ADC, f and D. Histopathology revealed that MVD was significantly lower in tumor as compared to non tumor (p=0.002) and % fibrosis was significantly higher in tumor (p=0.004). D, f and ADC0-800 were not significantly different between tumor and non-tumor tissue for either reader. There was moderate but significant correlation between D and % fibrosis in tumor tissue (excluding mRCC) for each reader (Reader 1, r=-0.48, p=0.04; Reader 2, r=-0.59, p=0.01. Including non-tumor and tumor tissues significance was maintained (Reader 1, r=-0.43, p=0.02; Reader 2, r=-0.47, p=0.007). D was lower for grades 3-4 vs. grades 1-2 fibrosis (1.11 μm²/ms vs. 1.45 μm²/ms, p=0.05). MVD did not significantly correlate with f or fD*. Cell density/tumor grade did not correlate with IVIM metrics.

**CONCLUSION**

D negatively correlates with % fibrosis in tumor and non-tumoral pancreatic tissue and may serve as a biomarker of treatment response.

**CLINICAL RELEVANCE/APPLICATION**

Development of imaging biomarkers that can monitor desmoplasia in pancreatic adenocarcinoma would be clinically useful.

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**SSA06-03** Pancreatic Neuroendocrine Neoplasms: Correlation of MR Imaging Appearance with Biological Behavior

Sunday, Nov. 29 11:05AM - 11:15AM Location: E353A

Participants
Mingliang Wang, MD, Shanghai, China (Presenter) Nothing to Disclose
Mengsu Zeng, MD, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Shengxiang Rao, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To describe MR imaging features of pancreatic neuroendocrine neoplasms (pNENs) and to identify MR imaging features in predicting biological behavior.

**METHOD AND MATERIALS**

MR imaging data from 35 patients (14 men and 21 women; age range 27-69 years) with pathologically proven pNENs was retrospectively reviewed. Of the pNENs, 14/35 (40.0 %) were G1, 19/35 (54.3 %) were G2 and 2/35 (5.7 %) were G3. Image analysis included tumor location, tumor diameter, signal intensity on precontrast images, enhancement pattern, pancreatic duct dilatation, vascular encasement, extrapancreatic spread, and presence of metastases.

**RESULTS**

2/35 (5.7 %) of lesions appeared as a cyst with thick wall. In other 33 cases, the median maximum diameter of pNENs was 2.67 cm (range 0.60-5.20 cm). 75.8 % of lesions appeared hyperintense on T2-weighted imaging. 36.4 % of lesions appeared inhomogeneity on T2-weighted imaging. On post-contrast images, 69.7% of lesions appeared early contrast enhancement on Arterial Phase images and continuous contrast-enhancement with its degrees higher than the pancreas on Delay Phase images Significant differences in gender, tumor diameter, signal intensity on precontrast images, and invasiveness were found between G1 group and G2 group ( P <0.05). The lesions in G2 group had larger size than that in G1 group. The tumor size had good diagnostic performance, with area under ROC curve (AUC) of 0.944. When a cutoff value for tumor size was set as 1.95 cm, diagnostic sensitivity was 88.9% and specificity was 92.3% in differentiating G1 group from G2 group.

**CONCLUSION**

MR imaging features such as tumor diameter, signal intensity on precontrast images, and invasiveness may preoperatively suggest the biological behaviour of pNENs, assisting decisions about treatment. Lesions with a larger diameter, irregular margins, absence of a cleavage plane, inhomogeneity and invasiveness were significantly associated with malignant pNENs.

**CLINICAL RELEVANCE/APPLICATION**

MR imaging can display malignant signs of pancreatic neuroendocrine neoplasms, predict biological behavior of the neoplasms and help assisting decisions about treatment.
SSA06-04  Enhancement Pattern of Pancreatic Neuroendocrine Tumors on Dynamic Enhanced CT: A Comparison between Tumors with Different Degree of Fibrosis Component

Participants
Cherry Kim, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Jae Ho Byun, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Seung-Mo Hong, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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Hyung Jung Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Moon-Gyu Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the enhancement pattern and other CT findings between pancreatic neuroendocrine tumor (NET) with different degree of fibrosis component.

METHOD AND MATERIALS
We retrospectively reviewed the CT images of 45 patients (17 males and 28 females) with surgically confirmed NET containing fibrotic component > 30% of the whole tumor (Group A). They were matched for age, gender, and tumor grade at a ratio of 1:1 to 45 NET patients with fibrotic component < 30% (Group B). Hounsfield unit (HU) of tumors in the precontrast (PC), arterial (AP), and portal (PP) phases, HU ratio (tumor to normal parenchyma) in each phase, HU enhancement pattern (progressive enhancement or wash-out pattern), and visible enhancement pattern change from AP to PP (peripheral to full, peripheral to peripheral, full to peripheral, or full to full) were compared between Group A and B. Other CT findings, including heterogeneity of enhancement, calcification, margin, perilesional infiltration, pancreatic duct dilation, direct invasion, lymph node and distant metastasis, were also compared between the two groups.

RESULTS
Group A showed progressive enhancement pattern and Group B showed wash-out pattern (P<0.05). HU of tumors and HU ratio in PC were higher in group A than in group B (42.5±7.5 vs. 38.6±4.8; 1.02±0.40 vs. 0.88±0.23; P≤0.04), whereas those in AP were lower in group A than in group B (146.2±48.2 vs. 183.1±49.7; 1.4±0.52 vs. 1.61±0.38; P≤0.003). Peripheral to full or peripheral enhancement change was more frequent in group A, while full to full enhancement change was more frequent in Group B (P<0.05). Other CT findings were not significantly different between the two groups (P>0.05).

CONCLUSION
On dynamic enhanced CT, NET with rich fibrotic component tended to show progressive enhancement pattern and peripheral to full or full enhancement change, while NET with poor fibrotic component tended to show wash-out pattern and full to full enhancement change.

CLINICAL RELEVANCE/APPLICATION
CT enhancement pattern has been suggested as a prognostic indicator of pancreatic NET. However, its degree of fibrotic component could be one of causes for its various enhancement patterns.

SSA06-05  Using Iodine Quantification from DECT Images to Differentiate Pancreatic Neuroendocrine Tumors from Splenules

Participants
Andrea Prochowski Jamurri, MD, Boston, MA (Presenter) Nothing to Disclose
Manuel Patino, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Diana Murcia, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Rodrigo Canellas, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Farhad Mehrkhani, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Yasir Andrabi, MD, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose
Avinash R. Kambadakone, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Dushyant V. Sahani, MD, Boston, MA (Abstract Co-Author) Research Grant, General Electric Company; Research Consultant, Allena Pharmaceuticals, Inc

PURPOSE
Differentiating intrapancreatic splenule from other solid pancreatic masses and pancreatic neuroendocrine tumors (pNET) can be challenging on a single phase CT exam. We investigated the role of iodine quantification from DECT for characterizing splenules (SPL).

METHOD AND MATERIALS
In this retrospective study, 45 patients (16 with pNET and 29 with SPL) underwent to portal phase DECT (750HD GE) and material decomposed iodine images (MD-I) were used to quantify mean iodine concentrations (MIC) for pNET, SPL, spleen, and aorta. Normalized iodine concentration (NIC) were calculated for pNET, SPL and spleen. MIC of pNET and of SPL were compared with spleen MIC. On the SECT images, mean HU (MHU) values were calculated for pNET, SPL and spleen. MHU and NIC values of lesions were: pNET 0.73±0.2, SPL 0.66±0.1 and spleen 0.66±0.1. The MIC ratio between pNET and spleen was 1.14±0.3, and for SPL/spleen 1.01±0.1 (p=0.047). The MHU ratios between pNET and spleen was 0.92±0.2 and for SPL/spleen 0.86±0.1 (p=0.174). SPL also demonstrated a homogenous appearance (29) vs the heterogeneous appearance of pNET (16, 4=mild heterogeneity, 12=obvious heterogeneous).

RESULTS
NIC values were: pNET 0.73±0.2, SPL 0.66±0.1 and spleen 0.66±0.1. The MIC ratio between pNET and spleen was 1.14±0.3, and for SPL/spleen 1.01±0.1 (p=0.047). The MHU ratios between pNET and spleen was 0.92±0.2 and for SPL/spleen 0.86±0.1 (p=0.174). SPL also demonstrated a homogenous appearance (29) vs the heterogeneous appearance of pNET (16, 4=mild heterogeneity, 12=obvious heterogeneous).
CONCLUSION
On the MD-I images from DECT, SPL's are homogenous and follow the iodine concentration of spleen whereas pNET are often heterogenous and show higher NIC values than spleen.

CLINICAL RELEVANCE/APPLICATION
Inaccurate diagnosis of intrapancreatic SPL and pNET on portal phase CT often leads to unnecessary interventions and surgeries and occasionally delay in much needed surgery in the cases of pNET. Reliable diagnosis of splenule on portal-venous phase DECT is feasible by subjective assessment and iodine quantification.

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Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator

SSA06-06 Low Contrast Enhancement of Primary Pancreatic Ductal Adenocarcinoma is Associated with Early Development of Metastases Following Resection

Sunday, Nov. 29 11:35AM - 11:45AM Location: E353A

Participants
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Ronald J. Zagoria, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Zhen J. Wang, MD, Hillsborough, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Previous studies suggest that enhancement patterns of pancreatic ductal adenocarcinoma (PDAC) reflect tumor angiogenesis and fibrosis, both of which are implicated in PDAC prognosis. The purpose of this study is to determine whether the degree of enhancement of resectable PDAC at pancreatic phase CT can predict subsequent early development of metastases.

METHOD AND MATERIALS
We retrospectively identified 38 patients with resectable PDAC who underwent multiphase pancreatic protocol CT prior to surgery (no neoadjuvant therapy), and who had >= 12 month follow up at our institution. Tumor enhancement was determined by measuring CT attenuation change (Δ Hounsfield unit (HU)) between the pancreatic phase and unenhanced images. Tumor grade, size, and AJCC stage at pathology were recorded. Follow up imaging studies were reviewed to determine any subsequent development of metastatic disease and its timing in these patients. Uni- and multi-variate analyses were used to determine predictors of the development of metastases within 12 month of surgery.

RESULTS
Fourteen of the 38 patients had developed metastases (liver, lung, peritoneum) by 12 months. The mean tumor enhancement in patients who had developed metastases by 12 months was significantly lower than that of patients who did not (32.1±13.7HU vs. 55.9±18.9HU, p=0.0002). A threshold of 40HU identified patients with metastases by 12 months with 79% sensitivity and 92% specificity. Both tumor grades and size at pathology were significantly higher in patients with metastases by 12 months than those without (both p values < 0.05). There was a trend of higher tumor stages in patients with metastases by 12 months (p=0.06). 32/38 patients underwent gemcitabine based adjuvant therapy post resection. The proportion of patients receiving adjuvant therapy was not significantly different between the two groups. Multivariate analysis showed that tumor enhancement < 40HU and tumor grade were independent predictors of development of metastases by 12 months (both p values <0.05).

CONCLUSION
Low contrast enhancement (<40HU) of primary PDAC is associated with development of metastases by 12 months following resection.

CLINICAL RELEVANCE/APPLICATION
Enhancement pattern of primary PDAC at CT may be a useful prognostic marker.

SSA06-07 Assessment of Iodine Uptake by Pancreatic Cancer Following Chemotherapy Using Dual Energy CT

Sunday, Nov. 29 11:45AM - 11:55AM Location: E353A

Participants
Satomi Kawamoto, MD, Baltimore, MD (Presenter) Research Grant, Siemens AG; 
Matthew K. Fuld, PhD, Iowa City, IA (Abstract Co-Author) Researcher, Siemens AG
Gale Christensen, Baltimore, MD (Abstract Co-Auth or) Grant, Becton, Dickinson and Company
Daniel Laheru, Baltimore, MD (Abstract Co-Auth or) Nothing to Disclose
Elliot K. Fishman, MD, Owings Mills, MD (Abstract Co-Auth or) Research support, Siemens AG Advisory Board, Siemens AG Research support, General Electric Company Advisory Board, General Electric Company Co-founder, HipGraphics, Inc

PURPOSE
To evaluate quantitative change of iodine uptake by pancreatic cancer using dual source dual energy CT before and after
METHOD AND MATERIALS

Twenty patients (13 males, 7 females, average age 67.8±11.8 years) with newly diagnosed pancreatic adenocarcinoma were scanned with dual source dual energy CT before and after (average interval: 71.9±42.8 days) chemotherapy. Dual phase CT protocol included arterial phase timed by bolus tracking, followed by a 60 second venous phase scanned with dual energy CT at 100 kV and 140 kV with tin filtration with reference dose of 250 and 193 mAs, respectively. Tumor segmentation was performed on a workstation using automated segmentation followed by manual editing. Iodine uptake by the tumor was obtained as an iodine concentration (mg/ml) and normalized by iodine uptake within the abdominal aorta (‘normalized tumor iodine uptake’). Tumor iodine uptake was compared to change in tumor volume and tumor markers.

RESULTS

At baseline, average iodine uptake by tumor was 1.26±0.37mg/ml in arterial phase and 1.79±0.50mg/ml in venous phase, and average normalized tumor iodine uptake was 0.10±0.05 in arterial phase and 0.38±0.09 in venous phase. After chemotherapy, average normalized tumor iodine uptake was significantly decreased compared to the baseline in both arterial phase (0.08±0.04 [p=0.016]) and venous phase (0.31±0.09 [p=0.0007]). The tumor was decreased in volume in 17 patients (average volume change: 71±15%), and increased in 3 patients (average volume change: 154±22%). Average normalized iodine uptake in tumors that reduced volume greater than 20% after chemotherapy (n=9) was 72% and 77% of the baseline in arterial and venous phase respectively, lower than that of the other tumors (n=11) (88% of the baseline in both phase), but there was no statistically significantly difference. Average normalized tumor iodine uptake in patients with decreased tumor markers (n=8) were 74% and 80% of the baseline in arterial and venous phase, and in patients with increased tumor markers (n=3) were 116% and 96% of the baseline in arterial and venous phase, but the number of subjects were too small for statistical analysis.

CONCLUSION

Iodine uptake by pancreatic adenocarcinoma evaluated using dual energy CT may decrease after chemotherapy.

CLINICAL RELEVANCE/APPLICATION

Iodine uptake by pancreatic adenocarcinoma evaluated by dual energy CT may be potentially useful for assessment of treatment response.

Honored Educators

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Elliot K. Fishman, MD - 2012 Honored Educator
Elliot K. Fishman, MD - 2014 Honored Educator

SSA06-08 Agreement of Results of CT-perfusion Measurements in Pancreatic Carcinoma: Comparison of Three Different Kinetic Calculation Models

Sunday, Nov. 29 11:55AM - 12:05PM Location: E353A

Participants

Gerd Grozinger, MD, Tubingen, Germany (Presenter) Nothing to Disclose
Sven Schneeweis, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolaou, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG
Marius Horger, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the interchangeability of perfusion parameters between three calculation methods for the post-processing of perfusion-CT images in pancreatic carcinoma.

METHOD AND MATERIALS

Perfusion-CT images was performed in 48 (32 male; mean age: 69±9 years) patients with adenocarcinoma of the pancreas. Images were post-processed using a software package based on the maximum-slope approach (blood flow-BF and blood volume-BV) and Patlak analysis (BV and k-trans), as well as a software package with deconvolution-based analysis (BF, BV and k-trans). Volume-of-interest (VOI) analysis of the tumor average perfusion was performed. Perfusion parameters were compared using the Wilcoxon matched-pairs test and Bland-Altman plots. Following CT-examinational protocol: 80kV, 100/120mAs, 64x0.6mm collimation, 26 consecutive scans, IV injection of 50 mL contrast at a flow rate of 5 mL/s, was used.

RESULTS

48 VOIs of tumors were analyzed. Moderate to good correlations were demonstrated between the various perfusion values (r = 0.42-0.90, P < .001). The Wilcoxon test revealed a significant difference between the methods (P < .001), with the BF and BV values obtained using the maximum-slope approach and Patlak analysis being lower than those obtained using deconvolution-based analysis. For analysis of k-trans deconvolution revealed significantly lower values (P<0.001). The Bland-Altman plots for BF and BV values revealed a proportionality trend with outliers, which were strongly associated with the magnitudes of the parameters. Analysis of the k-trans values did not show any systematic bias. Comparison of the three different BV-calculations revealed an equal distribution.

CONCLUSION

There were significant differences in the perfusion parameters obtained using the three software packages, and therefore these parameters are not directly interchangeable. However, the magnitude of pairs of parametric values is in constant relation to each other enabling the use of any of these methods.
Role of Sarcopenia and Visceral Obesity, Assessed Using Preoperative CT-scan, as Predictors of Short-term Outcome Following Pancreaticoduodenectomy in Pancreatic Cancer Patients

Sunday, Nov. 29 12:05PM - 12:15PM Location: E353A

Participants
Anna Damascelli, MD, Milan, Italy (Presenter) Nothing to Disclose
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Giulia Carrara, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Nicolo Pecorelli, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
Recent reports showed that body composition parameters, assessed using computed tomography (CT) images, may improve preoperative risk stratification in oncologic patients. The aim of this study is to evaluate how sarcopenia (depleted muscle mass) and visceral obesity impact on postoperative outcome in pancreatic cancer patients treated with pancreaticoduodenectomy (PD) in a high-volume institution, focusing on mortality and pancreatic fistula (PF) occurrence.

METHOD AND MATERIALS
Between 2010 and 2014, 284 consecutive patients underwent PD for pancreatic cancer; among them, 202 patients underwent preoperative staging CT-scan imaging at our institution within 30 days before PD, and were included in this study. Total abdominal muscle area (TAMA), visceral fat area (VFA) and subcutaneous fat area (SFA) were assessed using Slice-O-Matic 5.0 software (Tomovision, Montreal, Canada); TAMA and VFA were evaluated on two contiguous slices at the third lumbar vertebra, and then averaged, using Hounsfield unit threshold of -29 to +150 for skeletal muscle, -150 to -50 for visceral adipose tissue and -190 to -30 for subcutaneous and intermuscular fat. Perioperative variables and postoperative outcomes were prospectively collected. Multivariate analysis was performed to identify independent predictors of 60-day mortality, and pancreatic fistula according to the International Study Group of Pancreatic Fistula criteria. Sarcopenia was defined using predetermined sex-specific cut-off values (52.4 cm²/m² for men and 38.5 cm²/m² for women).

RESULTS
132 (65.4%) patients were classified as sarcopenic. Postoperative mortality occurred in 12 patients (5.9%), major complications in 40 (19.8%) and pancreatic fistula in 48 patients (23.8%). At multivariate analysis, VFA/TAMA and ASA score = 3 were the strongest predictors of mortality (p<0.001). Among patients who developed major complications, survivors had significantly lower VFA/TAMA ratio than non-survivors (p=0.017). VFA was an independent predictor of PF (p<0.001).

CONCLUSION
Preoperative analytic morphometric assessment, using CT images, is a useful tool for the prediction of mortality and pancreatic fistula occurrence, following PD for cancer.

CLINICAL RELEVANCE/APPLICATION
Preoperative CT assessment of sarcopenia and visceral adiposity improve risk stratification in patients undergoing pancreaticoduodenectomy for cancer, predicting mortality and pancreatic fistula occurrence.
**PURPOSE**

To evaluate the possibility of predicting local lymph node metastasis by extramural vascular invasion (EMVI) on preoperative MRI in patients with rectal cancer.

**METHOD AND MATERIALS**

MR images and clinical pathologic data of 183 consecutive patients with rectal cancer (between Dec. 2011 and Dec. 2014) were reviewed. MRI-detected extramural vascular invasion (MR-EMVI), with clinical pathologic factors (including age, gender, T stage, differentiation, size and pathological EMVI), were analyzed by chi-square crosstabs test (or t test) and multivariate logistic regression to determine risk factors for lymph node metastasis.

**RESULTS**

A total of 183 rectal cancer patients who underwent radical surgery were included in our study. Of them, 78 (42.6%) patients had lymph node metastasis according to pathology at the time of surgery. Among those clinical pathologic factors, T stage (odds ratio, 1.848), pathological EMVI (odds ratio, 4.878) and MRI-detected EMVI (odds ratio, 3.884) were independent risk factors for LNM. The incidence of LNM in the patients with pathological EMVI and MRI-detected EMVI was 78.7% and 75.4% respectively. By using pathological EMVI as a gold standard, sensitivity, specificity and agreement rate of MRI-detected EMVI were 61.7%, 82.3% and 77.0%.

**CONCLUSION**

MRI-detected EMVI could be used as a predictor for lymph node metastasis in patients with rectal cancer.

**CLINICAL RELEVANCE/APPLICATION**

This paper has shown that the lymph node status at the time of surgery in rectal cancer is related to preoperative MRI-detected extramural vascular invasion. The results may be useful for patients’ selection for preoperative neoadjuvant therapy.
Sixty-one patients with a pathologically proven T3 tumour were selected. Two readers with different experience in reading rectal cancer MRI (2 years and 5 years) measured the maximal depth of invasion of tumour into mesorectal fat in the axial plane perpendicular to the tumour axis. Clock position of the measurement was registered. ICC and Bland-Altman plots were used for analyses.

**RESULTS**

Intraclass correlation coefficient was 0.61. The Bland-Altman plot showed a mean difference between measurements of 2.45 (SD 3.53) mm with limits of agreement of -4.45 to 9.39. Differences between measurements ranged from -9 to 15 mm. In 36% of patients the clock position of the measurements of both readers was not in the same quadrant.

**CONCLUSION**

Reproducibility of measurement of invasion depth of tumour into the mesorectal fat is low, both with regard to the depth and to the location of the deepest invasion. Therefore, the distinction between T3ab and T3cd tumours is unreliable and should not be used for treatment decisions.

**CLINICAL RELEVANCE/APPLICATION**

The distinction between T3ab and T3cd tumours is deemed relevant to identify patients with a high risk tumor and administer neoadjuvant chemoradiation. Since measurement of invasion depth is only moderately reproducible, the use of this factor for risk and treatment stratification is questionable.
RESULTS
Among 291 patients, 69 patients (23.7%) were confirmed to have distant metastasis. In univariate analysis, MRI-T stage (P=0.005), MRI-N stage (P<0.001), CEA value (P=0.007), pT stage (P<0.001), pN stage (P<0.001), pMLNNs (P<0.001), pLNR (P<0.001), tumor deposits (P=0.014), pLVI (P=0.005), pNI (P=0.003) correlated significantly with metachronous distant metastasis. In multivariate analysis, only preoperative CEA values (P=0.038, Exp(B)=21.102), pLNR (P<0.001, Exp(B)=23.780) and pT stage (P=0.005, Exp(B)=3.677) were independent risk factors for distant metastasis. The mean DFS period for both groups was significantly different (57.2±0.62 vs 18.88±1.98 months, P<0.001). The 3-year OS rate for patients with distant metastasis was 35.0% compared with 97.1% for those without distant metastasis (P<0.001).

CONCLUSION
Preoperative MRI provided limited value in prediction of metachronous distant metastasis in patients with rectal cancer as independent risk factor. Compared with MRI features, preoperative CEA values, pLNR and pT stage were independent risk factors. Patients with the risk factors should be closely followed up for monitoring the metachronous metastasis status in order to take measures for the hope of a good survival outcome.

CLINICAL RELEVANCE/APPLICATION
Compared with MRI features, CEA values, pLNR and pT stage were independent risk factors to predict metachronous distant metastasis in patients with rectal cancer.

METHOD AND MATERIALS
To explore the risk factors for distant metastasis in patients with rectal cancer with MRI, clinical and pathologic outcomes.

PURPOSE
To determine factors for predicting disease free survival and recurrence in patients with rectal cancer.

RESULTS

Four factors were independent predictors of disease-free survival: preoperative CEA (P=0.038, Exp(B)=21.102), pLNR (P<0.001, Exp(B)=23.780) and pT stage (P=0.005, Exp(B)=3.677) were independent risk factors for distant metastasis. The mean DFS period for both groups was significantly different (57.2±0.62 vs 18.88±1.98 months, P<0.001). The 3-year OS rate for patients with distant metastasis was 35.0% compared with 97.1% for those without distant metastasis (P<0.001).

CONCLUSION
Preoperative MRI provided limited value in prediction of metachronous distant metastasis in patients with rectal cancer as independent risk factor. Compared with MRI features, preoperative CEA values, pLNR and pT stage were independent risk factors. Patients with the risk factors should be closely followed up for monitoring the metachronous metastasis status in order to take measures for the hope of a good survival outcome.

CLINICAL RELEVANCE/APPLICATION
Compared with MRI features, CEA values, pLNR and pT stage were independent risk factors to predict metachronous distant metastasis in patients with rectal cancer.

METHOD AND MATERIALS
To explore the risk factors for distant metastasis in patients with rectal cancer with MRI, clinical and pathologic outcomes.

PURPOSE
To determine factors for predicting disease free survival and recurrence in patients with rectal cancer.

RESULTS

Four factors were independent predictors of disease-free survival: preoperative CEA (P=0.038, Exp(B)=21.102), pLNR (P<0.001, Exp(B)=23.780) and pT stage (P=0.005, Exp(B)=3.677) were independent risk factors for distant metastasis. The mean DFS period for both groups was significantly different (57.2±0.62 vs 18.88±1.98 months, P<0.001). The 3-year OS rate for patients with distant metastasis was 35.0% compared with 97.1% for those without distant metastasis (P<0.001).

CONCLUSION
Preoperative MRI provided limited value in prediction of metachronous distant metastasis in patients with rectal cancer as independent risk factor. Compared with MRI features, preoperative CEA values, pLNR and pT stage were independent risk factors. Patients with the risk factors should be closely followed up for monitoring the metachronous metastasis status in order to take measures for the hope of a good survival outcome.

CLINICAL RELEVANCE/APPLICATION
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Median follow-up was 36 months, fourteen patients experienced relapse. 3-year DFS was 69%. On Cox multivariate analysis including all factors mrEMVI(p=0.028) and T-downstaging(p=0.032) were independent prognostic factors for DFS. mrEMVI(p=0.040), T-downstaging(p=0.013) and ypN(p=0.041) were significant independent factors for recurrence. Significant univariate factors for DFS were: Baseline mrEMVI status(p=0.0001),mrEMVI reversion(p=0.003),post-treatment MR T staging(ymrT)(p=0.007),mrTRG(p=0.011),pathological nodal status(p=0.02) and T-downstaging(p=0.0009). Significant univariate factors for recurrence were: mrEMVI(p=0.007),ymrT(p=0.008),mrTRG(p=0.019),T-downstaging(p=<0.0001),ypN(p=0.002) and ypT(p=0.022).

CONCLUSION
Baseline MRI-EMVI is an independent prognostic factor for survival and recurrence in intermediate risk rectal cancer treated with neoadjuvant chemotherapy.

CLINICAL RELEVANCE/APPLICATION
Future randomised trials should evaluate primary chemotherapy verses standard treatment in patients with T3,MRF clear and mrEMVI positive disease.Moreover mrEMVI positive may be recommended as a stratification factor.

SSA07-06 Follow-up with MRI of Rectal Cancer Treated by TEM: Recurrence Detection and Inter-observer Reproducibility

Sunday, Nov. 29 11:35AM - 11:45AM Location: E450A

Participants
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Geerard L. Beets, MD, PhD, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Regina G. Beets-Tan, MD, PhD, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose

PURPOSE
Small rectal cancers can be treated with transanal endoscopic microsurgery(TEM). Postoperative changes make follow-up with MRI challenging. Aim was to evaluate post-TEM-MRI at different time points for recurrence detection and assess interobserver-reproducibility.

METHOD AND MATERIALS
38 patients underwent TEM (8 after CRT). 122 MRIs were performed with a mean of 3 MRIs per patient. Seven patients had a recurrence. MRI was performed every 3-4 months during follow-up and consisted of T2W-MRI±DWI. MRIs were evaluated by readers with different experience by confidence level (CL) scoring for recurrence, reproducibility was evaluated with weighted kappa statistics.

RESULTS
For all MRIs AUC for recurrence detection was 0.79and0.73 for T2W-MRI and 0.69and0.76 for DWI. During follow-up AUC increased from 0.55-0.57 at the first MRI to 0.67-0.73 at subsequent MRIs for T2W-MRI. Interobserver-reproducibility was increased during FU for T2W-MRI from kappa 0.09 to 0.77. For DWI reproducibility was fair-good (kappa 0.49-0.61) which increased slightly during FU. Reproducibility also increased during FU from kappa 0.36 to 0.84. At the first MRI after TEM higher CL scores were given at DWI than at T2W-MRI, this difference disappeared as of the second MRI during FU. Number of equivocal scores decreased during FU. Iso-intensity in bowel wall and/or mesorectal fat were predictive for recurrence.

CONCLUSION
The first post-TEM MRI is difficult to assess. After the first MRI accuracy for recurrence detection increases dramatically, due to comparison with earlier studies. There is a learning curve during FU per patient leading to more certainty in readers. Reproducibility is fair-moderate, but increases during FU. Iso-intensity in bowel wall and/or mesorectal fat were predictive for recurrence.

CLINICAL RELEVANCE/APPLICATION
After TEM follow-up is crucial to detect recurrences. MRI is a feasible and reliable modality to perform follow-up after TEM to both detect luminal and nodal recurrences.

SSA07-07 Imaging Genomics of Colorectal Cancer: Patterns of Metastatic Disease at Time of Presentation Based on Mutational Status

Sunday, Nov. 29 11:45AM - 11:55AM Location: E450A

Participants
Cinthia Cruz, MD, Boston, MA (Presenter) Nothing to Disclose
James H. Thrall, MD, Boston, MA (Abstract Co-Author) Board Member, Mobile Aspects, Inc; Board Member, WorldCare International Inc; Consultant, WorldCare International Inc; Shareholder, Antares Pharma, Inc; Shareholder, iBio, Inc; Shareholder, Peregrine Pharmaceuticals, Inc
Debra A. Gervais, MD, Chestnut Hill, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To identify the most frequent genetic traits associated with metastatic colorectal tumors at time of presentation and whether there is a correlation between the genotypes and the metastatic disease patterns.

METHOD AND MATERIALS
Retrospective review of 713 subjects with cross-sectional imaging at time of diagnosis with no previous treatment. All tumor samples were tested for Single Nucleotide Polymorphisms (SNP). Mutations can be present individually or coexisting. Z tests were
used to assess differences.

RESULTS
Three-hundred-ninety-seven males and 316 females. Metastatic disease in 547/713 (76), 385/487(79) mutants (M) and 162/226(72) wild types (WT) (p=0.02). Incidence of metastatic disease per genotype as follows: NRAS 31/35(89%), KRAS 213/244 (87%), APC 47/55(85%), TP53 142/170(84%), PIK3C 59/81 (73%), BRAF 56/79(71%) and WT (72%)162/226. Metastasis to the liver, lymphnodes (LN), peritoneum and lung were observed with all genotypes. Liver:LN proportion of involvement was seen as follows: KRAS 62:28 (p<0.001), BRAF 55:62, NRAS 71:58, TP53 63:59, PIK3C 69:49, APC 64:47 and WT 51:49. Metastatic site involvement exclusive to certain genotypes was observed: duodenum/kidneys/uterus/cervix/vagina: KRAS+TP53, Brain:TP53, Appendix: KRAS, Retroperitoneum:PIK3C/WT and Bladder/Pancreas/Prostate/Mediastinum: WT. All genotypes except for BRAF demonstrated bone metastasis.

CONCLUSION
Our study suggests there is an association between mutational status and patterns of metastatic disease in Colorectal Cancer. Metastatic disease to the bladder, pancreas, prostate and mediastinum in CRC suggests wild type tumors. A lower involvement of LN suggests the presence of KRAS mutation.

CLINICAL RELEVANCE/APPLICATION
Genetic profiling should guide the search for specific metastatic patterns allowing special consideration for unusual sites of involvement of metastatic disease to suggest the presence of a specific mutation.

HONORED EDUCATORS
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Debra A. Gervais, MD - 2012 Honored Educator

SSA07-08 The Application of 3.0T MR Intravoxel Incoherent Motion Imaging and Diffusion Weighed Imaging in Preoperative Diagnosis of Lymph Node Metastatic of Rectal Carcinoma

Participants
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Meng Chen, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
You-Zhen Feng, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Zhong-Ping Zhang, MMEdSc, Guangzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the clinical value of Intravoxel Incoherent Motion imaging (IVIM) sequence in the diagnosis of lymph node metastatic of rectal carcinoma.

METHOD AND MATERIALS
87 lymph nodes from sixty-two rectal carcinoma patients with IVIM sequence (b=0,25,50,75,100,150,200,400,600,800,1000,1200,1500 and 2000 s/mm2) at 3.0T MR scanner and pathology data were collected. The parameter of IVIM(standard ADC, D, D* and f values) and the DWI signal strength value with b=1000 s/mm2 (S1000) in non-metastatic lymph nodes and metastatic lymph nodes were measured and calculated. Pathology findings and MR sequence were compared. The difference of metastatic lymph nodes and non-metastatic lymph nodes were compared by paired-samples t test.

RESULTS
There were 25 metastatic lymph nodes was found in 62 patients. The standard-ADC=(0.795 ±0.23)×10-3 s/mm²,D= (0.649 ±0.11) ×10-3 s/mm²,D*= (4.79±2.38)×10-3 s/mm², f=(0.27±0.09) % and S1000 =211.75±35.66 in the metastatic lymph nodes;the standard-ADC=(0.995 ±0.34)×10-3 s/mm²,D= (0.787 ±0.19) ×10-3 s/mm²,D*= (4.86±5.40)×10-3 s/mm², f=(0.33±0.33) % and S1000 =211.75±35.66 in non-metastatic lymph nodes. The difference of standard-ADC value (t=31.92, p<0.01), D (t=17.63, p=0.02) and S1000 (t=18.92, p<0.01) were statistically significant in the metastatic lymph nodes and non-metastatic lymph nodes;the standard-ADC value, D value and S1000 value of metastatic lymph nodes were higher than non-metastatic lymph nodes.

CONCLUSION
IVIM sequence can reveal standard ADC, D, D*, f and signal strength values, they are helpful for diagnose metastatic lymph node.

CLINICAL RELEVANCE/APPLICATION
IVIM sequence is helpful for diagnose metastatic lymph node.

SSA07-09 CT Texture Analysis in Patients with Locally Advanced Rectal Cancer Treated with Neoadjuvant Chemoradiotherapy: A Potential Imaging Biomarker for Treatment Response and Prognosis

Participants
Choong Guen Chee, MD, Seongnam, Korea, Republic Of (Presenter) Nothing to Disclose
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PURPOSE
To evaluate the association of texture of locally advanced rectal cancer in computed tomography (CT) with neoadjuvant concurrent chemoradiotherapy treatment (CRT) response and 3-year disease-free survival (DFS).

METHOD AND MATERIALS
Institutional review board approved this retrospective study and waived the requirement of informed patient consent. 95 consecutive patients who had neoadjuvant CRT followed by surgery for locally advanced rectal cancer have been included. Texture features were assessed with pretreatment CT scans by using independently developed software. Entropy, uniformity, kurtosis, skewness, and standard deviation were obtained from the largest axial image of the tumor (its boundary being manually drawn), without filtration and with Laplacian of Gaussian spatial filter of various filter values for fine (1.0), medium (1.5 and 2.0), and coarse (2.5) textures. Dworak pathologic grading was used for treatment response. Mean value of each texture parameter was compared between treatment responder (grade 3 and 4) and non-responder (grades 1 and 2) groups via independent t-test. Kaplan-Meier analysis was used to find the relationship between CT texture and 3-year DFS. Receiver operating characteristic curve was performed to determine the optimal threshold values. Using Cox proportional hazards model, independence of texture parameters from patient's stage and age was assessed.

RESULTS
Treatment responder group (n = 32) showed fine-texture features (lower entropy, higher uniformity, and lower standard deviation) with statistical significance in no filtration, and fine (1.0) and medium (1.5) filter values. Without filtration, Kaplan-Meier survival plots for entropy, uniformity, and standard deviation were significantly different (P = .03, P = .016, and P = .033) and fine-texture features (≤ 6.7 for entropy, > 0.0100 for uniformity, and ≤ 28.06 for standard deviation) were associated with higher 3-year DFS. Entropy, uniformity, and standard deviation were independent factors from the cancer stage and age in 3-year DFS (P = .033, P = .011, and P = .04).

CONCLUSION
Fine-texture features are associated with better neoadjuvant CRT response and higher 3-year DFS in patients with locally advanced rectal cancer.

CLINICAL RELEVANCE/APPLICATION
Our study implies the possibility of texture analysis as an imaging biomarker for the treatment response of neoadjuvant CRT and 3-year DFS in locally advanced rectal cancer.
PURPOSE
To evaluate, in a large population of patients with chronic liver disease, the performances of the different imaging techniques (contrast enhanced ultrasound (CEUS), CT scanner and MRI) alone and in combinations for the characterisation of hepatic nodules smaller than 3cm. This study was supported by a national institutional grant (PHRC 2008)

METHOD AND MATERIALS
From April 2010 to April 2013, 442 patients with a chronic liver disease have been prospectively included in 16 centres. They had 1 to 3 nodules 10 to 30 mm explored by CEUS, CT scanner and a MRI within a month. The examination was regarded as positive if the nodule displayed the typical landmark of HCC as defined by the European and American Association for the Study of the Liver (EASL and AASLD) recommendations. A composite gold standard was constructed with histology, imaging and follow up. We determined sensitivity and specificity for a given exam alone and for various combinations of exams as single tests. Results were given regarding the size of the nodules: 10-20mm and 20-30 mm.

RESULTS
382/442 patients with 551 nodules have been finally kept for the statistical analysis. They were 315 (82.46%) males; the mean age was 62.06 +/- 9.73 years. The causes of the chronic liver disease were mainly alcohol (58.12%), C virus (31.41%) and metabolic syndrome (19.11%). The mean size of the nodules was 18.15 +/- 5.74mm. For the 10 - 20mm nodules (n=347) sensitivity for the diagnosis of HCC was 70.2% for MR, 67.6% for CT scanner and 39.9% for the CEUS; and the specificity was respectively 83.1%, 76.6% and 93.5%. For the 20 - 30mm nodules (n=204) sensitivity for the diagnosis of HCC was 70.5% for MR, 67.5% for CT scanner and 52.4% for the CEUS; and the specificity was respectively 97.3%, 97.3% and 100%. For the 10 - 20mm nodules the sensibility and specificity were respectively 54.8% and 100% for the association of CT + MR; 27.7% and 100% for the association of CT + CEUS; and 28.7% and 99.4% for MR and CEUS

CONCLUSION
This study validates the use of sequential application of CT and MRI as recommended in the recent update of EASL and AASLD guidelines, in case of small HCC and in a large population. It shows the potential interest of CEUS for its high specificity. This study is part of the CHIC group.

CLINICAL RELEVANCE/APPLICATION
Recent updates of EASL and AASLD recommendations for the non invasive diagnosis of HCC are validated for the small HCC in a large population.
Preoperative MRI staging system may be comparable to the postoperative AJCC staging system in predicting prognosis following HCC resection. Survival was significantly different between T1a and T1b, and between T3a and T3b (median survival, 799 days vs. 141 days; P=0.0015). However, no significant difference was found in disease-free survival (median, 1925 days vs. 1668 days; P=0.048), between T2a and T2b (median, 1668 days vs. 799 days; P=0.0021), and between T3a and T3b (median survival, 799 days vs. 141 days; P=0.0015).

Both MRI and AJCC staging systems were excellent for predicting disease-free survival across different tumor stages 1, 2, and 3. Of 175 patients, 29 (16.6%), 6 (3.4%), 51 (29%), 51 (29%), 6 (3.5%), and 6 (3.5%) were staged as T1a, T1b, T2a, T2b, T3a, and T3b, respectively. Disease-free survival was significantly different between T1a and T1b, T2a and T2b, and T3a and T3b.

CONCLUSION
Preoperative MRI staging system may be comparable to the postoperative AJCC staging system in predicting prognosis following HCC resection.
curative resection of HCC. Furthermore, tumor stage 2 of the MRI staging system may be further divided into T2a and T2b.

CLINICAL RELEVANCE/APPLICATION

These advantages (preoperative staging and further stratification of T2 into T2a/b) can make the devised MRI staging useful in deciding on treatment plans of patients with HCC.

SSA08-05  Utilising the Full Potential of MRI in the Diagnosis of HCC - Time for a Game Changer?

Participants
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PURPOSE

The current cornerstone of HCC diagnosis is the wash-in/wash-out enhancement pattern. It is known that HCC might exhibit other MRI findings. Our aim was to retrospectively review the MRIs of histologically proven HCCs on liver explants, and to identify the best combination of sequences useful in HCC diagnosis.

METHOD AND MATERIALS

97 consecutive patients who underwent liver transplantation between 2004 and 2012 and Gd-BOPTA-MRI within 3 months of surgery were enrolled. A hepatobiliary histopathologist and two radiologists blinded to the radiological/histopathological findings performed a nodule by nodule analysis. The signal intensity of all nodules was assessed on the following axial sequences: T1 in/opposed phase, 3D fat suppressed (FS) T1 (pre-contrast, arterial, portal, equilibrium, and hepatobiliary phases), T2, T2 FS, and diffusion (B=800). Arterial enhancement was graded as none, mild, moderate, or intense. A multiple logistic regression analysis was performed following pathological/radiological correlation, and the Odds Ratio (OR) was calculated for every parameter analysed and adjusted for nodule size.

RESULTS

Imaging was performed 41.7±25.4 days pre-transplantation. 291 lesions were identified on histopathology, of which 193 were HCCs, 68 regenerative nodules, 8 low-grade dysplastic nodules (DN), 19 high-grade DNls, 2 cholangiocarcinomas, and 1 necrotic nodule. 48 HCCs (24.9%) were not detectable on imaging (24.9%), leaving a total of 145 HCCs (≤ 10 mm n=25; 11-19 mm n=58; ≥ 20 mm n=62). As expected, intense (OR 10.9, p<0.000) or moderate (OR 2.2, p=0.003) arterial enhancement and hypointensity on the portal venous (OR 14.3, p<0.000) or equilibrium (OR 15.9, p<0.000) phases were found to predict HCC. In addition, nodules showing hypointensity on the hepatobiliary phase and T2 hyperintensity were also highly likely to represent HCC. In the former, an OR of 10.2 was observed (p<0.000). The OR was 14.3 in non-FS T2 weighted sequences, and 10.2 in FS T2 weighted sequences (p<0.000).

CONCLUSION

In patients with a high risk of HCC, nodules lacking the typical hemodynamic findings are most likely HCC if they exhibit T2 hyperintensity and/or hypointensity on the hepatobiliary phase with an OR of 14.3 and 10.2, respectively (p<0.000).

CLINICAL RELEVANCE/APPLICATION

MRIs targeted at diagnosing HCC should include T2 weighted sequences with and without FS and Gd-BOPTA/Gd-EOB-enhanced hepatobiliary phases alongside standard sequences.

SSA08-06  A Tumor Suppression Factor HNF4α (Hepatocyte Nuclear Factor) Expression Correlates with Gadoxetic Acid Enhanced MRI Findings in Hepatocellular Carcinoma

Participants
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PURPOSE

Hepatocyte nuclear factor (HNF) 4A is one of transcription factors with tumor suppression effect, and besides, regulates expression of many molecules including organic anion transporting polypeptide (OATP) 1B3 (uptake transporter of gadoxetic acid) in hepatocellular carcinoma (HCC) (Yamashita T, Hepatology 2014). The purpose of this study is to clarify the correlation between HNF4A expression, pathological findings and imaging findings on gadoxetic acid enhanced MRI.

METHOD AND MATERIALS

The subjects are 138 surgically resected HCCs. We semiquantitatively evaluated the immunohistochemical HNF4A and OATP1B3 expression of HCC into four grades: grade 0: no expression, grade 1: weak expression, grade 2: moderate expression and grade 3:
intensive expression. We compared HNF4A grade of HCCs with OATP1B3 grade, enhancement ratio on the hepatobiliary phase of gadoxetic acid enhanced MRI and histological tumor differentiation grade (well, moderately and poorly differentiated HCC).

RESULTS

HNF4A grade in HCC showed a significant positive correlation with OATP1B3 grade (P=0.003, r=0.46). There was also a significant positive correlation between HNF4A grade and enhancement ratio on the hepatobiliary phase of gadoxetic acid enhanced MRI (P<0.0001, r=0.49). Especially, intensive HNF4A expression was observed in atypical HCC showing high enhancement ratio and increased OATP1B3 expression. HNF4A grade was decreased according to the decline of differentiation grade of HCC (P=0.0007, r=0.29).

CONCLUSION

The expression of HNF4A in HCC correlated with both of OATP1B3 expression and enhancement ratio on the hepatobiliary phase of gadoxetic acid enhanced MRI. In addition, HNF4A expression was decreased during multistep hepatocarcinogenesis. Gadoxetic acid enhanced MRI is useful to evaluate the expression of HNF4A in HCC.

CLINICAL RELEVANCE/APPLICATION

Gadoxetic acid enhanced MRI has a potential to reflect the expression of many genes and molecules regulated by HNF4A as imaging biomarkers (radiogenomics), which will be important for future personalized medicine.

SSA08-07  Presence of Hypovascular and Hypointense Nodules on Preoperative Gadoxetic Acid-enhanced MR Imaging: An Important Risk Factor for Recurrence after Liver Resection for Hypervascular Hepatocellular Carcinoma

Sunday, Nov. 29 11:45AM - 11:55AM Location: E450B

Participants
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PURPOSE

The hepatocyte phase (HP) of gadoxetic acid-enhanced magnetic resonance imaging (EOB-MRI) can reveal numerous hypovascular and hypointense nodules with malignant potential, which may progress to conventional hypervascular hepatocellular carcinoma (HCC). We retrospectively evaluated the prognostic factors for patients with hypervascular HCC after liver resection, including the presence of hypovascular hypointense nodules on HP of EOB-MRI (hypo-nodule).

METHOD AND MATERIALS

In total, 114 consecutive patients who had undergone surgical resection and were pathologically diagnosed with moderately differentiated HCC were included. For the analysis of risk factors for recurrence and a poor survival rate after liver resection, univariate and multivariate Cox regression analyses were performed for the following factors: age, tumor size, tumor number, vascular invasion, TNM stage, albumin level, prothrombin ratio, Child-Pugh class, alpha-fetoprotein level, protein induced by vitamin K absence/antagonist-II (PIVKA-II), liver cirrhosis, past history of HCC, and presence of hypo-nodules on HP of preoperative EOB-MRI. We compared the 5-year recurrence-free and overall survival rates between patients with and without hypo-nodules on HP of EOB-MRI.

RESULTS

Univariate and multivariate analyses revealed the presence of hypo-nodules as the only significant risk factor for recurrence after liver resection (risk ratio, 2.1 and 2.1; p-value, 0.014 and 0.020) and albumin level as the only significant risk factor for a poor survival rate (risk ratio, 10.3 and 6.1; p-value, <0.001 and 0.019). The 5-year recurrence-free rate was significantly lower for patients with hypo-nodules (13.1%) than for those without (48.8%; p = 0.008); similar results were observed for the 5-year survival rate (66.1% vs. 83.4%), although the difference was not significant (p = 0.222).

CONCLUSION

The presence of hypo-nodules on HP of preoperative EOB-MRI is an important risk factor for recurrence after liver resection for hypervascular HCC.

CLINICAL RELEVANCE/APPLICATION

The presence of hypovascular and hypointense nodules on hepatocyte phase of preoperative gadoxetic acid-enhanced MR imaging is an important risk factor for recurrence after liver resection for hypervascular hepatocellular carcinoma.

SSA08-08  Hepatocellular Carcinoma without Gadoxetic Acid Uptake on Preoperative MR Imaging: An Important Prognostic Risk Factor after Liver Resection

Sunday, Nov. 29 11:55AM - 12:05PM Location: E450B

Participants
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PURPOSE

Hepatocellular carcinomas (HCCs) commonly demonstrate hypointensity compared with the surrounding liver parenchyma on the hepatocyte phase (HP) of gadoxetic acid-enhanced MR imaging (EOB-MRI). However, some hypervascular HCCs with gadoxetic acid (EOB) uptake demonstrate iso- or hyperintensity on HP. Such lesions are known to be biologically less aggressive. A previous study showed a lower recurrence rate for hyperintense HCC than for hypointense HCC. In this study, we retrospectively evaluated the overall survival rate for patients with hyperintense and hypointense HCC on EOB-MRI.

RESULTS

In total, 114 consecutive patients with moderately differentiated HCC that was surgically resected from January 2008 to December 2013 were included in this study. According to their signal intensity on HP of EOB-MRI, the 114 patients were classified as EOB uptake (+) HCC (n = 23) and EOB uptake (-) HCC (n = 91). Risk factors for recurrence and a poor survival rate after liver resection were analyzed by univariate and multivariate Cox regression analyses of the following factors: age, tumor size, tumor number, vascular invasion, TNM stage, albumin level, prothrombin ratio, Child-Pugh class, alpha-fetoprotein level, protein induced by vitamin K absence/antagonist-II (PIVKA-II), liver cirrhosis, past history of HCC, and EOB uptake on HP of preoperative EOB-MRI. Then, we calculated the overall survival and recurrence-free rates for both groups using Kaplan-Meier survival curves. The log-rank and Wilcoxon tests were used to analyze significant differences.

CONCLUSION

The absence of EOB uptake was a significant risk factor for a poor survival rate after liver resection (risk ratio, 5.4; p < 0.05). The EOB uptake (+) group showed a higher overall survival rate compared with the EOB uptake (-) group (5-year survival rate, 100% and 73.3%; p < 0.05). However, the recurrence-free rate was not significantly different (p = 0.70).

CLINICAL RELEVANCE/APPLICATION

In patients with moderately-differentiated hepatocellular carcinoma, the absence of gadoxetic acid uptake is a significant risk factor for a poor survival rate after liver resection. The overall survival rate is higher for patients with gadoxetic acid uptake than for those without.

SSA08-09 Dual Energy Spectral CT Imaging for the Evaluation of Small Hepatocellular Carcinoma Microvascular Invasion

Sunday, Nov. 29 12:05PM - 12:15PM Location: E450B

Participants

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PURPOSE

To evaluate small hepatocellular carcinoma microvascular invasion using dual energy spectral CT imaging.

METHOD AND MATERIALS

This study was approved by our ethics committee. We retrospectively analyzed the images of 50 patients with 56 small hepatocellular carcinoma who underwent preoperative contrast enhanced dual-phase spectral CT scans before surgical resection. Tumors were divided into two groups based on the pathological findings for analysis: with (n=37) and without (n=19) microvascular invasion. Iodine concentration (IC) for tumors was measured in arterial phase (AP) and venous phase (VP) on the iodine-based material decomposition images to calculate IC reduction rate (ICrr) between AP and VP. IC values were further normalized to that of aorta to obtain normalized IC (NIC). Tumor CT attenuation number was measured on the monochromatic image sets to generate spectral HU curve and to calculate a slope (k) for the curve: (CT(40keV)-CT(90keV))/50.

RESULTS

Wilcoxon tests were used to analyze significant differences.

CONCLUSION

Using quantitative parameters obtained in spectral CT in the arterial phase provides new method with high accuracy to evaluate small hepatocellular carcinoma microvascular invasion.

CLINICAL RELEVANCE/APPLICATION

Quantitative iodine concentration measurement in spectral CT may be used to provide a new method to evaluate small...
hepatocellular carcinoma microvascular invasion.
PURPOSE
To investigate the feasibility of simultaneous conventional dynamic MR urography (MRU) and high temporal resolution perfusion MRI of bladder tumors using a novel free-breathing golden-angle radial acquisition scheme with compressed sensing reconstruction.

METHOD AND MATERIALS
22 patients with bladder lesions underwent MRU using the GRASP (Golden-angle RAdial Sparse Parallel) technique. Following contrast injection, GRASP was performed of the abdomen and pelvis during free breathing (voxel size 1.4x1.4x3.0 mm, 1,000 radial spokes, acquisition time 3:44 min). Two dynamic data-sets were retrospectively reconstructed from this single acquisition by combining a distinct number of spokes into each dynamic frame: 110 spokes per frame to provide a resolution of approximately 30 seconds, serving as conventional MRU for clinical interpretation, and 8 spokes per frame to provide 2 second resolution images for quantitative perfusion. Using the 2 second resolution images, ROIs were placed within the bladder lesion and normal bladder wall for all patients, an arterial input function was generated from the femoral artery, and the GKM perfusion model was applied.

RESULTS
Follow-up cystoscopy and biopsy demonstrated 16 bladder tumors (13 stage≥T2, 3 stage≤T1) and 6 benign lesions. All lesions were well visualized using the conventional 25 second clinical dynamic images. Based on the 2 second resolution images, Ktrans was significantly higher in bladder tumors (0.38±0.24) than in either normal bladder wall (0.12±8, p<0.001) or in benign bladder lesions (0.15±0.04, p=0.033). The ratio between Ktrans of the lesion and of normal bladder wall in each patient was nearly double in tumors than in benign lesions (4.3±3.4 vs. 2.2±1.6), and Ktrans was nearly double in stage≥T2 tumors than in stage≤T1 tumors (0.44±0.24 vs. 0.24±0.24), although these did not approach significance (p=0.180-0.209), likely related to small sample size.

CONCLUSION
GRASP DCE-MRI provides simultaneous conventional dynamic MR urography and high temporal resolution perfusion MRI of bladder tumors. Quantitative evaluation of bladder lesions based on the 2 second temporal resolution reconstructions showed associations with pathologic findings in our preliminary cohort.

CLINICAL RELEVANCE/APPLICATION
The novel GRASP sequence allows quantitative perfusion evaluation of bladder lesions within the context of a clinical MRU examination using a single contrast injection and without additional scan time.
METHOD AND MATERIALS

63 patients with clinical suspicion of prostate cancer were imaged on 3T Siemens Skyra /Verio scanners. MRF has been shown to measure T1 and T2 relaxation times with high accuracy and precision. In addition to this, a multiparametric MRI exam, MRF-FISP was acquired (slice thickness: 6 mm, in-plane resolution:1x1 mm2,FOV:400 mm, TR:11-13 ms, flip angle:5-75 deg, duration:50s per slice). b-values for DWI were 0, 500, 1000 s/mm2. T1, T2 maps were generated from MRF-FISP data and regions of interest (ROI) were drawn on T1, T2 and ADC maps in areas suspicious for cancer identified based on PIRADS score, and normal peripheral zone (NPZ). Matched pairs t-tests were used to compare T1, T2, ADC values in biopsy proven PCA and NPZ. Logistic regression model was applied to these parameters in differentiating PCA from NPZ. Receiver operating characteristic (ROC) analysis was performed for the parameters singly and in combination and area under the curve (AUC) was calculated.

RESULTS

29 patients were diagnosed with cancer on transrectal biopsy. T1, T2, ADC values were significantly lower in cancer compared to NPZ (p<0.0001). Mean T1, T2, ADC for prostate cancer were 141±60ms, 64±3ms, 745±54 x 10-6mm2/s, respectively. For NPZ, these values were 2059±77ms, 165±8ms, 1736±37 x 10-6mm2/s. The AUC for T1, T2, ADC values in separating PCa from NPZ was 0.978, 0.982, 0.801, respectively. The combination of T2 and ADC produced the most complete separation between cancer and normal tissues, resulting in AUC of 0.995.

CONCLUSION

MRF-FISP is a novel relaxometry sequence that allows quantitative examination of prostate in a clinical setting. The T1 and T2 relaxation times are obtained, in combination with ADC values show promising results in detecting prostate cancer.

CLINICAL RELEVANCE/APPLICATION

Quantitative MR parameters can help identify prostate cancer non-invasively. This could have broad applications in diagnosis, guiding biopsy, and follow up treatment.

SSA09-03 Contrast-enhanced Ultrasound for Renal Mass Characterization: Comparison of Low MI Time-intensity Curves and Destruction Reperfusion Techniques

Sunday, Nov. 29 11:05AM - 11:15AM Location: E351

Participants

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Lee Mullin, PhD, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate contrast enhanced US (CEUS) for renal mass characterization in chronic renal insufficiency (CRI), comparing nondestructive (low MI) and destruction-reperfusion techniques.

METHOD AND MATERIALS

Prospective study comparing 48 subjects: 24 with normal function and renal masses scheduled for excision; 24 with CRI and indeterminate renal lesions on non-contrast US/CT. CEUS was performed on an Acuson Sequoia with CPS software. Perflutren (Definity) 1.3mL was administered IV. Lesions were imaged at a low MI of 0.2. A 3 minute videoclip was recorded. Time Intensity curves (TICs) of the lesion and adjacent parenchyma were generated. After 30 minutes, a 2nd dose of Definity was given and a Destruction Reperfusion (DR) sequence performed on the same lesion. DR was performed under an IND exemption from the FDA. Bubble destruction was performed at an MI of 0.9. Reperfusion images were obtained using Motion Stabilized Persistence software (Siemens). A color-coded parametric map quantifying arrival time was generated in which Green=faster arrival, Red=slower, Black=no contrast. (Arrow=Bosniak IV mass). Reference standard was pathology, contrast CT/MR or absence of change on follow up imaging for benign lesions. Two blinded readers reviewed the low MI images and classified the lesions using Bosniak criteria.

RESULTS

Lesion size ranged from 1.7-7.6cm (mean 3.5cm). Histopathology of resected masses showed no cavitation or cellular injury from high MI of DR. DR arrival times correlated with low MI TIC parameters. Sensitivity for distinguishing Bosniak I/II/IF from III and higher was: Reader 1-96%, Reader 2-100%. Specificity was 78% and 63%. Sensitivity is lower because CEUS detects smaller amounts of contrast than CT/MR, leading to 'overstaging' with standard Bosniak. Reduced time to peak and arrival time (p<0.05) was seen in the parenchyma of CRI subjects compared to parenchyma of those with normal renal function.

CONCLUSION

CEUS can characterize renal lesions, but Bosniak criteria must be modified because US is more sensitive to slight enhancement. DR does not cause tissue injury, correlates with low MI findings, and takes less time. The parenchyma in CRI showed reduced/ delayed contrast uptake, suggesting CEUS may also be useful for renal functional imaging.

CLINICAL RELEVANCE/APPLICATION

CEUS can evaluate indeterminate renal lesions and renal function in CRI, a population where CT and MR contrast are contraindicated.
PURPOSE
To evaluate if ARFI can be a reliable technique in distinguishing ccRCCs from other solid and fluid-containing small renal masses.

METHOD AND MATERIALS
31 small (<4 cm) renal masses (27 were solid - 17/27 ccRCCs, 3/27 papillary RCCs, 2/27 chromophobe RCCs, 4 oncocytomas and 1 angiomylipoma - and 4 were cysts) were prospectively evaluated using US and ARFI. Each lesion was assigned an ARFI value obtained from the average of 12 measurements. All the solid masses underwent resection; all the cystic lesions were Bosniak 2, so were evaluated with follow-up. The difference existing between the two groups was evaluated by means of Student’s t-test. A cut-off value was determined to distinguish between ccRCCs and other lesions and sensitivity, specificity, PPV, NPV and accuracy were determined.

RESULTS
ccRCCs are characterized by a higher ARFI value and - when compared with all the other lesions - the difference existing between the two groups was statistically significant (p<0.001). Considering a cut-off value of 1.95 m/sec sensitivity, specificity, PPV, NPV and accuracy were respectively 94.1%, 78.6%, 84.2%, 91.7% and 87.1%.

CONCLUSION
ccRCC is characterized by a higher ARFI value which can be used to distinguish it from other solid and fluid containing masses.

CLINICAL RELEVANCE/APPLICATION
ARFI can be an useful tool in the evaluation of small renal masses, helping distinguish cc RCCs from other lesions.

SSA09-05 Fusion Imaging of (Contrast-enhanced) Ultrasound with CT or MRI for Kidney Lesions

PURPOSE
The aim of the study was to evaluate the feasibility of fusion imaging (FI) of (contrast-enhanced) ultrasound (CEUS) with CT/MRI in localization of sonographically challenging kidney lesions and usefulness for assessment of indeterminate kidney lesions.

METHOD AND MATERIALS
From March 2013 to January 2014, 30 consecutive patients were included in this retrospective study. All patients presented with previously in CT/MRI detected indeterminate kidney lesions that were either not detectable or hard to distinguish in conventional gray-scale ultrasound. In 26 (86.7%) of these patients FI and CEUS was simultaneously conducted.

RESULTS
FI could be performed in all of the 30 patients. FI-indication: In 18 of 30 patients (60%) FI was performed because a lesion of interest could not clearly be allocated due to multiple and directly adjacent similar lesions within one kidney. In 12 of 30 patients (40%) the kidney lesions were solitary or at least isolated but could not be detected with gray-scale US alone. CEUS-indication: Insufficient CT protocol (without NECT) and a not-water-isodens lesion (>20 HU) in 8 (30.8%) patients borderline CE in CT (10HU-20HU) in 11 (42.3%) patients non-conclusive CT/MRI studies in 5 (19.2%) patients CEUS for follow-up in 2 (7.7%) patients. Combined FI-CEUS: FI-CEUS could clearly differentiate between a surgical and non-surgical finding in 24 (80%) of 30 patients. In 2 (6.7%) of 30 patients conducted FI-CEUS lesions remained indeterminate. Final diagnosis: Histology revealed a surgical lesion in 6 (20%) patients, while in 18 (60%) patients a non-surgical lesion such as BII/BIF cysts, abscess formations, cicatricial tissue and a pseudotumor could be found. FI-CEUS didn't determine a final diagnosis in 2 patients (6.7%). In one elderly patient (3.3%) FI was performed without CEUS because only size control of was demanded. In 3 (10%) patients kidney lesions were not confidently detected with FI due to general US limitations.

CONCLUSION
Our data suggest that FI of the kidney is a feasible examination regarding the localization and further assessment of indeterminate kidney lesions.

CLINICAL RELEVANCE/APPLICATION
The combination of FI with a synchronous CEUS examination can clarify indeterminate renal CT or MRI findings, reduce radiation exposure and is cost effective.
Participants
Jason DiPoce, MD, Jerusalem, Israel (Presenter) Nothing to Disclose
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Jacob Sosna, MD, Jerusalem, Israel (Abstract Co-Author) Consultant, ActiViews Ltd Research Grant, Koninklijke Philips NV

PURPOSE
To evaluate image quality of kidney parenchyma in a spectrum of CT monoenergy levels and to select the optimal Monoenergy levels for visualization.

METHOD AND MATERIALS
IRB approval was obtained. 30-corticomedullary phase, IV contrast-enhanced CT abdomen scans (18 males, 12 females, mean age of 50 years) were evaluated. In each scan, kidney parenchyma (60 regions) was assessed. The scans were obtained from a 64-slice spectral detector CT prototype (Philips Healthcare, Cleveland, OH, USA) at 120 kVp with an average of 150 mAs. For each scan, simultaneous conventional polyenergetic and monoenergetic image datasets at 50, 60, 70, 100, and 140 keV were reconstructed. Two experienced radiologists analyzed subjectively in consensus visualization of the kidney parenchyma and selected the optimal visualization dataset based on the conspicuity of the cortex and medulla and compared to the conventional images. Objective kidney signal-to-noise ratio (SNR) in the optimal monoenergy images was measured and compared to data from the conventional CT images.

RESULTS
Optimal image quality for kidney visualization was subjectively selected with 60 - 70 keV monoenergy images and was judged to be better than the conventional dataset. The kidney SNR values in optimal monoenergy were highly significantly different (p<0.01) from conventional CT images. Average SNR was 10.9 and 16.3 in the conventional and optimal monoenergy respectively.

CONCLUSION
Optimal visualization of the kidney parenchyma on dual energy CT images is achieved with monoenergy image reconstruction at 60 - 70 keV based on both subjective and objective assessments and seems to improve image quality compared to conventional images.

CLINICAL RELEVANCE/APPLICATION
Optimal image quality in monoenergy images may be supplemental to conventional polyenergetic images and potentially increase the diagnostic yield.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jason DiPoce, MD - 2013 Honored Educator
Jacob Sosna, MD - 2012 Honored Educator

SSA09-07  The Use of New Tissue Strain Analytics Measurement in Testicular Lesions

Participants
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Alexander Karl, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Maximilian F. Reiser, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Virtual touch tissue imaging quantification (VTIQ) is a newly developed technique for the sonographic quantification of tissue elasticity. It has been used in the assessment of breast lesions. The purpose of this study was to determine the diagnostic performance of VTIQ in unclear testicular lesions.

METHOD AND MATERIALS
Twenty patients with known testicular pathology underwent conventional B-mode sonography with additional VTIQ of the testicular lesions using a Siemens Acuson S2000™ and S3000™ (Siemens Medical Solutions, Mountain View, CA, USA) system. Tissue mechanical properties were interpreted and compared in the VTIQ examination. The pathologic diagnosis was established after surgery or in the follow up examination in highly suspicious of benign lesions.

RESULTS
Over 36 months, 22 focal testicular lesions (median lesion size, 18 mm; range, 4-36 mm in 20 patients (median age, 43 years; range, 22-81 years) were examined. Lesions were hyperechoic (n = 1), hypoechoic (n = 14), isoechoic (n = 1), mixed echogenicity (n = 3) or anechoic (n = 3). Histological examination showed one benign lesion (6.25 %) with a mean size of 7 mm and 15 malignant lesions (93.75 %) with a mean size of 20 mm. The value of the shear wave velocity in normal testis tissue showed a mean shear wave velocity of 1.17 m/s. No value of the shear wave velocity could the measured in cystic lesions. The rest of the benign lesions showed a mean shear wave velocity of 2.37 m/s. The value of the shear wave velocity in germ cell tumours showed a mean shear wave velocity of 1.94 m/s and for seminoma it showed a mean shear wave velocity of 2.42 m/s.

CONCLUSION
VTIQ is a reliable new method for measuring qualitative and quantitative stiffness of testis lesions and tissue. The qualitative shear-
RESULTS were estimated and compared using ROC curve analysis. Sensitivity and specificity in tumor detection and characterization. The two imaging modalities were compared with cystoscopy and surgical results (N=8 patients) in order to assess the baseline US, and 4D Ultrasound with fly through (US virtual navigation system) by an expert radiologist blinded to cystoscopy.

30 consecutive patients with previous detected urinary bladder lesions at cystoscopy were prospectively evaluated with 2D imaging and contrast dynamic sequence (3D time-resolved imaging of contrast kinetics [TRICKS]). A contrast dilution of saline, iodine and gadolinium was instilled. Antral follicle counts, endometrial cavity findings, uterine wall pathology, tubal patency, and pelvic cavity findings were assessed with modalities.

RESULTS In all cases it was observed more ovarian follicles on MRI-HSG than in US. In 65% of patients, Fallopian tubes were visualized completely with MRI-HSG, whereas in the remaining 35% only look at its distal portion. In all cases was demonstrated tubal patency with free peritoneal spillage. In 45% of patients, MRI-HSG showed endoluminal lesions, likes polyps and miomas, that were corroborated with CT-HSG. In 14% of patients, MRI-HSG detected endometrial implants in pelvic cavity that could not be corroborated by the other methods.

CONCLUSION MRI-HSG allows a comprehensive evaluation for infertility diagnosis, with visualization and quantification of antral follicles, endometrial cavity, uterine wall and fallopian tubes as well as pelvic cavity findings such as endometrial implants.

4D Ultrasound Cistoscopy with Fly through in the Evaluation of Urinary Bladder Tumors Preliminary Experience

30 consecutive patients with previous detected urinary bladder lesions at cystoscopy were prospectively evaluated with 2D baseline US, and 4D Ultrasound with fly through (US virtual navigation system) by an expert radiologist blinded to cystoscopy results. The two imaging modalities were compared with cystoscopy and surgical results (N=8 patients) in order to assess the sensitivity and specificity in tumor detection and characterization. The diagnostic performance of 2D features and 4D ultrasound were estimated and compared using ROC curve analysis.

RESULTS 24/33 and 31/33 urinary bladder lesions were detected by 2 D US and 4 D Ultrasound respectively. The latter was also able to...
identify two additional lesions not previously detected at traditional cystoscopy. The US features of the lesions were consistent with the one provided at cystoscopy with not significant differences in term of characterization. Conclusion: Our preliminary results shows that 4 D ultrasound cystoscopy with fly through is more accurate than baseline 2D ultrasound to detect and characterize urinary bladder lesions with results comparable with traditional cystoscopy.

CONCLUSION

Our preliminary results shows that 4 D ultrasound cystoscopy with fly through is more accurate than baseline 2D ultrasound to detect and characterize urinary bladder lesions with results comparable with traditional cystoscopy.

CLINICAL RELEVANCE/APPLICATION

New ultrasound software such as 4 D ultrasound cystoscopy with fly through may help us to follow-up patients treated conservatively for urinary bladder lesions.
The Role of Peak Enhancement Values in Differentiating Pheochromocytomas from Adrenal Adenomas on CT

PURPOSE
The purpose of this study is to establish the role of the peak enhancement Hounsfield Unit (HU) value of focal adrenal lesions in differentiating potential pheochromocytomas from adrenal adenomas.

METHOD AND MATERIALS
The peak enhancement HU values of histologically confirmed pheochromocytomas (n = 24) were retrospectively compared with those of histologically confirmed adrenal adenomas (n = 28) on the 60-second contrast enhanced venous phase and compared utilizing a chi-square test. The studies were performed over a period of 5 years (2009-2014) on multi-detector CT scanners (MDCT). HU values were also measured on unenhanced (n = 34) and 15-minute delayed contrast enhanced (n = 27) phases. Measurements were obtained by drawing a representative region of interest over the target lesion. Peak enhancement values were recorded and absolute washout, relative washout and absolute enhancement (60-second enhanced minus unenhanced) were also calculated when available. Mass size was also recorded. The Student t test was used for comparing absolute enhancement and mass size.

RESULTS
83.3% (n = 20) of pheochromocytomas demonstrated a peak enhancement value of 85 HU or greater, compared to 10.7% (n = 3) of adrenal adenomas (p < 0.001, PPV = 86.96%, NPV = 86.2%). Absolute enhancement of pheochromocytomas was also higher than that of adrenal adenomas (mean = 66.2 HU [range, 51-95 HU] vs. 48.1 HU [range, 18-74]; p < 0.005). Of the pheochromocytomas imaged with a triphasic protocol (n = 9), 77.8% (n = 7) met absolute and relative washout criteria for the diagnosis of a lipid-poor adenoma (>= 60% and >=40% respectively). Pheochromocytomas were significantly larger than adrenal adenomas (mean diameter, 4.5 cm [range, 1-8.3 cm] vs. 1 cm [range, 0.8-6.2 cm]; p < 0.0001).

CONCLUSION
Peak enhancement values of 85 HU or greater in an adrenal lesion on the 60-second post contrast phase strongly suggest a diagnosis of pheochromocytoma rather than adrenal adenoma, regardless of whether or not the lesion demonstrates absolute or relative washout characteristics compatible with a lipid poor adenoma.

CLINICAL RELEVANCE/APPLICATION
Peak enhancement values on the 60-second post contrast phase should be routinely assessed in the workup of an adrenal lesion to avoid missing a pheochromocytoma.
This study was compliant with HIPAA and approved by the Institutional Review Board, with the waivers of informed consent. The consecutive research was performed between Aug 2013 to Aug 2014, with 40 adrenal nodules (21 histopathologically proven adenomas, 13 proven pheochromocytomas and 6 clinically proven metastases) who underwent MRI scanning with T1-independent volumetric multi-echo gradient-echo imaging with T2*-correction (IDEAL-IQ), following with an axial 3D dual-echo Dixon sequence (LAVA-FLEX) which performed IP and OP images. All MRI examinations were performed on a 3.0-T MR scanner. PDFF, SI index (SII), SI adrenal-to-liver ratio (ALR) and SI adrenal-to-spleen ratio (ASR) were calculated. All statistical analyses were performed by using statistical software SPSS 17.0.

RESULTS

PDFF of adenomas (21.39±10.09%) was significantly higher than of nonadenomas (2.25±2.73)(p=0.000, <0.05). PDFF was an effective tool for distinguishing adenomas from nonadenomas with an area under the curve (AUC) of 0.982, higher than 3.20 predicted adenomas with a sensitivity of 100% and a specificity of 89.5%. While, the sensitivities and specificities for adenomas were 90.0% and 100%, both for SII, ALR and ASR on IP/OP images, with AUC of 0.942, 0.937, 0.932, respectively.

CONCLUSION

PDFF measurements provided a more accurate estimation for fat content in adrenal nodules than with IP/OP images, and it could be a precisely parameter for differentiating adenomas from nonadenomas.

CLINICAL RELEVANCE/APPLICATION

In conclusion, IDEAL-IQ could be a valuable diagnostic tool for discriminating adenomas from nonadenomas with a high sensitivity and a relatively high specificity, avoiding radiation exposure, contrast media side-effect and complicated data calculation. IDEAL-IQ would be a prospective, reliable, and widely used method for diagnosing adrenal gland nodules in clinical study.
METHOD AND MATERIALS

The clinical manifestations and CT images for 30 patients with 31 lesions confirmed by pathological results from surgery were reviewed retrospectively. All of the patients were examined by a pre-contrast scan (true non contrast; TNC) and then arterial and venous phase enhanced scan. Then enhanced examinations were performed with dual-energy scan mode (SOMATOM Flash, Siemens Healthcare, Forchheim, Germany). The dedicated post processing application Liver VNC was used to get VNC images at the arterial and venous phase respectively. Mean CT values, signal-to-noise ratio, subjective image quality, and radiation dose were compared between routine TNC and VNC. The correlation between TNC and VNC images of the adrenal adenoma was evaluated. Sensitivity, specificity and accuracy of VNC images for the characterization of lipid-poor adenoma were calculated from contingency tables of contingency.

RESULTS

No significant differences were seen for mean CT values in normal adrenal tissue, adrenal adenoma and the muscles of posterior spine between TNC and VNC images (p>0.05), except the abdominal aortic and spleen which the mean CT values in VNC images was higher than that in TNC image, and the differences were statistically significant (p<0.05). SNR of all tissues in VNC images were higher than that in TNC image, and the differences were statistically significant (p<0.05) except the abdominal aortic (p>0.05). The subjective score of VNC images was lower than that of TNC image, but the difference was no statistically significant (p>0.05). The radiation dose of VNC images was lower than that of TNC (p<0.05). A positive correlation was found for CT values of adrenal adenoma between TNC and VNC images. Sensitivity, specificity, and accuracy from VNC images of arterial phase for the characterization of lipid-poor adenoma were 86.9%, 100%, 90.3% and from venous phase were 60.9%, 87.5%, 67.7%.

CONCLUSION

VNC images calculated from contrast-enhanced dual-energy CT have a potential to replace the TNC images to diagnose the adrenal adenoma and thus reduce the patient's radiation dose.

CLINICAL RELEVANCE/APPLICATION

Dual-energy VNC have a potential to replace the TNC images to diagnose the adrenal adenoma and thus reduce the patient's radiation dose.


Sunday, Nov. 29 11:25AM - 11:35AM Location: E353B

Participants
Jason A. Pietryga, MD, Birmingham, AL (Presenter) Nothing to Disclose
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Desiree E. Morgan, MD, Birmingham, AL (Abstract Co-Author) Research support, General Electric Company

PURPOSE

To characterize adrenal lesions as benign or malignant on contrast-enhanced dual energy CT using material suppression imaging (MSI) virtual unenhanced images and pseudo-unenhanced monoenergetic 140keV images.

METHOD AND MATERIALS

IRB-approved HIPAA-compliant study. A retrospective search identified consecutive adult outpatients who had undergone multiphasic dual energy CT(DECT) with an adrenal lesion ≥1cm reported. Two patients weighing ≥300 lbs were excluded. A single board-certified radiologist reviewed the CTs and placed ROIs on the adrenal lesions on the noncontrast (NC) series and simultaneously placed matching ROIs on MSI virtual unenhanced and virtual monoenergetic 140 keV images. The lesions were characterized by accepted clinical standards. Spearman rank correlation was performed to evaluate for associations between the virtual unenhanced, pseudo-unenhanced HU and NC HU and t tests to evaluate means. Regression analysis was performed to identify threshold values to characterize adrenal lesions as benign vs malignant. Myelolipomas were excluded from the regression analysis.

RESULTS

104 patients (52M,52F, mean age 62, weight 188 lb) with a total of 140 adrenal lesions were identified. 56%(78/140) of the lesions were lipid-rich adenomas, 6%(9/140) lipid-poor adenomas, 20%(28/140) malignancies, 8%(11/140) myelolipomas and 10%(14/140) indeterminate. The mean HUs for adenomas were -6.9 (NC), 11.3 (MSI), 12.5 (140 keV); mean HUs for malignant lesions were 34.2 (NC), 39.1 (MSI) 38.7 (140 keV); all p<0.0001. There were very strong Spearman correlations between NC and MSI HU (.83), NC and 140keV HU (.81) and MSI and 140keV HU (.98). Excluding 1 obvious necrotic RCC metastasis, a threshold of 20 HU on MSI and 16 HU on 140keV images correctly characterizes lesions as adenomas with a sensitivity of 68%(59/87) and 53%(46/87), respectively, both with specificity of 100%.

CONCLUSION

MSI virtual unenhanced and virtual 140keV monoenergetic contrast-enhanced DECT images can be used to characterize adrenal adenomas with a sensitivity of 72% and 59%, respectively, when using new HU threshold values of 20 and 16, respectively. Excluding an obvious necrotic RCC metastasis, both threshold values are 100% specific.

CLINICAL RELEVANCE/APPLICATION

In this largest DECT series of adrenal lesions, new HU criteria are presented that can characterize lesions on contrast-enhanced DECT, potentially obviating the need for further imaging for most patients.

SSA10-07 MASS Criteria as a Predictor of Survival in Sunitinib Treated Metastatic RCC - A Secondary Post-hoc Analysis of a Multi-institutional Prospective Phase III Trial
Participants
Andrew D. Smith, MD, PhD, Jackson, MS (Presenter) Research Grant, Pfizer Inc; President, Radiostics LLC; President, Liver Nodularity LLC; President, Color Enhanced Detection LLC; Pending patent, Liver Nodularity LLC; Pending patent, Color Enhanced Detection LLC;
Frederico F. Souza, MD, Madison, MS (Abstract Co-Author) Nothing to Disclose
Manohar Roda, MD, Jackson, MS (Abstract Co-Author) Nothing to Disclose
Haowei Zhang, MD, PhD, Jackson, MS (Abstract Co-Author) Nothing to Disclose
Xu Zhang, PhD, Jackson, MS (Abstract Co-Author) Nothing to Disclose

PURPOSE
To validate MASS Criteria as a predictive imaging biomarker in metastatic RCC treated with anti-angiogenic therapy.

METHOD AND MATERIALS
As part of a published multi-institutional prospective phase III trial, 375 adult patients with metastatic clear cell RCC were treated with sunitinib. In this secondary post-hoc retrospective analysis, initial post-therapy CT images were evaluated by RECIST, Choi Criteria, and MASS Criteria in patients with DICOM format images. Comparison of PFS and OS among MSKCC risk and imaging response groups was evaluated using log-rank test. Inter-observer agreement among 3 readers was assessed in 21 randomly selected cases using intra-class correlation coefficient (ICC).

RESULTS
Median PFS and OS of the full cohort (N=270) were 1.1 and 2.6 years, respectively. PFS and OS of all MASS Criteria objective response categories were significantly different from one another (p<0.0001 for each). By comparison, PFS of MSKCC low (N=186) and intermediate (N=84) risk groups, PFS of RECIST PR (N=33) and SD (N=228) groups, and OS of Choi Criteria SD (N=36) and PD (N=13) groups were not significantly different (p=0.225, 0.810 and 0.311, respectively). Median PFS for patients with baseline MSKCC Criteria low (N=186) and intermediate (N=84) risk were 1.2 and 0.9 years, respectively. By comparison, median PFS for patients with MASS criteria PR (N=177), IR (N=84), and UR (N=9) were 1.4, 0.5, and 0.1 years, respectively. Inter-observer agreement among 3 readers interpreting 21 randomly selected cases using MASS Criteria was substantial (ICC=0.70).

CONCLUSION
In patients with metastatic RCC treated with sunitinib, MASS Criteria response on the initial post-therapy CT is predictive of PFS and OS.

CLINICAL RELEVANCE/APPLICATION
MASS Criteria is currently the only quantitative biomarker for predicting response to anti-angiogenic therapy in metastatic RCC that has been validated in a multi-institutional study and it may potentially be useful in guiding therapy, reducing drug toxicities and costs, and planning adaptive design clinical trials.

SSA10-08 Prediction of Survival in Patients with Metastatic Clear Cell Carcinoma Treated with Targeted Anti-angiogenic Agent Sunitinib via CT Texture Analysis

Sunday, Nov. 29 11:55AM - 12:05PM Location: E353B

Participants
Masoom A. Haider, MD, Toronto, ON (Presenter) Consultant, Bayer AG
Alirea Vosoughi, MD, MRCP, Aberdeen, United Kingdom (Abstract Co-Author) Nothing to Disclose
Farzad Khalvati, PhD, MSc, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Alexander Kiss, PhD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Balaji Ganeshan, PhD, London, United Kingdom (Abstract Co-Author) Scientific Director, TexRad Limited
Georg Bjarnason, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the role of CT Texture analysis in prediction of progression free and overall survival and assessment of response to treatment with Sunitinib in patients with metastatic clear renal cell carcinoma (RCC).

METHOD AND MATERIALS
Contrast enhanced CT texture parameters were assessed in 40 patients with metastatic clear RCC who were treated with Sunitinib. Appropriate measurable lesions were selected based on RECIST criteria before and about two months after treatment with Sunitinib. Texture and histogram analysis of the lesions were performed using TexRad software. Using a Cox regression model, correlation of texture parameters with measured time to progression and overall survival were assessed.

RESULTS
"Size normalized tumor Entropy" (NE) was found as an independent predictor of time to progression and overall survival and can add to Heng; a well-known prognostic model for metastatic RCC patients. Cox proportional hazards regression analysis (HR) showed that NE was an independent predictor of time to progression. (HR = 0.01 and 0.02; 95% confidence intervals (CI): 0.00 - 0.29 and 0.00 - 0.39; p=0.01 and p=0.01 for NE before and two months after treatment, respectively). NE was also shown to be an independent predictor of overall survival. (HR = 0.01 and 0.01; 95% CI: 0.00 - 0.31 and 0.001 - 0.22; p=0.01 and p=0.003 for NE before and two months after treatment, respectively).

CONCLUSION
Tumor heterogeneity is a well-known feature of malignancy reflecting areas of increased cellular density, hemorrhage and necrosis. CT texture analysis can quantify heterogeneity by using a range of parameters including size normalized Entropy (NE) as a measure of texture irregularity. Our study showed that NE is an independent predictor of the outcome of treatment with Sunitinib in patients with metastatic RCC and can be used for prediction of time to progression and overall survival in these patients. This can help identify non-responders from the outset with the potential to avoid unnecessary toxicity and to start alternative therapies earlier.
The ability to identify poor responders early in the course of treatment or before starting the treatment can help patients be spared from toxicity usually associated with these treatments and could potentially receive alternative therapies earlier. Using the costly drugs of treatment only in patients who benefit from them will be a potential for cost-effectiveness improvement.

Participants
Hanmei Zhang, Chengdu, China (Presenter) Nothing to Disclose
Yinghua Wu, MD, PhD, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Panli Zuo, Beijing, China (Abstract Co-Author) Nothing to Disclose
Niels Oesingmann, PhD, Erlangen, Germany (Abstract Co-Author) Employee, Siemens AG
Bin Song, MD, Chengdu, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
The defect of pseudo-capsule is tightly correlated with the invasiveness of tumors. This study aimed to prospectively evaluate the performance of combining morphological imaging and functional imaging for detecting the defects of pseudo-capsule in renal tumors, and to predict renal capsule invasion which were confirmed histopathologically.

METHOD AND MATERIALS
Twelve patients with suspicious renal tumors underwent T2-weighted imaging and contrast-free renal ASL imaging at a 3.0T MR scanner. Renal ASL was performed using a prototype flow-sensitive alternating inversion recovery trueFISP (FAIR-trueFISP) sequence with a TI of 1200 ms for perfusion images and without inversion for M0 images. A modified Look-Locker inversion-recovery (MOLLI) sequence was used for T1 mapping. Renal blood flow (RBF) was quantitatively measured on the perfusion images which were determined on a pixel by pixel basis. For T2-weighted images alone, the discontinuous hypo signal intensity rim was defined as the defect of tumors' pseudo-capsule, for combination of T2-weighted images and ASL, the hypo signals in T2-weighted images as well hyper signals in perfusion images were defined as the defect of tumors' pseudo-capsule. The diagnostic performance was assessed using diagnostic test's index.

RESULTS
Twelve renal lesions (11 clear cell RCCs and 1 chromophobe RCC) were evaluated in 12 patients. All ccRCCs showed defect of tumors' pseudo-capsule on T2-weighted images. Of the 11 ccRCCs cases, 10 cases showed blood flow right on the defect area of tumors' pseudo-capsule on perfusion images and 1 case did not. All the defect areas of tumors' pseudo-capsule seen in the surgery operation had renal capsule invasion. For defecting of tumors' pseudo-capsule, i.e. predicting renal capsule invasion, sensitivity, specificity, positive predictive value and negative predictive value were 100%, 33.3%, 81.8%, 100% for T2-weighted images alone and 100%, 66.7%, 90%, 100% for combination of T2-weighted images and ASL images.

CONCLUSION
The combination of T2-weighted images and ASL images produced promising diagnostic accuracy for predicting renal capsule invasion, which could offer additional imaging information for clinical diagnosis of renal tumors.

CLINICAL RELEVANCE/APPLICATION
Noninvasively and prospectively evaluated the presence of the defect pseudo-capsule in renal tumors may help predict the invasiveness of tumor and influence clinical therapy strategy.
Participants
George L. Shih, MD, MS, New York, NY (Moderator) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Consultant, Angular Health, Inc; Stockholder, Angular Health, Inc;
Peter R. Bream JR, MD, Nashville, TN (Moderator) Consultant, Coeur, Inc; Advisory Panel, CryoLife, Inc
Luciano M. Prevedello, MD,MPH, Columbus, OH (Moderator) Nothing to Disclose

Sub-Events
SSA11-01  Informatics Keynote Speaker: Role of NLP and Machine Learning in Radiology
Sunday, Nov. 29 10:45AM - 10:55AM Location: S403A

Participants
George L. Shih, MD, MS, New York, NY (Presenter) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc; Consultant, Angular Health, Inc; Stockholder, Angular Health, Inc;

SSA11-02  Virtual Reality Training Modules Hold Potential for IR Education
Sunday, Nov. 29 10:55AM - 11:05AM Location: S403A

Awards
Trainee Research Prize - Fellow

Participants
Colin J. McCarthy, MD, Boston, MA (Presenter) Nothing to Disclose
Alvin Y. Yu, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Stephen R. Lee, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Synho Do, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Steven L. Dawson, MD, Cambridge, MA (Abstract Co-Author) Consultant, Cook Group Incorporated Royalties, CAE Healthcare, Inc
Raul N. Uppot, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Background
The challenge for all types of interventional radiology (IR) training is hands-on experience. Currently, IR trainees learn procedures by watching and assisting in cases. We set out to develop and evaluate an immersive virtual reality (VR) simulator, the aim of which was to provide trainees with an introduction to IR procedures. These modules differ from traditional textbooks or online learning sites, since they immerse the participant in the center of activity. Advances in the VR field have allowed for not only realistic display of stereoscopic and 360-degree images, but also the recording of such immersive content.

Evaluation
An introductory IR tutorial was recorded using a dual camera system (GoPro, Inc.) and post-processed to generate a stereoscopic 3D tutorial. The content was displayed using a head-mounted VR headset, featuring low-latency gyroscope paired with two low persistence OLED displays located immediately in front of the viewer's eyes, blocking out all external visual stimuli (Oculus VR, LLC). Additional tutorials were also constructed from a 7 camera rig (360Heros, Inc.) that captured 360-degree environmental images, allowing full immersion in the IR suite. Footage from 7 individual cameras was fused and synchronized using software (Autopano Video, Kolor SARL). Participants were asked to complete a survey after the tutorial, with questions designed around a Likert scale.

Discussion
12 participants agreed to partake in the study, 6 Attending Radiologists, 5 Fellows and 1 Resident. 75% (n = 9) of those surveyed felt that the immersive VR training module was "good" or "excellent". All participants felt that the VR headset had potential to improve IR training in the future. Feedback included some reports of initial motion sickness, potential to interact with the 3D environment and the need to incorporate radiology images into the interactive content.

Conclusion
Immersive VR platforms hold potential to enhance education in Interventional Radiology. The technology is in its early stages, but may serve as an adjunct to existing methods of training. In addition to stereoscopic 3D tutorials, interactive 360-degree video content may prove valuable to those unfamiliar with an interventional suite.

SSA11-03  Teaching File 2.0: The Next Generation of Radiology Education with Open Web Technologies
Sunday, Nov. 29 11:05AM - 11:15AM Location: S403A

Participants
Jason M. Hostetter, MD, Baltimore, MD (Presenter) Nothing to Disclose
Christopher Trimble, MD, MBA, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Michael A. Morris, MD, MS, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Jean Jeudy JR, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

Background
Radiology education has long consisted of static images displayed alongside text, often in powerpoint slides or textbooks. This
presentation style is incongruent with the modern radiologist's digital, interactive workflow. Our project aims to allow radiologists to easily create interactive, anonymized, standards compliant teaching files, available anywhere, on any device.

Evaluation

Using standard web technologies of HTML5 and JavaScript, we created a cloud-based application to create and store radiology cases. Integrated with our enterprise PACS via DICOM standards, studies are fully anonymized with one click, creating a web-based teaching case that is always-on, shareable, and available to desktop PCs, tablet devices, and modern smartphones without installing third party software. Similar to normal web pages, cases can be manipulated with hyperlinks in case descriptions or in other web pages in which the case is displayed. Cases are viewed in a web browser with full DICOM support allowing a true PACS environment. The application has been used at our institution over the past year to create educational modules for medical students as well as to create interactive educational e-books about radiology and pathology topics. Residents and faculty also utilize the system to maintain personal case logs and share interesting cases via email or text within HIPAA compliance.

Discussion

Our implementation brings full PACS functionality to a portable and extensible educational platform. By utilizing existing web and DICOM standards, any device with a modern web browser is a fully enabled DICOM viewer, and any standards compliant PACS can be easily integrated to generate anonymized cases in a single click. A cloud based solution also allows easy sharing and collaboration, by simply sending a link via email, text, or social media, in same way one may share an interesting article. Our architecture eliminates the need for local archival storage, ensuring cases are always instantly available.

Conclusion

We created a cloud based radiology educational resource using standard web technologies, with full PACS functionality, and automated anonymization to bring radiology educational materials to the modern web.

SSA11-04 Simultaneous Human-Readable and Structured Data Encoding from PDF Forms

Sunday, Nov. 29 11:15AM - 11:25AM Location: S403A

Participants
Zachary S. Delproposto, MD, Detroit, MI (Presenter) Nothing to Disclose
Matthew C. Rheinboldt, MD, New Orleans, LA (Abstract Co-Author) Nothing to Disclose

Background

Clinical and research needs often demand the need to store metadata which is not integral to the EHR (e.g., RECIST data). While PDF files can be saved as DICOM images, structure is lost and maintained only by entry into a separate system which requires maintenance and dissociates captured information from the study data. We have created a system to extract data from PDF Forms and simultaneously embed the form itself as a human-readable DICOM image, and the structured form data as an embedded QR code within a DICOM image.

Evaluation

Using PDF forms eliminates the need for custom local or web applications to edit structured data. Storing the PDF data as an image allows for facile retrieval of human-readable information sans additional software. QR-encoded structured data is stored as DICOM image data, not using private/non-standard fields, maintaining superb vendor neutrality and compatibility. QR-codes also permit structured data capture directly into mobile applications. Leveraging existing PACS infrastructure obviates the need for an external database. Extraction of structured data and PDF form re-creation occurs as needed; the presence of image-embedded structured data does not diminish the performance of the PACS or impede interpretation of diagnostic data.

Discussion

Built using open-source components and leveraging the existing PACS infrastructure, we find that our system allows easy, reliable metadata entry and recall (Figure 1). Since forms are stored both as a PDF image and as QR-encoded structured data image, workstations without the need for structured metadata entry or recall function normally without workflow impact. Most users are familiar with PDF forms, which are in common use and routinely used at both public and private institutions. PDF forms can be constructed to constrain input fields to appropriate types (e.g., numeric fields), enforcing data consistency. Ease of use is a key factor in this system. Additional data storage requirements are minimal, adding only a few images to each study.

Conclusion

We show a robust, efficient, cost-effective method to encode metadata from PDF forms simultaneously in a human-readable image and machine readable structured image formats.

SSA11-05 Call Cases Dashboard: What a First-Year Radiology Resident Knows before Call

Sunday, Nov. 29 11:25AM - 11:35AM Location: S403A

Participants
Linda Kelahan, MD, Washington, DC (Presenter) Nothing to Disclose
Allan Fong, BS,MS, Washington, DC (Abstract Co-Author) Nothing to Disclose
Raj Ratwani, Washington, DC (Abstract Co-Author) Nothing to Disclose
Ross W. Filice, MD, Washington, DC (Abstract Co-Author) Nothing to Disclose

Background

Current ACGME guidelines do not help first-year radiology residents prepare for the daunting task of taking call. Tracking exposure to high-acuity cases that are likely to be encountered while taking call can provide a framework for focused study and reflection. Furthermore, these cases can subsequently be utilized for educational or research purposes.

Evaluation

We focused on cases most likely to be encountered in a resident call setting. First, we limited evaluation to relevant procedures (i.e. CT abdomen/pelvis for appendicitis). We then applied natural language processing (NLP) techniques (specifically sentence
For the second consecutive year, the 2014 RSNA DPS offered electronic education exhibit (EEE) viewers the opportunity to "like" an EEE. We sought to 1) evaluate any relationship between an EEE's popularity and its chance of winning an award or being selected for RadioGraphics, 2) evaluate any relationship between an EEE's recognition and its subsequent popularity, and 3) assess overall audience "like" participation at the 2014 meeting as compared to 2013.

**METHOD AND MATERIALS**

The number of likes each EEE received was recorded from DPS on 1) Wednesday morning before award selections and RadioGraphics invitations had been announced and 2) Saturday morning after the meeting had concluded. Data analysis was performed by means of one-way ANOVA.

**RESULTS**

At the 2014 RSNA meeting, there were 1793 EEEs, which received 11074 likes (Mean 6.2, Min 0 [n=124], Max 109 [n=1]). Awards were given to 404 EEEs (22.5%), which received 3452 likes (31.2%, Mean 8.5, Min 0 [n=13], Max 109 [n=1]). RadioGraphics
Structured Reporting of Focal Lesions in the Abdomen to Assess Radiology Trainees’ Performance Demonstrates Decreased Detection Errors for Suspicious Lesions with Increased Training

Sunday, Nov. 29 11:55AM - 12:05PM Location: S403A

Participants
Joe C. Wildenberg, MD, PhD, Philadelphia, PA (Presenter) Nothing to Disclose
Po-Hao Chen, MD, MBA, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Charles E. Kahn JR, MD, MS, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Hanna M. Zafar, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Tessa S. Cook, MD, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Structured reporting (SR) of focal masses in the solid abdominal organs can be used, in the context of education, to assess the ability of radiology trainees to detect and characterize these lesions. Using an existing SR initiative at our institution, we investigated if there was a difference in detection of focal abdominal mass lesions by trainee level.

METHOD AND MATERIALS
All CT and US studies of the abdomen performed between 7/1/2013 and 12/15/2014 in a call setting, without immediate attending input, were reviewed. Trainees evaluated the liver, pancreas, kidneys, and adrenal glands within the SR framework. Numeric codes, analogous to BI-RADS, and corresponded to both the presence of focal masses and the likelihood of malignancy. All preliminary interpretations were subsequently reviewed by attending radiologists, and differences in the numerical categories noted. Non-visualization was representative of a change from an assignment of “no mass” to any benign, indeterminate or suspicious lesion. Data was analyzed by level of training.

RESULTS
Among 12081 studies that met inclusion criteria, residents failed to visualize focal abdominal masses more often than fellows (80/3699, 2.2% versus 128/8382, 1.5%, respectively) (p<0.02). Sub-analysis revealed no difference in detection when the lesion was classified as benign; however, fellows demonstrated a lower miss rate for suspicious lesions (p<0.05). Furthermore, although direct year-to-year comparisons were not significant, there was a near-linear decrease in non-visualization rate with increased trainee year (r=-0.96; p<0.05).

CONCLUSION
SR can be leveraged to assess radiology trainees’ performance and guide education in call situations. We found that increased training was associated with a lower proportion of missed focal masses. Additionally, we found that inexperienced trainees made more errors when the lesion was eventually classified as suspicious, whereas there was no difference for benign lesions.

Clinical Relevance/Application
Trainee education in the clinical setting is often subjective, with incomplete metrics to assess trainee performance. Structured reporting of focal abdominal masses is an objective metric to understand the progression of trainees’ proficiency and provide targeted feedback for studies read in a call setting. The effect of alternative methods of targeted educational outreach to residents on non-visualized abdominal masses can be explored.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Charles E. Kahn JR, MD, MS - 2012 Honored Educator

TROVE: Open Source Resident Dashboard with Disease Classification Using Natural Language Processing (NLP) and Machine Learning (ML)

Sunday, Nov. 29 12:05PM - 12:15PM Location: S403A

Participants
Kurt T. Teichman, BSc, MEng, New York, NY (Abstract Co-Author) Nothing to Disclose
Shlomo Minkowitz, BA, MD, New York, NY (Presenter) Nothing to Disclose
Charles Hemmann, MS, New York, NY (Abstract Co-Author) Nothing to Disclose
George L. Shih, MD, MS, New York, NY (Abstract Co-Author) Consultant, Image Safely, Inc; Stockholder, Image Safely, Inc;
Background

Determining if a radiology resident has met the goals of the residency curriculum, which outlines different pathologies and conditions for imaging, is challenging. Our TROVE dashboard (DEMO: http://demo.trovedashboard.com / SOURCE: http://src.trovedashboard.com) displays the volume of exams and now classifies the radiology reports to determine which diseases a resident has seen during clinical rotations.

Evaluation

Machine learning algorithms are applied using a training dataset from our billing company which provides ICD9 codes for all radiology reports. The disease view of the TROVE dashboard utilizes 174 support vector machine (SVM) classifiers to associate radiology free text reports with 174 specific disease labels, which correspond to diseases that were determined to be important for resident training by the different departmental division chiefs. Resident reports are processed using Natural Language Processing techniques by finding both positive and negative labels for a particular disease and then compiling a MESH concept list of the most common concepts associated with that particular disease to determine features to be used in SVM training. Utilizing solely the impression text of a report, the average F1-score across all 174 svm classifiers is 0.801894 (best = 1.0). Some diseases scored higher such as Carotid Stenosis (0.883001144096) and Wrist Fracture (0.886353355114). Other diseases had lower scores such as Testicular Torsion (0.676691729323). A single report may include multiple diseases and will be classified as such by the SVMs.

Discussion

With an average F1-measure of 0.801894 we can conclude that the methodology outlined above provides fairly robust predictions associated with the SVM classifiers, giving a reasonable estimate of resident experience. Lower scores are generally associated with either improper feature selection and/or shortage of training data which may improve over time with more data. Future work on these SVM classifiers should include the use of MetaMap for better feature selection.

Conclusion

TROVE dashboard, using NLP and ML, provides classification of radiology reports to determine the diseases residents have seen during their clinical rotations.
**Molecular Imaging Profiling of Treatment Effects in Experimental Multiple Sclerosis**

**OBJECTIVE**

To evaluate the molecular imaging signatures of interferon beta (IFN) and glatiramer acetate (GA), two first-line agents used in multiple sclerosis (MS), with an activatable molecular MR probe specific to myeloperoxidase (MPO), an enzyme secreted by pro-inflammatory myeloid cells, to better profile and study their effects on the innate immune response in vivo.

**METHOD AND MATERIALS**

Thirty-five female SJL mice were injected with proteolipid protein to induce experimental autoimmune encephalomyelitis, a mouse model of MS, and treated with IFN (1 μg/day), GA (150 μg/day), MPO inhibitor ABAH (0.8 mg/day), or saline. Mice underwent MRI at 4.7T with MPO-Gd at disease peak (day 12). Lesion volume, number, contrast-to-noise ratio (CNR), and total MPO-Gd enhancement were quantified on delayed images. Mechanistic in vitro experiments were performed.

**RESULTS**

CNR (MPO activity in vivo) was decreased with ABAH and IFN, but not with GA. Lesion volume, lesion number, and total MPO-Gd enhancement was decreased with all three agents (Fig., A-B). These findings suggest that IFN may have the imaging signature of an MPO inhibitor. However, direct enzymatic inhibition was only found with ABAH, and not with IFN or GA (C). When primary neutrophils were stimulated to secrete MPO, IFN decreased activity of the MPO enzyme, similar to ABAH (D), while GA did not have a similar effect (D). When neutrophils were incubated with IFN, increased superoxide anion production (as measured by dihydroethidium [DHE] fluorescence) was detected (E). Inhibition of superoxide anion production by apocynin resulted in the restoration of MPO activity from stimulated neutrophils (F). Spectrophotometry revealed that IFN-mediated superoxide anion production abolished absorbance of MPO at 430 nm, consistent with irreversible destruction of the iron-containing prosthetic group (G).

**CONCLUSION**

Molecular imaging profiling with MPO-Gd reveals differential treatment effects of the two first-line drugs used in the treatment of MS (H), and led to the discovery of a novel mechanism of action of IFN: IFN triggers superoxide anion production in myeloid cells to irreversibly inactivate MPO.

**CLINICAL RELEVANCE/APPLICATION**

Molecular imaging profiling with imaging agents that probe the immune response could open up a new avenue to study the effects of current and future novel therapeutic drugs for MS.
PURPOSE
Previously we reported increased axonal transport in young mice transgenic (Tg) for Alzheimer's disease (AD) after intranasal administration of a microtubule-stabilizing therapeutic, paclitaxel using MRI with manganese (MEMRI). In this study we administered paclitaxel to aged 3xTg-AD mice with established pathology from 10-18 mos and hypothesized that cognition would improve and be associated with increased axonal transport.

METHOD AND MATERIALS
Mice, (3xTg-AD n=10, age=44wks) were treated by intranasal lavage with paclitaxel (TAX: 0.6 mg/kg) or 0.9% saline (SAL) in 5 µl per nostril at intervals of 2wks. MEMRI was obtained after first treatment to assess acute effect on transport. Scanning (14T Bruker MR: MDEFT, TR/TE: 5000ms/1.9ms, 0.140x0.140x0.25mm3) pre and immediately after treatment occurred at 100 min. and from 370-400 min after delivery of 5 µl of 1M MnCl2 intranasally. Images were coregistered stereotactically aligned and normalized to a mouse atlas. Tracer kinetic analysis based on dispersion model was used to estimate transport. At 56 wks after 5 treatments, mice were tested in radial water tread maze for memory deficits and compared to age-matched WT (n=5) and at 75 wks after 11 treatments, anxiety was assessed by elevated plus maze.

RESULTS
At 10 mos, 3xTg-AD have amyloid and neurofibrillary tangles. There was a significant acute effect of TAX on transport in the olfactory tract. Transport rates decreased slightly in SAL (-13%) in the 3wk interval between MEMRI scans however TAX increased (>100%) transport at 24hrs after administration (p<0.05). Cognition was tested in the water tread maze (memory) and elevated plus maze (anxiety). TAX had improved memory as compared to SAL and not significantly different from WT (Day 5, 36% dec, 143.8±43 vs 91.5±77s and Day 12, 22% dec, 138.4±52 vs 107.7±45s for SAL vs. TAX, p<0.05). 3xTg-AD mice exhibit anxiety. TAX spent more time exploring open arms than SAL (Open arm 84% inc, 129.1±80 vs 20.9±31s for TAX vs SAL, p<0.05). There were no differences in Mn2+ uptake indicating delivery thru activity-dependent Ca2+ channels was not affected by treatment.

CONCLUSION
MEMRI indicated that paclitaxel has an acute effect on axonal transport processes in AD mice. Paclitaxel also improved cognition and anxiety in AD mice when administered after pathology was well-established.

CLINICAL RELEVANCE/APPLICATION
Microtubule-stabilizing drugs present an exciting new therapeutic option for Alzheimer's disease.
CONCLUSION

This is the first time that 5-ALA-induced fluorescence has been shown to correlate with MRSI-derived metabolic markers in brain tumors. The correlation of MRSI abnormality with histopathology and quantitative intraoperative fluorescence supports the use of MRSI for identifying regions of tumor infiltration outside of T1W-CE.

CLINICAL RELEVANCE/APPLICATION

As MRSI is independent of contrast diffusion, it defines tumor infiltration more precisely than T1W-CE; and when combined with FGS, results in more complete resections that may extend patient survival.

SSA12-04 Motexafin Gadolinium (MGd) - Enhanced MR and Optical Imaging of Rat Gliomas for Potential Intraoperative Determination of Tumor Margins

Participants
Longhua Qiu, Seattle, WA (Presenter) Nothing to Disclose
Feng Zhang, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Yaoping Shi, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
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Donghoon Lee, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Xiaoyuan Feng, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Xiaoming Yang, MD, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate the possibility of using motexafin gadolinium (MGd)-enhanced molecular MR imaging and optical imaging to identify the genuine margins of rat gliomas.

METHOD AND MATERIALS

Rat glioma model was created by inoculating C6 glioma cells in right caudate nucleuses of male Sprague-Dawley rats (160g ± 20g). Thirty six rats with tumors were randomized into six groups (n=6/group). Five groups were euthanized at different time points of 15, 30, 60, 120 and 240 minutes after intravenous administration of 6-mg/kg MGd respectively, while one group received saline as a control. After a craniotomy, ex vivo optical imaging was performed to identify the tumors featuring as MGd-emitting red fluorescence. Then, the whole brains were harvested for ex-vivo T1-weighted MRI (T1WI). Optical photon intensities and MRI signal-to-noise ratio (SNR) were quantified for plotting the times to photon/SNR curves. Tumor extent was demarcated on optical and MR images. Subsequently, confocal microscopy of brain tissues was performed to confirm the intracellular uptake of MGd by tumor cells and correlate the tumor margins determined on both optical and MR images.

RESULTS

Fluorescent optical imaging could sensitively detect the deep-seated tumors with red fluorescence in rat brains and clearly outlined the tumor margins. T1WI showed the tumors heterogeneous enhancement. Both the photon intensity and the maximal enhancement on T1WI reached the peak at 15 minutes after MGd administration, with a continuing tumor visibility lasting for 2-4 hours. Confocal microscopy confirmed the exclusive accumulation of MGd in tumor cells which was well correlated with imaging findings.

CONCLUSION

Both MGd-enhanced optical imaging and molecular MR imaging can sensitively determine rat glioma tumor margin within the optimal time window of 15~30 minutes post-MGd administration, which pose the potential clinical application for aiding the complete removal of gliomas at a hybrid surgical setting with intraoperative optical and MR imaging capabilities.

SSA12-05 Generation of a Bispecific Antibody for Combined EGFR/CD105 Targeting of High-Grade Gliomas

Participants
Reinier Hernandez, MSc, Madison, WI (Presenter) Nothing to Disclose
Haiming Luo, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Hao Hong, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Stephen Graves, Madison, WI (Abstract Co-Author) Nothing to Disclose
Robert J. Nickles, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Weibo Cai, PhD, Palo Alto, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Our aim was to design and generate a heterodimer [Bs-F(ab')2] using two mAb Fab fragments for dual-targeting of epidermal growth factor receptor (EGFR) and CD105. The synergistic targeting properties of Bs-F(ab')2 were investigated in vitro/in vivo.

METHOD AND MATERIALS

Bs-Fab'2 was synthesized by reacting two mAb fragments (Cetuximab Fab and TRC105 Fab) derivatized with the 'Click' chemistry pair tetrazine/trans-cyclooctene. Bs-Fab'2 was purified by size exclusion chromatography, conjugated to NOTA, and labeled with 64Cu for positron emission tomography (PET). In vitro and in vivo dual-receptor binding studies were performed in a U87MG human
RESULTS

Purified Bs-F(ab')2 was confirmed by SDS-PAGE (~100 kDa, >90% pure), whereas the two Fab fragments were each at ~50 kDa. Flow cytometry showed an enhanced fluorescence signal for the heterodimer compared with either Fab. PET of U87MG tumor bearing mice with 64Cu-NOTA-Be-F(ab')2 revealed a strikingly higher tumor uptake (32.0±6.9, 47.5±6.7, 46.0±3.3 and 44.1±9.4 %ID/g at 3, 15, 24, and 36 h postinjection, respectively; n=3) compared to those observed with 64Cu-NOTA-Cet-Fab and 64Cu-NOTA-TRC105-Fab (both <15%ID/g). Injection of a blocking dose (100mg/kg) of Cetuximab or TRC105 prior to the administration of the tracer resulted in a significantly reduced tumor uptake of 64Cu-NOTA-Be-F(ab')2, which confirmed that Bs-F(ab')2 tumor-uptake was mediated by both EGFR and CD105 expression. Owing to the low tracer uptake in non-target organs (e.g. liver and kidney), we attained excellent tumor-to-normal tissue contrasts.

CONCLUSION

We report the first successful dual-targeting of EGFR and CD105, with a "click" heterodimer featuring two mAb Fab fragments, which led to synergistic enhancement of tumor uptake over either Fab alone. These results may improve future cancer diagnosis and therapeutic efficacy.

CLINICAL RELEVANCE/APPLICATION

Combined EGFR/CD105-targeting provides increased tumor-targeting efficacy and specificity, which may ultimately lead to better diagnostic sensitivity and increased tumor cytotoxicity.

PURPOSE

A frequency selective saturation RF pulse across a broad frequency range produces a Z-spectrum. This Z-spectrum receives contributions from components mainly including direct saturation (DS) of bulk water, magnetization transfer, chemical exchange saturation transfer, and Nuclear Overhauser Enhancement. When a weak saturation regime is applied, such as B1rms< 50 Hz and duration < 500 ms, the Z-spectrum is mainly attributed to the DS spectrum, characterized by a Lorentzian-shape. The DS magnitude at a given frequency offset has been used to measure iron content in brain. Additionally, the position of maximum DS has been exploited to map B0 field variations (ΔB0). In this study, we investigate additional contrasts revealed by analyzing DS spectrum.

METHOD AND MATERIALS

This study was performed under an approved IRB protocol. DS spectra within ±1 ppm were acquired from the brain and cervical spinal cord of healthy subjects at 3T scanner with a 32 channel head-coil and a 16 channel head and neck spine coil, respectively. The pulse sequence consists of a pre-saturation pulse (B1rms = 12.2 Hz for brain, 24.4 Hz for spinal cord, 200 ms) followed by a 2D single-shot SPGR readout. The DS data was fitted pixel by pixel with a Lorentzian function to produce B0 field, DS line-width, and DS magnitude maps. In addition, simulations with Bloch equations were performed to correlate with experimental data.

RESULTS

Beside the ΔB0 map, the Lorentzian fitting of data obtained from both brain and spinal cord was used to produce new maps based on the DS line-width and magnitude. In the brain and spinal cord respectively, the DS line-width of gray matter is slightly narrower than that of the white matter. As expected, CSF gave the narrowest line-widths. DS amplitude was reversed. Simulation further showed that DS line-width is positively proportional to 1/T2 and inversely proportional to 1/T1. DS magnitude was found to be proportional to proton density.

CONCLUSION

Two quantitative contrasts (DS line-width and magnitude) that reflect tissue relaxation rates and proton density have been demonstrated in the human CNS tissues.

CLINICAL RELEVANCE/APPLICATION

The discovered contrasts induced by DS MRI have the clinically potential for characterization of normal and pathological tissues.

PURPOSE

The goal of this study is to establish CD146 as a novel target for in vivo immunoPET imaging of mice bearing orthotopic high-grade gliomas (HGG).

METHOD AND MATERIALS
An improved immunization approach was used to generate YY146, a murine anti-CD146 monoclonal antibody. RT-PCR, western blot, flow cytometry, and immunofluorescence staining studies were conducted to determine in vitro CD146 expression. Subcutaneous (s.c.) U87MG human glioblastoma (CD146+) and PC3 human prostate cancer (CD146-) tumors were induced in athymic nude mice. Additionally, orthotopic U87MG tumors were generated in nude mice and its progression monitored by T2-weighted MRI. YY146 was conjugated to p-SCN-Bn-NOTA and radiolabeled with 64Cu. Sequential PET scans, blocking, histological, and biodistribution studies were carried out to determine in vivo CD146 specificity of 64Cu-NOTA-YY146.

RESULTS
Flow cytometry demonstrated that chelator conjugation to YY146 did not compromise its CD146-binding affinity/specificity. 64Cu-NOTA-YY146 was obtained with high radiochemical purity (>95%) and specific activity, in yields surpassing 90%. MicroPET imaging studies revealed an elevated and persistent uptake of 64Cu-NOTA-YY146 in U87MG (CD146+) s.c. xenografts which peaked at 13.7±0.7 %ID/g, 48h post-injection (n=3). In contrast, significantly lower accumulation was observed in PC3 (CD146-) tumors (<5 %ID/g). Excellent tumor homing was observed from PET/CT imaging of orthotopic U87MG tumors, where 64Cu-NOTA-YY146 was able to infiltrate the brain and accumulate in tumorous tissue (21.5±3.5 %ID/g at 48h post-injection; n=5). The attained exquisite tumor-to-normal brain contrast allowed for the sensitive detection of small malignancies (~2 mm). Biodistribution, blocking experiments, as well as histological examination validated PET data, and confirmed the CD146 specificity of 64Cu-NOTA-YY146.

CONCLUSION
We successfully implemented noninvasive immunoPET imaging of in vivo CD146 expression in an orthotopic human glioblastoma cancer model. The high affinity and specificity of 64Cu-NOTA-YY146 envisages the potential of this novel mAb for targeted HGG diagnosis and therapy.

CLINICAL RELEVANCE/APPLICATION
Herein, we show for the first time that CD146 is a promising tumor-specific target for noninvasive in vivo imaging and targeted therapy of high-grade gliomas.

SSA12-09  The Expression of P2X7 Receptors in EPCs and Their Potential Role in the Targeting of EPCs to Brain Gliomas

Sunday, Nov. 29 12:05PM - 12:15PM Location: S504CD

Participants
Xiao Chen, Chongqing, China (Presenter) Nothing to Disclose
Weiguo Zhang, Chongqing, China (Abstract Co-Author) Nothing to Disclose
Jingqin Fang, Chongqing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the functional expression of P2X7 receptors in EPCs, role of P2X7 receptors in proliferation and homing to glioma of EPCs.

RESULTS
We confirmed, for the first time, the expression of P2X7 receptors in rat spleen-derived EPCs. Activation of P2X7 receptors in EPCs by BzATP promoted cells proliferation and migration, rather than apoptosis. Compared to the group without BBG treatment, less transplanted EPCs homed to gliomas in the group with BBG treatment, especially integrated into the vessels containing tumor-derived endothelial cells in gliomas. Moreover, western blot showed that CXCL1 expression was downregulated in gliomas with BBG treatment, which meant P2X7 receptors suppression inhibited the homing of EPCs to gliomas through down-regulation of CXCL1 expression. Additionally, MTT assay and MRI revealed that P2X7 receptors exerted no significant promoting effect on C6 glioma cells proliferation, glioma growth and angiogenesis.

CONCLUSION
Taken together, our findings imply the possibility of promoting proliferation and targeting ability of transplanted EPCs to brain gliomas in vivo through P2X7 receptors, which may provide new perspectives on application of EPCs as a therapeutic and imaging probe to overcome antiangiogenic resistance for gliomas.

CLINICAL RELEVANCE/APPLICATION
Apply EPCs as a therapeutic and imaging probe to overcome antiangiogenic resistance for gliomas.
### Fluoroscopic Guided Sacroiliac Joint Injections - Comparison of Intra-articular and Peri-articular Injections on Immediate and Short-term Pain Relief

#### Purpose
To determine if intra-articular sacroiliac (SI) joint injections provide greater immediate and short-term pain relief compared to peri-articular SI joint injections.

#### Method and Materials
All fluoroscopic guided SI joint injections targeting the inferior 1 cm of the SI joint, performed over a 4-year period, were identified. All patients were injected with 2.5 mL of Bupivacaine and 20 mg (0.5 mL) of triamcinolone. Patients were excluded if another triamcinolone dose or a different steroid/anesthetic combination was used, or if either the pre-injection, immediate (5-10 minute) post-injection, or 1-week post-injection pain score was not recorded. Two MSK radiologists with 2 and 13 years post-fellowship experience independently retrospectively reviewed the fluoroscopic images to determine intra-articular or peri-articular placement. Univariate and multivariate statistical analysis was performed.

#### Results
169 patients (114F:55M; mean age 60.9 years) met the inclusion criteria with 88 intra-articular and 81 periarticular injections. Pre, immediate and 1-week post-injection pain scores for the intra-articular and periarticular injections were 6.2/2.0/4.1 and 6.0/2.3/4.2, respectively. Immediate and 1-week post-injection pain reduction was statistically significant in both groups (p<0.001). After adjusting for age, gender, pre-pain level, time of year, and reason for exam there was no significant difference in the pre-injection to immediate post-injection change in pain between intra-articular and periarticular injections (mean change 0.35, p=0.30) or in the pre-injection to 1-week postinjection change in pain (mean change 0.03, p=0.92). Geometric mean fluoro time was 27 sec for intra-articular injections and 42 sec for periarticular injections (p<0.001).

#### Conclusion
Both intra-articular and periarticular SI joint injections provide statistically significant immediate and 1-week post-injection pain relief. However, there was no significant difference in the degree of pain relief provided by intra-articular and peri-articular injections.

#### Clinical Relevance/Application
Since similar pain relief was provided with intra-articular and periarticular SI joint injections, fluoroscopy is an adequate method for performing most SI joint injections.

### Ten Years' Experience in Combined Intradiscal and Periradicular Injection of Medical Ozone and Periradicular Administration of Steroids and Anesthetic for the Treatment of Lumbar Disk Herniation: Effects on Disk Size and Lumbar Radiculopathy in 437 Patients

#### Purpose
To evaluate the therapeutic benefit and morphologic changes in herniated lumbar disk after CT-guided intradiscal and periradicular ozone-oxygen injection combined with a periradicular administration of steroids and anesthetic.

#### Method and Materials
All fluoroscopic guided SI joint injections targeting the inferior 1 cm of the SI joint, performed over a 4-year period, were identified. All patients were injected with 2.5 mL of Bupivacaine and 20 mg (0.5 mL) of triamcinolone. Patients were excluded if another triamcinolone dose or a different steroid/anesthetic combination was used, or if either the pre-injection, immediate (5-10 minute) post-injection, or 1-week post-injection pain score was not recorded. Two MSK radiologists with 2 and 13 years post-fellowship experience independently retrospectively reviewed the fluoroscopic images to determine intra-articular or peri-articular placement. Univariate and multivariate statistical analysis was performed.

#### Results
169 patients (114F:55M; mean age 60.9 years) met the inclusion criteria with 88 intra-articular and 81 periarticular injections. Pre, immediate and 1-week post-injection pain scores for the intra-articular and periarticular injections were 6.2/2.0/4.1 and 6.0/2.3/4.2, respectively. Immediate and 1-week post-injection pain reduction was statistically significant in both groups (p<0.001). After adjusting for age, gender, pre-pain level, time of year, and reason for exam there was no significant difference in the pre-injection to immediate post-injection change in pain between intra-articular and periarticular injections (mean change 0.35, p=0.30) or in the pre-injection to 1-week postinjection change in pain (mean change 0.03, p=0.92). Geometric mean fluoro time was 27 sec for intra-articular injections and 42 sec for periarticular injections (p<0.001).

#### Conclusion
Both intra-articular and periarticular SI joint injections provide statistically significant immediate and 1-week post-injection pain relief. However, there was no significant difference in the degree of pain relief provided by intra-articular and peri-articular injections.

#### Clinical Relevance/Application
Since similar pain relief was provided with intra-articular and periarticular SI joint injections, fluoroscopy is an adequate method for performing most SI joint injections.
316 patients with lumbar radiculopathy received an intradiscal (3 mL) and periradicular (7 mL) injection of an ozone-oxygen mixture (ratio 3:97), followed by a periradicular injection of corticosteroid (1 mL of Celestan®Depot) and anesthetic (2 mL of Carbostesin®0.25%) in the same session. Under CT guidance, intradiscal and periradicular injection was administered by means of an extraspinal lateral approach, using a 22-gauge 17.8-cm spinal needle. 6 months after treatment, clinical outcome was assessed by applying the modified MacNab method. The effects on disk matrix and disk volume were evaluated by MRI.

RESULTS

Treatment was successful in 316 patients (72.3%). In the remaining 121 patients (27.7%), treatment was considered to have failed. Among the patients whose treatment was a success, outcome was excellent in 153 patients (48.4%) and good in 163 patients (51.6%). Among the patients whose treatment was a failure, this was poor in 87 patients (71.9%) and poor with recourse to surgery in 34 patients (28.1%). Initial disk volume was 8.06-29.15 cm³ (mean, 18.29 cm³). 6 months after treatment, in patients with excellent outcome disk volume reduction was 5.67-22.11% (mean, 12.11%), in patients with good outcome 2.61-16.11% (mean, 7.29%) and in patients with poor outcome 0.33-8.21% (mean, 2.46%).

CONCLUSION

Our study shows that the combined intradiscal and periradicular injection of medical ozone and periradicular injection of steroids affects both the mechanical and the inflammatory components of pain caused by disk herniation. For this reason, this is a therapy option for treating lumbar disk herniation that has failed to respond to conservative management, before recourse to surgery or when surgery is not possible.

CLINICAL RELEVANCE/APPLICATION

CT-guided combined intradiscal and periradicular injection of ozone-oxygen represents a therapeutic alternative for lumbar radiculopathy with promising results. The ease of execution and non-invasiveness of this therapy permit the successful outpatient treatment of lumbar sciatic pain.

SSA13-03 Computed Tomography (CT) Guided O2-O3 Discolysis: Critical Review of Indications According to Our Experience

Sunday, Nov. 29 11:05AM - 11:15AM Location: E451B

Participants

Marco Perri, MD, L’Aquila, Italy (Presenter) Nothing to Disclose
Marco Varrassi, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Claudia Marsequan, MD, Fiuggi, Italy (Abstract Co-Author) Nothing to Disclose
Alessandra Speldinian, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Massimo Gallicci, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

The aim of this study was to clarify the O2-O3 discolysis indications and outcomes depending on the type of disc disease.

METHOD AND MATERIALS

Medical Ethical Committee approval was obtained for prospective double-blind trial. A total of 517 patients gave informed consent and were randomly assigned to two groups. Control group of 159 men and 101 women with age range 25-89 years, underwent percutaneous steroid treatment while Study Group of 163 men and 94 women with age range 22-92 years underwent the same treatment with the addiction of oxygen-ozone discolysis. Procedures were performed under computed tomographic guidance. Visual Analog Scale Questionnaire was administered before treatment and at intervals, the last at 6-month follow-up. Results were compared with the X2 and t-test.

RESULTS

After 6 months, O2-O3 discolysis was successful in 106 Study Group patients (41.24% with extrusions) compared with 9 Control Group patients (3.5%) with the same disco vertebral pathology (P <.001). Moreover in 89 (34.6%) Study Group patients with protrusions success rate was statistically significant (P<.001) compared with 5 Control Group patients (1.9%) with the same pathology. Furthermore statistically significant difference (P<.001) was detected in the presence of Grade I, II, III of Degenerated Disc in 185 of Study Group patients (68.4%) compared with 4 Control Group patients (1.5%).

CONCLUSION

O2-O3 discolysis is more effective at 6 months than steroid and anesthetic injection near intraforaminal sites especially in cases of sciatica due to hemiated or protruded disc and with a Grade of Disc Degeneration from mild to moderate range.

CLINICAL RELEVANCE/APPLICATION

Our approach leads to relief in sciatica symptoms and obtains the best results in case of extrusions, protrusions and in presence of discal degenerative aspects from mild to moderate grade.

SSA13-06 Magnetic Resonance Guided Focused Ultrasound Surgery (MRgFUS) for Totally Non-Invasive Treatment of Osteoid Osteoma: A Prospective Development Study

Sunday, Nov. 29 11:35AM - 11:45AM Location: E451B

Participants

Maurizio Del Monte, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Gaia Cartocci, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Napoli, MD, Rome, Italy (Presenter) Nothing to Disclose
Valeria De Socco, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Fabrizio Boni, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate mid-to long-term efficacy of MRgFUS in the treatment of symptomatic osteoid osteomas

METHOD AND MATERIALS

This prospective study involved 29 consecutive patients with clinical and imaging diagnosis of Osteoid Osteoma; all patients underwent MRgFUS ablation (ExAblate, InSightec; 3T MR). Lesions located in vertebral body were excluded; prior RFA or surgery was not considered an exclusion criteria. Patients received therapy using MRgFUS, delivered toward the nidus, identified on MRI and/or CT. Primary endpoints were adverse events (serious and otherwise) and pain relief assessed using Quality of Life questionnaires in patients with bone pain (FACT-BP), Visual Analog Pain Score (VAS) and daily intake of Non-steroidal drugs (NSAIDs). Patient's follow-up, including clinical and imaging examinations, was established at 1, 12 and 24 months. As secondary endpoint, imaging examinations (CT and dynamic CE-MRI, Gd-BOPTA, Bracco) were used to evaluate inflammatory status after treatment and bone remodeling.

RESULTS

29 patients (4 female; 25 male; mean age 23.4 yo) were recruited for totally non-invasive MRgFUS treatment. The treatment was well tolerated by all patients and no adverse events were recorded. A mean number of 5.6 sonications with mean energy of 894 ± 209 J was necessary to complete the treatment. Complete clinical response was found in 27/29 patients. There was a significant (p=0.001) improvement in quality of life, according to FACT-BP (mean values: 33.7 at baseline and 54.7 at follow-up). A statistically significant difference (p=0.001) was noted between pre- and post-treatment VAS scores (8.4 vs 0.6, respectively). Imaging evaluation with CE-MRI demonstrated edema and hyperemia decrease in lesions associated with complete response. At CT, bone remodeling was evident in all complete responders (27/29 patients, 93%); in 15/29 (51%), nidus fading was demonstrated and in 10/29 (34%) restitutio-ad-integrum of bone abnormality was depicted.

CONCLUSION

MRgFUS can be safely and effectively adopted for the treatment of Osteoid Osteomas. This application is totally non-invasive, carried out in a single session and with pain relief attainable since the very following day after treatment. Our results also indicated a positive trend to bone restoration especially in younger patients.

CLINICAL RELEVANCE/APPLICATION

MRgFUS allows single session, totally non-invasive treatment of osteoid osteomas.

SSA13-07 Minimally Invasive Screw Fixation of Fractures in the Cervical and Thoracic Spine: CT-controlled Pre-surgical Guidewire Implantation in Clinical Routine

Sunday, Nov. 29 11:45AM - 11:55AM Location: E451B

Participants
Sebastian Fischer, MD, Frankfurt, Germany (Presenter) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Maximilian Kreising, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Ingo Marzi, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Stefan Zangos, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Martin G. Mack, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Karin Eichler, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS

293 guidewires were inserted in 35 patients (42.9 ± 21.2 years) under CT fluoroscopy (286 thoracic, 7 cervical). There were 28 traumatic cases, 3 pathologic fractures, 3 fractures due to infectious infiltrations and 1 osteoporotic fracture. In 151 pedicles the screwing was directly performed and controlled in the CT-room. CT-images were reviewed regarding accuracy and cortical violations using the popular 2 mm increment deviation classification by Gertzbein and Robbins.

RESULTS

The guidewire implantation resulted in 28 cortical contacts. Minor affections of the pedicle wall by the inserted screws occurred in 39.1% (59 of 151), respectively 23.8% if taking unavoidable encroachments into account (30 of 59). The width of the pedicular isthmus correlated to the number of cortical guidewire-contacts (r=-0.449; p=0.077) and pedicle violations (all graded “A”) by the inserted screws (r=-0.581; p=0.049). Total procedural duration was 138.6 ± 44.2 min, representing 14.5 ± 11.6 min for each pedicle violations (r=0.641; p=0.027).

CONCLUSION

The treatment of vertebral fractures with a guidewire-based insertion technique for pedicle screws results in a very high accuracy and a low complication rate if performed under CT-imaging.

CLINICAL RELEVANCE/APPLICATION

Guidewires help in precise placement of cervical and thoracic screws for vertebral osteosynthesis. Special attention should be taken in the mid-thoracic levels due to a smaller width of the pedicle isthmus.

SSA13-08 Feasibility of CT Guided Needle Biopsy in Harvesting Chondrocytes for Autologous Chondrocyte Implantation: An Initial Experience on Human Cadavers

Sunday, Nov. 29 11:55AM - 12:05PM Location: E451B

Participants
Nima Hafezi Nejad, MD, MPH, Baltimore, MD (Presenter) Nothing to Disclose
PURPOSE

To evaluate the timing, accuracy and technical feasibility of CT guided chondrocyte retrieval from superior medial and lateral non weight-bearing margins of the trochlea.

METHOD AND MATERIALS

As an initial experience, 10 human knee cadavers were selected as samples. Osteosite bone biopsy needle (G13761 - Murphy M1M - 11G/10cm) was used for the purpose of chondrocyte retrieval. Two operators, one musculoskeletal radiologist and one orthopedic surgeon performed the chondrocyte retrieval procedures. Each performed one sampling from the medial and one sampling from the lateral margins of trochlea. In the first planning phase, operators selected the proper target for chondrocyte retrieval, in the CT examination. Time (seconds), accuracy (mm distance from the target) and needle readjustment attempts were recorded during chondrocyte retrieval.

RESULTS

All samplings resulted in eventual tissue retrieval. Samplings from the lateral margin were performed faster (Operator 1: 74 ± 34 sec vs. 106 ± 36 sec; P value: 0.056 - Operator 2: 72 ± 30 sec vs. 111 ± 35 sec; P value: 0.014) and more accurate (Target error: Operator 1: 1.32 ± 1.01 mm vs. 3.23 ± 1.72 mm; P value: 0.007 - Operator 2: 1.17 ± 0.57 mm vs. 2.81 ± 1.36 mm; P value: 0.040) than samplings from the medial margin. There was no significant difference in the mean number of needle adjustment rates (ranging from 1.50 ± 0.71 to 1.10 ± 0.74 readjustment attempts); neither between the operators, nor between lateral and medial margins.

CONCLUSION

This preliminary results supports the hypothesis that CT guided needle biopsy may be a feasible and accurate method for chondrocyte retrieval from non weight-bearing margins of the trochlea. Sampling from the lateral margin may be relatively advantageous in terms of procedure time and accuracy.

CLINICAL RELEVANCE/APPLICATION

Feasibility of CT-guided chondrocyte retrieval for autologous chondrocyte implantation may obviate one arthroscopic surgery; and therefore, reduce the cost, morbidity and complication.

SSA13-09 US and MRI Follow-up after Treatment of Supraspinatus Tendon Tendinopathy: PRP vs Needling

Sunday, Nov. 29 12:05PM - 12:15PM Location: E451B

Participants

Alice La Marra, MD, L’Aquila, Italy (Presenter) Nothing to Disclose
Francesco Arrigoni, Coppito, Italy (Abstract Co-Author) Nothing to Disclose
Silvia Mariani, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Simone Quarchioni, Laquila, Italy (Abstract Co-Author) Nothing to Disclose
Luigi Zugaro, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Barile, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the efficacy of infiltrative treatment with PRP versus needling, in patients with tendinosis of the supraspinatus tendon at level of its crescent area.

METHOD AND MATERIALS

We enrolled 40 patients (aged 40-60), with tendinosis of the supraspinatus tendon at its crescent area, evaluated through ultrasound-US and MRI exams; we excluded patients with partial lesions. Twenty patients were submitted to PRP treatment (group 1); 20 patients were submitted to needling treatment (group 2). All patients, 6 months after treatment (T1) underwent US examinations and 1 year after treatment (T2) underwent US and MRI examinations. We considered some fundamental parameters: morphology of the tendon, echogenicity or signal intensity of its structures, presence or not of bursitis, evolution in partial or full tear. All patients were evaluated through VAS (Visual Analogic Scale) for pain and Constant scale for functionality.

RESULTS

In group 1, at T1 the ultrasound exams showed disappearance of bursitis and recovery of tendon echogenicity in 15/20 patients; 5 patients had no changes. At T2, in 17/20 patients MRI and US showed morphological recovery; we observed non-substantive modifications in 2 patients and a worsening in 1 patient. 85% of the patients showed improvement in VAS and 77% in Constant values already at T1; the mean values were 70% at T2. In group 2, at T1, US showed disappearance of bursitis and recovery of tendon echogenicity in 8/20 patients; 12 patients showed no changes. At T2 in 6/20 patients, MRI and US showed morphological recovery; 8 patients had no significant variations; 4 patients had worsening of tendinosis; 2 patients showed partial tears of the tendon. 65% of the patients showed improvement in VAS and 62% in Constant values at T1; the mean values were only 33% at T2.

CONCLUSION

Compared to needling, the PRP infiltrative treatment of tendinosis of the supraspinatus tendon showed major possibilities of recovery, with a slower evolution of tendinosis or tendon’s tear.

CLINICAL RELEVANCE/APPLICATION

Both PRP and needling are effective minimally invasive treatments suitable for large range of patients. PRP resulted to be more effective with a lower rate of progression of the tendinosis or tendon tear.
**Participants**

Craig W. Walker, MD, Omaha, NE (Moderator) Nothing to Disclose
Corrie M. Yablon, MD, Ann Arbor, MI (Moderator) Nothing to Disclose

**Sub-Events**

**SSA14-01 Musculoskeletal Keynote Speaker: Bone Tumor**

Sunday, Nov. 29 10:45AM - 11:05AM Location: E451A

Participants
Mark J. Kransdorf, MD, Phoenix, AZ (Presenter) Nothing to Disclose

**SSA14-03 Distinguishing Untreated Osteoblastic Metastases from Enostoses Using CT Density Measurements**

Sunday, Nov. 29 11:05AM - 11:15AM Location: E451A

Participants
Adam C. Ulano, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Miriam A. Bredella, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Patrick J. Burke, MBCh, Madison, WI (Abstract Co-Author) Nothing to Disclose
Ivan Chebib, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Frank J. Simeone, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ambrose J. Huang, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Martin Torriani, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Connie Y. Chang, MD, Boston, MA (Presenter) Nothing to Disclose
Young Cheol Yoon, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Eunsun Oh, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

**PURPOSE**

Differentiating osteoblastic metastases from benign enostoses on CT can be challenging. The purpose of our study was to determine if CT density thresholds of osteoblastic bone lesions can be used to distinguish untreated osteoblastic metastases from benign enostoses.

**METHOD AND MATERIALS**

Our study was IRB approved and complied with HIPAA guidelines. The study group comprised 62 patients (mean age 62± 20 y, 35 f, 27m) with sclerotic bone lesions found on CT. Etiology of sclerotic lesions was assessed by biopsy (n=17) or clinical and imaging follow-up (n=45). None of the patients had prior treatment for metastases. CT density of all lesions was measured by a MSK and an abdominal imaging fellow. If multiple lesions were present, the largest lesion was evaluated. The average and maximum densities in Hounsfield Units (HU) were measured. ROC analysis was performed to determine sensitivity and specificity, area under the ROC (AUC), and confidence intervals (CI), as well as cutoff values of CT densities to differentiate metastases from enostoses. Interreader reproducibility was assessed using intraclass correlation coefficient (ICC) with 95% CI.

**RESULTS**

A total of 37 enostoses and 25 untreated osteoblastic metastases were evaluated (primary tumors: breast cancer n=12, prostate cancer n=11, ovarian cancer n=1, transitional cell carcinoma n=1). Mean and maximum CT densities of enostoses were 1190 HU and 1323 HU, respectively and of osteoblastic metastases were 654 HU and 787 HU, respectively. Using a cut-off of 885 HU for average density, the AUC was 0.982, sensitivity was 94.6%, and specificity was 96%. Using a cut-off of 1058 HU for maximum CT density, the AUC was 0.976, the sensitivity was 94.6%, and specificity was 96%. ICC for mean density was 0.987 for enostoses and metastases. ICC for maximum density was 0.814 for enostoses and 0.980 for metastases.

**CONCLUSION**

Density measurements using CT can be used to distinguish untreated osteoblastic metastases from enostoses.

**CLINICAL RELEVANCE/APPLICATION**

An average density of 885 HU and a maximum density of 1058 HU provide reliable thresholds below which a metastatic lesion is the favored diagnosis.

**SSA14-04 Multiparametric Approach with Diffusion Weighted Imaging (DWI) and Dynamic Contrast Enhanced (DCE) Magnetic Resonance Imaging (MRI): A Comparison Study in Differentiation between Benign and Malignant Bone Lesions**

Sunday, Nov. 29 11:15AM - 11:25AM Location: E451A

Participants
Young Cheol Yoon, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Eunsun Oh, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

**PURPOSE**

To evaluate and compare the diagnostic performance of quantitative parameters derived from DWI and DCE-MRI in differentiating...
METHOD AND MATERIALS

This study obtained IRB approved. Fifty five patients (23 men, 32 women; 21-82 years; mean age of 55 years) underwent MRI prior to treatment. ADC values were calculated by using three DW images (b = 0, 400, and 1400). DCE-MRI data were analyzed yielding estimates of Ktrans (volume transfer constant), Ve (extravascular extracellular volume fraction) and Kep (rate constant) with population based arterial input function. Additionally, a ratio of Ktrans and ADC was calculated. Difference of each parameter between benign and malignant bone tumors were evaluated after adjusting age and sex. ROC curve analysis was done to calculate and compare sensitivity, specificity, accuracy, positive predictive value, negative predictive value, and AUC after determining the optimal cut-off value for each parameter. Odds ratio (ORs) with 95% confidence intervals of each parameter in diagnosing malignant bone tumor was calculated with logistic regression.

RESULTS

Fifty five lesions were pathologically proven benign (n =19), and malignant (n=36) bone tumor. All parameters except Ve were significantly different between benign and malignant bone tumors. The highest of AUC was seen in Ktrans, followed by Ktrans/ADC. With comparison of AUC of each parameter, Ktrans, Kep, and Ktrans/ADC showed significantly higher AUC than that of ADC. However, there were no significant difference among these three parameters. The parameters with best sensitivity and specificity were Ktrans/ADC, and Kep, respectively. The best parameters with positive predictive value and negative predictive value were Kep and Ktrans/ADC, respectively. The highest ORs was Ktrans/ADC, presenting 17.38 (P = .0019).

CONCLUSION

Quantitative parameters, Ktrans, Kep, ADC, and Ktrans/ADC, are good to differentiate benign and malignant bone tumor. Ktrans/ADC shows superior performance in differentiation of malignancy and benign bone tumors, suggesting that the combination of parameters derived from perfusion and diffusion MRI may be much useful for differentiating benign and malignant bone tumor.

CLINICAL RELEVANCE/APPLICATION

Multiparametric approach for the differentiation of benign and malignant bone is feasible with DWI and DCE-MRI. A parameter combining both DWI and DCE-MRI may be much useful.
To retrospective investigate whether intravoxel incoherent motion (IVIM) diffusion-weighted imaging (DWI) parameters correlate with dynamic contrast-enhanced (DCE) magnetic resonance imaging (MRI) perfusion parameters in patients with bone metastasis from non-small cell lung cancer (NSCLC) at 3.0 T.

**RESULTS**

Median Ktrans, Kep, Ve, and iAUC were 138 (107–213) 10−3/min, 506 (319–647) 10−3/min, 334 (236–513) 10−3, and 16 (11–27), respectively. Median ADC, Dslow, Dfast, and f were 973 (849–1198) μm²/sec, 898 (786–1128) μm²/sec, 274 (224–311) μm²/sec, and 98 (59–118), respectively. Ktrans demonstrated a significant inverse correlation with Dslow (r = −0.405, P = .013). Kep revealed a significant inverse correlation with ADC and Dslow (r = −0.370, P = .024; r = −0.352, P = .033, respectively). There was a significant inverse correlation between iAUC and ADC and Dslow (r = −0.434, P = .007; r = −0.486, P = .002, respectively). However, there was no significant correlation between Ve and IVIM parameters.

**CONCLUSION**

Ktrans inversely correlates with Dslow, while Kep and iAUC inversely correlate with ADC and Dslow in patients with bone metastasis from NSCLC at 3.0 T.

**CLINICAL RELEVANCE/APPLICATION**

IVIM DWI could help assume tumor perfusion in bone metastasis from NSCLC, particularly when DCE MRI cannot be performed.

**PURPOSE**

Recent studies have suggested that abdominal adiposity may be risk factor of progression from monoclonal gammapathy of undetermined significance (MGUS) to multiple myeloma (MM). The purpose of our study was to determine abdominal body composition parameters on PET/CT that may serve as predictors of progression of MGUS to MM. We hypothesized that patients with MM had higher abdominal adiposity and higher fat metabolic activity compared to subjects with MGUS.

**METHOD AND MATERIALS**

Our study was IRB approved and complied with HIPAA guidelines. The study group comprised 38 patients (mean age 63±12 y, 20 m, 18 f) with MGUS and 31 patients (mean age 61±11 y, 14 m, 17 f) with recently diagnosed MM (mean time from diagnosis to PET/CT: 4.7±6.7 mo). All patients underwent whole body PET/CT. Total abdominal adipose tissue (TAT), abdominal subcutaneous adipose tissue (SAT) and visceral adipose tissue (VAT) cross sectional areas (CSA) (cm²) and metabolic activity (SUV) were assessed at the level of L4 on the unenhanced PET/CT. Date and type of therapy were recorded. None of the patients had active malignancy other than MM at the time of PET/CT. Variables were tested for normality of distribution using the Shapiro-Wilk test. Variables that were not normally distributed were log transformed. Groups were compared by ANOVA.

**RESULTS**

Patients with recently diagnosed MM had higher TAT and SAT CSA (p=0.03 and p=0.04) and higher TAT and VAT metabolic activity (p=0.0001). Seventeen patients with MM had not undergone MM therapy prior to PET/CT. There were no differences in body composition between MM patients with or without treatment at time of PET/CT (p > 0.5).

**CONCLUSION**

Abdominal adiposity and fat metabolic activity may serve as novel biomarkers of disease progression in MM. Larger longitudinal studies are necessary to test this hypothesis.

**CLINICAL RELEVANCE/APPLICATION**

Abdominal adiposity and fat metabolic activity may serve as novel biomarkers for disease progression from MGUS to MM.
SSA14-09  Assessment of Therapeutic Response in Ewing’s Sarcoma Based on One-, Two-, and Three-dimensional Tumor Size Measurements

Participants
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PURPOSE
The Children’s Oncology Group (COG) established criteria to assess therapeutic response in Ewing sarcoma based on three-dimensional tumor size measurements. The purpose of our study was to compare COG criteria with one-dimensional Response Evaluation Criteria in Solid Tumors (RECIST) and two-dimensional tumor measurements defined by the World Health Organization (WHO) and to determine which method correlates best with clinical outcomes.

METHOD AND MATERIALS
Seventy-four patients (mean age of 14.5±6.5 years) with newly diagnosed Ewing sarcoma treated at three medical centers were evaluated. Primary tumor size was assessed on pre- and post-treatment Magnetic Resonance (MR) scans according to COG, RECIST, and WHO criteria. Effective tumor volume (using OSIRIX software) served as the standard of reference. The agreement of each criterion with the standard of reference was assessed using Cohen kappa coefficient analysis. Tumor therapy responses based on changes in tumor length, area or volume, were compared with patient survival using the Log-rank test and Kaplan-Meier plots.

RESULTS
Based on Cohen’s kappa coefficient, the agreement with the standard of reference was very good for COG (κ=0.89) while it was fair for RECIST (κ=0.39) and moderate for WHO (κ=0.55). COG criteria had significantly greater sensitivity to predict responders (92%) compared to RECIST (54%) and WHO (66%). Only COG demonstrated a significant difference in survival between responders and non-responders (p=0.003) compared to RECIST (p=0.41) and WHO (p=0.48).

CONCLUSION
Three-dimensional tumor measurements according to COG criteria are better predictors of therapeutic response of Ewing sarcoma than RECIST or WHO. These results could motivate more aggressive treatment for patients identified as non-responders by COG criteria.
CLINICAL RELEVANCE/APPLICATION

In clinical practice, a high sensitivity of response assessments is warranted in order to avoid ineffective therapies and stratify non-responders to other therapies at a time point when interventions can still impact prognosis. Our data in EFST showed that volumetric tumor measurements are substantially more sensitive for detection of tumor non-response than unidimensional measurements.
SSA15-03

Next Generation Digital PET/CT: A Phase I Intra-Individual Comparison with Current Photomultiplier TOF PET/CT

Sunday, Nov. 29 11:05AM - 11:15AM Location: S505AB

Participants

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PURPOSE

To objectively assess the oncologic imaging characteristics of a next generation solid state digital PET detector system compared to current state of the art photomultiplier based time of flight PET/CT imaging.

METHOD AND MATERIALS

A next generation, solid state, digital PET/CT system (Vereos 64 TF, Philips Healthcare) operated in pre-factory release was used to compare image characteristics in 25 clinical care patients to current photomultiplier detector based time of flight PET/CT. The order of imaging (placement on the system) was randomized with the SOC imaging at 75 min and investigational at 55 and 95 min p.i. Image characteristics were assessed by blinded readers (3) using a scoring system and blinded quantitative ROI analysis.

RESULTS

All matched exams were rated evaluable with decay corrected higher count intensity on all digital PET images. Image quality and detection ability was consistently rated significantly higher (p<.01) on the digital PET images. Comparing different reconstruction approaches, 2mm whole body, PSF with Gaussian filtering achieved the highest image quality score. Confidence of lesion detectability was rated significantly higher on the digital PET when evaluating lesions of <15 mm. While larger lesions and soft tissue presented equivalent SUV readouts at ROI analysis, smaller (<15 mm) and metabolic active lesions revealed substantially higher SUV values suggestive that also in vivo the improved recovery coefficient will lead to more correct, precise metabolic activity readouts. Tracer dose simulations indicate that no impact on quality and detectability was found while reducing the count equivalency from 13 mCi FDG to 6mCi.

CONCLUSION

The digital PET system demonstrated higher count sensitivity, improved spatial and contrast resolution that led to better lesion detection and improved quantification especially of small, metabolic active lesions. This Phase I trial suggests, that the next generation PET detection technology has the opportunity to substantially advance the visual and quantitative quality, accuracy and measurement reproducibility for clinical PET imaging. Furthermore, substantially reduced tracer dose appear feasible in clinical PET.

CLINICAL RELEVANCE/APPLICATION

This presentation introduces the clinical capabilities of the next generation digital detector PET/CT technology for oncologic PET imaging and present initial clinical findings on improved lesion visualization, detection and quantification.

SSA15-04

Staging of Patients with Advanced Melanoma - CT or PET/CT? Impact of Imaging on Decision Making and Survival Analysis of Patients with Stage III and IV Melanoma

Sunday, Nov. 29 11:15AM - 11:25AM Location: S505AB
To compare the therapy management based on CT alone vs. 18F-FDG-PET/CT in patients with metastatic stage III/IV melanoma and to evaluate the 5-year long term survival.

**METHOD AND MATERIALS**

Patient-related re-assessment of CT and 18F-FDG-PET/CT scans of 64 patients with advanced melanoma, primarily evaluated by a lesion-based analysis at our institution. The study cohort included 52 primary and 12 restaging examinations. For each patient it was defined if PET/CT caused a change in therapy in comparison to the decisions based on CT alone. Therapy modifications ranged from "major" (e.g. surgery instead of systemic therapy) to "minor" (e.g. change in systemic therapy). Patient outcome was evaluated by calculation of the 5-year survival rates according to Kaplan-Meier.

**RESULTS**

PET/CT resulted in a change of therapy in 54% of patients of the entire group including "major" changes in 45%. The highest number of PET/CT-induced therapy shifts occurred in the primary staging group with 52% major changes. The corresponding data for the restaging group were 33% therapy changes (4/12 patients), thereof 2 patients with a major shift. In 16 patients already planned for metastasectomy based on CT alone PET/CT CT excluded metastases in 13 patients and revealed further metastases in 3 patients making an operation futile. The 5-year survival rate of the entire cohort was 30%, with an increase to 34% in the primary staging and a decline to 17% in the surveillance group. Comparing overall survival of patients in which metastases could be excluded by PET/CT or in which metastases could be completely removed (n=43) with those patients not eligible for surgery (n=21), a significant overall survival benefit for the first group could be revealed (40.5 % vs. 10.0; p=0.000185).

**CONCLUSION**

FDG-PET/CT affects surgical decision making in patients with metastatic melanoma mainly by the proper selection of patients for a complete metastasectomy, which is associated with increased long time survival.

**CLINICAL RELEVANCE/APPLICATION**

FDG-PET/CT significantly influences therapeutic management in patients with advanced melanoma, thereby increasing the long-time survival of this patient group.

**SSA15-05** Comparison of Pulmonary Nodule Detection in Lung Cancer Patients Using Whole Body FDG PET/CT, High Resolution Lung Reformat of FDG PET/CT, or Diagnostic Breath Hold Chest CT

**Participants**

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**PURPOSE**

Previous reports have documented that pulmonary nodules can be missed on the non-breath hold CT portion of FDG PET/CTs. We evaluated the image quality and rate of pulmonary nodule detection of whole body PET/CT (WB PET/CT), high-resolution sharp lung reconstruction of PET/CT (HR PET/CT), and diagnostic breath hold chest CT (BH CT).

**METHOD AND MATERIALS**

A cohort of 25 patients was identified who had a history of lung cancer as well as a PET/CT staging or re-staging scan and a diagnostic chest CT within 15 days of each other. Per our standard protocol, all PET/CTs included a high resolution lung reformat with sharp reconstruction filter and 2 mm slice thickness. WB PET/CT, HR PET/CT, and BH CT were reviewed by 3 radiologists, and the number and size of pulmonary nodules detected were recorded, as was a subjective assessment of image quality. Statistical significance of differences between reader and modality groups was analyzed by two-way repeated measures ANOVA.

**RESULTS**

On average, 2.84 nodules were found per patient with WB PET/CT, 3.93 nodules with HR PET/CT, and 3.91 nodules with BH CT. When only nodules less than or equal to 8 mm in size were considered, BH CT (2.86) and HR PET/CT (2.95) revealed more nodules per patient than WB PET/CT (1.99). While statistically significantly more nodules and nodules less than 8 mm were detected by HR PET/CT and BH CT than WB PET/CT (p<0.001) no difference was noted between the two higher resolution modalities. Comparisons of image quality revealed reader preference for BH CT over HR PET/CT (p = 0.01), and HR PET/CT over WB PET/CT (p<0.001).

**CONCLUSION**

More pulmonary nodules are detected using HR PET/CT reformats than the standard WB PET/CT images, and overall image quality was rated as higher. The ability to detect nodules was indistinguishable from dedicated BH CTS. These data suggest that use of high-resolution reformats of PET/CT images of the lungs increases sensitivity for pulmonary nodule detection, approaching that of dedicated Chest CT.
CLINICAL RELEVANCE/APPLICATION

Routine application of a high-resolution lung reformat to PET/CT images may increase the rate of pulmonary nodule detection to rates comparable to routine chest CT.

SSA15-06  Value of FDG PET/CT for Systemic Staging of Newly Diagnosed Invasive Lobular Breast Cancer (ILC) as Compared with Invasive Ductal Breast Cancer (IDC)

Sunday, Nov. 29 11:35AM - 11:45AM Location: S505AB

Participants
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PURPOSE

While NCCN guidelines consider FDG PET/CT for systemic staging of newly diagnosed stage III breast cancer patients, factors in addition to stage may influence PET/CT utility. For example, primary ILC demonstrates lower conspicuity on FDG PET than the more common IDC. We evaluated utility of PET/CT systemic staging of newly diagnosed patients with ILC as compared to IDC.

METHOD AND MATERIALS

A retrospective study was performed under IRB waiver. Our Hospital Information System was screened for ILC patients who underwent PET/CT 2006-2013 prior to systemic or radiation therapy. Initial stage was determined from records of physical exam, mammography, ultrasound, MRI and/or surgery. PET/CT was evaluated to identify unsuspected distant metastases. A cohort of patients with stage III IDC was evaluated for comparison. Upstaging rates were compared using chi square test and the relative risk with 95% CI was calculated.

RESULTS

146 ILC patients fulfilled inclusion criteria. PET/CT revealed unsuspected distant metastases in 12 patients (8%): 0 of 8 initial stage I, 2 of 50 (4%) stage II, and 10 of 88 (11%) stage III. All patients upstaged to IV were confirmed by pathology. 3 of the 12 upstaged patients were upstaged only by the CT component of the PET/CT, as metastases were non-FDG-avid. In the comparison stage III IDC cohort, 22% (26 of 69) of patients were upstaged to IV by PET/CT. All 26 demonstrated FDG avid metastases. The relative risk of PET/CT revealing unsuspected distant metastases in stage III IDC patients was 1.98 times (95% CI 0.98-3.98) that of stage III ILC patients (p=.049). For FDG-avid metastases, the relative risk of PET/CT revealing unsuspected FDG-avid distant metastases in stage III IDC patients was 2.82 times (95% CI 1.26-6.34) that of stage III ILC patients (p=.007).

CONCLUSION

FDG PET/CT is more likely to reveal unsuspected distant metastases in stage III IDC patients than in stage III ILC patients. In addition, some ILC patients were upstaged only by the CT component of PET/CT, as the metastases detected on CT were not FDG-avid. As PET/CT may have lower impact on systemic staging of ILC patients, ILC patients should not be pooled with IDC patients when exploring the utility of PET/CT.

CLINICAL RELEVANCE/APPLICATION

NCCN guidelines and planned studies may need to consider histologic subtype of breast cancer. FDG PET/CT may have less impact on systemic staging of newly diagnosed ILC than IDC.

SSA15-07  FDG PET/CT and Recurrent Colorectal Cancer Patient Survival: FDG Avidity and Tumor Burden

Sunday, Nov. 29 11:45AM - 11:55AM Location: S505AB

Participants
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PURPOSE

The aim of the study was to assess the value of quantitative PET parameters in the prediction of survival in recurrent colorectal cancer patients.

METHOD AND MATERIALS

This was a retrospective study of 126 patients with biopsy proven colorectal cancer recurrence from 2000 to 2012. Maximum and peak standardized uptake values (SUVmax, SUVpeak), metabolic tumor volume (MTV) and total lesion glycolysis (TLG) were measured for each biopsy confirmed recurrent lesion using gradient segmentation method. The median follow up period was 32.1 months. The primary outcome was overall survival (OS). Kaplan-Meier survival plots and Cox regression analyses were performed.

RESULTS

The mean ± SD SUVmax, SUVpeak, total TLG and total MTV of the study population were 7.1 ± 4.3, 5.3 ± 3.2, 378.3 ± 917.1g and 234.2 ± 420.8mL, respectively. Multivariate cox regression analysis showed total TLG (p=0.001) and total MTV (p=0.001) were associated with OS. Kaplan-Meier survival analysis was performed and SUVmax (threshold=5.9, HR=2.5; 95%CI:1.4-4.2; p<0.0001), SUVpeak (threshold=4.31, HR=2.1; 95%CI:1.2-3.5; p=0.005), total TLG (threshold=137.1g, HR=2.9; 95%CI:1.7-4.8; p<0.0001) and
total MTV (threshold=32.17mL, HR=2.5; 95% CI:1.5-4.2; p<0.0001) were significant predictors of survival during follow-up. An integrated risk stratification model using SUVmax and total MTV to stratify patients into three subgroups predicted patient survival outcomes (HR=2.1, 95% CI:1.5-2.9; log-rank p<0.0001).

CONCLUSION
FDG PET SUVmax, SUVpeak, TLGtotal, MTVtotal and an integrated risk stratification with FDG avidity and tumor burden provide significant prognostic information in patients with biopsy proven recurrent colorectal cancer.

CLINICAL RELEVANCE/APPLICATION
FDG PET/CT in recurrent colorectal cancer can help stratify patients in different groups for which different treatment strategies can be applied.

SSA15-08 Association between Prognosis and FDG-PET Parameters, ADC of MRI and Oncogene Expression in Pancreas Cancer

Sunday, Nov. 29 11:55AM - 12:05PM Location: S505AB

Participants
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PURPOSE
The study was done to determine the significant prognostic factor among FDG-PET parameters, apparent diffusion coefficients (ADC) of MRI and various oncogenes expression in pancreas cancer.

METHOD AND MATERIALS
Sixty-five pancreas invasive ductal cancer patients those underwent F-18 FDG PET/CT and subsequent surgical resection were evaluated. The maximum standardized uptake value (SUVmax), the peak of standardized uptake value (SUVpeak), metabolic tumor volume (MTV), and total lesion glycolysis (TLG) were calculated on 18F-FDG PET/CT in both early (1hr) and delayed (2hr) examinations. The threshold value for calculating MTV was 40% of SUVmax. In addition, apparent diffusion coefficient (ADCmean and ADCmin) of MRI, various oncogenes expressions including EGFR, VEGFA, Ki-67, HIF-1, KRAS, BRAF, CDH13 were evaluated. Among various clinical parameters including imaging parameters, independent significant prognostic factors for overall survival (OS) were determined by multivariate analysis with Cox proportional hazards model. Among various significant prognostic parameters, univariate analysis with mantel-cox test was done for comparing OS.

RESULTS
The pathologic T (pT) stage, TLG on early PET image, SUV max on delayed images and ADCmean was significant prognostic factor for OS (<0.05). Regarding gene expressions, only KRAS was significant predictive factors (P <0.05). In univariate analysis, patients of larger TLG (>=55) showed higher cumulative survival rate compared with that of smaller TLG group (<55). Similarly, lower ADCmean (<1300) showed shorter OS than that of higher ADCmean (>=1300).

CONCLUSION
Both FDG parameters (TLG on early PET image, SUV max on delayed images) and ADCmean were significant parameters for predicting OS, in addition to pT stage and KRAS expression. Thus, both 18F-FDG PET/CT and MRI diffusion images can provide useful prognostic information for patients undergoing resection of pancreatic cancer.

CLINICAL RELEVANCE/APPLICATION
In the prediction of prognosis of invasive ductal pancreas cancer after surgical operation, TLG of FDG-PET and ADCmean of MRI were useful imaging parameters.

SSA15-09 Body Weight-based Protocols during Whole Body FDG PET/CT Significantly Reduces Radiation Dose without Compromising Image Quality

Sunday, Nov. 29 12:05PM - 12:15PM Location: S505AB

Participants
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PURPOSE
To investigate radiation dose reduction during head to mid thigh fluorodeoxyglucose (FDG) positron emission tomographic (PET)/computed tomography by employing weight based protocols.

METHOD AND MATERIALS
520 consecutive patients were referred for FDG PET/CT study using a 16-detector PET/CT. Patients were allocated to one of two scanning protocols: Group A, the conventional protocol: 120 kVp, 120 mAs, 0.5 sec rotation time, pitch 0.8mm/rot across all body weights; Group B, employed a 4 tier body weight protocol: protocol A: ≤ 60 kg: 140 kVp, 35 mAs, 0.75 sec rotation time, pitch 0.8mm/rot; group B: 60 - 80 kg: 140 kVp, 50 mAs, 0.75 sec rotation time, pitch 0.8mm/rot; group C: 80 - 100 kg: 140 kVp, 65 mAs, 0.75 sec rotation time, pitch 0.8mm/rot; group D: > 100 kg: 140 kVp, 100 mAs, 0.75 sec rotation time, pitch 0.8mm/rot all protocols employed tube current modulation. Patient demographics were measured. Age and sex-specific lifetime attributable risk
(LAR) of individual cancers were estimated using the approach of BEIR VII and summed to obtain whole body LAR.

**RESULTS**

Mean patient demographics demonstrated no significant difference. Mean effective dose CTDIvol and DLP significantly reduced in protocol B (CTDIvol; 4.60 ± 1.49, DLP; 823.35 ± 280.70 mSv) compared to A (CTDIvol; 7.36 ± 1.79, DLP; 1260.96 ± 304.7 mSv) (p<0.0001). Mean FDG administration demonstrated no significant differences in each protocol (p=0.873). Contrast to noise ratio demonstrated no differences between each group (p<0.21). Mean LAR cancer risk was significantly reduced for females by 35% and males 125% in protocol B compared to A (p<0.04).

**CONCLUSION**

Significant reduction in radiation dose can be achieved using patient-specific body weight based protocols during whole-body FDG PET/CT without compromising image quality.

**CLINICAL RELEVANCE/APPLICATION**

FDG and PET/CT have revolutionized the practice of medicine. With the expanding use of PET/CT, ionizing radiation may eventually result in an increased incidence of cancer in the exposed population. This problem can be minimized by optimizing the CT protocol to achieve optimal image quality with the lowest possible radiation dose.
**PURPOSE**

Parotidectomy with facial nerve (VII) sacrifice is often necessary in patients with malignant tumor. In all parotid masses, diagnosis of perineural spread is important as a prognosis biomarker since patients may have asymptomatic nerve invasion. Recently, the feasibility of intraparotid VII tractography was assessed to identify nerve contact with parotid tumors. The aim of this study was to determine if VII fractional anisotropy (FA) was linked to histologic grade in patients undergoing surgery for parotid tumors.

**METHOD AND MATERIALS**

Study ethics approval was obtained from our institutional review board (IRB 5891). Patients aged 18 or over, were included in this prospective study if they had:

- (a) A history of parotid tumors, requiring surgical management between December 2013 and April 2015
- (b) Undergone MR scans with diffusion acquisition and post-processing tractography
- (c) Surgical intraoperative checking of the intraparotid facial nerve

Patients underwent MR scans with VII tractography calculated with the constrained spherical deconvolution model. We performed scans on a 3T MRI Philips ACHIEVA® 3.0T TX with a 32 channel head coil. The post-processing steps were performed using MRtrix package software. The parameters of the diffusion sequence were: b-value of 1000 s/mm², 32 directions, voxel size: 2 mm isotropic, scan time: 9'31''.

**RESULTS**

Twenty patients (mean age: 53 years, 5 women) were enrolling in this study. The first group (n=10) referred with a benign tumor without facial nerve compression or invasion as checked by surgical team. The second group (n=10) referred with a malignant tumor and included three patients with clinical facial nerve palsy. The VII mean FA value was estimated as being 0.53±0.06 in patients with benign tumors and 0.37±0.08 in malignant tumor group. Mean FA value was significantly lower in the second group (t-test, p≤0.05) and was also reduced in patients free from clinical facial palsy with surgically evidence of VII perineural spread (n=3).

**CONCLUSION**

In these preliminary results, MRI using diffusion tractography was a promising procedure to assess parotid tumor histologic grade and potential perineural spread.

**CLINICAL RELEVANCE/APPLICATION**

A reliable imaging biomarker of histologic grade and perineural spread in cases with parotid tumors may help to better inform and manage patients.
Hearing preservation is a therapeutic goal for many patients with vestibular schwannoma (VS). We examined the relationship between pre-treatment MRI and post-treatment hearing status in an effort to define factors that may influence management.

**METHOD AND MATERIALS**

From September 2010 through January 2014, consecutive cases of VS treated with stereotactic radiosurgery (SRS) or microsurgery were reviewed. Preoperative MRIs were analyzed by two readers with respect to three-dimensional tumor size, shape (round vs. oval), cochlear T2 signal, relationship of tumor to internal auditory canal (IAC), and presence of necrosis. Patients were excluded if they had prior treatment or no pre-treatment MRI within one year. "Serviceable" hearing was defined as speech discrimination score (SDS) ≥70% or AAO-HNS class A/B. Post-treatment hearing "preservation" was defined as maintenance or development of serviceable hearing after SRS or microsurgery using non-translabyrinthine approach. Bivariate statistics were calculated.

**RESULTS**

191 cases were reviewed; 68 patients met criteria for inclusion. A majority underwent SRS (69%), had tumors in the distal IAC (52%), oval shape (56%), without confluent necrosis (68%), and median volume of 0.95 mL. Of these patients, 55 and 30 had pre- and post-treatment audiometry, respectively; 56% and 67% had "serviceable" pretreatment hearing on SDS or AAO-HNS, respectively. People without serviceable pre-treatment hearing on SDS had significantly larger (p=0.05) and round (p=0.02) tumors. Reduced cochlear T2 signal trended towards worse hearing on AAO-HNS (p=0.12). Preserved cochlear T2 signal was the only variable significantly associated with post-treatment hearing preservation as measured by SDS or AAO-HNS in all tumors (p<0.001 and p<0.01, respectively) or SDS for those in the distal IAC (p=02). Interobserver agreement measuring cochlear T2 signal was 92%.

**CONCLUSION**

Preoperative MRI identified patients more likely to have better hearing outcomes, thus aiding clinicians in pretreatment counseling. Decreased cochlear T2 signal may indicate close association with the cochlear neurovascular bundle, influencing endolymph protein concentration and negatively influencing hearing outcome.

**CLINICAL RELEVANCE/APPLICATION**

Pre-treatment cochlear T2 signal is associated with hearing outcomes after treatment for vestibular schwannoma. Use of thin section MRI has the potential to better inform treatment decisions.
In the control group, 3 healthy subjects were found with EH in either cochlea or vestibule with these criteria. EH prevalence was assessed by the Student's t-test. Patients were graded based on the number and localization of hydrops and results were analyzed using radiologists performed blind, semi-quantitative evaluations of MRI scan. Cochlear EH have been noted as present if nodular or irregular dilatation of endolymphatic canal and VH recorded as present when more than 50% of the vestibule have been occupied by endolymphatic space. Participants included 300 patients and 25 healthy subjects were recruited between January 2013 and May 2015. Patienst were consecutively included if they had: (a) A history of clinically define MD (n=100), RPV (n=100), SHL (n=50) or rBPPV (n=50)(b) Have undergone this study if they had: (a) A history of clinically define MD (n=100), RPV (n=100), SHL (n=50) or rBPPV (n=50)(b) Have undergone MRI seeking for endolymphatic hydrops (EH) was recently found as closely reflecting histopathologic findings in patients with Meniere's disease (MD). However, the lack of healthy subject data was problematic to precisely define the pathological condition. The aim of this study was to assess EH prevalence in a large cohort of patients with four clinical presentations: MD, sensorineural hearing loss (SHL), recurrent peripheral vestibulopathy (RPV) and recurrent benign paroxysmal positional vertigo (rBPPV) in comparison with healthy subjects. We also evaluated EH localization (i.e cochlear or vestibular) in each group.

METHOD AND MATERIALS

With IRB approval and informed consent, nine patients with pathologically suspected and subsequently confirmed vestibular schwannomas were recruited. The SII acquisition is similar to MR elastography (MRE) in which low-amplitude mechanical vibration is applied to the head with a pillow-like device placed in the head coil and the resulting shear waves are imaged using a phase-contrast pulse sequence with motion encoding gradients synchronized with the applied vibration. Imaging was performed on a 3T MR system with an 8-channel head coil in a scan time of less than 7 minutes. The acquired shear motion data were processed with two different algorithms (shear line analysis and calculation of octahedral shear strain (OSS)) to identify the degree of tumor-brain adhesion. Blinded to the SII results, neurosurgeons qualitatively assessed tumor adhesion at the time of tumor resection as one of three patterns: no adhesion, partial adhesion, and complete adhesion. Correlations between SII and surgical findings were determined, and the ability to use OSS to quantify the tumor adhesion was tested using a Mann-Whitney U test with a statistical significance set at p < 0.05.

RESULTS

In SII, the presence of a non-adhesive tumor-brain interface appears as a dark line in the shear line images and exhibits higher OSS values than an adhesive interface. The absence of shear lines corresponded to complete tumor adhesion. Surgical results for the nine patients included 2 cases with complete adhesion, 3 with partial adhesion, and 4 with no adhesion. SII results were concordant with the intraoperative assessment of tumor adhesion in 8 cases (88%). One case was identified as having no adhesion with SII, but adhesions were found at surgery. The OSS values for the non-adhesive interfaces were significantly larger (p=0.012) than the adhesive interfaces.

CONCLUSION

Our results demonstrate that SII is a clinically feasible method to preoperatively predict the degree of tumor-brain adhesion in patients with vestibular schwannomas.

CLINICAL RELEVANCE/APPLICATION

The SII technique shows promise for allowing radiologists and neurosurgeons to preoperatively quantify the degree of intracranial tumor adhesion and predict potential complications of tumor resection.

SSA16-06 Endolymphatic Hydrops as an Imaging Biomarker: A Chronic Disease with Various Clinical Presentations

Sunday, Nov. 29 11:35AM - 11:45AM Location: N226

Participants

Amaud Attye, MEd, Grenoble, France (Presenter) Research Grant, Guerbet SA Georges Dumas, Grenoble, France (Abstract Co-Author) Nothing to Disclose Irene Tropes, Grenoble, France (Abstract Co-Author) Nothing to Disclose Matthieu Roustit, Grenoble, France (Abstract Co-Author) Nothing to Disclose Elida Banciu, MD, La Tronche, France (Abstract Co-Author) Nothing to Disclose Johan Pietras, Grenoble, France (Abstract Co-Author) Nothing to Disclose Laurent Lamalle, Grenoble Cedex, France (Abstract Co-Author) Nothing to Disclose Sebastien Schmerber, Grenoble, France (Abstract Co-Author) Nothing to Disclose Alexandre Krainik, MD, PhD, Grenoble CESEX, France (Abstract Co-Author) Nothing to Disclose

PURPOSE

MRI seeking for endolymphatic hydrops (EH) was recently found as closely reflecting histopathologic findings in patients with Meniere's disease (MD). However, the lack of healthy subject data was problematic to precisely define the pathological condition. The aim of this study was to assess EH prevalence in a large cohort of patients with four clinical presentations: MD, sensorineural hearing loss (SHL), recurrent peripheral vestibulopathy (RPV) and recurrent benign paroxysmal positional vertigo (rBPPV) in comparison with healthy subjects. We also evaluated EH localization (i.e cochlear or vestibular) in each group.

METHOD AND MATERIALS

300 patients and 25 healthy subjects were recruited between January 2013 and May 2015. Patients were consecutively included in this study if they had: (a) A history of clinically define MD (n=100), RPV (n=100), SHL (n=50) or rBPPV (n=50)(b) Have undergone an MRI scan 4 hours after intravenous gadoteric acid injection using FLAIR imaging (TR: 8000 ms, TE: 316 ms, TI: 2400 ms) with subtraction process. Control subjects inclusion was approved by our institutional review board (IRB 6705/15-CHUG-02). Two radiologists performed blind, semi-quantitative evaluations of MRI scan. Cochlear EH have been noted as present if nodular or irregular dilation of endolymphatic canal and VH recorded as present when more than 50% of the vestibule have been occupied by endolymphatic space. Patients were graded based on the number and localization of hydrops and results were analyzed using the Student's t-test.

RESULTS

In the control group, 3 healthy subjects were found with EH in either cochlea or vestibule with these criteria. EH prevalence was...
approximately estimated as being 85%, 50%, 40% and 40% in MD, SHL, RPV and rBPPV groups respectively. The results showed a significantly higher average number of hydrops localizations in the MD group when compared to other groups (t-test, p<0.01). Cochlear EH was found in 36% and 38% of RPV and rBPPV patients. Vestibular EH was displayed in 20% of SHL patients.

CONCLUSION

MRI criteria for EH allowed to distinguish pathology from healthy condition. However, EH appeared as a chronic disease rather than directly responsible of patient symptoms.

CLINICAL RELEVANCE/APPLICATION

We aimed to better explain pathophysiology of inner ear disorders, allowing better patient information and adapted therapeutic strategies in patients with endolymphatic hydrops.

SSA16-07 Superiority of Heavily T2-weighted 3D-FLAIR Over Regular 3D-FLAIR for the Detection of Cochlear Lymph Fluid Signal Abnormality in Patients with Sudden Sensorineural Hearing Loss

Sunday, Nov. 29 11:45AM - 11:55AM Location: N226

Participants
Shinji Naganawa, MD, Nagoya, Japan (Presenter) Nothing to Disclose
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Shingo Iwano, MD, Nagoya, Japan (Abstract Co-Author) Nothing to Disclose
Hisashi Kawai, Nagoya, Japan (Abstract Co-Author) Nothing to Disclose
Michihiko Sone, Nagoya, Japan (Abstract Co-Author) Nothing to Disclose
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PURPOSE

To compare the signal increase of cochlear lymph fluid on 3D-FLAIR in patients with sudden sensorineural hearing loss (SNHL) between the regular contrast 3D-FLAIR (FL) and heavily T2-weighted 3D-FLAIR (HF).

METHOD AND MATERIALS

25 patients with unilateral sudden SNHL and 8 healthy volunteers were included. Patients were divided into mild group of 9 patients, average hearing level of 60 dB or less; and severe group of 16 patients, hearing level of more than 60dB. All patients and healthy volunteers underwent a MR cisternography (MRC) for anatomical reference of the fluid space, FL and HF at 3T. Region of interest (ROI) was manually drawn on mid-modiolar section of MRC around cochlea. ROI for noise was drawn in the air area. ROIs were copied onto FL and HF. Contrast-to-noise ratio (CNR) between affected and non-affected ear was measured in patients' group and CNR between right and left ear was measured in control group. Differences in CNR on FL and HF among 3 groups were tested by one-way analysis of variance (ANOVA).

RESULTS

There was a statistically significant difference in the mean of CNR on HF among the three groups (p < 0.001). Further, from the pairwise comparisons among them, there was a statistically significant difference with each other in the mean of CNR on HF (p < 0.05). There was no statistically significant difference in the mean of CNR on FL among the three groups (p = 0.074).

CONCLUSION

HF is more sensitive to signal alteration of cochlea with sudden SNHL than FL.

CLINICAL RELEVANCE/APPLICATION

Heavily T2-weighted 3D-FLAIR (HF) is more sensitive to high signal of cochlea in the ears with sudden sensorineural hearing loss (SNHL) than regular contrast 3D-FLAIR (FL).

SSA16-08 Three-Dimensional Fluid-Attenuated Inversion Recovery Signal Changes as a Prognosis Predictor in Idiopathic Sudden Sensorineural Hearing Loss

Sunday, Nov. 29 11:55AM - 12:05PM Location: N226

Participants
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Hsiu-Mei Wu, MD, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose
Jiing-Feng Ling, MD, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate the relationship of 3D FLAIR findings and outcome in patients with idiopathic sudden sensorineural hearing loss (ISSNHL).

METHOD AND MATERIALS

We retrospectively reviewed consecutive 66 patients presenting with unilateral ISSNHL from June 2013 to September 2014. Before treatment, all patients underwent MRI exams, including 3D-FIESTA, and 3D-FLAIR without gadolinium enhancement. One blind observer registered 3D-FIESTA and 3D-FLAIR on a dedicated workstation and drew ROIs to measure the signal intensity of cochlea in both affected and unaffected ears on 3D-FLAIR.

RESULTS

The ratio of the cochlear signals between the affected and unaffected ears showed significant correlation with the severity of pre-treatment hearing loss and the clinical outcome (Siegel criteria) after treatment. The increased FLAIR signal intensity is a specific prognostic predictor of poorer outcome (Siegel grade III/IV) after treatment. (sens./spec: 32%/86% (cutoff value: 1.2) and 5%/91% (cutoff value, 1.4)).
CONCLUSION

This study demonstrated a correlation between cochlear FLAIR signal and pre-treatment hearing level, and post-treatment outcome. Increased FLAIR signal is a specific prognostic predictor of poorer outcome after treatment.

CLINICAL RELEVANCE/APPLICATION

The causes of sudden deafness now are still idiopathic. In general, labyrinthitis caused by viral infection, blood circulation disorders, or ruptures of the inner ear membrane are believed to cause sudden deafness. The unpredictability of idiopathic sudden sensorineural hearing loss (ISSNHL) presents a challenge to preventive care. Prognosis can be predicted that the patients poor post-treatment outcome from the high intensity signal inner ear of 3D FLAIR sequence on MRI.

SSA16-09  Flat Panel CT in Diagnosis of Superior Canal Dehiscence. A Really New Diagnostic Approach?

Participants
Christina Loberg, MD, Aachen, Germany (Presenter) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Bruners, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
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Martin Westhofen, Aachen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Superior canal dehiscence (SCDS) is a rare defect, caused by a thinning or complete absence of temporal bone overlying superior semicircular canal of vestibular system. Treatment of choice is covering the defect with ceramic implant. Flat panel CT is an innovative technique that permits visualization of the complex anatomy of temporal bone with high spatial resolution. The utility of flat panel CT has been demonstrated in multiple disease states including neurovascular disease, peripheral vascular disorders and oncology. We therefore evaluated flat panel CT in diagnosis of SCDS.

METHOD AND MATERIALS
30 patients (m = 18/ f = 12) age 36 - 63 (m= 48.2) with symptoms of SCDS underwent flat panel CT examination between January 2013 and January 2015. 13 patient underwent MSCT imaging before, these images were assessed as normal. Flat panel CT was performed by Siemens Axion Artis, rotation 220°. Postprocessing was done at Siemens leonardo workstation with reconstructions in bone window in 3D projection and adapted to superior semicircular canal. Applied Radiation dose inbetween flat panel CT and MSCT was compared.

RESULTS
In 5/ 17(29%) patients who underwent flat panel CT imaging SCDS was confirmed. In 6/ 13 (46%) patients who underwent MSCT and flat panel CT defect of temporal bone overlying superior semicircular canal was found and SCDS was intraoperatively confirmed. Applied radiation dose was nearly equal (flat panel CT 276, 5mGy/ cm / MSCT 277,4mGy/ cm).

CONCLUSION
Flat panel CT should be performed in cases with symptoms SCDS when MSCT is assessed normal. It is a reliable diagnostic tool and a new diagnostic approach in diagnosis of SCDS.

CLINICAL RELEVANCE/APPLICATION
Flat panel imaging is a reliable tool in imaging temporal bone and inner ear structures and can improve preoperative virtual planning.
SSA17

Neuroradiology/Head and Neck (Vascular Disease of the Head and Neck)
Sunday, Nov. 29 10:45AM - 12:15PM Location: N227

AMRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
FDA Discussions may include off-label uses.

Participants
Mahmud Mossa-Basha, MD, Seattle, WA (Moderator) Research support, General Electric Company

Sub-Events
SSA17-01 The CTA Rim Sign: Calcification Pattern Predicts Carotid Intraplaque Hemorrhage
Sunday, Nov. 29 10:45AM - 10:55AM Location: N227

Participants
Laura B. Eisenmenger, MD, Salt Lake City, UT (Presenter) Nothing to Disclose
Joseph S. McNally, MD, PhD, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose

PURPOSE
Carotid intraplaque hemorrhage (IPH) is associated with a high risk of future stroke. The gold standard for IPH detection is MRI with heavily T1-weighted sequences. This study was undertaken to determine essential CTA imaging predictors of carotid IPH.

METHOD AND MATERIALS
In this IRB-approved retrospective cross sectional study, 172 patients (244 carotid arteries) were studied having undergone carotid disease workup with both MRA and CTA from 2009-present. IPH was detected with the Magnetization Prepared Rapid Acquisition Gradient-recalled Echo (MPRAGE) sequence. CTA predictors included the presence or absence of calcification, type of calcification (rim, adventitial or bulky), percent diameter stenosis, mm stenosis, maximum plaque thickness, ulceration, and intraluminal thrombus. Clinical covariates included age, male sex, diabetes, hypertension, hyperlipidemia and body mass index. Cardiovascular medication confounders included antihypertension, antiplatelet, anticoagulation and statin medication classes. A mixed effects multivariable Poisson regression model was used accounting for 2 vessels per patient. A backwards-elimination method was used to determine the final model, in which prevalence ratios were reported and all remaining predictors had a p<.10. ROC analysis was used to determine discriminatory power measured by area under the curve (AUC).

RESULTS
The final model for carotid IPH prediction included the rim sign (prevalence ratio, PR=8.6, p<.001, 95%CI: 4.0,18.5) and maximum plaque thickness (PR=1.2, p=.001, 95%CI: 1.1,1.4). In the final model, no other imaging criteria were significant predictors of IPH. The discriminatory value of the final model was extremely high (AUC=93.9%), significantly higher than the rim sign alone (86.1%, p<.001), thickness alone (85.2%, p<.001), NASCET stenosis (78.4%, p<.001), mm stenosis (77.7%, p<.001) or ulceration (71.9%, p<.001).

CONCLUSION
The carotid CTA rim sign is highly predictive of carotid IPH.

CLINICAL RELEVANCE/APPLICATION
Because most patients undergoing acute stroke workup receive lumen imaging with CTA, MRI is often not performed and IPH is ignored. The CTA rim sign and maximum plaque thickness allow high discrimination of carotid IPH. Future prospective studies may be envisioned to determine if the rim sign indicates a higher future stroke risk.

SSA17-02 Clinical Risk Prediction Models for the Identification of Patients with High-Risk Carotid Plaque
Sunday, Nov. 29 10:55AM - 11:05AM Location: N227

Participants
Navneet Singh, MD, Toronto, ON (Presenter) Nothing to Disclose
Alan R. Moody, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Kush Kapur, PhD,MENG, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
High-risk carotid plaque containing intraplaque hemorrhage predicts stroke, however, it is not yet routinely screened for in practice. We aimed to develop cross-validated clinical models to identify patients at risk of high-risk carotid plaque.

METHOD AND MATERIALS
Between 2003 and 2014, 1862 suspected neurovascular disease patients had MRI. High-risk carotid plaque was defined by presence of intraplaque hemorrhage on 3D T1w GRE black-blood MRI, a sequence routinely included in our institutional neurovascular MRI protocol. Using derivation and validation cohorts with 931 patients each, two risk-prediction logistic regression models considering 11 risk factors, with and without inclusion of stenosis grade, were developed. Receiver-operator characteristic curves were used to compare discriminatory ability of these two models.

RESULTS
The overall prevalence of high-risk carotid plaque was 19.3% (359/1862). Patients with high-risk carotid plaque could be identified
using age, sex, hypercholesterolemia, and peripheral vascular disease (AUC 0.781, 95% CI 0.747 to 0.815). Optimal threshold sensitivity and specificity was 81.8% and 62.4%, respectively. The addition of carotid stenosis grade improved discrimination of patients (AUC 0.826, 95% CI 0.795 to 0.856), and improved optimal threshold specificity to 72.8% without a significant change in sensitivity.

CONCLUSION

Patients prone to high-risk carotid plaque, containing intraplaque hemorrhage, may be identified using a simple clinical risk prediction model of cardiovascular risk factors and carotid stenosis grade.

CLINICAL RELEVANCE/APPLICATION

The model provides an opportunity for targeted carotid MRI screening in patients not already undergoing neurovascular MRI, but external validation studies are required.

SSA17-03 Identification of the Vulnerable Carotid Plaque Using Dynamic Contrast Enhanced Ultrasound

Sunday, Nov. 29 11:05AM - 11:15AM Location: N227

Participants

Brahman Dhammarajah, MBBS, MRCS, London, United Kingdom (Presenter) Nothing to Disclose
Michalakis A. Averkiou, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Damiános Christofides, MSc, Nicosia, Cyprus (Abstract Co-Author) Nothing to Disclose
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Alan Davies, FRCR, London, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE

Carotid atherosclerosis is implicated in 15-20% of all strokes. Dynamic contrast enhanced ultrasound (DCEUS) is a simple adjunct to color Doppler ultrasound for the assessment of carotid atherosclerosis. It has been identified that DCEUS can demonstrate perfusion within carotid plaques of greater than 50% stenosis with some differentiation observed between symptomatic and asymptomatic patients. In this study the perfusion of carotid plaques is evaluated both qualitatively and quantitatively to evaluate carotid perfusion of asymptomatic and asymptomatic patients.

METHOD AND MATERIALS

After ethical approval, the carotid arteries of 24 patients were imaged using the L9-3 probe of the Philips iU22 ultrasound platform. Patients were injected with a bolus of 2ml of Sonovue with subsequent dynamic phase imaging acquisition. Offline blinded analysis was performed using DICOM data transferred to QLAB commercial analysis software. Qualitative perfusion assessment used binary grading: 0 represented less than 50% of carotid plaque area contained moving microbubbles and 1 represented more than 50% of carotid plaque area contained moving microbubbles. Static reflectors were not considered as valid microbubble signal. For quantitative DCEUS analysis, a region-of-interest (ROI) was drawn around the plaque. Plaques were delineated from the lumen signal to remove potentially large amplitude differences between the plaque and lumen signal intensity. A time intensity curve (TIC) was derived from the dynamic phase ROIs with mean plaque intensity signal calculated from the TIC.

RESULTS

The qualitative analysis results showed that 75% (9/12) of asymptomatic patients had >50% carotid plaque perfusion in comparison to only 33% (4/12) of symptomatic patients. After quantitative image analysis, the mean DCEUS intensity signal from the TIC of the carotid plaques was again significantly higher for asymptomatic patients than symptomatic patients (P<0.05).

CONCLUSION

Contrary to previous studies, this study suggests that patients with greater carotid plaque perfusion are more likely to have an asymptomatic carotid symptom status where as those with reduced perfusion are more likely to be symptomatic from their carotid disease.

CLINICAL RELEVANCE/APPLICATION

In patients with greater than 50% carotid stenosis, reduced plaque perfusion on DCEUS may represent vulnerable, symptomatic carotid atherosclerosis.

SSA17-05 Advanced Atherosclerotic Disease with Intraplaque Hemorrhage is Present in Non-Stenotic Carotid Arteries of Diabetic Patients

Sunday, Nov. 29 11:25AM - 11:35AM Location: N227

Participants

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David Jenkins, Toronto, ON (Abstract Co-Author) Nothing to Disclose

PURPOSE

Diabetic patients have an increased risk of ischemic cerebrovascular events with worse outcomes than the non-diabetic population. Carotid artery stenosis currently stratifies patient risk but, even without significant stenosis, intraplaque hemorrhage (IPH) may predict cerebrovascular events. We report the prevalence of IPH in an asymptomatic diabetic population without carotid artery stenosis, using 3-dimensional (3D) magnetic resonance imaging (MRI) and investigate its association with carotid artery wall...
METHOD AND MATERIALS

Patients were recruited from a prospective dietary trial between 2010 and 2013, with a carotid intima-media thickness (IMT) > 1.2mm and non-stenotic carotid arteries on ultrasound. All were asymptomatic type 2 diabetic patients who underwent baseline 3D T1-weighted black blood imaging for visualization of intraplaque hemorrhage (3D-MRIPH) and 3D-time of flight imaging. Carotid artery vessel wall (VW) volumes and IPH volumes were determined bilaterally for a standard 32 mm segment centered at each carotid bifurcation, using a validated approach with the software, VesselMASS (Medis, Netherlands). Descriptive statistics as well as repeated measures linear regression analyses were performed.

RESULTS

159 patients were included with mean age 63.1 ± 7.9 years, 62.3% male, 17.9% with a smoking history and 69.2% on hypertensive medication. The prevalence of IPH was 23.3% (n=37) with five patients exhibiting IPH in both carotid arteries. VW volume of the IPH positive carotid arteries was found to be significantly different from IPH negative arteries (β=0.15mm³ SE=0.03, p<0.01) and independent from other factors that affected VW volume - age (β=0.01yrs SE=0.002, p<0.01), sex (β=0.21 SE=0.04, p<0.01), BMI (β=0.22 SE=0.10, p<0.03) - when adjusted (none significant) for disease duration, smoking, blood pressure, and medications (statins, anti-hypertensive, anti-platelet).

CONCLUSION

IPH can be found in the absence of carotid artery stenosis in asymptomatic diabetic patients and is associated with an increased carotid artery wall volume as measured by 3D-MRI. It represents a biomarker of advanced atherosclerotic disease and may identify individuals at higher risk of cardiovascular disease.

CLINICAL RELEVANCE/APPLICATION

3D MRI can identify high risk cardiovascular biomarkers, such as intraplaque hemorrhage, in diabetic patients before onset of stenosis.

SSA17-06 Feasibility of High-resolution MR Imaging for the Diagnosis of Posterior Inferior Cerebellar Artery Dissection

Sunday, Nov. 29 11:35AM - 11:45AM Location: N227

Participants
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Yoolim Baek, MD, Suwon, Korea, Republic Of (Presenter) Nothing to Disclose

PURPOSE
To evaluate the feasibility of HR-MR imaging diagnosing posterior inferior cerebellar artery (PICA) dissection and to find most useful imaging findings suggesting dissection

METHOD AND MATERIALS

We retrospectively reviewed 104 patients suspected of having arterial dissection involving posterior cerebral circulation and underwent HR-MR imaging between March 2012 and March 2015. 66 patients were diagnosed with arterial dissection involving posterior cerebral circulation and 16 patients among them (24.2%) were diagnosed with isolated PICA dissection by the consensus among neuroradiologists, neurointerventionist and neurologist after reviewing all clinical and paraclinical investigations available at hospital discharge (initial CT, MR, DSA images and etiologic work-ups) and follow up. Two neuroradiologists independently reviewed the HR-MR images of patients finally diagnosed as PICA dissection and looked for evidence of dissection (mural hematoma, dissection flap, outer wall enlargement on T2WI) on each sequence of HR-MRI (PDWI, T2WI, T1WI and CE-T1WI). Inter- and intraobserver agreement for detecting evidence of dissection was estimated using the Cohen's kappa coefficient.

RESULTS

Dissection flaps were seen in all cases on T2WI (100%) and secondly detected on CE-T1WI (81.3%). Outer-diameter enlargement of the steno-occlusive lesions on angiography was detected in most of cases (81.3%). A mural hematoma was best detected on CE-T1WI (50.0%). The two reviewers showed substantial to almost perfect agreement for detecting dissection signs on every sequence (Cohen's kappa coefficient: 0.63 ~0.94)

CONCLUSION

HR-MR imaging could be a useful and non-invasive diagnostic tool for PICA dissection and dissection flap with outer wall enlargement on T2WI is most confident sign for suggesting dissection.

CLINICAL RELEVANCE/APPLICATION

HR-MR imaging can demonstrate direct findings of dissection and be non-invasive useful diagnostic tool for the diagnosis of posterior inferior cerebellary artery dissection

SSA17-07 Correlation of Carotid Plaque Features with Acute Cerebral Infarction in Type 2 Diabetic Patients - A Magnetic Resonance Imaging Study

Sunday, Nov. 29 11:45AM - 11:55AM Location: N227

Participants
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Huilin Zhao, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Xiaosheng Liu, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Ye Cao, Shanghai, China (Abstract Co-Author) Nothing to Disclose
PURPOSE
The aim of this study was to investigate the association between carotid atherosclerotic plaque characteristics and the severity of acute cerebral infarct (ACI) in symptomatic patients with T2DM.

METHOD AND MATERIALS
We studied 204 arteries in 102 stroke patients by carotid and brain MRI. ACI volume was determined from symptomatic internal carotid artery territory on diffusion-weighted imaging (DWI). The symptomatic carotid plaque burden and compositional characteristics between stroke patients with T2DM and without T2DM were compared by using independents sample t-test and nonparametric Wilcoxon signed rank test after analyzed with MR vessel imaging. Pearson correlation test was applied to determine the correlations between volume of ACIs and carotid features in T2DM patients, then univariate and multivariate linear regressions were applied to assess the independent associations of carotid characteristics with severity of ACIs.

RESULTS
Out of 104 enrolled stroke patients, 44(42%) had T2DM. They were distinguished as atherosclerotic plaque based on carotid artery with presence of any plaque component on MRI, such as calcification, LRNC, or IPH. The occurrence rate of carotid artery plaque was higher in diabetics vs non-diabetics (76.1% vs 52.6%, p<0.001). Compared with patients without T2DM, the T2DM subjects showed significantly higher prevalence of LRNC (70.5% vs 48.3%, P=0.038) as well as a larger volume of LRNC (76.82±114.31 mm3 vs 35.91±73.79 mm3; P=0.042). Among these stroke patients, ACIs size of T2DM subjects in internal carotid artery (ICA) territory (7.75±11.49 mm3 vs 3.77±6.33 mm3; P=0.042) are greater than that of non-T2DM subjects. In addition, The LRNC volume had superior correlation (r=0.77, P<0.001) with the infarction volume of ipsilateral ICA territory, outperforming the other parameters in T2DM patients. Univariate and multivariate linear regression analysis showed close correlation of LRNC volume and MWT with the severity of ACI (B= 0.15, P<0.01 and B=4.99, P<0.05, respectively).

CONCLUSION
LRNC prevalence and volume of carotid plaques are significantly different between stroke patients with T2DM and without T2DM. In addition, LRNC volume and MWT are independently associated with cerebral infarction as measured by DWI.

CLINICAL RELEVANCE/APPLICATION
Our findings indicate that characterizing atherosclerotic plaque by MR vessel wall imaging might be useful for stratification of plaque risk and infarction severity in T2DM patients.

SSA17-08 Early Atherosclerotic Disease Detected by MRI and CT in the Carotid and Coronary Arteries in Low-moderate Risk Individuals

Sunday, Nov. 29 11:55AM - 12:05PM Location: N227

Participants
Mariana Selwaness, MD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
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PURPOSE
We examined the relationship between positive remodeling in the carotid and coronary arteries and investigated determinants of remodeling in a population with low-moderate risk of cardiovascular disease.

METHOD AND MATERIALS
Study subjects >55 years old with history of hypercholesterolemia underwent high resolution black blood carotid MRI using dedicated surface coils at 3T. In addition, CT angiography was performed using 320 slice scanning. Arterial wall area (outer vessel area-lumen) and the remodelling index (RI) (wall area/outer vessel area) were measured by observers blinded to clinical status. Data were analyzed using Spearman’s correlation coefficient and multivariate linear regression analysis adjusted for sex, age, height and weight.

RESULTS
In 201 individuals (mean age 65.3±6.5, 64% men) with a low-moderate risk (Framingham Risk Score 7.8±7.6%), we found a strong association between wall area and outer vessel area in both the carotid (r=0.80; p<0.001, adjusted beta 1.67 [95%CI 1.43-1.92]) as well as the coronary arteries (r=0.82; p<0.001, adjusted beta 1.48 [95%CI 1.24-1.72]). This association was stronger when we compared the third tertile of lumen area to the first tertile, indicating more outward remodeling. The RI of the right and left carotid artery in a study subject was strongly correlated (r=0.75, p<0.001), whereas intra-individual RI between carotid and coronary disease was weak (r=0.20, p<0.001). In multivariate analysis, hypercholesterolemia, height and CAC score were associated with the RI of the coronary arteries.

CONCLUSION
This study is the first to combine MRI and CT imaging to investigate positive remodeling in the carotid and coronary arteries of low-moderate risk individuals from the general population. Early atherosclerosis was associated with positive remodeling with larger diameter in the coronary and carotid arteries. Positive remodeling was not the same for different vascular beds.
Characterization of Restenosis after Carotid Endarterectomy Using Contrast-Enhanced Black Blood MRI

Sunday, Nov. 29 12:05PM - 12:15PM Location: N227

Participants
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PURPOSE
To characterize restenosis after carotid endarterectomy (CEA) using high-resolution contrast-enhanced black blood MRI (CEMRI) and compare with primary atherosclerotic lesions.

METHOD AND MATERIALS
17 consecutive patients (10 male; mean age 73.4±11.9 years) with carotid restenosis (13 unilateral; 4 bilateral) after CEA underwent CEMRI at 3T. The median interval between surgery and CEMRI was 16.5 months (IQR, 9.3-95.5 months). Patients were matched with 20 asymptomatic patients with primary carotid atherosclerosis (19 unilateral; 1 bilateral) by age and luminal stenosis. All MRI images were de-identified and interpreted by two readers who were blinded to the history of CEA. The presence of plaque and plaque components was recorded for each lesion based on previous criteria on CEMRI. The lesions were classified as plaques or intimal hyperplasia based on the presence/absence of plaque features on CEMRI. The MRI morphological measurements included wall thickness (WT), area, normalized wall index and eccentricity (maximum WT - minimum WT)/maximum WT), and the signal measurements included heterogeneity (defined by coefficient of variation of signal intensity) and contrast-enhancement (%CE, the percent change in signal intensity from the pre- to post-contrast images).

RESULTS
A total of 42 carotid lesions from 37 patients were analyzed, and classified as primary plaques (n=21), recurrent plaques (n=13) and intimal hyperplasia lesions (n=8). Compared with plaques (both primary and recurrent), lesions with intimal hyperplasia exhibited smaller eccentricity (0.48 vs. 0.74, p<0.001), lower signal heterogeneity (20.0% vs. 27.2%, p=0.004) and higher % CE (88.4% vs 43.9%, p=0.002). Recurrent plaques had similar MRI characteristics when compared with primary plaques. However, recurrent lesions demonstrated higher CE (57.5% vs 35.4%, p=0.046) and more frequently involved in the medial wall of the internal carotid artery, an uncommon location for a plaque formation (recurrent vs. primary; 38.5% vs 4.8%, p<0.001).

CONCLUSION
Carotid restenosis from intimal hyperplasia demonstrated distinct imaging characteristics on CEMRI compared with atherosclerotic lesions.

CLINICAL RELEVANCE/APPLICATION
The phenotype of the restenotic lesions after CEA imposes different stroke risks. CEMRI imaging allows for the differentiation of these lesions and may provide insight into the treatment of restenosis.
SSA18-01 Electrical Conductivity Characteristics of Glioma and Potential Usefulness of Noninvasive Electrical Conductivity Measurement in Evaluation of Glioma

PURPOSE
Direct electrical conductivity measurements to identify tumor location, before the era of CT and MRI, had documented difference in electrical conductivity values of tumors from normal brain parenchyma and among tumor types. Recent advances in MRI have allowed noninvasive measurement of electrical conductivity values. This study aimed to noninvasively determine the electrical conductivity characteristics of glioma and evaluate potential usefulness of noninvasive electrical conductivity measurement in glioma evaluation.

RESULTS
The contrast-enhanced tumor component of grade III gliomas had higher mean and mode of electrical conductivity histograms than the non-contrast-enhanced tumor component and normal-appearing brain parenchyma (P<0.017). The non-contrast-enhanced tumor component of grade II gliomas had higher mean electrical conductivity than the normal brain parenchyma (P=0.012). Mode of electrical conductivity histograms for both components of grade IV tumors were higher than grade III tumors (P<0.017).

CONCLUSION
The electrical conductivity characteristics of glioma were determined noninvasively by MRI. Electrical conductivity difference of gliomas from the normal brain parenchyma and between tumor grades suggests potential usefulness of noninvasive electrical conductivity measurements.

CLINICAL RELEVANCE/APPLICATION
Information about tissue electrical conductivity can be obtained noninvasively by MRI; and this information can be beneficial in distinguishing gliomas.

SSA18-02 Symptomatic Seizures in Primary Glioblastoma: A Radiogenomic Approach towards a Possible Prognostic Factor

PURPOSE
In patients with primary glioblastoma (pGB), tumor-induced seizures (TIS) are a common symptom and are possibly a positive prognostic factor for progression free and overall survival (PFS, OS). Explanations of the pathogenesis of TIS range from tumor location and pressure effects to neurochemical particularities based on the genetic profile of the tumor. This study evaluates if TIS in pGB can be correlated with imaging or genetic aspects of the lesion.

METHOD AND MATERIALS
Retrospective analysis of pre-operative 3 T MRI brain scans (Achieva TX; Philips Healthcare) of 64 pGB patients (29 with TIS; 35 without seizures). Analysis criteria: gender, age, PFS and OS, genetic profile (TERT mutation/rs2853669 polymorphism, MGMT promoter status), midline shift, subventricular pGB growth, bilaterality, multifocality as well as multiple volume ratios. Volumetry of contrast-enhancing (vital) tumor (CER), central necrosis (CN) and peri-focal FLAIR hyperintensities was based on 3D contrast-enhanced T1w, T2w and FLAIRw maps. MRI were analyzed with post-processing software (Philips Intellispace) by three readers.
independently. Statistic analyses were performed with SPSS 22.0 with TIS as the independent variable.

RESULTS

OS was significantly longer in pGB patients with TIS (p=0.004). There was a tendency for longer PFS in this group (p=0.08; mean 13.3 vs. 8.3 months). In pGB patients with TIS, total tumor volume was significantly smaller (p=0.017; 50.3 v. 29.4 cm³) and the tumor was significantly more often found in the subventricular zone, yet surprisingly not in the hippocampal area. TIS was not associated with any of the tested genetic markers known to be associated with longer OS and PS.

CONCLUSION

TIS in pGB patients could significantly be correlated with distinct imaging aspects of the tumor (size and location) as well as with longer OS and PFS. Commonly analyzed genetic markers for OS and PFS (MGMT, hTERT) were yet not associated with TIS.

CLINICAL RELEVANCE/APPLICATION

While TIS proved a prognostic factor for OS and PFS, this is not correlated with MGMT and hTERT status in pGB, but TIS does correlate with distinct imaging aspects on MRI. Whether TIS lead to earlier diagnoses of pGB and hence longer OS/PFS due to smaller tumor volume remains an intricate question to solve.

SSTA18-03 Investigation into the Effect of Diagnostic Ultrasound and Microbubble on the Blood-Brain Tumor Barrier Permeability of C6 Glioma

Sunday Nov. 29 11:05AM - 11:15AM Location: N229

Participants

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Weiguo Zhang, Chongqing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To explore the effect of microbubble-enhanced diagnostic ultrasound (MEUS) on the blood-brain tumor barrier permeability and the possible mechanism.

METHOD AND MATERIALS

C6 Glioma-bearing Sprague-Dawley rats were assigned to 3 separate groups; the microbubble-enhanced continued diagnostic ultrasound group (CMEUS), the microbubble-enhanced intermittent diagnostic ultrasound group (IMEUS) and the control group. Rats were sonicated through skull with low-frequency diagnostic ultrasound and injected with Evans Blue (EB) dye and microbubbles through their tail veins to test changes in capillary permeability. Confocal laser scanning microscopy was used to observe the deposition of red fluorescence-dyed EB in tumor tissues. HE staining and MRI SWI were used to evaluate whether MEUS can damage normal brain tissue. The distribution and expressing levels of JAM-1 and calcium-activated potassium channels (Kca channels) was detected by western blot and immunohistochemical.

RESULTS

In the MEUS groups, EB exudation exhibited a significant increase in the tumor tissue compared with the control group. While the IMEUS group had more EB exudation than the CMEUS group. LSCM showed that a bright red fluorescence of EB was extensively distributed in the tumor interstitium. Western blot and immunohistochemical revealed MEUS significantly increased Kca channel protein expression and reduced JAM-1 expression in glioma tissue. And these changes were more obvious in the IMEUS group than the CMEUS group.

CONCLUSION

MEUS could effectively increase blood-brain tumor barrier permeability without causing damage to normal nerve tissue. The mechanism might be up-regulation of Kca channels expression in glioma tissue and affecting the formation of tight junction in blood-brain tumor barrier by reduction of JAM-1 expression. These findings might provide some new guidance to find a therapeutic option to site-specific open the BTB and deliver anti-cancer agents to glioma.

CLINICAL RELEVANCE/APPLICATION

These findings might provide some new guidance to find a therapeutic option to site-specific open the BTB and deliver anti-cancer agents to glioma.

SSTA18-04 Improved Clinical DCE-MRI Pipeline for High Resolution, Whole Brain Imaging: Application to Brain Tumor Patients

Sunday Nov. 29 11:15AM - 11:25AM Location: N229

Participants

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PURPOSE

To develop novel DCE-MRI acquisition, reconstruction, and processing approaches that are targeted towards providing complete clinical assessment of brain tumors

METHOD AND MATERIALS

A prospective evaluation of a novel sparse sampling and constrained reconstruction scheme to enable whole brain DCE-MRI.
A clinical prospective evaluation of a novel sparse sampling and constrained reconstruction scheme to enable whole brain DCE-MRI imaging (22x22x20 cm³ coverage at spatial resolution of 0.9x0.9x1.9mm³) is demonstrated. Our approach uses multiple sparsity constraints in the spatial and temporal domain, which are spatial wavelet, spatial total variation and temporal finite difference, all with low weights, to mitigate potential bias from any one constraint. We compare with a current clinical scan (Rate 2 SENSE: 22x22x4.2cm³ at spatial resolution of 0.9x1.3x7mm³) on 15 brain tumor (BT) patients. PK parameters (Ktrans, vp) were derived, and image quality scores (4 point Likert scale) from two experienced neuroradiologists were used to evaluate the anatomic images and PK maps. We also propose two novel constraints that leverage knowledge from the PK model, to improve the above constraints, and obtain reduced dependence on free parameters; these are evaluated in a retrospective undersampling study of 10 BT patients.

RESULTS
We obtained higher image quality scores with our experimental scan compared to the clinical scan. The combined radiologists scores for each of the time-resolved, post-contrast, Ktrans images, respectively for the accelerated and clinical scans were 1.2± 0.6 v/s 2.2± 0.7 (p<0.001). Fig1 demonstrates two examples of improved volume coverage in imaging a patient with a 6cm glioblastoma multiforme tumor, and a patient with 14 metastatic lesions spread throughout the brain. In the retrospective study, the novel PK derived constraints achieved improved PK parameter map depiction at acceleration rates greater than 20; (not shown)

CONCLUSION
A novel high resolution whole brain DCE-MRI method using constrained reconstruction that is clinically feasible is demonstrated; which constituted a substantial 36 fold improvement in resolution and coverage compared to current clinical scans

CLINICAL RELEVANCE/APPLICATION
The combined use of modern sparse sampling, and constrained reconstruction techniques enables whole brain isotropic resolution DCE-MRI which greatly improves the clinical value of DCE-MRI in characterizing brain tumors (eg. guaranteed imaging of large tumors, multiple small lesions, assessment of anti-angiogenic therapies for brain tumors).

SSA18-05 Two-dimensional Localized Correlated Spectroscopy (2D L-COSY) at 7T for Detection of 2-hydroxyglutarate in Gliomas with IDH Mutations

Sunday, Nov. 29 11:25AM - 11:35AM Location: N229

Participants
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PURPOSE
Mutations in the isocitrate dehydrogenase (IDH) 1 and 2 genes in oligodendroglioma, astrocytoma and secondary glioblastoma are associated with better prognosis. Previous magnetic resonance spectroscopy (MRS) studies have suggested the oncometabolite 2-hydroxyglutarate (2HG) as a potential biomarker for these mutant gliomas. Two-dimensional localized correlated spectroscopy (2D L-COSY) has demonstrated unambiguous and reliable measurement of several brain metabolites, including 2HG. Spectroscopy at ultra-high fields affords proportionally higher signal quality and spectral separation resulting in improved sensitivity and specificity. In this study we demonstrate the utility of 2D L-COSY for detection of 2HG in human gliomas.

METHOD AND MATERIALS
Seven brain tumor patients with prior magnetic resonance imaging/spectroscopy (MRI/MRS) scans at 3T were studied using 2D L-COSY on a 7T whole-body scanner with a 32-channel transmit/receive head coil. Scan parameters were as follows: TE = 20 ms, TR = 2 s, 8 averages, 64 Δt1 increments of 0.4 ms, 2048 t2 points with F2 bandwidth = 4000 Hz and F1 bandwidth = 2500 Hz, scan time 17 min. Voxels were localized using T2-weighted fluid-attenuated inversion recovery (FLAIR) imaging and ranged from 11-15 ml. L-COSY data were reconstructed offline using a custom MATLAB-based post-processing algorithm and quantified through peak volume integration. IDH1/2 mutation status was subsequently determined with pathology.

RESULTS
2D L-COSY detected 2HG peaks in two of the seven patients. A third patient was prospectively declared inconclusive due to artifact ridging in the region where 2HG would be expected. Pathology results confirmed IDH1 mutation in these three patients and the absence of mutation in the remaining four. 2D L-COSY further demonstrated the unambiguous separation of other metabolites including choline-containing metabolites like phosphocholine (PC) and glycerophosphocholine (GPC) and separation of lactate (Lac) from background lipid signal.

CONCLUSION
This study using 2D L-COSY represents the unambiguous detection of 2HG in vivo at 7T, which could serve as an biomarker for malignant progression in brain tumors.

CLINICAL RELEVANCE/APPLICATION
Pre-surgical detection of 2HG could alter treatment strategies as both an early marker for malignant progression and as an endpoint for targeted therapy (AGIOS 121 drug) against IDH1 mutation.
SSA18-06  Amide Proton Transfer and Magnetization Transfer Imaging of Primary CNS Lymphomas and High-grade Gliomas: Differential Diagnostic Performance and Comparison with Nuclear-Cytoplasm Ratios

Sunday, Nov. 29 11:35AM - 11:45AM Location: N229

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Zhibo Wen, Guangzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To show the ability of using the novel amide proton transfer-weighted (APTW, sensitive to mobile proteins, such as those in the cytoplasm), as well as conventional magnetization transfer (MT, sensitive to semi-solid macromolecules) MRI signals as imaging biomarkers to differentiate primary CNS lymphomas (PCNSLs) from high grade gliomas (HGGs), and evaluate the correlations between APTW and MT imaging signals and nuclear-cytoplasm (N/C) ratios.

METHOD AND MATERIALS
Eleven patients with lymphomas and 21 patients with HGGs were studied. MT spectra over an offset range of ±6 ppm (eight acquisitions at ± 3.5 ppm to increase the signal-to-noise ratio) and the conventional MT ratio (MTR) at 15.6 ppm (2 kHz) were acquired. The multiple APTW signals and MTR signal were obtained and compared between PCNSLs and HGGs. The diagnostic performance was assessed with the receiver-operator-characteristic (ROC) analysis. Image analysis software (Image-Pro Plus) was applied to calculating N/C ratios on HandE sections.

RESULTS
The PCNSLs usually showed more homogeneous APTW hyperintensity (spatially compared to the normal brain tissue) than the HGGs. The maximum APTW signal (APTWmax) and APTW signal inhomogeneity (APTWmax-min = APTWmax - APTWmin) within a lesion were significantly lower (P < 0.05 and 0.001, resp.), while the MTR signal was significantly higher (P < 0.01) in PCNSLs lesions than in HGG lesions. APTWmax-min had the highest area under the ROC (0.963) and accuracy (94.1%) in differentiating PCNSLs from HGGs. There were significantly larger N/C ratios in PCNSLs (1.69 ± 0.72) than in HGGs (0.55 ± 0.21; P < 0.01), consistent with the APTW and MTR measurements. There was a strong, significantly negative correlation between APTWmax and N/C ratio (R = 0.576, P < 0.01), and there was a moderate positive correlation between MTR and N/C ratio (R = 0.326, P < 0.084).

CONCLUSION
The endogenous protein-based APTW signal would be a valuable MRI biomarker that can to provide an additional value to identify PCNSLs and HGGs presurgically.

CLINICAL RELEVANCE/APPLICATION
The addition of APT imaging to the currently used MRI protocol (including the conventional and advanced MRI sequences) would enhance the differential diagnostic accuracy of MRI between PCNSLs and HGGs ultimately.

SSA18-07  Computer Extracted Texture Descriptors from Different Tissue Compartments within the Tumor Habitat on Treatment-naïve MRI Predict Clinical Survival in Glioblastoma Patients

Sunday, Nov. 29 11:45AM - 11:55AM Location: N229

Participants
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Anant Madabhushi, MS, Piscataway, NJ (Abstract Co-Author) Research partner, Siemens AG Research partner, General Electric Company Research partner, F. Hoffmann-La Roche Ltd Founder and President, Ibris, Inc

PURPOSE
Glioblastoma Multiforme (GBM) is a highly aggressive and heterogeneous brain tumor. Currently all GBM patients are given "one-dose-fit-all" treatment. Identification of prognostic markers can allow for personalized therapy options for GBM. The underlying hypothesis of this study is that the heterogeneity in GBM (due to subtle variations in tumor enhancement, cellular density, fibrosis, necrosis that are not visually appreciable on volumetric analysis of MRI) is prognostic and can be captured using computerized texture descriptors extracted from within different tumor compartments (enhancing tumor, necrotic core, edema). These compartments together define tumor "habitat", and computerized texture features from within the habitat can be predictive of short-term (STS) (overall survival (OS) <6-months) from long-term survival (LTS) (OS>24-months).

METHOD AND MATERIALS
A total of 62 3 Tesla MRI studies (27 STS, 35 LTS) with Gd-T1C, FLAIR, and T2w protocols were obtained from the TCIA repository. Enhancing tumor, and necrotic regions on Gd-T1 and edematous region jointly on T2-w and FLAIR, were manually segmented by an expert using Slicer 3D. 135 2-D texture descriptors on a per-voxel basis (e.g. co-occurrence matrices, gray-level dependence matrices, Gabor), and volumetric measurements were extracted from each oftumor, necrosis, edema compartments on every MRI protocol. Feature selection was used to identify most discriminative features with a random forest classifier trained via 3-fold cross validation. Kaplan-Meier (KM) curves were used for survival analysis, with correction for multiple hypothesis testing to identify features that were significantly (p<0.05) correlated with survival.

RESULTS
Contributions from top 18 texture features within the tumor habitat, (from edema, necrotic core, enhanced tumor), when analyzed together, were most significantly associated with survival, across Gd-T1-C (p=0.003), FLAIR (p=0.006), and T2-w (p=0.02) as compared to individual features, and volumetric measurements from the tumor habitat.
**CONCLUSION**

Computerized texture features when jointly interrogated across compartments within the tumor habitat appear more prognostic of clinical survival in GBM than features from enhancing tumor and tumor volume alone.

**CLINICAL RELEVANCE/APPLICATION**

Identifying MRI differences in survival characteristics for patients with long term and short-term survival can allow for designing personalized therapeutic decisions for GBM.

**SSA18-08 Using Pre-Operative Dynamic Contrast-Enhanced MRI to Evaluate Tissue Factor Expression: A Potential Role in Prediction of Glioma Malignancy**

Sunday, Nov. 29 11:55AM - 12:05PM Location: N229

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**PURPOSE**

To correlate dynamic contrast-enhanced MRI (DCE-MRI) parameters with tissue factor (TF) expression for assessing glioma malignancy

**METHOD AND MATERIALS**

Thirty-two patients with histopathologically diagnosed supratentorial glioma received DCE-MRI. Extended Tofts linear model based parameters(Ktrans, Kep, Ve, Vp) were obtained, which were analyzed by hot-spot and whole tumor cross-sectional method, as well as histogram. Four serial paraffin sections were stained with TF, CD105, CD34 and α-SMA, respectively. Percentage area of TF was calculated at 200 × magnification. Microvascular parameters were calculated at 100 x magnification, including microvascular density (MVD), microvascular area (MVA), proliferating capillary index (PCI), and microvessel pericyte coverage index (MCI), Pearson correlation was performed between TF and multiple microvascular indexes, DCE-MRI parameters.

**RESULTS**

TF was associated with glioma grade and significantly correlated with proliferating capillary index (PCI), microvascular pericyte coverage index (MP) (r=0.798, p<.001; r=0.835, p<.001) and also showed moderate correlation with microvascular area (MVA) and microvessells density (MVD). volume transfer constant from plasma to tissue (Ktrans) hot-spot value best correlated with TF (r=0.886, p<.001), followed by 90th percentile Ktrans value (r=0.801, p<.001). Moreover, histogram analysis of Ktrans value demonstrated that weak TF expression was associated with less heterogeneous and positively skewed distribution.

**CONCLUSION**

Correlation of TF with microvascular indexes indicated that TF tightly linked with glioma malignancy. And Ktrans parameters provided reliable estimation of TF expression in glioma patients.

**CLINICAL RELEVANCE/APPLICATION**

DCE-MRI could pre-operatively evaluate tissue factor expression, thus it can be utilized for assessing glioma malignancy, particularly on neovascularization, like vascular endothelium proliferation and pericytes coverage

**SSA18-09 Chemical Shift Imaging (CSI) for Detection of 2-Hydroxyglutarate (2HG) in Human Gliomas at 3T**

Sunday, Nov. 29 12:05PM - 12:15PM Location: N229

Participants
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Suyash Mohan, MD, Philadelphia, PA (Abstract Co-Author) Consultant, ACR Image Metrix; Investigator, Rad Dx

**PURPOSE**

The "oncometabolite" 2-hydroxyglutarate (2HG) has been shown to be an ideal biomarker for detection of isocitrate dehydrogenase (IDH) mutated gliomas. The presence of IDH mutation may be an early genetic marker of malignant transformation in gliomas and non-invasive detection of 2HG may aid in better treatment planning of these tumors. Chemical Shift Imaging (CSI) at 3T has been proposed for detection of 2HG and this study was performed to prospectively detect 2HG in tumors suspected of gliomas on imaging.

**METHOD AND MATERIALS**

Five patients were studied on a 3T scanner with a 12-channel receive head coil. Scan parameters were: TE=97 ms, TR=1.7s, NEX=3 with weighted phase-encoding, 1024 complex points, bandwidth=2000 Hz, 16x16 matrix, scan time 7 min. Voxels were localized using FLAIR or contrast enhanced images and were each 1 x 1 x 3 cm³. CSI data were reconstructed offline and quantified using the LCModel prior-knowledge based fitting program. A Cramer-Rao lower bound (CRLB) of 40% was used along with the criteria that multiple neighboring voxels show presence of 2HG. IDH1/2 mutation status was subsequently determined on pathology.

**RESULTS**

2HG resonance was detected in three patients who were later found to be: low grade (WHO Grade II, n=2) and high grade (WHO Grade III, n=1). The remaining two patients did not show a 2HG peak and were found to be: WHO grade IV, n=1; metastases, n=1. Presence of mutant IDH mutation was subsequently confirmed on pathology in all three patients where 2HG was detected while the
remaining two patients were IDH mutation negative.

**CONCLUSION**

LCModel fitting of CSI data successfully detected 2HG, confirming previous studies. This study further confirms the role of 2HG as a marker for malignant transformation indicating that IDH positive low grade gliomas where 2HG is detected should be treated more aggressively and can be ideal candidates for IDH targeted therapies.

**CLINICAL RELEVANCE/APPLICATION**

In vivo 2HG detection has significant translational implications: Early biomarker of malignant progression, treatment response and recurrence Endpoint for therapy (AGIOS 121 drug) targeted against IDH1
**SSA19-01** Preclinical CT Angiography Imaging in a Large Animal Model Using a Whole-body Photon Counting CT Scanner Prototype  

*Sunday, Nov. 29 10:45AM - 10:55AM Location: S403B*

**Participants**
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Research support, General Electric Company; Research support, Koninklijke Philips NV; Consultant, Varian Medical Systems, Inc; Consultant, Nanox; Scientific Advisory Board, RefleXion Medical Inc; Scientific Advisory Board, Prismatic Sensors AB; Medical Advisory Board, OurCrowd, LP;  
Mats Danielsson, PhD, Stockholm, Sweden (*Moderator*)  
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Stockholder, Innovicum AB; President, Innovicum AB; Research Grant, Koninklijke Philips NV; Stockholder, Biovica International AB;  
Board Member, Biovica International AB;

**PURPOSE**
To investigate CT Angiographic (CTA) imaging capabilities of a whole-body prototype photon counting CT scanner in a large animal model, in comparison to 2nd generation dual-source dual energy CTA imaging.

**METHOD AND MATERIALS**
The prototype, whole-body photon counting CT (PCCT) scanner (Siemens Healthcare, Forchheim, Germany) is built on a Definition Flash dual-source platform, where the "A" detector/source sub-system uses a conventional energy-integrating detector (EID) and the "B" detector/source sub-system uses a photon-counting detector (PCD). Six pigs were imaged at clinically equivalent doses on the PCCT scanner (140 kV, 140 mAs, 15.51 mGy, 0.5 second rotation, 0.6 pitch, 32x0.5 collimation) and a commercial dual-source CT system (Definition Flash, Siemens Healthcare) (80/Sn140kV, 406/157 mAs, 15.4 CTDIvol, 0.5 second rotation, 0.5 pitch, 32x0.6 collimation). Energy spectrum thresholding on the PCCT scanner was set for 25 keV and 65 keV, resulting in two threshold (25-140 keV and 65-140keV) and two bin (25-65keV and 65-140keV) image datasets. CT angiograms of the head and neck, thorax, and abdomen/pelvis were obtained on both systems (100 ml Iohexol 350 Injection + 35 ml saline chaser). Images were reconstructed using the same clinical parameters (3.0 mm slices / 2.0 mm increment, D30f kernel) and qualitatively evaluated for general image quality and the presence of artifacts. Material decomposition was performed using an in-house developed material decomposition algorithm.

**RESULTS**
PCD images demonstrated decreased beam hardening relative to EID images and minimal ring, cupping or streaking artifacts. Qualitatively, CTA results were judged to be equivalent. Initial material decomposition results demonstrated good sensitivity to iodine and calcium separation.

**CONCLUSION**
The evaluated prototype whole-body PCD CT system was capable of producing clinical image quality CT angiographic exams with reduced artifacts and improved beam hardening.

**CLINICAL RELEVANCE/APPLICATION**
Whole-body CTA can be obtained with a whole-body photon counting CT scanner, using a single x-ray source while retaining the energy separation of a dual-source CT system with optimized filtration.

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**SSA19-02** Dose Efficiency of a Prototype, Whole-body, Photon-counting CT System versus a Conventional CT System for Imaging of Iodinated Contrast Media  

*Sunday, Nov. 29 10:55AM - 11:05AM Location: S403B*

**Participants**
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Nothing to Disclose

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Nothing to Disclose

Erik L. Ritman, MD, PhD, Rochester, MN (*Abstract Co-Author*)  
Nothing to Disclose

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Research Grant, Siemens AG

**PURPOSE**
To investigate the dose efficiency of a whole-body photon counting CT system versus a conventional CT system for imaging of iodinated contrast media.

**METHOD AND MATERIALS**
The prototype, whole-body photon counting CT (PCCT) scanner (Siemens Healthcare, Forchheim, Germany) was built on a Definition Flash dual-source platform, where the "A" detector/source sub-system uses a conventional energy-integrating detector (EID) and the "B" detector/source sub-system uses a photon-counting detector (PCD). The prototype scanner was compared to a commercial dual-source CT system (Definition Flash, Siemens Healthcare) in terms of dose efficiency and image quality. Image datasets were acquired using the same clinical parameters (3.0 mm slices / 2.0 mm increment, D30f kernel) and qualitatively evaluated for general image quality and the presence of artifacts. Material decomposition was performed using an in-house developed material decomposition algorithm.

**RESULTS**
PCD images demonstrated reduced dose requirements compared to EID images, with minimal ring, cupping or streaking artifacts. Qualitatively, CTA results were judged to be equivalent. Initial material decomposition results demonstrated good sensitivity to iodine and calcium separation.

**CONCLUSION**
The evaluated prototype whole-body PCD CT system was more dose-efficient than the conventional CT system, while maintaining clinical image quality and reduced artifacts.
The quantitative aspect of spectral imaging using the new imaging chain and improved contrast-to-noise at lower energies is

CLINICAL RELEVANCE/APPLICATION
improvement in CNR is achieved at lower energies without compromising on the density accuracy.

The phantom study demonstrates superior image on both material and monochromatic images with the new image chain. Significant reduction at 40 and 140 keV for the 33 cm GAMMEX is measured to be 59% and 63% relative to MD images with no noise reduction.

40 keV for both 20 and 33 cm GAMMEX. The density accuracy of Iodine is within 5% of the known density for all rods. The noise reconstruction using a slice thickness of 0.625 mm. The monochromatic images are generated from 40 - 140 keV. First noise in the

RESULTS
At 140 keV, the PCCT system provided increased CNR values (for a given dose) in the 10 year old (+10.7%), small adult (+13.2%), and large adult phantoms (+16.2%). An increase in CNR values (at a given dose) was also observed at 120 keV (10 year old: +10.7%, small adult: +12.9%, large adult: +18.7%) and at 100 kV (10 year old: +9.9%, small adult: +10.9%, large adult: +21.8%).

CONCLUSION
Relative to conventional CT, PCCT provided increased dose efficiency for iodine imaging for all presented phantom sizes. This is a result of the heavier weighting of the lower energy photons, apparent with PCCT technology.

CLINICAL RELEVANCE/APPLICATION
PCCT provides greater dose efficiency for iodine imaging relative to conventional energy integrating CT systems.

METHOD AND MATERIALS
Photon Counting CT (PCCT) imaging was performed on a whole-body prototype system (Siemens Healthcare, Forchheim, Germany), while conventional CT imaging was performed on a commercially available energy-integrating CT system (SOMATOM Definition Flash). The PCCT prototype system is built on a dual-source platform, where the “A” tube/detector uses a conventional energy integrating detector and the “B” tube/detector uses a photon-counting detector. Imaging was performed with similar geometries, identical beam filtration and equivalent tube and detector parameters. Three anthropomorphic phantoms (CIIRS, Inc., Norfolk, VA, USA), mimicking: a: 10 year old, small adult, and large adult were scanned. Each phantom contained Lucite vials of four different iodine concentrations: 5, 10, 15 and 20 mg/mL. Images were acquired on each system with four different tube voltages (80, 100, 120, 140 keV) and ten different tube currents (50, 100, 150, 200, 250, 300, 350, 400, 500, 550 mA). CT numbers and noise were measured in both tissue-equivalent and iodine regions of interest (ROIs) and averaged over 10 neighboring slices. The calculated CNR values were plotted against CTDIvol(32 cm) for each ROI, tube voltage and phantom size and fitted with a square root-function.

RESULTS
The image chain is evaluated on GAMMEX phantoms with different size and dose level. The CNR monotonically increases from 140 to 40 keV for both 20 and 33 cm GAMMEX. The density accuracy of Iodine is within 5% of the known density for all rods. The noise reduction at 40 and 140 keV for the 33 cm GAMMEX is measured to be 59% and 63% relative to MD images with no noise reduction. The noise reduction for the 20 cm GAMMEX at 40 and 140 keV is 58% and 61%.

CONCLUSION
The phantom study demonstrates superior image on both material and monochromatic images with the new image chain. Significant improvement in CNR is achieved at lower energies without compromising on the density accuracy.

CLINICAL RELEVANCE/APPLICATION
The quantitative aspect of spectral imaging using the new imaging chain and improved contrast-to-noise at lower energies is
RESULTS
measured across different monochromatic keV and MD volume images.

CM liquid iodine rods submerged. CT Hounsfield Unit (HU) and Material Density (MD) Mean, standard deviation, and uniformity were evaluated on simulations.

Phantoms used include: 20-cm and 33-cm dual-energy phantom with varying Iodine densities from 2.5mg/cc to 20mg/cc (Gammex, Inc., Middleton, WI), 20-cm water-filled phantom and custom-made 24.5-cm water-filled phantom with three segmented tissue contents. System evaluation was done by acquiring dual-energy scans across different dose levels at 40, 80, and 160-mm pitch helical CT scanning.

Advanced spectral modeling, projection-based material decomposition, and advanced noise modeling have also been developed for dual-energy CT. Collimator and advanced detector design help reduce X-ray scatter and electronic noise, respectively, in the dual-energy images.

Healthcare, Waukesha, WI). Generator improvements allow for 3x faster switching performance between low and high kV. The 3D spectral imaging evaluation was done on a 160-mm wide cone clinical CT system with Fast kVp switching (Revolution CT, GE Healthcare, Waukesha, WI).

METHOD AND MATERIALS
A common approach of DE-based three material decomposition can be visualized by a triangle in a DECT-diagram. The number of basis materials can be increased by using many triangles to tessellate the DECT-diagram into a mix of basis materials like air, blood, bone, contrast agent, fat, liver, etc. In contrast to other methods attempting such multi material decompositions we first segment and classify the anatomical structures shown in the DECT data set into the region types air, fatty tissue, soft tissue, (dense and) bone, enhanced tissue, bone, dense bone. Heuristics then choose the basis material triple (triangle vertices) that should be used for each region type among the set of the following basis materials: air, adipose tissue, liver tissue, contrast agent (CA), and calcium hydroxyapatite (CaHA). ROIs can be placed to quantify the contents. If an ROI contains no bone type region the decomposition into CaHA is omitted. In bone regions CA is not quantified. ROIs containing bone together with tissue the tissue evaluation is ambiguous—it may represent organs, connective tissue or bone marrow. Therefore CaHA and CA are quantified simultaneously. Our approach was tested on simulations and on patient data acquired with a dual source CT system.

RESULTS
Due to segmentation of a patient data set the CaHA content inside a rib is determined (c ~ 106 mg/mL) independently of the iodine content in neighboring fatty tissue of CA (c ~ 0.8 mg/mL). Segmented tissue is ambiguous—iodine c = 0.4 mg/mL and CaHA c = 17 mg/mL are evaluated. Representative adipose and liver tissue content are always assessed.

CONCLUSION
Our approach quantifies multiple materials according to the anatomical regions they belong to. No manual segmentation is required at improved accuracy to previous methods.

CLINICAL RELEVANCE/APPLICATION
The improved material quantification is important for diagnostics, e.g. to evaluate the vascularization of tumors or for CT-based bone mineral density analysis.

SSA19-04  Segmentation-Assisted Material Decomposition in Dual Energy Computed Tomography (DECT)

Sunday, Nov. 29 11:15AM - 11:25AM Location: S403B

Participants
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Marc Kachelriess, PhD, Heidelberg, Germany (Presenter) Nothing to Disclose

PURPOSE
Prior knowledge is required to decompose DECT data into more than two basis materials. Published methods show limitations regarding the assumptions made: The basis materials chosen often do not correspond to the anatomical structures (e.g. contrast agent represents bone, adipose tissue contains air, ...). Our purpose is to improve the prior knowledge to avoid misclassifications. In cases where ambiguities cannot be avoided we want to present them to the reader of the decomposed images.

METHOD AND MATERIALS
A common approach of DE-based three material decomposition can be visualized by a triangle in a DECT-diagram. The number of basis materials can be increased by using many triangles to tessellate the DECT-diagram into a mix of basis materials like air, blood, bone, contrast agent, fat, liver, etc. In contrast to other methods attempting such multi material decompositions we first segment and classify the anatomical structures shown in the DECT data set into the region types air, fatty tissue, soft tissue, (dense and) bone, enhanced tissue, bone, dense bone. Heuristics then choose the basis material triple (triangle vertices) that should be used for each region type among the set of the following basis materials: air, adipose tissue, liver tissue, contrast agent (CA), and calcium hydroxyapatite (CaHA). ROIs can be placed to quantify the contents. If an ROI contains no bone type region the decomposition into CaHA is omitted. In bone regions CA is not quantified. ROIs containing bone together with tissue the tissue evaluation is ambiguous—it may represent organs, connective tissue or bone marrow. Therefore CaHA and CA are quantified simultaneously. Our approach was tested on simulations and on patient data acquired with a dual source CT system.

RESULTS
Due to segmentation of a patient data set the CaHA content inside a rib is determined (c ~ 106 mg/mL) independently of the iodine content in neighboring fatty tissue of CA (c ~ 0.8 mg/mL). Segmented tissue is ambiguous—iodine c = 0.4 mg/mL and CaHA c = 17 mg/mL are evaluated. Representative adipose and liver tissue content are always assessed.

CONCLUSION
Our approach quantifies multiple materials according to the anatomical regions they belong to. No manual segmentation is required at improved accuracy to previous methods.

CLINICAL RELEVANCE/APPLICATION
The improved material quantification is important for diagnostics, e.g. to evaluate the vascularization of tumors or for CT-based bone mineral density analysis.

SSA19-05  Volumetric Fast kV Switching Development on Wider Cone Geometry System

Sunday, Nov. 29 11:25AM - 11:35AM Location: S403B

Participants
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Scott Slavic, Sussex, WI (Abstract Co-Author) Employee, General Electric Company

PURPOSE
The purpose of this work is to evaluate the clinical feasibility of using a wider cone beam geometry system for volumetric fast kV switching imaging. With a detector width of 160-mm and fast helical pitch capability, spectral (dual-energy) scanning of larger volume coverages can be acquired faster with reduced motion artifacts but no increase in overall dose.

METHOD AND MATERIALS
Spectral imaging evaluation was done on a 160-mm wide cone clinical CT system with Fast kVp switching (Revolution CT, GE Healthcare, Waukesha, WI). Generator improvements allow for 3x faster switching performance between low and high kV. The 3D collimator and advanced detector design help reduce X-ray scatter and electronic noise, respectively, in the dual-energy images. Advanced spectral modeling, projection-based material decomposition, and advanced noise modeling have also been developed for spectral imaging. System evaluation was done by acquiring dual-energy scans across different dose levels at 40, 80, and 160-mm pitch helical CT scanning.

Phantoms used include: 20-cm and 33-cm dual-energy phantom with varying Iodine densities from 2.5mg/cc to 20mg/cc (Gammex, Inc., Middleton, WI), 20-cm water-filled phantom and custom-made 24.5-cm water-filled phantom with three segmented tissue contents. Phantoms used include: 20-cm and 33-cm dual-energy phantom with varying Iodine densities from 2.5mg/cc to 20mg/cc (Gammex, Inc., Middleton, WI), 20-cm water-filled phantom and custom-made 24.5-cm water-filled phantom with three 5-cm liquid iodine rods submerged. CT Hounsfield Unit (HU) and Material Density (MD) Mean, standard deviation, and uniformity were measured across different monochromatic keV and MD volume images.

RESULTS
160-mm scans were acquired using 80/140 protocols as low as 3mGy. The 3x faster switching performance between kVps increased energy separation by 20%. With hardware improvements, measured CT HU and MD values for different Iodine concentrations in the monochromatic keV and MD images were within 2% across all dose levels. MD values in the Iodine and Water material images were accurate within 6% and 2%, respectively. Due to modeling of the Heel Effect in the Advanced Spectral algorithm, increased uniformity was observed at wider scan coverages.

CONCLUSION
With advanced hardware and image processing improvements, system and phantom evaluation has shown that dual-energy imaging can be achieved on a wide coverage CT system using fast kV switching technology.

CLINICAL RELEVANCE/APPLICATION
Benefits of spectral imaging (i.e. reduced beam hardening artifacts, improved CNR over single kVp, material information) can be achieved for wider coverage scanning with minimal impact to overall image quality and dose.

SQA9-06 Reliability of the Iodine Signal in Dual-energy CT on Two Scanner Types: A Phantom Study Featuring Beam Hardening
Sunday, Nov. 29 11:35AM - 11:45AM Location: S403B

Participants
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Johan De Mey, Jette, Belgium (Abstract Co-Author) Nothing to Disclose
Nico Buls, Dsc, PhD, Jette, Belgium (Abstract Co-Author) Nothing to Disclose

PURPOSE
A dual-energy (DE) phantom study was performed on two scanner types in order to evaluate (1) the stability and accuracy of CT numbers and iodine concentrations in function of object size; (2) the effect of beam hardening.

METHOD AND MATERIALS
Iodine concentrations of 3 and 6 mgI/ml were poured into two respective rows of cylindrical cavities with diameters ranging from 3 to 25.5 mm in an AAPM CT performance phantom. Besides this, a 16 mm diameter tube filled with 6 mgI/ml was placed in the main water-filled compartment, partly covered by a Teflon beam hardening ring. The phantom was scanned in standard 120 kVp and DE mode on a GE Healthcare Discovery HD750 and Siemens SOMATOM Definition Flash scanner at 3 CTDIvol's (9, 19 and 29 mGy).

RESULTS
(1) Relatively constant (max VAR 14%) HU values for both scanners as a function of the object diameters were observed. The Siemens scanner showed a consistent overestimate of approximately 0.5 mg/ml for both contrast concentrations. A significant decrease in concentration accuracy for object diameters smaller than 6 mm was present for both scanners. (2) A step-like increase of 10 HU upon transitioning out of the Teflon part was observed for both scanners at single energy 120 kV and the Siemens blended DE image, less for the GE DE image (AV 148 HU, max VAR 5 HU).

CONCLUSION
(1) Measured and true iodine concentrations were consistent down to 6 mm object size, notwithstanding an observed offset with one scanner type. (2) A step-like increase in HU highlights the effect of beam hardening, and is more prominent for classical scans compared to DE.

CLINICAL RELEVANCE/APPLICATION
DE CT techniques are being increasingly used in tumor imaging. Since iodine is a contrast agent commonly used in CT imaging, determining its detectable lower limit is a crucial factor. Iodine concentration estimations should be made with appropriate consideration.

SQA9-07 Comparison of the Accuracy of Iodine Quantification with a Novel Split Filter Single-source Dual-energy CT Technique and a Second Generation Dual-source Dual-energy CT
Sunday, Nov. 29 11:45AM - 11:55AM Location: S403B

Participants
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Sebastian T. Schindera, MD, Basel, Switzerland (Abstract Co-Author) Research Grant, Siemens AG; Research Grant, Ulrich GmbH & Co KG; Research Grant, Bayer AG

PURPOSE
To evaluate the accuracy of iodine quantification with a novel dual-energy technique on a single-source CT scanner using a split filter (TwinBeam Dual-Energy, Siemens) compared with dual-source dual-energy and single-source dual-spiral mode in a phantom.

RESULTS
The error of measurement for the iodine quantification ranged for the simulated intermediate-sized patient from 0.1 - 2.5 mgI/ml for
protocol A, from 0 to 6.9 mg/ml for protocol B and from 0.1 - 2 mg/ml for protocol C. For the simulated large patient, the error ranged from 0.6 - 7.1 mg/ml for protocol A, from 0.2 - 7.4 mg/ml for protocol B and from 0.3 - 3.3 mg/ml for protocol C.

CONCLUSION
The novel single-source dual-energy CT technique with a split filter offers comparable accuracy for iodine quantification to a second generation dual-source CT scanner in a simulated intermediate-sized patient. However in simulated large patients, greater measurement errors have to be expected with the single-source dual-energy technique.

CLINICAL RELEVANCE/APPLICATION
Accurate iodine quantification with the novel split filter dual-energy CT technique offers the possibility to eliminate additional CT examinations or phases (e.g. assessment of iodine uptake of a renal lesion).

SSA19-09 Evaluation of Three-Stage Metal Artifact Reduction Software for 256-slice Fast-kV Switching Spectral CT System and a Living Swine Model
Sunday, Nov. 29 11:55AM - 12:05PM Location: S403B

Participants
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PURPOSE
The purpose of this work is to evaluate the image quality of a prototype metal artifact reduction (MAR) algorithm for severe metal cases on a prototype fast-kV switching spectral CT scanner with wide-cone capability (Revolution CT, GE Healthcare, Waukesha, WI).

METHOD AND MATERIALS
A three-stage projection based metal artifact reduction algorithm (SmartMAR, GE Healthcare) originally designed for single energy
A three-stage projection-based metal artifact reduction algorithm (SmartMAR, GE Healthcare) originally designed for single energy CT is extended to spectral CT. The algorithm is developed to further improve the quantitative aspect of spectral imaging in the presence of dense metal objects such as hip implants, dental fillings. Two phantoms with metal inserts of various sizes were constructed: (1.) Titanium and Stainless Steel rods in water cylinders (Fig. A), (2.) torso phantom fitted with metal implants at extremities (Fig. C, D). The phantoms were scanned on a prototype fast-kV switching spectral CT scanner under the following protocol (80/140 kVp, 400 to 500 mAs). Scan-data was reconstructed without (baseline-recon) and with the new MAR algorithm. Three ROIs were placed at different locations in the phantoms as shown in Figs. A, D (two in area of high metal streak, and one away from metal). Noise performance was quantified for the two phantoms by calculating the average standard deviation $s_1$, $s_2$, and $s_3$ in selected ROI-s across all the slices affected by metal.

RESULTS

Images reconstructed with MAR (Figs. B, E) showed reduced beam hardening and streaks compared to baseline-recons (Figs. A, C, D). In area of metal streaks, the noise performance was improved for MAR recon ($s_1 : 15.25$, $s_2 : 25.28$) compared to baseline recon ($s_1 : 42.05$, $s_2 : 97.99$), i.e. a reduction of 63%, and 74% respectively). In areas away from metal, the standard deviation $s_3$ was reduced from 29.84 (baseline) to 17.54 (MAR), i.e. an improvement of 41%.

CONCLUSION

For severe metal cases, a prototype three-stage MAR algorithm for projection-based spectral CT showed improvements over baseline-recon in terms of image quality and noise performance.

CLINICAL RELEVANCE/APPLICATION

Projection based spectral CT allows native reduction of beam hardening artifacts arising from metallic objects; MAR processing further improves the quantitation by reducing residual artifacts caused due to factors such as photon starvation and partial volume.
Realistic Simulation of X-ray Phase-contrast Imaging at a Human Scale

PURPOSE

X-ray phase-contrast imaging (XPCI) can dramatically improve soft tissue contrast in medical imaging. Despite worldwide efforts to develop novel XPCI systems, a numerical framework to rigorously predict the performance of a clinical XPCI system at a human scale is not yet available.

METHOD AND MATERIALS

We have developed a novel method of propagating the X-rays through a human-scale 3-D object [1]. Specifically, we have adopted the wave equation simplified with the first-order Rytov approximation, which allows us to quickly and accurately generate simulated amplitude and phase images that an XPCI detector would see. For our numerical phantom, we have adopted the XCAT model as defined with non-uniform rational B-splines (NURBS) [2]. Existing methods using the XCAT rely on ray tracing or Monte-Carlo simulation, which produce inaccurate XPCI simulations. Using our wave-based approach, we can accurately simulate the phase-contrast signal from the NURBS phantom.

RESULTS

Using the developed method, we have generated a projection image of a human chest for the grating-based method, the most popular XPCI method (Figure 1b). Compared to the attenuation image (Figure 1a), there is higher contrast between soft-tissue structures on the phase-contrast image. For example, all the structures obscured by the diaphragmatic silhouette are much better appreciated in the phase image. Similarly, the intra-vertebral disks are seen with greater clarity in phase-contrast than in attenuation. The phase-contrast image also demonstrates the bronchial tree (including the primary, secondary, and tertiary branches) better than the attenuation image.

CONCLUSION

Combining the NURBS-based XCAT phantom and our wave propagation simulator, we could simulate various XPCI methods at a full adult human scale, for the first time with the best of our knowledge.

CLINICAL RELEVANCE/APPLICATION

There is currently no XPCI system that can image a human torso. Our numerical tool can be used to predict and compare the performance of new XPCI systems on various disease entities in a clinical scenario.

Comparison of Detection Performance between 2D Digital Mammography and Breast Tomosynthesis Using a Structured Physical Phantom

PURPOSE

To propose and apply a phantom for performance comparison between digital mammography (DM) and breast tomosynthesis (BT).

METHOD AND MATERIALS

The phantom consists of a 48 mm thick breast-shaped acrylic container, filled with water and acrylic spheres of different diameters. Three-dimensionally printed spiculated (diameter range: 3.8-9.7 mm) and non-spiculated (1.6-6.2 mm) masses as well as
Intra-operative vessels visualization is highly desirable in neurosurgery, especially when the target is related or close to main vessels. A 96-channel transducer array (P4-1) providing 3 cm coverage was incorporated into a benchtop thermoacoustic imaging system for imaging fresh surgical specimens. Thermoacoustic signal was generated by 700 ns irradiation pulses with 11 kV/m electric field strength. Data was acquired simultaneously in step-and-shoot mode by the array and a 2.25 MHz focused single-element transducer. In-plane resolution and contrast were measured by imaging an 80-micron wire and a homogeneous cylindrical phantom. Several fresh human prostates were imaged immediately after surgery. Two sets of sinograms were acquired, separated by a 2 cm translation along the tomographic axis. The P4-1 data was reconstructed over a 6 x 6 x 5 cm³ volume. Rudimentary 3D CNR in the single element and P4-1 images of the cylindrical phantom were greater than 5 and less than 1/5, respectively. A weighted average of the two images provides better image quality than either individually. Volumetric reconstruction of the multi-channel P4-1 data visualizes anatomic features that are rarely seen in ultrasound, CT, or MRI.

CONCLUSION
The phantom was able to show detectability differences between DM and BT for four commercial systems. These results are comparable to published clinical findings: BT performed better for the detection of masses, while both modalities were equivalent for the detection of microcalcifications.

CLINICAL RELEVANCE/APPLICATION
The proposed phantom enables the detection performance evaluation of BT against DM during acceptance testing, routine quality control or image quality benchmarking of BT systems.

SSA20-04 VHF-Induced Thermoacoustic Imaging Using a Clinical Ultrasound Transducer Array

Participants
Sarah K. Patch, PhD, Milwaukee, WI (Presenter) Nothing to Disclose
William See, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose

PURPOSE
To demonstrate that a clinical ultrasound transducer array can detect VHF-induced thermoacoustic pulses with sufficient bandwidth for quantitative whole organ imaging. This is an important step because thermoacoustic signal strength is directly proportional to SAR, which is lower in the VHF regime than in microwave or optical regimes.

METHOD AND MATERIALS
A 96-channel transducer array (P4-1) providing 3 cm coverage was incorporated into a benchtop thermoacoustic imaging system for imaging fresh surgical specimens. Thermoacoustic signal was generated by 700 ns irradiation pulses with 11 kV/m electric field strength. Data was acquired simultaneously in step-and-shoot mode by the array and a 2.25 MHz focused single-element transducer. In-plane resolution and contrast were measured by imaging an 80-micron wire and a homogeneous cylindrical phantom. Several fresh human prostates were imaged immediately after surgery. Two sets of sinograms were acquired, separated by a 2 cm translation along the tomographic axis. The P4-1 data was reconstructed over a 6 x 6 x 5 cm³ volume. Rudimentary comparison to histology was performed.

RESULTS
As expected, the larger single element transducer was more sensitive and required 8-fold less signal averaging than the P4-1 array. Although nominal bandwidths of the P4-1 array and 2.25 MHz transducer are comparable, the single element transducer was more sensitive to low frequencies and provided better contrast, whereas the higher frequency P4-1 array provided better resolution. Full width at half maximum in the P4-1 and single element images of the 80-micron wire at isocenter were smaller and greater than 1 mm, respectively. CNR in the single element and P4-1 images of the cylindrical phantom were greater than 5 and less than 1/5, respectively. A weighted average of the two images provides better image quality than either individually. Volumetric reconstruction of the multi-channel P4-1 data visualizes anatomic features that are rarely seen in ultrasound, CT, or MRI.

CONCLUSION
VHF-induced thermoacoustic pulses can be detected by clinical ultrasound arrays. Quantitative imaging can be achieved using transducers and electronics with sensitivity to kHz frequencies.

CLINICAL RELEVANCE/APPLICATION
VHF-induced thermoacoustics requires propagating powerful EM pulses, similar to B1 excitation pulses used in MRI, but without the need for a costly superconducting magnet.

SSA20-05 Intra-Operative Cerebral Angio-Sonography with Ultrasound Contrast Agents

Participants
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Luigi Sobbati, MD, Busto Arsizio, Italy (Abstract Co-Author) Nothing to Disclose
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Background
Intra-operative vessels visualization is highly desirable in neurosurgery, especially when the target is related or close to main vessels.
vessels, such as in skull base and vascular surgery. Contrast enhanced ultrasound (CEUS) is an imaging technique that allows visualization of tissue perfusion and vascularization, through the infusion of purely intravascular ultrasound contrast agents (UCA).

**Evaluation**

After cerebral scanning with B-mode ultrasound (US) CEUS is performed: UCA are injected and insonated with low mechanical index US. UCA specific harmonic signal is transduced using contrast specific algorithm, to obtain real-time angio-sonography (ASG).

**Discussion**

UCA depicts flow entity and direction in the target vessels, through the visual qualitative detection of movement, velocity and number of MB. Through the UCA dynamics it is possible to study all the vascular districts simultaneously, both arterial and venous, without the necessity to set gain or pulse repetition frequency as in Doppler imaging that however permits to quantify the flow; 3 phases of enhancement are notable: arterial, parenchymal and venous. ASG, being an echotomographic examination, provides a representation of the vessels within the surgical fields, not only on the surface, as showed by microscopic fluorescence, but also of those deeply seated and still embedded within the surgical field, allowing to visualize them in depth and follow their entire course simply tilting the probe.

**Conclusion**

Real time intra-operative ASG is a rapid, reliable, repeatable method for vessels visualization and evaluation of tissue perfusion.

**SSA20-06 A New AEC Set-up Achieves Constant Lesion Detectability for Different Breast Thicknesses in Digital Mammography**

**Sunday, Nov. 29 11:35AM - 11:45AM Location: S404AB**

**Participants**

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**METHOD AND MATERIALS**

520 screening mammograms, acquired under standard AEC mode, were selected and divided into 4 thickness groups (T-groups), T1≤29mm, T2=30-49mm, T3=50-69mm, T4=70mm. Each group contained 130 cranio-caudal lesion-free images. BI-RADS density scores and Volpara density maps were available for each image. Simulated lesions of microcalcification clusters and masses were inserted into half of the images. A specific lesion template was inserted into one image of each T-group having the same BI-RADS score and local Volpara value in order to separate the influence of thickness from the background. A new AEC set-up, designed to give constant theoretical object detectability as a function of thickness rather than constant detector pixel value. Modified AEC was then implemented for breast thicknesses above 30 mm resulting in an average dose increase of 60%. New patient data were collected and lesion insertion was repeated for the new dataset. Four radiologists performed a free search study on both datasets. JAFROC analysis was then applied. The alternative free-response receiver operating characteristic (AFROC) areas were calculated for each T-group.

**RESULTS**

For standard AEC mode: AFROC area decreases from 0.802 to 0.553 with increasing thickness for groups T1 to T3 while the area for T4 (0.565) was found almost equal to T3 (0.553). All p-values were smaller than 0.05 except for the T3-T4 pair. Detection differences between T3 and T4 were not significantly different, while the decreasing trend from T1 to T3 is significant. For the modified AEC mode: the AFROC area for T1 was equal to 0.802, while for T2, T3 and T4 it was equal to respectively 0.650, 0.652 and 0.652. No significant differences were found for these T-groups (p-values>0.05) while T1 remained significantly different from all others T-groups.

**CONCLUSION**

A significant decrease in lesion detection for increasing breast thickness is seen when the standard AEC mode is used. The modified AEC mode instead provided constant lesion detection for breast thicknesses above 30 mm.

**CLINICAL RELEVANCE/APPLICATION**

This study quantifies the influence of breast thickness on lesion detectability and proposes a new AEC set-up with improved detectability for digital mammographic systems.

**SSA20-07 X-ray Attenuation of Normal and Cancerous Breast Tissue Measured with Photon-counting Spectral Imaging**

**Sunday, Nov. 29 11:45AM - 11:55AM Location: S404AB**

**Participants**

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Koen Michielsen, Msc, Leuven, Belgium
Spectral imaging is emerging as a promising method to extract quantitative information from x-ray images, applied in mammography to improve lesion visibility, discriminate between lesion types, and measure breast density. Common for the development of these applications is that prior knowledge of tissue x-ray attenuation is required, but the sources of such information are sparse. Moreover, attenuation is often measured on formalin-fixed tissue specimens, but the effect of such fixation on the obtained attenuation values is largely unknown. The purpose of this study is to measure the attenuation of fresh and fixed samples of normal and cancerous breast tissue.

**METHOD AND MATERIALS**

7 samples of adipose breast tissue, 3 samples of glandular tissue and 8 samples of tumor tissue in the thickness range 3-12mm were imaged on a photon-counting spectral mammography system before and after formalin fixation. The energy dependent x-ray attenuation was measured in terms of equivalent thicknesses of aluminum (Al) and poly-methyl methacrylate (PMMA) for 10mm of tissue.

**RESULTS**

Figure 1 shows the equivalent Al and PMMA thicknesses (mean ± 1 standard deviation of individual samples): -0.110± 0.022mm Al, 8.60± 0.13mm PMMA for fresh adipose tissue, 0.268± 0.040mm Al, 8.44± 0.26mm PMMA for glandular tissue, 0.312± 0.024mm Al, 8.55± 0.17mm PMMA for tumor tissue. The difference between fixed and fresh tissue were -0.007mm Al, 0.01mm PMMA for adipose tissue, -0.041mm Al, 0.22mm PMMA for glandular tissue, and -0.039mm Al, 0.07mm PMMA for tumor tissue.

**CONCLUSION**

There was a measurable difference in attenuation between fresh and fixed tissue that was consistent for all investigated tissue types. There was a relatively large difference between glandular and tumor tissue, but the number of samples is still too limited to show significance. The equivalent PMMA thicknesses were slightly higher than values derived from published data (Hammerstein 1979, Johns and Yaffe 1987), but the Al thicknesses agreed well values derived from Johns and Yaffe.

**CLINICAL RELEVANCE/APPLICATION**

Accurate data on tissue attenuation is crucial for the development and implementation of spectral imaging techniques, which can potentially improve sensitivity and specificity of mammography.

**S2A20-08 Dedicated High-Resolution Breast CT Allows Imaging Micro-Calcifications down to 130 µm at Screening Mammography Dose Levels**

**Participants**

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**PURPOSE**

Computed tomography of the breast (BCT) has been a topic of interest for about two decades. It was proposed and evaluated in different designs by a number of groups as a potential alternative method for breast imaging. So far efforts have shown success with respect to soft tissue imaging but suffer from limited spatial resolution. We designed and evaluated a BCT scanner aiming for three-dimensional (3D) spatial resolution of better than 100 µm to provide means for improved assessment of 3D micro-calcification clusters.

**METHOD AND MATERIALS**

The concept of the scanner is built on fast spiral CT using directly converting cadmium telluride detector technology with 100 µm pixel pitch; it was evaluated and confirmed previously by simulations. Here we assessed spatial resolution on a prototype setup by measuring the modulation transfer function (MTF) using a 10 µm diameter tungsten wire. High precision Ruby beads immersed in a plastic breast-mimicking setup and 10 surgically resected breast specimens were measured in direct comparison to full field digital mammography (FFDM). The same 60 kV scan protocol was used for all BCT measurements; standard clinical settings were used for FFDM imaging. Micro-CT at 30 µm resolution was employed as reference standard for judging the specimen results.

**RESULTS**

BCT exposures were kept at a level corresponding to below 6 mGy average glandular dose related to exposure of a tissue-equivalent cylinder of 14 cm diameter. Spatial resolution characterized by the MTF’s 10% value was measured as 64 lp/cm. Ruby beads were clearly visible in BCT exams down to 130 µm, the smallest size available; FFDM revealed beads down to 160 µm. Specimen examinations confirmed these results qualitatively. For specimens, BCT showed micro-calcifications down to 100 µm; it was vastly superior in separating structures in different layers by virtue of its slice imaging nature.

**CONCLUSION**

High-resolution BCT allows improving the assessment of 3D micro-calcification clusters and avoids erroneous superimposition effects, which may pretend fictitious lesions in projection imaging.

**CLINICAL RELEVANCE/APPLICATION**

Breast CT offering high resolution in all three dimensions shall enable improved analysis and diagnostics of micro-calcifications.

**S2A20-09 Performance Evaluation of Microcalcification Detection in a Multi-contrast Breast X-ray Imaging System**
PURPOSE

The breast anatomical background noise power spectrum (NPS) and quantum NPS jointly impact the final detection performance of an x-ray breast imaging system. For a grating-based multi-contrast breast imaging system, it has recently been discovered that differential phase contrast (DPC) and dark-field (DF) contrast images have fundamentally different anatomical background NPS and quantum NPS. These dramatic differences should result in fundamentally different imaging performance, particularly in the context of microcalcification detection. The purpose of this study was to evaluate the diagnostic performance of the three-contrast mechanisms for the breast microcalcification detection task.

METHOD AND MATERIALS

To evaluate imaging performance, a quantitative model observer performance analysis framework was used in this study. To model the microcalcification detection task for each contrast mechanism, a microcalcification signal was segmented from absorption, DPC, and DF images of a cadaver breast specimen. Two-component (quantum + anatomical) NPS were directly measured from multi-contrast images of cadaver breasts. A generalized model observer was used to combine the task functions and NPS to quantify the microcalcification detectability indices for a range of radiation exposure levels (5-100%) and calcification sizes (diameter = 0.25-2.5 mm).

RESULTS

For the 1 mm calcification, the highest diagnostic performance corresponded to DPC imaging (7.4), with DF the next highest (3.8), and absorption the lowest (3.2). However, absorption imaging also showed the most relaxed dependence on radiation exposure level among the three modalities due to the larger portion of low frequency content in its anatomical noise. Among the calcifications with different sizes, DPC showed a peak in detectability at 1.25 mm and DF showed a peak at 0.75 mm, while absorption imaging had no such peak in the range explored.

CONCLUSION

The microcalcification detection performance in multi-contrast breast imaging is strongly influenced by both anatomical noise and radiation dose level. The results presented here offer new insight into how each individual modality can be optimized to maximize the likelihood of detecting early breast cancers.

CLINICAL RELEVANCE/APPLICATION

Understanding how additional information from DPC and DF imaging may aid in breast cancer is a crucial step in designing next generation multi-contrast breast imaging systems.
**SSA21**

**Physics (Image Processing/Analysis I)**

Sunday, Nov. 29 10:45AM - 12:15PM Location: S405AB

**Participants**

Kenneth R. Hoffmann, PhD, Buffalo, NY (Moderator) Vice President, Imagination Software Corporation; Stockholder, Imagination Software Corporation; Officer, Imagination Software Corporation; Robert M. Nishikawa, PhD, Pittsburgh, PA (Moderator) Royalties, Hologic, Inc;

**Sub-Events**

**SSA21-01  Mapping the Brain by a New Multiparametric Quantitative MRI Method**

Sunday, Nov. 29 10:45AM - 10:55AM Location: S405AB

**Background**

Multi-parametric quantitative MRI (qMRI) has long been an active field of research, with several approaches aiming to estimate a subset of $R_1$, $R_2$, $R_2^*$, proton density (PD) and magnetic susceptibility (QSM) maps of the tissues. We used a set of Steady-State sequences, acquired with variable flip angles (FAs) and different phase coherence, to derive, in a fully analytical way, quantitative volumetric $R_1$, $R_2$, $R_2^*$, PD and QSM maps.

**Evaluation**

Two dual-echo fully flow-compensated (FC) FLASH and one phase-cycled balanced Steady-State Free-Precession (bSSFP) sequences were acquired at different FAs with very low sensitivity to blood or Cerebrospinal Fluid (CSF) flow. The full brain of each volunteer was scanned in a total acquisition time of 14 minutes with a voxel size of 0.6 mm$^3$. The datasets were processed to remove banding artifacts and used to invert voxelwise the relaxometry equations in the FOV.

**Discussion**

Unlike most existing approaches, the maps obtained by our method entirely rely on widely available 3D sequences, thus overcoming usual 2D resolution constraints, and are not affected by intra-voxel biases arising from imperfect 2D radio frequency-pulse profiles, which in turn cause different isochromat evolutions in response to different effective FAs. Moreover, unlike other 3D schemes based on unbalanced SSFP, our method does not suffer from high sensitivity to flow of relatively long $T_2$ fluids (as CSF), thus being apt to image other body districts. Also, several issues of the DESPO methods are solved. In particular, the $B_1^\pm$ inhomogeneity dependence can be either removed by providing a measured $B_1$ field map, if an ad hoc protocol is available on the scanner, or largely compensated for by the proposed information theory approach. Furthermore, a judicious use of the Bloch equations for the acquired MR signals proved useful to skip the acquisition of the high-FA bSSFPs required by DESPOT2, thus limiting the acquisition time and avoiding at once SAR issues and CSF pulsation artifacts.

**Conclusion**

Our method allows for the quantitation of 5 independent parameters and gets rid of the sensitivity to $B_0$ inhomogeneity by means of a fully analytical solution, thus also speeding up the computation step.

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**SSA21-02  Hybrid Exact Maximum Likelihood Estimation (HE-ML) Algorithm for Accurate qMRI Over the Full T2 Biological Spectrum with Only Two Echoes**

Sunday, Nov. 29 10:55AM - 11:05AM Location: S405AB

**Participants**

Hernan Jara, PhD, Belmont, MA (Presenter) Patent holder, qMRI algorithms Research Grant, General Electric Company Royalties, World Scientific Publishing Co

Stephan W. Anderson, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Osamu Sakai, MD, PhD, Boston, MA (Abstract Co-Author) Speaker, Bracco Group; Speaker, Eisai Co, Ltd; Consultant, Guerbet SA

**Background**

To develop a T2 qMRI mapping algorithm for the DE-TSE pulse sequence that is accurate over the full T2 biological range. To create a T2 mapping program that combines the exact dual echo T2 formula and the methods of maximum likelihood (ML) estimation for estimating long T2 values. The dual echo turbo spin echo (DE-TSE) pulse sequence is consistently being adopted for routine clinical use and for research protocols: it is fast, efficient, highly resilient to susceptibility artifacts, and diffusion insensitive. It also has qMRI applications for mapping T2 and the proton density (PD). The main limitation in terms of qMRI is that only two echoes are
available for T2 mapping, thus limiting the accuracy range of T2 estimation. The purpose of this work was to develop a T2 qMRI mapping algorithm for the DE-TSE pulse sequence that is accurate over the full T2 biological range, from soft tissues to pure cerebrospinal fluid (CSF). Specifically, to create a T2 mapping program that combines the exact dual echo T2 formula as well as the methods of maximum likelihood (ML) estimation for estimating long T2 values. ML estimators are optimal in the sense that the variance of the estimates reaches asymptotically the greatest lower bound of the variance.

Evaluation

HE-MLE algorithm was programed in Mathcad using the formulation of Bonny et al. (MRM 1996; 36(2):287-293.) and used to process the images of a phantom and the head images of a volunteer. The T2 values were compared to those obtained with a single slice multi spin echo (mSE) sequence. The phantom T2 obtained with both techniques are graphed in Fig. 1a: linear correlation analysis reveals strong linear relationship ($R^2=0.9988$) with a slope of 0.975.

Discussion

DE-TSE is available from all major MRI manufacturers and efficiently produces excellent PD- and T2-weighted images with high anatomic coverage in less than four minutes.

Conclusion

The developed hybrid exact maximum likelihood T2 qMRI algorithm produces accurate measurements over the full T2 biological spectrum and could extend the usefulness of the DE-TSE pulse sequence in clinical and research applications.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Hernan Jara, PhD - 2014 Honored Educator
Osamu Sakai, MD, PhD - 2013 Honored Educator
Osamu Sakai, MD, PhD - 2014 Honored Educator
Osamu Sakai, MD, PhD - 2015 Honored Educator

SSA21-03 Prognostic Value of Quantitative MRI Biomarkers for Treatment Response Assessment of Multiple Myeloma

Sunday, Nov. 29 11:05AM - 11:15AM Location: S405AB

Participants

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PURPOSE

We are investigating a radiomics approach to treatment response assessment of multiple myeloma (MM) using MRI. This study assessed the value of our developed MRI biomarkers as prognostic factors in patients with MM after autologous bone marrow transplant (BMT).

METHOD AND MATERIALS

With IRB approval, 63 pairs of spine MRI scans performed pre- and post-BMT (3-6 months) and clinical tests (< ± 7 days of post-MRI) were collected retrospectively from 63 MM patients. A 3D dynamic intensity entropy transformation (DIET) method was developed to transform MR T1-weighted signal voxel by voxel to a quantitative entropy enhancement value (qEEV), from which two MR image biomarkers, the mean difference in qEEV between the pre- and post-BMT MR scans over the vertebras (m-qEEV) and the percentage of vertebras with an increased qEEV in the post-BMT scan (p-qEEV), were derived for each patient to estimate progression-free survival. The values of age, gender, and the clinical test outcomes including M-protein in serum and urine, ratio of free light chain (FLC), % plasma cell (PC), beta-2-microglobulin and immunoglobulin levels were also assessed. Univariate analysis was performed with the Kaplan-Meier method and log-rank test, and multivariate analysis was performed with the Cox proportional hazards regress model, with respect to the time to progression (TTP) censored at 3 years.

RESULTS

The univariate analysis showed that the patients with optimal cutoff points of m-qEEV < - 0.1 and p-qEEV < 10% determined by the maximally selected rank statistics had significantly shorter TTP (P = 0.047 and P < 0.001, respectively). The age (<60), gender and all individual clinical tests in their normal ranges did not significantly predict longer TTP, except normal FLC (P = 0.040) and PC (P = 0.022). The multivariate analysis showed that the best predictive factor for TTP was p-qEEV (P < 0.018; hazard ratio (HR) 31.2). Other factors such as m-qEEV (P =0.276; HR=5.6), FLC (P = 0.510; HR = 1.4) and PC (P < 0.217; HR = 1.2) did not provide significant predictive value for TTP.

CONCLUSION

The study demonstrated the feasibility of using the quantitative MRI biomarker (p-qEEV) as prognostic predictor for patients with MM after BMT.

CLINICAL RELEVANCE/APPLICATION

MR-based radiomic biomarker with prognostic significance may improve the accuracy for staging and assessing treatment response for MM, allowing clinicians to optimize therapy for individual patients.
SSA21-04 Validation of a Quantitative Masking Index for Digital Mammography

Sunday, Nov. 29 11:15AM - 11:25AM Location: S405AB

Participants
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Martin J. Yaffe, PhD, Toronto, ON (Abstract Co-Author) Research collaboration, General Electric Company Founder, Matakina International Ltd Shareholder, Matakina International Ltd Co-founder, Mammographic Physics Inc

PURPOSE
Mammography has reduced sensitivity for detecting cancer in dense breasts, for which superposition of shadows of normal structures can "mask" the presence of cancer either by a loss of contrast or by the distracting complexity of the surrounding parenchymal structures. We have developed a quantitative measure of masking by evaluating the signal-to-noise ratio (SNR) of a localized model observer.

METHOD AND MATERIALS
On a grid of sub-regions (ROIs), the parenchymal texture was quantified by extracting the inverse power-law exponent, β, from the noise power spectrum (NPS). The localized detection task SNR, d_L, for a simulated 5 mm diameter lesion was estimated using a non-prewhitening observer and measurements of the system MTF, and NPS from each ROI. The resulting map of d_L is analyzed to extract the masking potential of each mammogram. The d_L maps were validated with a 4 alternative forced choice (4AFC) of a simulated lesion (diameter 5 mm) inserted into ROIs randomly selected from a single mammogram, across 7 β categories (0.5 intervals from 1.5-5.0). A second reader study compared a radiologist's perception and accuracy to the d_L maps generated for a set of 78 screening cases.

RESULTS
The 4AFC study was performed on 20 mammograms and over 5000 ROIs. Preliminary results on one reader showed that mean d_L was highly correlated with inverse threshold lesion thickness (r=0.897, p<1e-10). In the second study, a radiologist estimated the probability of malignancy, BI-RADS density and assessed the difficulty level of each case. Initial results showed a 36% difference (p<1e-6) in mean d_L between non-dense and dense mammograms and a 28% difference (p<1e-3) in mean d_L between "easy" and 'hard" images.

CONCLUSION
A quantitative measure of masking by background parenchyma has been developed. Strong correlation is seen with both breast density and texture. Two preliminary reader studies confirm that local task SNR tracks with reader performance, in both simulated conditions and clinical evaluations of mammograms.

CLINICAL RELEVANCE/APPLICATION
A measure of masking by mammographic density can have a number of applications, e.g., to conform to recent changes to BI-RADS density assessment, to categorize mammograms that require more careful assessment, or as a selection tool to identify those women who should be invited to be screened with alternative technologies.

SSA21-05 Virtual Monochromatic CT Numbers from a Dual-Energy MDCT Acquisition: Comparison between Single-Source Projection-Based and Dual-Source Image-Based Platforms in a Phantom Environment

Sunday, Nov. 29 11:25AM - 11:35AM Location: S405AB

Participants
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Sandra Stinnett, MS, MPH, Durham, NC (Abstract Co-Author) Nothing to Disclose
Kingshuk Choudhury, PhD, Durham, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate in a phantom experiment whether there is any variability in virtual monochromatic CT numbers from a dual energy MDCT acquisition, across single- and dual-source hardware implementations.

METHOD AND MATERIALS
A polyethylene terephthalate torso phantom, filled with water, was employed to simulate the human abdominal environment. This contained a cylindrical polypropylene bottle, filled with 12 mg/mL of iopamidol 300, with serially suspended polyethylene terephthalate spheres (15 and 18 mm) filled with two iodine-to saline iodine dilutions (0.8 mgI/mL and 1.2 mgI/mL). Dual energy (80/140 kVp) and single energy (100 and 120 kVp) scans were performed using single-source (HD750 GSI, GE Healthcare) and dual-source (SOMATOM Definition Flash, Siemens Healthcare) MDCT systems. Virtual monochromatic images were reconstructed at energy levels ranging from 40 to 140 keV (at 10 keV increments), in either the projection- or the image-space domains.

RESULTS
There were significant differences between the single-source projection-based platform and the dual-source image-based platform in the measured attenuation values of the simulated lesions tested (P <0.001, for all comparisons). The magnitude of these differences was greatest at lower monochromatic energy levels and at lower iodine concentrations. The dual energy hardware platform, the virtual monochromatic energy level, and the lesion iodine concentration had a highly statistically significant effect on the difference in the measured attenuation values between the two platforms, indicating that the platforms respond differently to changes in these variables (P <0.001, for all comparisons).

CONCLUSION
A significant variability in CT numbers exists between single-source projection-based and dual-source image-based virtual monochromatic datasets, as a function of the selected energy level and the lesion iodine content.

CLINICAL RELEVANCE/APPLICATION

The variability in monochromatic CT numbers between the two clinically available dual energy platforms may impact clinical decisions that depend on subtle differences in measured attenuation values. For example, when minimally-vascularized abdominal neoplasms are repeatedly imaged with different dual energy platforms, differences in measured attenuation values between the imaging studies due to variability between scanners might be erroneously attributed to changes in tumor vascularity.

SSA21-06  Accuracy Enhancement with Deep Convolutional Neural Networks for Classifying Regional Texture Patterns of Diffuse Lung Disease in HRCT

Sunday, Nov. 29 11:35AM - 11:45AM Location: S405AB

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June-Goo Lee, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To introduce deep learning-based feature extraction method which adaptively learns the most significant features for the given task using deep structure to classify six kinds of regional patterns in diffuse lung disease.

METHOD AND MATERIALS

HRCT images were selected from images of 106 patients having diffuse lung disease from a Siemens CT scanner (Sensation 16, Siemens, Forchheim, Germany) and 212 patients from a GE CT scanner (Lightspeed 16, GE, Milwaukee, WI, USA). Two experienced radiologists marked sets of 600 rectangular regions of interest (ROIs) with 20×20 pixels on HRCT images obtained from GE and Siemens scanners, respectively. These were consisted of a hundred of ROIs for each of six local patterns including normal, consolidation, emphysema, ground-glass opacity, honeycomb lung, and reticulonodular opacity. The CNN classifier having a deep architecture (Fig. 1(b)) was compared with that of support vector machine (SVM) having a shallow architecture. In the SVM classifier, 22 features including histogram, gradient, run-length, gray level co-occurrence matrix, low-attenuation area cluster, and top-hat transform were extracted. In the CNN classifier, a hundred features in the last layer (FC #1), however, were extracted automatically with deep learning classifier manner. All experiments were performed based on forward feature selection and five fold cross-validation with 20 repetitions.

RESULTS

The accuracies of the SVM classifier were achieved 92.34 ± 2.26 % at 600 ROI images acquired in a single scanner (GE) and 91.18 ± 1.91 % at 1200 ROI images of the integrated data set (GE and Siemens). The accuracies of the CNN classifier showed a higher performance of 93.72 ± 1.95 % and 94.47 ± 1.19 % in a single and the integrated HRCT, respectively (Fig. 1(c)).

CONCLUSION

The SVM accuracy in the integrated data showed not inferior to that in a single vender data, due to the effect of different scanners. In the CNN classifier, however, the CNN performance in the integrated data might be better, due to more robustness to image noise and higher performance in larger data set. In addition, the CNN shows higher performance than the SVM in both of data types.

CLINICAL RELEVANCE/APPLICATION

Deep learning based automated quantification system of regional disease patterns at HRCT of interstitial lung diseases can be more useful in the diagnosis, severity assessment, and monitoring of treatment effects.

SSA21-07  Predicting Radiologists' Diagnostic Performances Using Quantitative Image Features: Preliminary Analysis

Sunday, Nov. 29 11:45AM - 11:55AM Location: S405AB

Participants
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Ingrid Reiser, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
John M. Boone, PhD, Sacramento, CA (Abstract Co-Author) Research Grant, Siemens AG Research Grant, Hologic, Inc Consultant, Varian Medical Systems, Inc

PURPOSE

The endpoint for assessing image quality should be related to radiologists’ diagnostic performances, instead of imaging statistics, such as contrast to noise ratio. The purpose of this preliminary study is to evaluate breast computed tomography (CT) image quality using quantitative image features that are correlated with radiologists’ diagnostic performances.

METHOD AND MATERIALS

A total of 102 pathology proven breast lesions in 92 dedicated breast CT images were used. An iterative image reconstruction (IIR) algorithm was used to obtain CT images with different image qualities (28 different qualities). Through image feature analysis from breast lesions (developing classifiers on image features from the lesion), two reconstruction options (i.e., 2 out of 28 different qualities) and one clinical reconstruction with area under the ROC curve (AUC) values of 0.67, 0.75, and 0.86 were selected for a reader study. A subset of breast lesions (N = 50, half malignant) were selected for the reader study. One experienced MQSA assistant:
Coronary calcium (CAC) scores obtained in low-dose chest CT without ECG-synchronization, as acquired in lung cancer screenings, are strong and independent predictors of cardiovascular events (CVE). However, due to acquisition, interscan CAC score reproducibility is moderate. This may result in incorrect CVE risk prediction. To increase the interscan reproducibility of CAC scores, we have developed a method to quantify CAC using partial volume correction (PVC).

METHOD AND MATERIALS

Three phantoms were scanned (Philips Brilliance 64, 120 kVp, 20 mAs, 3.0 mm slice thickness, 3.0 mm increment), each containing 3 inserts differing in size (9.1, 24.6 and 62.8 mm³) and calcium density (0.197, 0.401 and 0.796 mg/mm³). Total CAC volume per scan

RESULTS

The radiologist's AUCs for each quality were 0.74, 0.79, and 0.81. The trained classifier achieved averaged AUCs of 0.72, 0.76, and 0.77. The linear correlation coefficients between the radiologist's probability and the radiologist's probability on the test set were 0.51, 0.6, and 0.54 (all p-values < 0.001).

CONCLUSION

The classifier was able to learn the radiologist's estimation of lesion malignancy. More readers are required to generalize our results.

CLINICAL RELEVANCE/APPLICATION

Quantitative image features were used to correlate radiologists' diagnostic performances. These features may be useful for optimizing reconstruction algorithms and evaluating dose reduction techniques.

SSA21-08  Multivariate Modeling for Prediction of Cervical Cancer Treatment Outcomes

Sunday, Nov. 29 11:55AM - 12:05PM Location: S405AB

Participants
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Background
Several studies reported univariate correlation analysis of radiomics as predictive factors for treatment clinical outcomes. This study investigated building a multivariate linear regression model that combines several predictive metrics in correlation with treatment outcomes.

Evaluation
Our dataset consisted of the pretreatment PET/CT scans from a cohort of 74 patients diagnosed with cervical cancer, FIGO stage IB-IVA, age range 31-76 years, treated with external beam radiation therapy to a dose range between 45-50.4 Gy (median dose: 45 Gy), concurrent cisplatin chemotherapy and MRI-based Brachytherapy to a dose of 20-30 Gy (median total dose: 28 Gy). Pearson's correlation (PC) and Area under (AUC) the receiver operator curve (ROC) were used to assess the correlation with treatment outcomes. Radiomics features were extracted; Co-occurrence (COM), Gray Level Size Zone (GLSZ) and Run Length (RLM) and Intensity Based (IBM) Matrices algorithms. Afterwards, they were selected using sequential backward selection to predict for distant metastases (DM), Locoregional recurrence (LRR) and last follow-up status (LFS).

Discussion
The models consisted of linear combination of 2 to 3 radiomics features for each outcome. LRR model consisted of (Intensity contrast and Low Gray-Level Run Emphasis). LFS model consisted of (Different Entropy, Intensity contrast and Low-Intensity small-area emphasis). DM models consisted of (size zone variability and small-area emphasis) and (surface/Area and Volume). Models showed PC scores range (0.3-0.5) and AUC range (0.75-0.9) with 95% CI (0.6-1.0). All models scored low Variance Inflation Factor (VIF < 5) based on multicolinearity diagnostics test. All tests were statistically significant (p<0.05).

Conclusion
Multivariate linear regression models of radiomics features improved prediction power of treatment outcomes in comparison to univariate analysis. Moreover, all models passed multicolinearity diagnostics test. LRR model scored highest improved predictive power followed by LFU then DM models respectively. This approach may contribute to incorporate PET radiomics in patient's response analysis in clinic.

SSA21-09  Increasing the Interscan Reproducibility of Coronary Calcium Scoring by Partial Volume Correction in Low-Dose non-ECG Synchronized CT: Phantom Study

Sunday, Nov. 29 12:05PM - 12:15PM Location: S405AB

Participants
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PURPOSE
Coronary calcium (CAC) scores obtained in low-dose chest CT without ECG-synchronization, as acquired in lung cancer screenings, are strong and independent predictors of cardiovascular events (CVE). However, due to acquisition, interscan CAC score reproducibility is moderate. This may result in incorrect CVE risk prediction. To increase the interscan reproducibility of CAC scores, we have developed a method to quantify CAC using partial volume correction (PVC).

METHOD AND MATERIALS

Three phantoms were scanned (Philips Brilliance 64, 120 kVp, 20 mAs, 3.0 mm slice thickness, 3.0 mm increment), each containing 3 inserts differing in size (9.1, 24.6 and 62.8 mm³) and calcium density (0.197, 0.401 and 0.796 mg/mm³). Total CAC volume per scan
was 96.5 mm³. Each phantom was scanned 3 times with slight rotation and translation between acquisitions, and in 3 different scenarios: 1 stationary and 2 moving with speed of 10 mm/s and 30 mm/s without ECG-synchronization, resulting in total of 27 scans. CAC was scored by clinically used thresholding at 130 HU. Thereafter, PVC employing Expectation-maximization algorithm for learning a multi-dimensional Gaussian mixture was used to determine partial content of calcium in the voxels of each identified calcification and its vicinity. The total CAC volumes per scan were computed by thresholding and using the proposed PVC method.

**RESULTS**

For the stationary phantom with low, medium and high density inserts, thresholding resulted in CAC volumes of 60.9, 142.9 and 213.2 mm³, while PVC determined 70.4, 88.9 and 92.9 mm³, respectively. For the phantom moving at 10 mm/s, thresholding resulted in CAC volumes of 50.3, 149.8 and 224.6 mm³, while PVC gave 58.2, 91.2 and 96.7 mm³, respectively. For the phantom moving at 30 mm/s, thresholding resulted in CAC volumes of 15.1, 147.2, and 306.3 mm³ and PVC determined 51.8, 78.8 and 106.5 mm³, respectively.

**CONCLUSION**

Thresholding underestimates volume of low density and overestimates volume of high density calcifications. The effect is emphasized with increasing motion artefacts. PVC provides better estimates of true calcium volume and it is less affected by motion.

**CLINICAL RELEVANCE/APPLICATION**

CAC quantification using PVC may increase interscan reproducibility of the CAC volume score.
Purpose/Objective(s): In this study, our purpose was to compare the difference of overall survival (OS) between squamous (SCC) and non-squamous cell (non-SCC) non-small cell lung cancer patients, with consideration of other clinical factors. Materials/Methods: Study population included patients treated from 2002 to 2014 in our center and with data recorded in the Tumor Registry. Age, gender, race, marital status, insurance status, tumor location, clinical stage, pathology, alcohol and smoking history, and treatments were tested for their significances. All alive patients had to be followed for at least 12 months to enter this study. Kaplan-Meier analysis and Cox proportional hazards model were used to determine differences in overall survival (OS). All tests were two-sided and p = 0.05 was considered to be significant. Results: A total of 1116 consecutive patients were eligible in which SCC and non-SCC patients accounted for 31.7% and 68.3%. Patients with stage I, II, III and IV for SCC and non-SCC were 20.3%, 8.6%, 33.1%, 38.0% and 16.9%, 6.0%, 23.9%, 53.2%, respectively. In multivariate analysis, age, gender, stage, chemotherapy and surgery were significantly correlated with OS. Median OS was not significantly different between SCC and non-SCC (9.6 vs 8.5 months, HR = 0.99, 95% CI: 0.87-1.15, p = 0.992). There was no significant difference in OS between SCC and non-SCC patients stratified by age, gender and race. For stage I patients, non-SCC had longer OS than SCC patients (49.5 vs 38.1 months, p = 0.013), while no significant difference was observed in patients with stage II, III and IV. Patients treated with chemotherapy had significantly better median OS than those who didn’t receive chemotherapy: SCC (15.9 vs 6.9 months, HR = 0.63, 95% CI: 0.48-0.81, p Conclusion: No significant difference of OS were found between SCC and non-SCC patients in this study. While surgery and chemotherapy improve OS in both SCC and non-SCC groups, radiotherapy extended OS only significantly for advanced stage non-SCC patients.
ABSTRACT

Purpose/Objective(s): Phase II study of intensity-modulated stereotactic body radiotherapy (SBRT) using compensated filter for patients with stage I NSCLC was conducted. In this study, an internal target volume (ITV) was set to compensate for respiratory movement, the abdomen was pressed by a custom-made plastic immobilization belt. While wearing this device, a planning CT was taken during the inspiratory and expiratory phases, and the positron emission tomography or tumor growth rates of 25% compared to a previous image, 3. a clinical stage of T1-2N0M0 which showed a tendency of decreased agreement with increasing tumor volumes.

RESULTS

The median values (+ range) of the GTV for PET-CT and MRI (DWI and T2w imaging) did not differ significantly (PET-CT 69 ml (3 - 229 ml), DWI 71 ml (4 - 361 ml), T2w 65 ml (5 - 350 ml). The measured tumor volumes with all three techniques showed a highly significant correlation (PET/CT vs. DWI: r=0.97; PET/CT vs. T2w imaging: r=0.89; DWI vs. T2 imaging: r=0.92; p <0.0001). However in 9 out of 13 cases DWI showed a larger volume as compared with the FDG-PET data (mean difference 29.8% ± 19.5%). Comparing PET-CT and DWI a good agreement regarding the spatial target volume was found (HD: 2.5 ± 1.1 mm; DC 0,65 ± 0.08), which showed a tendency of increased agreement with increasing tumor volumes.

CONCLUSION

FDG-PET-CT and MR based GTV definition overall shows a good agreement, especially regarding the spatial-topographic tumor localization. Tumor volumes may differ considerably in a particular case and further studies have to evaluate the added value of DWI in radiotherapy planning.

CLINICAL RELEVANCE/APPLICATION

Based on our initial findings DWI in radiation therapy planning can give important additional information and should be evaluated in larger scale studies.

SSA22-05 The Impact of Respiratory Movement on Local Recurrence in Patients with Stage I Non-Small Cell Lung Cancer in the Treatment of Intensity Modulated SBRT

Participants
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SSA22-04 Evaluation of Tumor Volume and Target Volume Definition Based on Diffusion-weighted MRI in Radiotherapy of Non-Small Cell Lung Cancer

Participants
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PURPOSE

The purpose of this study was to evaluate DWI of the thorax in determination of tumor volume and assessment of target volume for radiation therapy planning of non-small cell lung cancer (NSCLC) in comparison to a FDG-PET-CT based approach.

METHOD AND MATERIALS

13 pts with NSCLC and indication for primary radio(chemo)therapy were prospectively evaluated with both MRI and PET-CT. 13 primary tumors with UICC stages I (4 pts.), II (1 pt.), IIIA (3 pts.) and IIIB (5 pts.) were evaluated. For MRI a respiratory gated T2-weighted sequence in axial orientation and non-gated DWI (b= 0, 800, 1400 and ADC map) were acquired on a 1.5 T scanner (Siemens, Magnetom® Aera). FDG PET-CT was performed as part of the routine staging. Both MR and PET-CT images were coregistered on a radiation treatment planning system (Phillips, Pinnacle3®). For the FDG-PET-CT data a semiautomatic contouring of the gross tumor volume (GTV) of the primary tumor based on a "source-to-background"-Algorithm was applied. For DWI and the T2w sequences a visual definition of the GTV was performed. Beside a statistical comparison of the GTV an evaluation of the target volume based on the "Hausdorff-Distance" (HD) and the "Dice Similarity Coefficient" was performed.

RESULTS

The measured tumor volumes with all three techniques showed a highly significant correlation (PET/CT vs. DWI: r=0.97; PET/CT vs. T2w imaging: r=0.89; DWI vs. T2 imaging: r=0.92; p <0.0001). However in 9 out of 13 cases DWI showed a larger volume as compared with the FDG-PET data (mean difference 29.8% ± 19.5%). Comparing PET-CT and DWI a good agreement regarding the spatial target volume was found (HD: 2.5 ± 1.1 mm; DC 0,65 ± 0.08), which showed a tendency of decreased agreement with increasing tumor volumes.

CONCLUSION

FDG-PET-CT and MR based GTV definition overall shows a good agreement, especially regarding the spatial-topographic tumor localization. Tumor volumes may differ considerably in a particular case and further studies have to evaluate the added value of DWI in radiotherapy planning.

CLINICAL RELEVANCE/APPLICATION

Based on our initial findings DWI in radiation therapy planning can give important additional information and should be evaluated in larger scale studies.

SSA22-04 Evaluation of Tumor Volume and Target Volume Definition Based on Diffusion-weighted MRI in Radiotherapy of Non-Small Cell Lung Cancer

Sunday, Nov. 29 11:15AM - 11:25AM Location: S104A

Sunday, Nov. 29 11:25AM - 11:35AM Location: S104A

Sunday, Nov. 29 11:15AM - 11:25AM Location: S104A

Sunday, Nov. 29 11:25AM - 11:35AM Location: S104A
rates by univariate analysis. By multivariate analysis, an ITV minus GTV volume larger than 30 ml (hazard ratio = 11.2, p = 0.04) was a statistically significant indicator of poor local progression-free survival rates. Minimum dose of ITV and tumor location were not significant. Conclusion: A large volume of ITV minus GTV was a negative prognostic factor for local progression in SBRT, which suggested that in instance of high respiratory movement, special technique of respiratory gaiting or tumor-tracking may be necessary.

SSA22-06 Comparison of Dose Distributions Calculated with Different Dose Calculation Algorithms in Pulmonary Lung Lesions in Order to Analyze the Influence of Different Algorithms on the Dose Prescription

Sunday, Nov. 29 11:35AM - 11:45AM Location: S104A

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PURPOSE
To introduce more accurate algorithms like Monte Carlo (MC) into the clinical routine, an adjustment of the currently used EPL or PB dose prescription is required. The goal of this study was to find the dose prescription adjustment when switching from PB to MC in iPlan and from EPL to MC in MultiPlan, respectively. For that reason dose distributions calculated with the different algorithms were analyzed for patients with malignant pulmonary lung lesions with different tumor size and location.

METHOD AND MATERIALS
For 124 lung lesions, treated between 2010 and 2014 at the Novalis TX (Varian Medical Systems) and at the CyberKnife (Accuray), dose distributions were initially calculated with PB and retrospectively re-calculated with MC in iPlan. In the same way, dose distributions were initially calculated with EPL and retrospectively re-calculated with MC in Multiplan. We compared the PB with the MC dose distribution within iPlan as well as the EPL with the MC dose distribution within MultiPlan. The following parameter were compared: minimum dose to 99% (D99), 95% (D95) and Dmean of the different target volumes (GTV, CTV, ITV, PTV), prescription isodose volume (PIV), the heterogeneity index (HI) and Dmean as well as Dmax to the organs at risk (OARs). Based on changes in D99, D95 and mean PTV dose, the prescription dose was converted from PB to MC and from EPL to MC, respectively.

RESULTS
So far, 64/124 lesions were evaluated (PB n=52, EPL n=12). The D99 and D95 to the PTVs were reduced when using MC in comparison to PB and EPL. Reduction was larger for peripheral than for central tumors (up to 25% vs. 5%). Maximum in reduction was seen in small peripheral lesions, i.e. the PIV can be reduced up to 95% (PB volume 8.36ccm vs. MC volume 0.37ccm). Based on D95, for small peripheral lesions the PB prescription of 5x12Gy has to be reduced to 5x9.5Gy for MC. The mean and maximum dose to OARs decreased when using MC in comparison to EPL or PB.

CONCLUSION
Our preliminary results confirm that the dose prescription has to be adjusted when switching from PB to MC in iPlan. Furthermore we found, that the adjustment is different when switching from PB to MC in iPlan in comparison to switching from EPL to MC in MultiPlan.

CLINICAL RELEVANCE/APPLICATION
Future trials will show, if the more accurate dose calculation by MC might increase the probability of tumor control and/or might lower the toxicity.

SSA22-07 Dynamic Contrast-enhanced Perfusion Area-Detector CT Assessed by different Mathematical Models vs. FDG-PET/CT: Capability for Therapeutic Outcome Prediction in Non-Small Cell Lung Cancer Patients with Chemoradiotherapy

Sunday, Nov. 29 11:45AM - 11:55AM Location: S104A

Participants
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PURPOSE
To directly compare the capability for therapeutic outcome prediction between dynamic first-pass contrast-enhanced (CE-) perfusion area-detector CT (ADCT) assessed by different mathematical methods and FDG-PET/CT in non-small cell lung cancer (NSCLC) patients treated with chemoradiotherapy.
ABSTRACT

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ABSTRACT

Oligometastases was divided into sync-oligometastases and oligo-recurrence, the difference being that the
primary site of oligometastases was uncontrolled (sync-oligometastases) or controlled (oligo-recurrence). The purpose of this study was to evaluate treatment outcomes after stereotactic body radiotherapy (SBRT) for pulmonary oligometastases.

Materials/Methods: A total of 96 patients (65 males and 31 females) who received SBRT for pulmonary oligometastases between January 2004 and April 2014 at 4 high-volume institutions in Japan were enrolled in this retrospective study. The primary sites were the colorectum (n=25), lung (n=24), head and neck (n=8), and others (n=39). Ten cases were sync-oligometastases, 79 cases were oligo-recurrences and 7 cases were unclassified oligometastases. The median disease-free interval (DFI) between initial therapy and SBRT was 24 months (range, 0-246 months). The median prescribed BED was 105.6 Gy (range, 75-134.4 Gy). Overall survival (OS), local control rate (LCR) and relapse-free survival rate (RFS) were calculated using Kaplan-Meier curves, and the log-rank test was used to compare the curves. Multivariate analysis for RFS was performed using a Cox proportional hazards model. Statistical significance was set at p Results: The median follow-up periods were 21 months (range, 1-119 months) for all patients. The 3-year OS, LCR and RFS rates were 52%, 75% and 25%, respectively. Radiation pneumonitis of grade 3 was found in 2 patients and gastrointestinal toxicity of grade 4 was found in 1 patient. No grade 5 toxicity occurred. The 3-year RFS for sync-oligometastases was 0% and that for oligo-recurrence was 28% (Figure, p Conclusion: In SBRT for pulmonary oligometastases, control of the primary site is a significant prognostic factor for RFS.
**SSA23**

**Vascular/Interventional (Venous Interventions)**

Sunday, Nov. 29 10:45AM - 12:15PM Location: E350

**Participants**

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**Sub-Events**

**SSA23-01 Prophylactic Antibiotics during Totally Implantable Venous Access Device Placement Does Not Decrease the Rate of Infection**

Sunday, Nov. 29 10:45AM - 10:55AM Location: E350

**Participants**

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**PURPOSE**

Controversy still exists regarding antibiotic use in totally implantable venous access device (TIVAD) placement. A recent study showed a <1% risk of catheter related bloodstream infection (CLABSI) without the use of antibiotic prophylaxis. The current study seeks to delineate the efficacy of prophylactic antibiotics in TIVAD placement and to identify parameters associated with infection risk in an institution where antibiotic prophylaxis was used in the majority of cases.

**METHOD AND MATERIALS**

Following IRB approval, retrospective review of consecutive patients receiving TIVADs from January 2008 - December 2012 were analyzed for port infections. Post-procedural infection was defined as port removal within 30 days of placement with clinical signs of infection. Demographic information, comorbidities, hospital admission status, port characteristics, as well as prophylactic and supplemental antibiotic use were documented. Preoperative laboratory results were reviewed for white blood cell count (WBC), platelet count, and coagulation studies. Chi-square tests were used to determine associations between patient characteristics and procedural infection.

**RESULTS**

Of 1438 patients, 1158 (80.5%) received antibiotics and 280 (19.5%) did not. Of the patients given antibiotics, 143 (12.3%) also received supplemental antibiotics within 30 days of port placement and were excluded from analysis. Among the remaining 1295 patients, 7 post-procedural infections were identified (0.5%), all occurring in the antibiotic group (p<0.0001). Post-procedural infection was also significantly associated with inpatient status versus outpatient (3.8% vs. 0.1%, p<0.0001) and double lumen ports versus single lumen (1.9% vs. 0.2%, p=0.002).

**CONCLUSION**

Prophylactic antibiotic therapy does not reduce the post-procedure infection rate. Infection rates are higher with inpatients and those receiving double lumen ports.

**CLINICAL RELEVANCE/APPLICATION**

With level 8 evidence in existence, the Society of Interventional Radiology guidelines suggests that prophylactic antibiotics are unnecessary for tunneled central lines. No consensus exists for totally implantable venous access devices. Despite mounting evidence of the limited utility of antibiotics, many interventional radiologists and the majority of fellows of the American College of Surgeons still use antibiotics. The study seeks to add to the evidence that prophylactic antibiotics may not add benefit in this setting.

**SSA23-02 Developing a Method for Testing Mechanical Properties for Implantable Catheter Lines**

Sunday, Nov. 29 10:55AM - 11:05AM Location: E350

**Participants**

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Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Harald Ittrich, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To develop a reproducible and sensitive method for the quantification of parameters of mechanical properties of catheter lines as well as to investigate the influences of artificial aging.

**METHOD AND MATERIALS**
Constructing an experimental setup and performing uniaxial tensile tests with 5F-silicone- and 6F-polyurethane catheter lines. Subgroups were each with unattended (n=6), chemically aged (n=7), and mechanically aged samples. Material behavior was analyzed by optical strain measurement (EOS 700D, Canon, Tokio/ Japan) and force measuring system (Xforce P, Zwick Roell AG, Ulm/ Germany). Maximum force (N), stress at break (Pa), strain at break (%), and Young's elastic modulus (Pa) were evaluated.

RESULTS
In the 5F-silicone catheter trial series ANOVA shows significant differences in subgroups with Young's elastic module (p<0.001); in the 6F-polyurethane catheters with Young's elastic module (p<0.001) maximum force (p<0.001), stress at break (p<0.001), as well as strain at break (p=0.001).

CONCLUSION
We successfully developed an experimental setup to quantify mechanical properties of various catheter lines and proofed reliability and sensitivity to determine artificial aging induced modification. The low range of variance promises to detect even minor deviations in material features.

CLINICAL RELEVANCE/APPLICATION
According to recurrent failures with catheter lines among the patient cohort with totally implanted port systems within our medical center it is necessary to gain knowledge about influences of long-term usage and to quantify aberrations to avoid risk owing to material fatigue or potentially faulty batches.

SSA23-03 Adrenal Venous Sampling in Primary Aldosteronism: Value of a Multinomial Regression Model to Detect Aldosterone Hypersecretion Lateralization When the Right Adrenal Vein Sampling is Missing

Sunday, Nov. 29 11:05AM - 11:15AM Location: E350

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PURPOSE
To assess the value of a multinomial regression model to detect aldosterone hypersecretion lateralization (AHL) with adrenal venous sampling (AVS) when the right adrenal vein sampling is missing.

METHOD AND MATERIALS
All consecutive AVS from November 1990 to December 2014 were included. Non selective AVS, repeated AVS and AVS with missing data were excluded. Cortisol and aldosterone levels were measured simultaneously from the adrenal veins and left iliac vein before (basal) and after intravenous cosyntropin injection. Reference standard for AHL was a basal adrenal vein aldosterone /cortisol ratio (A/C) >4 the opposite side. Two multinomials regressions models were built to predict AHL (right, left or no lateralization) using only the left adrenal and iliac veins hormone concentration, 1) before and 2) after cosyntropin injection. AHL detection accuracy was assessed with receiver operating characteristic (ROC) curves.

RESULTS
AVS of 171/186 (91.9%) patients (60 women; 126 men, mean age 53.5 years) met the inclusion/exclusion criteria. AHL was found in 106 (62%) patients. Areas under the ROC curves for AHL detection with the basal and the post-cosyntropin models were respectively 0.907 (95%CI; 0.862-0.952) and 0.928 (95%CI; 0.892-0.965) for the right side (p=0.11) and 0.915 (95%CI; 0.872-0.958) and 0.917 (95%CI; 0.875-0.959) for the left side (p=0.84). Sensitivities to detect AHL with a specificity of 95% with the basal and the post-cosyntropin models were respectively 52.7% (95%CI; 38.9%-66.1%) and 56.4% (95%CI; 42.4%-69.4%) for the right side and 52.9% (95%CI; 38.6%-66.8%) and 59.2% (95%CI; 44.2%-72.7%) for the left side. There were no contralateral AHL among false positives in both models.

CONCLUSION
Multinominal regression models of AVS can determine AHL in the majority of patients even when the right adrenal vein sampling is missing. Basal and post cosyntropin multinominal regression models had similar accuracy to detect AHL.

CLINICAL RELEVANCE/APPLICATION
Adrenal venous sampling is essential to assess aldosterone hypersecretion lateralization before adrenalectomy but is limited by a high right adrenal vein cannulation failure rate.

SSA23-04 Selective Arterial Calcium Stimulation (SACST) with Hepatic Venous Sampling Differentiates Occult Insulinoma from Nesidioblastosis in Patients with Endogenous Hyperinsulinemic Hypoglycemia and Negative or Inconclusive Noninvasive Imaging

Sunday, Nov. 29 11:15AM - 11:25AM Location: E350

Participants
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Closure, compared to filter placement by vascular surgery. Demonstrating superior technique and lower procedure cost is essential in promoting VIR practice development. IVC filter placement times, less need for anesthesia consultation, and more precise placement centered in the IVC.

**METHOD AND MATERIALS**

An IRB-approved retrospective review was undertaken of 116 patients with biochemical evidence of endogenous hyperinsulinemic hypoglycemia, negative or inconclusive noninvasive imaging and surgically and pathologically confirmed occult insulinoma (N=42) or nesidioblastosis (N=74) who underwent SACST with hepatic venous sampling from 1/1996 to 3/2014. Clinical, laboratory, radiologic and pathology data were reviewed. The maximum hepatic venous insulin concentration (mHVI; μIU/mL) and relative-fold increase in hepatic venous insulin concentration over baseline (rHVI) following calcium injection from the dominant artery were compared between insulinoma and nesidioblastosis groups. ROC curves were generated to determine the specificity of mHVI and rHVI in differentiating insulinoma from nesidioblastosis.

**RESULTS**

The biochemical results of SACST were positive (>2.0-fold) in two or more arterial distributions in 26.2% of patients in the insulinoma group and 73.0% of patients in the nesidioblastosis group (p<0.0001). The mean (±SEM) mHVI post calcium injection was significantly higher in the insulinoma group compared to the nesidioblastosis group (778.6 ± 189.6 μIU/mL v. 36.2 ± 4.1 μIU/mL, respectively; p<0.001). The mean (±SEM) HVI from baseline was significantly higher in the insulinoma compared to the nesidioblastosis group (25.1 ± 4.4 v. 6.4 ± 0.5, respectively; p<0.001). The area under the receiver operator curve (AUC) for mHVI and HVI was excellent (0.94; p<0.0001) and good (0.83; p<0.0001), respectively. mHVI cutoffs of >91.5μIU/mL and >263.5μIU/mL were 95% and 100% specific for insulinoma, respectively. A 19.0-fold increase in rHVI over baseline was 99% specific for insulinoma.

**CONCLUSION**

These data suggest that the biochemical results of SACST can differentiate occult insulinoma from nesidioblastosis with high specificity in patients with hyperinsulinemic hypoglycemia and negative noninvasive imaging.

**CLINICAL RELEVANCE/APPLICATION**

SACST should be considered in patients with hyperinsulinemic hypoglycemia and negative noninvasive imaging to differentiate occult insulinoma from nesidioblastosis, thereby avoiding blind pancreatic exploration.

**SSA23-05**  
**Comparison of Inferior Vena Cava Filter Placement by Two Different Vascular Physician Specialties**  
**Sunday, Nov. 29 11:25AM - 11:35AM Location: E350**

**Participants**

Matthew Neill, New York, NY (Presenter) Nothing to Disclose  
Heams W. Charles, MD, New York, NY (Abstract Co-Author) Nothing to Disclose  
Eric T. Aaltonen, MD, MPH, New York, NY (Abstract Co-Author) Nothing to Disclose  
Amy R. Deipolyi, MD, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

**METHOD AND MATERIALS**

All IVCF placements using contrast venography by VIR or VS in 2014 in a single tertiary hospital center were identified by a PACS database search. The operator, filter type, angulation and distance from the lowest renal vein, radiation dose, fluoroscopy time, and anesthesia type were noted. Angulation was measured as the angle between the midline of the IVC and centerline of the filter.

**RESULTS**

Of 176 IVCF placements performed in VIR in 2014, carbon dioxide venography was used in 15 cases which were excluded. One case was a combined retrieval and placement and was also excluded, resulting in 160 cases for analysis. A total of 21 filters were placed by VS in 2014; 5 were placed as a part of another fluoroscopic procedure and were excluded from dose and fluoroscopy time analysis. Among the 160 cases performed by VIR, 152 were performed with topical access site anesthesia only; 2 with nursing-administered intravenous sedation; and 6 with anesthesia. By comparison, all 21 cases by VS were performed with anesthesia. Comparing cases performed by VS and VIR, mean radiation dose was higher (180 vs. 66 mGy; p<0.001), fluoroscopy time longer (4.6 vs. 2.5 minutes; p<0.0009), and filter angulation greater (3.8 vs. 2.5 degrees; p=0.006), respectively. There was no statistically significant difference in distance of the filter tip from the most inferior renal vein (1.7 vs. 1.1 cm; p=0.19).

**CONCLUSION**

IVCF placement by VIR, compared to VS, entails less radiation exposure, less procedure time as indicated by lower fluoroscopy times, less need for anesthesia consultation, and more precise placement centered in the IVC.

**CLINICAL RELEVANCE/APPLICATION**

Demonstrating superior technique and lower procedure cost is essential in promoting VIR practice development. IVC filter placement performed by interventional radiologists is faster, involves less radiation exposure, and reduces need for anesthesiology consultation, compared to filter placement by vascular surgery.

**SSA23-06**  
**Up to 96% Dose Reduction in Pediatric and Young Adult Venous Interventions: Too Good to Be True?**
Participants
Timothy Singewald, MD, Cincinnati, OH (Presenter) Nothing to Disclose
Rami Nachabe, PhD, Best, Netherlands (Abstract Co-Author) Employee, Koninklijke Philips NV
Nicole Hilvert, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
John M. Radiodio, MD, Cincinnati, OH (Abstract Co-Author) Research Consultant, Koninklijke Philips NV; Travel support, Koninklijke Philips NV
Manish N. Patel, DO, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose of this study is to evaluate dose reductions achieved during venous interventions such as IVC filter placement/retrieval and thrombolysis performed on an enhanced low-dose interventional radiology system.

METHOD AND MATERIALS
An IRB approved retrospective review of patients who underwent a relatively low-dose venous procedure (IVC filter placement/retrieval) or a relatively high-dose venous intervention (lower extremity thrombolysis) was performed. Radiation doses for cases performed on an enhanced low-dose interventional system (AlluraClarity, Philips Healthcare, Best, The Netherlands) were compared with cases from our former system used as a reference (AlluraXper, Philips Healthcare, Best, The Netherlands). Nineteen IVC filter placements or retrievals (5 male/7 female, 9-35 years, 37-84 kg) were performed on the low-dose system and were compared with 21 cases (4 male/10 female, 13-31 years, 49-112 kg) on the reference system. Twelve thrombolysis cases (3 male/4 female, 15-18 years, 51-77 kg) performed on the low-dose system were compared with 12 cases (0 male/5 female, 14-18 years, 53-146 kg) on the reference system.

RESULTS
Overall radiation doses were substantially reduced using the low-dose system compared to the reference system (the following doses are reported as low-dose vs reference system). For IVC filter placement/retrieval, median cumulative procedure dose-area product (DAP) was 3.5 vs 30.9 Gy.cm² (89% dose reduction), fluoroscopy dose/frame was 0.03 vs 0.72 Gy.cm²/frame (96% dose reduction). For thrombolysis, median cumulative procedure DAP was 25 vs 409 Gy.cm² (94% dose reduction), fluoroscopy dose/frame was 1.4 vs 5.2 Gy.cm²/frame (73% dose reduction), and the DSA dose/frame was 0.06 vs 1.6 Gy.cm²/frame (96% dose reduction).

CONCLUSION
Significant radiation dose reduction is possible in pediatric and young adult patients undergoing venous interventions by using an enhanced low-dose interventional radiology system.

CONCLUSION
Use of an enhanced low-dose interventional radiology system for venous interventions results in substantial dose reduction of up to 96% for pediatric and young adult patients.

SSA23-07 Balloon Pulmonary Angioplasty: Applicability of Fluoroscopy-based Registration of a Pre Acquired C-Arm CT for Procedure Guidance

Sunday, Nov. 29 11:45AM - 11:55AM Location: E350

Participants
Jan Hinrichs, MD, Hannover, Germany (Presenter) Nothing to Disclose
Christian Von Falck, MD, Hannover, Germany (Abstract Co-Author) Research Grant, Pro Medicus Limited Research Grant, Siemens AG
Marius Hoepner, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Julius Renne, MD, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Karen Olsen, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Frank K. Wacker, MD, Hannover, Germany (Abstract Co-Author) Research Grant, Siemens AG Research Grant, Pro Medicus Limited
Bernhard C. Meyer, Hannover, Germany (Abstract Co-Author) Research Consultant, Pro Medicus Limited

PURPOSE
To investigate the use of a fluoroscopy-based registration of a pre acquired C-Arm CT (CACT) for procedure guidance in patients suffering from chronic thromboembolic pulmonary hypertension (CTEPH) undergoing balloon pulmonary angioplasty (BPA).

METHOD AND MATERIALS
42 BPA procedures performed in 27 CTEPH patients (9m, 70±14y) were included in this study. Twenty-two BPAs were guided by selective CACT (syngo DynaCT, Artis Q®, Siemens Healthcare, Forchheim, Germany) acquired immediately before BPA (G3D). In another twenty BPAs (G2D), two orthogonal fluoroscopic images of the chest where acquired semi-automatically matched with a product (DAP) was 3.5 vs 30.9 Gy.cm² (89% dose reduction), and the digital subtraction angiography (DSA) dose/frame was 0.03 vs 0.72 Gy.cm²/frame (96% dose reduction). For thrombolysis, median cumulative procedure DAP was 25 vs 409 Gy.cm² (94% dose reduction), fluoroscopy dose/frame was 1.4 vs 5.2 Gy.cm²/frame (73% dose reduction), and the DSA dose/frame was 0.06 vs 1.6 Gy.cm²/frame (96% dose reduction).

RESULTS
Overall, 143 SPA were intended to undergo BPA. Agreement of WP-P and WP-U was obtained in G3D 82% and G2D 86%. The guide wire was successfully placed in G3D 93% and G2D 94% and subsequent BPA was successfully performed in G3D 91% and G2D 94%. CACT post-processing took a mean of 8min G3D and 7min G2D. Overall intervention time was 126min G3D and 117min G2D. No severe reperfusion edema occurred and no patient needed mechanical/assisted ventilation.Dose-area product (DAP) was significantly higher for G3D (G3D 9289±4221 vs. G2D 5448±2629 µGym², p=0.002).
The use of fluoroscopy based 2D3D registration of CACT images for BPA guidance is feasible and accurate. 2D3D registration can be used to save radiation exposure if a pre-acquired CACT for guidance is available.

**CLINICAL RELEVANCE/APPLICATION**

CACT of the pulmonary arteries bares the opportunity to increase patient’s safety during BPA, when used as guidance method. Additionally, 2D3D fusion of pre-acquired CACT’s saves radiation dose in repeated BPAs.

**SSA23-08 Added Value of Fluoroscopy/Venography during Endovenous Laser Therapy for Symptomatic Varicose Veins**

Sunday, Nov. 29 11:55AM - 12:05PM Location: E350

Participants
Ricardo Yamada, MD, Charleston, SC (Presenter) Nothing to Disclose
J. Bayne Selby JR, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Marcelo Guimaraes, Charleston, SC (Abstract Co-Author) Consultant, Cook Group Incorporated ; Consultant, Baylis Medical Company; Consultant, Terumo Corporation; Patent holder, Cook Group Incorporated
John Selby III, Charleston, SC (Abstract Co-Author) Nothing to Disclose
James P. Gregg, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Procedural difficulties or unexpected findings may occur during endovenous laser therapy of varicose veins using ultrasound alone. Fluoroscopy/venography can be a useful adjunctive modality.

**METHOD AND MATERIALS**

After IRB approval, EVLT performed in the last 10 years were reviewed. Fluoroscopy/venography and ultrasound were used in all cases. Images, procedure report and patient’s clinical condition were reviewed. Three graders evaluated whether this imaging method changed the treatment plan, aided completion of the procedure, displayed unexpected findings or clarified previous treatments results.

**RESULTS**

A total of 169 treatments were identified, in 142 patients. Fluoroscopy/venography had impact in 67 procedures (39%). In 25 cases it clarified multiple complex collateral veins. In 23 cases it helped navigate the guide-wire. In 16 cases it identified duplicated/accessory veins. In 3 cases it identified the need for second access. 23 patients had prior surgical ligation/stripping, sclerotherapy or endovenous thermal ablation. Among them fluoroscopy/venography contributed to procedure completion in 18 patients(78%).

**CONCLUSION**

Fluoroscopy/venography were helpful in patients previously treated, in whom passage of the guide wire was difficult and in those with bifurcated/accessory veins. Of these, patients with prior treatment benefited the most from fluoroscopy/venography.

**CLINICAL RELEVANCE/APPLICATION**

Fluoroscopy/venography during EVLT is particular helpful in patients with recurrent varicose veins after prior treatment. This additional imaging modality may be considered in all patients undergoing repeated treatment.

**SSA23-09 Large Primary Varicose Veins: Combined Ultrasound Guided Endo-venous Laser Therapy and Selective Surgical Ligation at Sephano-Femoral Junction-A Mean 7 Years Follow-up with Review of Literature**

Sunday, Nov. 29 12:05PM - 12:15PM Location: E350

Participants
Kiran C. Patil JR, MD, Jalgaon, India (Presenter) Nothing to Disclose
Anurag Singh, MBBS,MD, Sharjah, United Arab Emirates (Abstract Co-Author) Nothing to Disclose
Rajesh D. Jawale, MBBS, MD, Nasik, India (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

1) To evaluate our experience and curative effect of the combination of ultrasound guided endovenous Laser therapy (EVLT) and surgical detail separate ligation of each tributaries at S-F junction. 2) To review our experience with mean 7 years followup. 3) To compare our resultswitch reviewed literature.

**METHOD AND MATERIALS**

Over the period from Jan 2005 to Dec 2013, 118 patients with 135 limbs were identified to have symptomatic primary large varicose veins (Criteria was SF junction diameter > 10 mm and saphenous vein > 8mm) were treated with this combined approach. Separate surgical ligation of each tributary at SF junction followed by ultrasound guided EVLT of rests of the lower limb large tributaries, duplicated veins and short saphenous vein (SSV) done by using 980-nm pulse wave Laser. Superficial subcutaneous tumescent injection of saline toprvent skin complications was used. Principal outcome measures were abolition of reflux, cosmetic improvement and improvement in Aberdeen Varicose Veins Symptome Score (AVVSS) . Future followup on duplex ultrasound at week 1 , months 1, 3, 6 then yearly for mean of 7 years.

**RESULTS**

The procedure was technically successful in all cases. Spot skin burns in 2, short term peri ankle parasthesia in 25, recurrent minor tributaries and spider veins in 12, 4 patients developed new parallel GSV. 2patient developed significant recurrence. All results were much better than only laser or only surgical or other combined methods reviewed in literature.

**CONCLUSION**

This combination therapy of intervention radiology and local surgery in treatment of large primary varicose veins appears to be very
This combination therapy of intervention radiology and local surgery in treatment of large primary varicose veins appears to be very effective and safe approach. Its long term outcome is more superior and well accepted by patients than the other traditional methods compared from literature.

CLINICAL RELEVANCE/APPLICATION

Combined surgical and endovenous approach appears promising in good outcome in large primary varicose veins treatments. Large primary varicose veins of both lower limbs are often associated with Sephano-femoral (S-F) junction diameter and saphenous vein diameter larger than 10 mm with multiple large varicose tributaries. These are notorious for recurrence even after intervention or surgical treatment. Hence combined intervention radiological and surgical approach was selected to obtain the best long term results.
**SSA24**

**Vascular/Interventional (Hepatobiliary Interventions)**

Sunday, Nov. 29 10:45AM - 12:15PM Location: E352

**GI IR**

**AMA PRA Category 1 Credits ™:** 1.50  
**ARRT Category A+ Credits:** 1.50  
**FDA**  
Discussions may include off-label uses.

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**Participants**

Wael E. Saad, MBBCh, Ann Arbor, MI (Moderator)  
Research Grant, Siemens AG; Consultant, Siemens AG; Consultant, Boston Scientific Corporation; Consultant, Medtronic, Inc.; Consultant, Getinge AB; Consultant, Merit Medical Systems, Inc;  
Hyeon Yu, MD, Chapel Hill, NC (Moderator)  
Nothing to Disclose

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**SSA24-01 Percutaneous Biliary Drainage Catheters Fluid Dynamics: In Vitro Flow Rates and Patterns**

Sunday, Nov. 29 10:45AM - 10:55AM Location: E352

**Participants**

Anna Y. Li, BA, Shreveport, LA (Presenter)  
Nothing to Disclose  
David H. Ballard, MD, Shreveport, LA (Abstract Co-Author)  
Nothing to Disclose  
Horacio R. D’Agostino, MD, FACR, Shreveport, LA (Abstract Co-Author)  
Inventor, Vibrynt, Inc  
Consultant, Boston Scientific Corporation  
Speaker, Cook Group Incorporated

**PURPOSE**

The purpose of our study was to evaluate the flow rates and patterns of simulated bile through drainage catheters in an in vitro biliary system model.

**METHOD AND MATERIALS**

The in vitro model consisted of a manometer-monitored constant pressure chamber containing simulated bile connected to a biliary tree made from airline and heat shrink cable tubing. Three types of 12-French drainage catheters (Cook Medical, Bloomington, IN) were inserted through a “T” shaped sidearm in the biliary tree section of the model: biliary (32 sideholes along the shaft and locking pigtail), pigtail (6 sideholes within the pigtail), and a prototype pigtail catheter with a single sidehole in the catheter mid-shaft. Simulated bile at 4 different viscosities (guar gum solutions in water determined by a rotational viscometer to be in the range of human bile viscosity) flowed through the system under a constant pressure of 12 cm of water. A circumferential occlusion device was used to occlude distal flow. Flow volumes through each catheter were recorded over 1-minute intervals with the “common bile duct” unobstructed or obstructed. Ten trials were performed for each catheter and flow rates compared using Student’s t-test.

**RESULTS**

Without obstruction, there was no significant difference in the flow rates between all catheters tested. With obstruction, there was no significant difference in the flow rates between the prototype and standard biliary catheters while no flow was observed with the pigtail catheter. Fluid was seen flowing along the external shaft of all unobstructed catheters. In the obstructed prototype and biliary catheters, fluid was seen to exit from the sidehole(s) proximal to the obstruction and out of the distal sideholes.

**CONCLUSION**

Our data suggest that biliary drainage may be achieved with fewer sideholes proximal to the obstruction. Similar flow rates were obtained with multiple sideholes as compared to one proximal sidehole.

**CLINICAL RELEVANCE/APPLICATION**

Biliary catheters with multiple sideholes do not improve flow rates and may facilitate encrustation with debris that could lead to catheter obstruction and sepsis. Catheters with one or fewer sideholes may achieve the same flow rate while reducing the likelihood of catheter obstruction.

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**SSA24-02 Benign Biliary Strictures Treated Using Biodegradable Biliary Stents: Multicentric Data Analysis on 99 Patients**

Sunday, Nov. 29 10:55AM - 11:05AM Location: E352

**Participants**

Giovanni Mauri, MD, San Donato Milanese, Italy (Presenter)  
Consultant, Esaote SpA  
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Nothing to Disclose  
Fabio Melchiorre, MD, Milan, Italy (Abstract Co-Author)  
Nothing to Disclose  
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Nothing to Disclose  
Vittorio Pedicini, Napoli, Italy (Abstract Co-Author)  
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Jiri Panek, Brno, Czech Republic (Abstract Co-Author)  
Nothing to Disclose  
Tomáš Andrasina, MD, PhD, Brno, Czech Republic (Abstract Co-Author)  
Nothing to Disclose

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Mariano J. Gimenez Sr, MD, La Plata, Argentina (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

to assess the mid-term outcome of biodegradable biliary stents (BBS) to treat benign biliary strictures.

**METHOD AND MATERIALS**

Institutional Review Board approval was obtained and patients' consent was waived. Between 2007 and 2014, ninety-nine patients (mean age 57±16 years [mean±standard deviation]), 57 males (61±15 years), 42 females (54±17 years), were treated. Technical feasibility, technical success, and immediate complications were recorded. In 89 patients (51 males, 38 females, aged 57±17 years) with at least 6 months follow-up (mean follow-up 20.2±4.9 months), late complications, episodes of cholangitis, episodes of altered hepatic functional tests without symptoms of cholangitis, episodes of biliary stones, and development of imaging demonstrated biliary structure recurrence were recorded. Fisher's exact test, Mann-Whitney U test, and Cox regression model were used.

**RESULTS**

Stent implantation was feasible in 99/99 cases (100%). In 2/99 cases (2%), migration of the stent occurred immediately after deployment (technical success 98%). In 4/99 cases (4%), immediate mild haemobilia occurred. No major or late complications occurred. In 24/89 patients (26.9%) subsequent cholangitis occurred. 15/89 (16.8%) patients had episodes of altered hepatic functional tests without symptoms of cholangitis. Six out of 89 patients (6.7%) developed biliary stones. In 19/89 patients (21.3%), stricture recurrence occurred. The estimated mean time to stricture recurrence was 32.9 months (95% C.I 29.6-36.2 months).

**CONCLUSION**

Percutaneous placement of BBS is a feasible, safe and effective strategy to treat benign biliary strictures and may represent a further option for treating patients in whom standard percutaneous therapy failed.

**CLINICAL RELEVANCE/APPLICATION**

Percutaneous placement of BBS is a feasible, safe and effective strategy to treat benign biliary strictures, potentially representing a further option for treating patients in whom standard percutaneous therapy failed.

**SSA24-03 Interventional MRI-Guided Local Delivery of Agents into Swine Bile Duct Walls Using MR Compatible Needle-Integrated Balloon Catheter System**

Sunday, Nov. 29 11:05AM - 11:15AM Location: E352

**Participants**

Feng Zhang, MD, Seattle, WA (Presenter) Nothing to Disclose
Zhibin Bai, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Yaoping Shi, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Jianfeng Wang, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Yonggang Li, MD, Suzhou, China (Abstract Co-Author) Nothing to Disclose
Xiaoming Yang, MD, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the feasibility of interventional magnetic resonance imaging (MRI)-guided local agent delivery into pig common bile duct (CBD) walls using a newly-designed MR-compatible, needle-integrated balloon catheter system.

**METHOD AND MATERIALS**

We first designed a needle-integrated balloon catheter system that is comprised of a 22-G MR-compatible Chiba biopsy needle and a conventional 12mm×2cm balloon catheter. Under fluoroscopy guidance, a custom needle/balloon system was positioned into the target CBD via a transcholecystic access. T1-weighted MR imaging was used to localize and reposition the needle/balloon system in the target. A 0.5-mL mixture of motexafin gadolinium (MGd) and trypan blue dye as well as 5-fluorouracil (5-Fu) was delivered into the CBD wall through the needle/balloon system. Post-infusion T1-weighted MR imaging was obtained and contrast-to-noise ratios (CNR) of CBD walls of pre- and post-MGd/blue infusions were compared by a paired t-test. In addition, post-infusion x-ray cholangiography was achieved to evaluate the potential injuries of CBDs by the needle/balloon system. High-pressure liquid chromatography was used to quantify 5-FU in the bile duct tissue. Subsequent histologic analysis was performed to correlate and confirm the imaging findings.

**RESULTS**

Post-infusion cholangiogram didn't show any extravasation of contrast agent, indicating no procedure-related damage to the CBDs. MR imaging demonstrated the clear enhancement of the target bile duct walls infused with MGd/trypan blue dye with average penetration depth of 4.7±1.2mm. The average CNR of the post-infusion bile ducts was significantly higher than that of the pre-infusion bile ducts (110.6±22 vs 5.7±2.8, p<0.0001). Out of the total 5mg 5-Fu injected into the bile duct tissue, 4.1±0.12 mg 5-Fu were retrieved, proving an approximately 80% drug delivery efficiency. Histology depicted the blue dye staining and red fluorescence of MGd through the target CBD walls, which was well correlated with the imaging findings.

**CONCLUSION**

It is feasible to use the new MR compatible, needle-integrated balloon catheter system for intrabiliary local agent delivery into CBD walls under MR imaging guidance.

**CLINICAL RELEVANCE/APPLICATION**

This study may open new avenues for efficient management of pancreatobiliary malignancies using MR-guided interventional oncology.

**SSA24-04 Portal Vein Embolization via an Ipsilateral Approach is Safe and Effective**

Sunday, Nov. 29 11:15AM - 11:25AM Location: E352

**Participants**

Feng Zhang, MD, Seattle, WA (Presenter) Nothing to Disclose
Zhibin Bai, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Yaoping Shi, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Jianfeng Wang, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Yonggang Li, MD, Suzhou, China (Abstract Co-Author) Nothing to Disclose
Xiaoming Yang, MD, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the feasibility of interventional magnetic resonance imaging (MRI)-guided local agent delivery into pig common bile duct (CBD) walls using a newly-designed MR-compatible, needle-integrated balloon catheter system.
Liver failure represents the most severe post-operative complication of major hepatic resection. Our aim was to prospectively compare percutaneous portal vein embolization (PVE), portal vein ligation (PVL), and associating liver partition and portal vein ligation for staged hepatectomy (ALPPS) in terms of FLR hypertrophy, complications and clinical outcome.

METHOD AND MATERIALS

From January 2004 to January 2015, 118 patients with an inadequate FLR underwent procedures to induce preoperative hypertrophy before major liver resection. 73 patients underwent PVE, 27 underwent PVL and 18 ALPPS. PVE was percutaneously performed under US and fluoroscopy, with a 4-F catheter, using PVA particles, coils and glue. Total liver volume (TLV), tumor volume and FLR were calculated before both the procedure and surgery. The following outcome measures were considered: operating time, intraoperative blood losses, hospital stay, morbidity and mortality rate. Plasma samples were collected preoperatively and in 1st, 2nd and 5th postoperative day to assess liver function. Moreover, serum levels of white blood cells, C-reactive protein (CRP), Interleukin-6 (IL-6) and Endothelin-1 (ET-1) were determined as markers of inflammatory surgical stress.

RESULTS

The three groups were homogeneous in terms of pre-procedural volumes, comorbidities and histopathological findings. In ALPPS group, FLR mean hypertrophy was higher than PVE and PVL groups (PVE=5.45 ± 3.17 cc/day, PVL=5.59 ± 2.19 cc/day, ALPPS =21.03 ± 11.09 cc/day, p<0.05). A higher grade of severe complications was recorded in ALPPS group compared to PVE and PVL groups. Postoperative plasma levels of AST, ALT, WBC, CRP, IL-6 and ET-1 showed a higher increase after the first surgical stage in the ALPPS series compared with the same stage of patients subjected to PVE/PVL.

CONCLUSION

PVE and PVL are comparable in inducing FLR hypertrophy. ALPPS assures the possibility to obtain a higher rate of hypertrophy in a shorter time even if with an higher rate of complications. PVE is preferable to PVL in all cases of unrequired two stage hepatectomy. ALPPS should not be considered a substitute for PVE or PVL but rather a technique to expand the pool of resectable
Clinical Relevance/Application

Percutaneous PVE remains the first option to induce hypertrophy of the FLR in case of major hepatic resection. ALPPS should be proposed with caution in selected cases due to its high risk of complications.

Purpose

To identify fundamental causes underlying recurrent variceal hemorrhage (VH) following transjugular intrahepatic portosystemic shunt (TIPS) creation in order to ascertain opportunities for improvement of TIPS-based management of VH and rebleeding prevention.

Method and Materials

In this single-center retrospective study, 166 patients (M:F=101:65, median age 52 years, median MELD score 14) who underwent TIPS creation for VH between 1999-2014 were studied. Medical record review was used to detect patients who had recurrent VH events, and root cause analysis (RCA) allowed identification of most probable causal factors. A 5-person Interventional Radiology physician group then generated quality improvement (QI) recommendations for process changes to address causal factors, with consensus achieved using a modified Delphi method.

Results

Twenty-five (15%) patients suffered variceal rebleeding post-TIPS. The 1-, 3-, and 5-year variceal rebleeding incidence was 17%, 21%, and 21%. Variceal rebleeding was associated with high 90-day all-cause mortality incidence (10/25, 40%). Male gender (P=0.018) and MELD score (P=0.009) were statistically associated with variceal rebleeding. The most common primary and secondary causes of recurrent VH were lack of or insufficient variceal embolization (48%, 12/25) and coagulopathy (44%, 11/25). Other causal factors included TIPS stenosis or occlusion (n=8) with recurrent portosystemic pressure gradient (PSG) elevation (n=5), inadequate PSG reduction (n=3), and TIPS under dilation (n=1). Fourteen preventative QI recommendations, spanning items related to TIPS portal venous puncture, venographic assessment, stent type and deployment technique, PSG reduction, embolotherapy methodology, and coagulopathy correction, were developed to potentially address variceal rebleeding.

Conclusion

While recurrent VH rates following TIPS are non-trivial, rebleeding may be related to addressable underlying causal factors. Further investigation may assess the efficacy of QI-based procedure methodological enhancements in reducing post-TIPS rebleeding incidence.

Clinical Relevance/Application

Root cause analysis based identification of fundamental reasons underlying recurrent variceal hemorrhage after TIPS creation may help reduce the significant morbidity and mortality associated with this condition by targeting causal factors for correction through quality improvement measures.
because of severe thrombocytopenia, pancytopenia or recurrent bleeding from other sites than varices (n=5) and thrombocytopenia associated with hepatic encephalopathy (n=3). TIPS was carried out for the secondary prevention of variceal bleeding (n=6), refractory ascites (n=6) and portal venous thrombosis (n=1). The PPG decreased from 15.2 ± 3.7 mm Hg before PSE to 11.8 ± 4.0 mm Hg after PSE. This allowed limiting the TIPS size to 6 mm in 7 patients. The PPG was 6.3 ± 2.1 mm Hg after the TIPS placement. The platelet count increased from 52 ± 27 G/L before PSE to 209 ± 109 G/L two months after the combined therapy. After the procedure, there was one splenic abscess leading to death, one splenic hematoma and one hepatic abscess and three cases of transient hepatic encephalopathy.

CONCLUSION

Our study evaluated the hemodynamic effects of this combined therapy. It showed that PSE decreases the PPG and can allow the creation of a smaller caliber TIPS.

CLINICAL RELEVANCE/APPLICATION

Randomized controlled studies are needed to evaluate the possible benefits of this combined therapy over encephalopathy and complications of splanchnic hemodynamic stress in patients with PH and hypersplenism undergoing TIPS placement.

SSA24-08 The Effect of Locoregional Therapies and Transjugular Intrahepatic Portosystemic Shunting for Hepatocellular Carcinoma (HCC) Liver Transplant Patients: A UNOS Population Study

Sunday, Nov. 29 11:55AM - 12:05PM Location: E352

Participants
Minzhi Xing, MD, New Haven, CT (Presenter) Nothing to Disclose
Hyun S. Kim, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate the utility of bridging locoregional therapies (LRT) and transjugular intrahepatic portosystemic shunts (TIPS) in HCC patients undergoing orthotopic liver transplant (OLT) and its effect on survival outcomes in a national population study.

METHOD AND MATERIALS

The United Network for Organ Sharing (UNOS) database was used to identify patients who were listed for OLT from 2002 to 2013 and followed through 2014. Patients within the Milan Criteria with approved HCC Model for End-Stage Liver Disease (MELD) exception and available pre-OLT TIPS placement data were included. Overall survival (OS) from OLT was stratified by TIPS status and bridging LRT (including transarterial chemoembolization (TACE), radiofrequency ablation (RFA) and cryoablation). Chi-squared tests were used to compare categorical variables and t-tests to compare continuous variables. Kaplan-Meier estimation and log-rank test were used for survival analysis.

RESULTS

Of 17,291 HCC patients who were listed for OLT during the study period, 14,511 patients received OLT, of whom 13,299 patients had adequate pre-OLT TIPS placement data, mean age 57.5 years, 77.1% male; 616 (4.6%) patients received pre-OLT TIPS, and 6,358 patients received at least one LRT. Comparison groups were similar for age at OLT, waitlist duration, gender, ethnicity, BMI, Child and MELD scores (p>0.05 for all). No significant differences in survival from OLT were observed between patients who received pre-OLT TIPS (mean 108.6 months) vs. those who did not (118.9 months), p=0.84. TIPS Patients who received at least one bridging LRT had significantly higher mean survival vs. those who received no bridging LRT (106.1 vs. 102.5 months, p=0.03).

CONCLUSION

In a national population study, OS from transplant in HCC patients was not significantly affected by pre-OLT TIPS placement status. TIPS Patients who received at least one bridging locoregional therapy had significantly improved post-OLT survival compared to those who did not.

CLINICAL RELEVANCE/APPLICATION

Pre-OLT TIPS for HCC patients may be safely performed without significant impact on post-OLT survival. Bridging LRT may improve post-OLT survival in HCC patients who require TIPS placement.

SSA24-09 Outcomes in Transjugular Intrahepatic Portosystemic Shunting for Liver Transplant Patients: A UNOS Population Study

Sunday, Nov. 29 12:05PM - 12:15PM Location: E352

Participants
Minzhi Xing, MD, New Haven, CT (Presenter) Nothing to Disclose
Hyun S. Kim, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate the utility of pre-transplant transjugular intrahepatic portosystemic shunts (TIPS) in patients undergoing orthotopic liver transplant (OLT) and its effect on survival outcomes in a national population study.

METHOD AND MATERIALS

The United Network for Organ Sharing (UNOS) database was used to identify patients who were listed for OLT from 2002 to 2013 and followed through 2014. Patients within the Milan Criteria for whom pre-OLT TIPS placement data was available were included. Overall survival (OS) from OLT was stratified by TIPS status, and differences in TIPS placement rates and survival between geographic regions were analyzed. Chi-squared tests were used to compare categorical variables and t-tests to compare continuous variables. Kaplan-Meier estimation and log-rank test were used for survival analysis; Pearson coefficient was used to calculate correlation between variables.

RESULTS

Of 154,626 patients who were listed for OLT during the study period, 71,733 patients received OLT, of whom 69,686 patients had
pre-OLT TIPS placement data, mean age 48.9 years, 67.4% male; 5,304 (7.6%) patients received pre-OLT TIPS. Comparison groups were similar for age at OLT, waitlist duration, gender, ethnicity, BMI, Child and MELD scores (p>0.05 for all). No significant differences in survival from OLT were observed between patients who received pre-OLT TIPS (mean 112.9 months) vs. those who did not (123.6 months), p=0.07. There were significant regional and geographic differences in TIPS placement rates (range 1.9-12.24%, p<0.001) and mean OS from OLT (range 36.3-101.9 months, p<0.001). Increasing longitudinal 12-month OS rates were observed in both TIPS and non-TIPS patients from 2002-2012.

CONCLUSION

In a national population study, OS from transplant was not significantly affected by pre-OLT TIPS placement status. Increasing longitudinal trends in 12-month post-OLT survival and significant geographic disparities in TIPS placement rates and survival from OLT were observed.

CLINICAL RELEVANCE/APPLICATION

Pre-OLT TIPS may be safely performed without significant impact on post-OLT survival.
The ability to predict and reduce toxicities by applying a learning health system (LHS) model is thus an important goal. The quality of life (QOL) of irradiated head and neck cancer (HNC) patients is significantly limited by toxicities leading to weight loss. The purpose of this study was to determine the impact of patient and tumor characteristics on time-to-treatment (TTT) from diagnosis in HNC patients treated with curative intent radiation therapy (RT).

**Materials/Methods:** From August 2004 to May 2011, 131 non-metastatic and non-recurrent biopsy proven HNC patients completed definitive RT at an urban academic safety net hospital. Patient and tumor factors examined included: race/ethnicity (Black, White, Hispanic, Other), English proficiency (English proficient, EP), Limited English proficient, LEP), marital status (Married, Non-married), insurance coverage (Private/Medicare, Medicaid/Free care), age at diagnosis (years) (median, 50) and AJCC stage (stage I-III versus stage IV). TTT was calculated from date of biopsy to date of first treatment received (surgery, induction chemotherapy/IC, radiotherapy alone/RT or concurrent radiotherapy/CCRT). Analysis of Variance was performed using SAS version 9.1 to determine the drivers of TTT. Data were analyzed using a 0.05 level of significance. Results: The median TTT was 41 days (range 6-249 days). Surgery, IC, RT or CCRT was the first treatment received in 45 (34.4%), 22 (16.8%), 13 (9.9%) and 51 (38.9%) patients, respectively. TTT did not differ by first treatment received (time to surgery 48 days, time to IC 47 days, time to RT 40 days and time to CCRT 51 days, P=0.802. No statistically significant differences in TTT were noted for gender (P=0.637), race/ethnicity (P=0.996), marital status (P=0.737), insurance coverage (P=0.836), age at diagnosis (P=0.571), and AJCC stage (P=0.889). TTT among EP and LEP patients was 46 and 57 days, respectively (P=0.197). Conclusion: Limited English proficient patients had longer TTT compared to EP, although this result failed to reach statistical significance. Other patient and tumor factors were not found to be predictive of TTT.

**MSRO25-03 Prediction of Weight Loss in Irradiated Head and Neck Cancer Patients Based on the Clinical and Dosimetric Big Data**

**Participants**
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Harry Quon, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

**Purpose**
The quality of life (QOL) of irradiated head and neck cancer (HNC) patients is significantly limited by toxicities leading to weight loss. The ability to predict and reduce toxicities by applying a learning health system (LHS) model is thus an important goal. The
The aim of this study is to determine the predictors for weight loss based on the outcomes of similar patients previously treated with radiation therapy (RT) to develop a real-time clinical decision-support system.

METHOD AND MATERIALS

From a database of systematically captured prospective data elements, NCI-CTCAEv4.0 toxicity assessments and all aspects of RT planning, 326 HNC patients with longitudinal records from 2007 to 2014 were identified. The records consisted of 2,985 variables, including planned dose-volume histogram at 1% volume increments (2,020 variables), distance between planning target volume (PTV) and organs at risk, diagnostic ICD-9 code, QOL and toxicities during treatment. Weight loss of 5kg or more at 3 months post-RT was predicted by the Classification and Regression Trees algorithm. Two different prediction models at the time of RT planning and at the end of treatment were developed.

RESULTS

Weight loss predictors during treatment were 1) patient reported outcome of oral intake, 2) ICD-9 code, N stage, 3) nausea, esophagitis/pharyngitis, skin toxicity, pain intensity, 4) dose to larynx, parotid, cricopharyngeal muscle and 5) minimum distance between low dose PTV and larynx. The weight loss prediction at RT planning was also developed excluding assessment variables during treatment. The sensitivity of the model at treatment / RT planning was 0.988 / 0.860 and the positive predictive value (PPV) was 0.467 / 0.451 respectively.

CONCLUSION

The informatics framework combined with data mining tools can facilitate large-scale analysis predicting for weight loss and is encouraging for the development of a LHS model to reduce the risk of toxicities. The two prediction models at RT planning / treatment show the potential for a real-time decision-support based on the incremental data collection in each patient’s RT course. Given the importance of diagnostic modality, we believe that incorporation of imaging features is an important next step to improve PPV.

CLINICAL RELEVANCE/APPLICATION

The weight loss prediction model at RT planning / treatment can support decisions regarding treatment planning and toxicity management during treatment.

MSR025-04 Short Treatment Time and Excellent Treatment Outcome in Accelerated Hyperfractionated Radiation Therapy for T1 Glottic Cancer

Monday, Nov. 30 11:00AM - 11:10AM Location: S103CD

Participants
Yukishita Tamaki, MD, Izumo, Japan (Presenter) Nothing to Disclose
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ABSTRACT

Purpose/Objective(s): Accelerated hyperfractionated radiotherapy was performed as treatment for patients with T1 glottic cancer, and its utility was evaluated based on treatment outcomes and adverse effects. Materials/Methods: Subjects were 58 men (median age, 70 years) who underwent radiotherapy at a University Hospital between January 2000 and November 2013. Tumor classification was Tis (6.9%) in 4 patients, T1a (65.5%) in 38, and T1b (27.6%) in 16. Histological examination revealed squamous cell carcinoma in the majority of cases (55 patients, 94.8%). Travel time from home to hospital was 2 h for 25 patients (43.1%). Laser vaporization was performed prior to radiotherapy in 38 patients (65.5%), and 19 patients (32.8%) received concurrent chemotherapy with an agent such as S-1. Patients were irradiated twice daily (morning and evening) using an irradiation container. Most patients received a dose of 1.5 Gy/fraction up to a total of 60 Gy. Results: The median overall treatment time was 30 days (range, 26–45 days), with a median observation period of 59.6 months. After completion of radiotherapy, a complete response was observed in all patients. The overall 5-year and 7-year survival rates were 93.2% and 82.2%, respectively. The 5-year and 7-year disease-free survival rates were 93.2% and 82.2%, respectively. The 5-year and 7-year local control rates were both 97.8%. Seven patients died either of other cancer (3/7) or disease (4/7), with no death due to glottic cancer or treatment-related causes. Although grade 3 pharyngeal mucositis was observed in 2 (3.4%) patients, there were no other grade 3 or higher acute adverse events. As late toxicity, grade 2 laryngeal edema and grade 1 laryngeal hemorrhage were observed in 1 patient each, but no serious events such as laryngeal necrosis or laryngeal stenosis were observed. Conclusion: The outcome of accelerated hyperfractionated radiotherapy for T1 glottic cancer was excellent, and the adverse events were acceptable. The present treatment method will substantially reduce the treatment duration among patients who need to stay at nearby hotels while undergoing treatment at hospitals in rural areas.

MSR025-05 Are Contouring Time and Multimodality Imaging Prognostic Factors for Radiation Therapy of Head and Neck Cancer?

Monday, Nov. 30 11:10AM - 11:20AM Location: S103CD

Participants
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ABSTRACT

Purpose/Objective(s): Are Contouring Time and Multimodality Imaging Prognostic Factors for Radiation Therapy of Head and Neck Cancer?
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PURPOSE
In the DEGRO-Quiro Trials correlation of clinical outcome with contouring time in the planning process of radiation therapy and the amount of multimodality imaging has not been analyzed. To evaluate if contouring time and multimodality imaging are prognostic factors for radiation therapy of advanced head and neck cancer 207 patients were analyzed retrospectively between 2001 and 2012.

METHOD AND MATERIALS
Before 2007 radiation treatment planning CT was done without contrast enhancement, MR imaging and 18F-FDG PET/CT as additional imaging modalities were used only occasionally. From 2007 contrast enhanced planning CT in addition to multimodality imaging consisting of MR imaging (including DWI and ADC) and 18F-FDG PET/CT was used routinely for every head and neck cancer patient. Additionally, in unclear or equivocal imaging findings of lymph nodes a re-report was performed with a higher sensitivity at the expense of specificity to minimize geographical miss in the contouring procedure for radiation treatment and to maximize the binary decision for each lymph node (malignant vs benign). The re-reports were done in conjunction with radiooncologists, nuclear physicists and radiologists. The mean contouring time was 60 min before 2007 and 150 min after 2007 (Including the time of a re-report). Clinical outcome (local, regional and locoregional control) of advanced oropharyngeal, laryngeal and hypopharyngeal cancers with lymph node metastases was assessed in two groups (group I: 2001-2007 vs group II: 2008-2012).

RESULTS
Group I: n=113, group II: n=94. Regional recurrence was significantly reduced in group II (log-rank-test p = 0.03. regional control after 1, 2 and 3 years was 88%, 79% and 76%, respectively as compared to 95%, 92% and 88%, retrospectively. Locoregional control for 207 patients shows no difference in survival (p = 0.08), inclusion of 340 patients leads to a p-value p < 0.05.

CONCLUSION
Imaging findings of multimodality imaging and a critical re-report of these imaging findings in conjunction with a longer contouring time may have an impact on clinical outcome of advanced head and neck cancers. However, this overtime is not reimbursed.

CLINICAL RELEVANCE/APPLICATION
A close collaboration of radiooncologists, nuclear physicians and radiologists in the radiation treatment planning process may have a benefit for patients with advanced head and neck cancer.

MSRO25-06 Lessons from a Standardized Program Using PET-CT to Avoid Neck Dissection after Primary Radiation Therapy for N2 Squamous Cell Carcinoma of the Oropharynx: Beware the Late Recurrence and Salvage Is Unlikely

Monday, Nov. 30 11:20AM - 11:30AM Location: S103CD

Participants
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ABSTRACT
Purpose/Objective(s): To report the results of a standardized program using positron emission tomography (PET)-computed tomography (CT) approximately 12 weeks after primary radiotherapy to determine the need for a planned neck dissection in patients with radiographic N2 squamous cell carcinoma (SCC) of the oropharynx.Materials/Methods: Fifty consecutive patients with T1-4 and hemineck radiographic stage N2A-B SCC of the oropharynx for whom the only indication for planned neck dissection was a positive PET-CT performed ~12 weeks after completing primary treatment with radiotherapy. Endpoints to determine the value of 12-week PET-CT in identifying residual neck disease were pathologic status of planned neck dissection specimens and neck recurrence at any time during the follow-up period.Results: All patients at risk for neck recurrence at last follow-up had =1 year of follow-up after PET-CT (median, 2.0 years). Results of PET-CT to identify residual neck disease were as follows: Sensitivity and positive predictive value: 0% (zero true positive) Specificity: 89% (4 False Negatives), and negative predictive value: 91% Potential neck recurrence from using this 12-week PET-CT program: 2% (Three of 4 neck recurrences would not have been prevented by historic approaches.) Time between negative PET-CT and detection of neck recurrence was 0.8, 0.9, 2.4, and 2.7 years. Rate of successful (>1 year) salvage of neck recurrence: 25% (1/4).Conclusion: PET-CT approximately 12 weeks after radiotherapy for oropharyngeal cancer is an excellent way to identify patients who do not need neck dissection, but low-risk is not no-risk. Approximately half of neck recurrences present over 2 years after negative PET-CT and the chance of successful salvage is low. Accurate results for this kind of program will require long-term follow-up and support a policy of frequent neck imaging for years in patients with N2 oropharyngeal cancer who do not undergo neck dissection after primary treatment with radiotherapy.

MSRO25-07 Megavoltage Radiation Therapy of Skin Malignancies of the Nose Using Custom Nasal Paraffin Bolus

Monday, Nov. 30 11:30AM - 11:40AM Location: S103CD

Participants
Randy Wei, MD, Orange, CA (Presenter) Nothing to Disclose
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Samar Azawi, MD, Long Beach, CA (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): To treat surface malignancies, bolus materials are used to enhance the dose delivered at the surface and
to reduce hot and cold spots due to sharp surface irregularities and oblique incident angles. Radiation treatment of skin malignancies on the nose is challenging due to the irregular surface anatomy of the nose to which homogenous dose must be delivered. Materials/Methods: Superflab is a commonly used bolus material that is non-conformal for irregular surface contours of the nose making it difficult to reproducibly apply and maintain. Additionally, air gaps from non-conformal bolus will result in dose inhomogeneity. We present our experiences and outcomes using custom-made paraffin bolus to conform to the shape of the nose for the treatment of basal cell cancer (BCC) or squamous cell cancer (SCC). A mold of the patient’s nose was created and a negative impression made in a paraffin rectangle block. Minimum thickness was 1.5 cm laterally and 1 cm anterior-posteriorly. Thin coating of petroleum jelly was applied within bolus to reduce air gaps. Nine patients were treated to 60 Gy at 2 Gy per fraction with parallel opposing 6 MV photon beams using three-dimensional conformal treatment planning. Six patients had BCC and three patients had SCC. Six patients had two or more distinct sites of disease. Results show that 100% prescription isodose line conforms to the planned target volume and dose to critical structures are well below tolerance limits. Daily kilovoltage orthogonal and weekly cone beam CT show close patient and wax bolus contact and reproducibility. Six thermoluminescent dosimetry (TLD) chips (LIF) were used to measure doses deposited and matched the planned dosimetry for each patient. TLD measurements showed a 2.6% average difference between planned dose and delivered dose. Results: Of the 9 patients treated with this method, maximum hot spot was 102.7% (101.1%-104%) for all 9 plans. Mean follow-up time was 25 months (10 – 58 months). Of the 9 treated, two patients developed new lesions on the nose and one patient had recurrent disease at the columna. Acute side effects were erythema and congested nose. None of the patients developed RTOG Grade 3 skin toxicity immediately following radiation treatment. Followup visits reported no telangiectasia and good cosmetic outcomes. Conclusion: This study demonstrates a practical approach to radiotherapy of the nose which minimizes air gaps and daily setup variability, while achieving dose homogeneity with minimal hotspots.

MSRO25-08 Superior Carotid Artery Sparing by Proton Radiation Therapy Compared to IMRT/VMAT for Reirradiation of Locally Recurrent Cancers of the Base of Tongue

Participants
Upendra Parvathaneni, MBBS,FRANZCR, Seattle, WA (Presenter) Nothing to Disclose
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Kent McCabe, CMD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Jay J. Liao, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Salvage treatment options for isolated in-field local recurrences in the base of tongue (BOT) after previous radiotherapy (RT) are limited. Total glossectomy is extremely morbid and re irradiation (reRT) is often preferred in an attempt to preserve function. However, the close anatomical proximity of the carotid arteries to the BOT makes it difficult to avoid this structure with photon based conformal planning such as IMRT or VMAT. Adding radiation dose to a previously irradiated carotid artery may increase the risk of a carotid blow out, which is a fatal complication. Although a clear dose threshold for this complication has not been established, a treatment plan that delivers the least dose to the carotid would be preferred. We hypothesized that compared with photon based planning (IMRT/VMAT), proton radiotherapy (PRT) may decrease the dose to the carotids as there is no exit dose distal to the target, thereby limiting cumulative dose to surrounding organs at risk (OARs). We compared the dose to carotid arteries and other OARs with IMRT/VMAT versus PRT for two patients who had reRT for locally recurrent cancers of the tongue base.Materials/Methods: Comparative plans with photons using an IMRT or VMAT technique and PRT with uniform scanning or pencil beam scanning technique were generated for two patients on Eclipse and RayStation planning systems. Both patients had BOT recurrences that were located centrally within the high dose region of previous RT fields. They also received elective nodal RT for their initial BOT cancers and hence their carotid arteries were irradiated. The patients developed local recurrences after one and 3 years following initial RT. The BOT recurrences were treated to a dose of 66-72 Gy. Elective nodal RT was not given with reRT. Target cover and OAR doses, including dose to the carotid artery were evaluated by standard dose volume histograms. Results: In both patients, the proton plans spared the surrounding OARs including carotid arteries better than IMRT or VMAT photon plans. For patient 1, mean dose to both carotids was lower with protons (right, 3.0 vs 28.0 Gy; left, 4.8 vs 15.7 Gy). Dose to the spinal cord (max, 0 vs 14.9 Gy) was also lower with protons versus photons. Similarly, in patient 2, the proton plan had a lower mean dose to both carotids (right, 5.9 vs 15.9 Gy; left, 0.7 vs 8.1 Gy) and parotids (right, 1.6 vs 19.0 Gy; left, 0 vs 10.7 Gy). Both techniques provided adequate target coverage.Conclusion: Compared with conformal photon techniques such as IMRT/VMAT, proton radiotherapy reduces dose to previously irradiated carotid arteries and other surrounding OARs during treatment of recurrent cancers of the base of tongue. In the re irradiation setting, this advantage may translate to a reduced risk of a fatal carotid blow out. This case study suggests that proton therapy should be considered for reirradiation of locally recurrent tongue base cancers.

MSRO25-09 Hyperbaric Oxygen Therapy for Radiation Induced Toxicity: A Retrospective Review from a Single-Institution

Participants
Leah Katz, MD, MPH, New York, NY (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Adverse reaction (RT) side effects pose an important barrier to progress in the field of radiation oncology. While hyperbaric oxygen therapy (HBOT) is recognized as an effective treatment for RT side effects, in particular for osteoradionecrosis (ORN); many radiation oncologists fail to refer patients. We evaluated NYU’s HBOT experience over the past three years to assess its safety and efficacy in treating various RT toxicities. It is our hope that clinicians consider HBOT more frequently and develop a prophylactic referral pattern.Materials/Methods: A retrospective 3-year (2013-2015) chart review of a three years to assess its safety and efficacy in treating various RT toxicities. It is our hope that clinicians consider HBOT more frequently and develop a prophylactic referral pattern.Materials/Methods: A retrospective 3-year (2013-2015) chart review of a prospectively maintained database was performed. Thirty-three patients were evaluated with a median age of 62 (range 37-80), 16 F, 17 M.Sites of initial therapeutic RT included truncal and extremity soft tissue sarcoma (12 %), squamous cell and adenocarcinoma, anorectum (9 %), adenocystic vulvar cancer (3%), adenocarcinoma, prostate (12%), squamous cell carcinoma, head and neck (12%), adenocarcinoma, breast (6%), and squamous cell carcinoma, cervix (9%). RT induced toxicities were non-healing soft tissue wounds (39%), mandibular ORN (37%), radiation cystitis (15%), and rectal bladder fistula (3%). The median time from end of radiation therapy to HBOT initiation was 7 years, and median follow-up was 8 months. Patients were treated with a median of 35 HBOT treatments (range 5-90). All patients were treated at the NYU Hyperbaric Center with no adverse
Effects. Results: Each RT injury category was evaluated. Symptoms associated with RT soft tissue injury included chronic wound infection, vaginal bleeding/pain, rectal pain, dyspareunia, and perineal pain. 38% of patients had complete resolution of symptoms after HBOT alone, 31% underwent adjuvant flap closure with complete wound healing, and 31% experienced no wound healing. For radiation cystitis, 60% had complete symptom resolution within a one month period after HBOT. A single patient treated for a rectal bladder fistula enjoyed complete resolution of the fistula with cessation of rectal urine drainage within one month after HBOT. Patients with ORN of the mandible with BRONJ stage I experienced complete resolution of intraoral deficits. Patients with BRONJ stage 2 experienced complete resolution of infection after HBOT with adjuvant debridement. Patients with BRONJ stage 3 experienced complete fracture healing after HBO with adjuvant mandibulectomy. Conclusion: The NYU experience demonstrates both safety and efficacy in ameliorating symptoms and improving patient quality of life with various types of RT morbidity. Our data encourages early referral to HBOT in an effort to save patients time, medical costs, energy, and psychological stress associated with ineffective medical measures. This study encourages further research with longer follow-up to better define the benefit and durability of HBOT.
**PURPOSE**

T2-weighted magnetic resonance imaging (MRI) visualizes myocardial injuries that are different from late gadolinium enhancement (LGE). The aim of this study was to evaluate the distribution and clinical significance of myocardial hyperintensity on T2-weighted MRI (T2-high) in patients with two phenotypes of hypertrophic cardiomyopathy (HCM): asymmetrical septal HCM (ASH) and apical HCM (APH).

**METHOD AND MATERIALS**

Thirty-six ASH and 18 APH patients and their 864 myocardial segments based on the American Heart Association model were investigated using cardiac MRI. The two patient groups were age-matched. The distribution of T2-high was compared with that shown by LGE. The relationships between T2-high and the episode of unexpected syncope or nonsustained ventricular tachycardia and elevated troponin T levels were evaluated. In four patients with HCM, T2 values of the T2-high were quantitatively estimated with multi-echo spin-echo T2 mapping.

**RESULTS**

T2-high was observed in 18 segments (3.1%) in 13 ASH patients (36.1%) and in 12 segments (4.2%) in 8 APH patients (44.4%). One-third of T2-high was located outside LGE in ASH patients, and half of the T2-high was outside LGE in APH patients. The concordance of T2-high and LGE was moderate when analyzed on the per-patient basis (k = 0.47) and mild when analyzed on the per-segment basis (k = 0.30) in ASH. In APH, the concordance of T2-high and LGE was fair when analyzed on both the per-patient basis (k = 0.05) and per-segment basis (k = 0.20). In ASH patients, the presence of T2-high was significantly related to the episode of unexpected syncope (P = 0.016). T2-high had greater T2 values (mean, 61.1 ms) than the remote myocardium of HCM (mean, 47.3 ms) and the normal myocardium of 5 volunteers (mean, 47.4 ms).

**CONCLUSION**

T2-high reflects changes in myocardial water contents, which may be related to syncope associated with ASH. Because the T2-high is often localized outside the LGE area, T2-weighted MRI should be interpreted carefully in HCM.

**CLINICAL RELEVANCE/APPLICATION**

Myocardial hyperintensity on T2-weighted MRI, which may be related to syncope, should be investigated carefully in patients with hypertrophic cardiomyopathy.
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PURPOSE
Cardiac magnetic resonance (MR) can visualize inflammatory tissue changes in acute myocarditis. Several quantitative image-derived parameters have been described to enhance the diagnostic value of cardiac MR, but no direct comparison of all these techniques is available.

METHOD AND MATERIALS
34 patients with suspected acute myocarditis and 50 control subjects underwent cardiac MR. Cardiac MR protocol included quantitative assessment of T1 relaxation times using modified Look-Locker inversion recovery (MOLLI) and shortened MOLLI (ShMOLLI) acquisition schemes, extracellular volume fraction (ECV), T2 relaxation times, and longitudinal strain. Established Lake-Louise Criteria (LLC) consisting of T2-weighted signal intensity ratio (T2 ratio), early gadolinium enhancement ratio (EGEr) and late gadolinium enhancement (LGE) were assessed. Receiver operating characteristics analysis was performed to compare diagnostic performance.

RESULTS
Areas under the curve of native T1 (MOLLI: 0.95; ShMOLLI: 0.92) and T2 relaxation times (0.92) were higher compared to those of other cardiac MR parameters (T2 ratio: 0.71, EGEr: 0.71, LGE: 0.87, LLC: 0.89, ECV MOLLI: 0.77, ECV ShMOLLI: 0.80, longitudinal strain: 0.83). Combined with LGE each native mapping technique outperformed the diagnostic performance of LLC (P<0.01 respectively). A combination of native parameters (T1, T2 and longitudinal strain) significantly increased the diagnostic performance of cardiac MR compared to LLC without the need of contrast media application (0.99 vs. 0.89; P=0.002).

CONCLUSION
In patients suspected of having acute myocarditis, diagnostic performance of cardiac MR can be improved by implementation of quantitative cardiac MR parameters. Especially native mapping techniques have the potential to replace current LLC.

CLINICAL RELEVANCE/APPLICATION
Based on these study findings, an update to the Lake-Louise criteria with respect to quantitative CMR parameters may become necessary.

SSC01-03 Myocardial T1-mapping and T1-derived Extracellular Volume Fraction (ECV) in Patients with Chronic HIV Infection

Monday, Nov. 30 10:50AM - 11:00AM Location: SS02AB

Participants
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PURPOSE
Chronic HIV infection is associated with an increased risk for cardiovascular disease. Diffuse myocardial pathologies may noninvasively be assessed by quantitative cardiac magnetic resonance (CMR) using myocardial T1 mapping, and T1-derived extracellular volume fraction (ECV).

METHOD AND MATERIALS
The institutional review committee approved the study and all subjects gave informed consent prior to CMR. Patients with chronic HIV infection undergoing combination antiretroviral therapy and healthy controls were included in this study. All patients had no medical history of cardiac disease and no cardiac risk factors. CMR protocol at 3 Tesla (Ingenia, Philips Healthcare, The Netherlands) included common SSFP sequences, T2 STIR imaging, late gadolinium enhancement imaging, and a pre- and 10 minutes post-contrast 3-3-5 MOLLI scheme for myocardial T1 mapping. Hematocrit-corrected ECV was derived from the pre- and post-contrast T1 maps.

RESULTS
27 patients with HIV infection (age 49.1 ± 9.5 years) and 18 controls (age 40.6 ± 15.6 years) underwent CMR. Pre-contrast global T1 relaxations times were significantly prolonged in HIV patients compared to healthy controls (1116.1 ± 57.0 ms vs. 1075.1 ± 65.5 ms; P=0.033). Post-contrast T1 relaxation times were decreased (405.0 ± 50.5 ms vs. 455.7 ± 77.5 ms, P=0.007). ECV was higher in the HIV group compared to controls (25.8 ± 3.5 % vs. 22.4 ± 5.1 %, P=0.015). Left ventricular ejection fraction was lower in the HIV group (60.3 ± 6.6 % vs. 64.4 ± 5.4 %; P=0.038).

CONCLUSION
This study revealed signs of subtle myocardial disease (i.e. cardiac fibrosis) in asymptomatic HIV using quantitative myocardial T1 mapping analysis. Preclinical detection of myocardial involvement in HIV infection appears feasible and may allow for early risk factor modification.

CLINICAL RELEVANCE/APPLICATION
Myocardial T1 mapping might serve as a potential screening parameter for beginning cardiovascular disease in the course of HIV-infection.
Characteristics of Peak Systolic Longitudinal Strain Using Strain-encoded Magnetic Resonance in Patients with Hypertrophic Cardiomyopathy: Comparison with Healthy Subjects and Relationship with Late Gadolinium Enhancement and with Wall Thicknes

PURPOSE
To clarify characteristics of peak systolic longitudinal strain (PSLS) using strain-encoded cardiac magnetic resonance (SENC) in patients with hypertrophic cardiomyopathy (HCM) with normal left ventricular ejection fraction (LVEF)

METHOD AND MATERIALS
We retrospectively assessed 31 patients with HCM with LVEF ≥ 55% (20 men, 11 women; mean age 62.6 ± 12.3 years; mean LVEF 68.7 ± 8.6%) who underwent MR evaluation of late gadolinium enhancement (LGE) and PSLS using a 1.5 T-system in 2 hospitals between August 2012 and December 2014. For reference, we assessed the PSLS of 9 healthy control subjects. We compared the average segmental PSLS and the variability of segmental PSLS using 16-segment models between the HCM and control groups and then, in patients with HCM, directly correlated PSLS with corresponding myocardial wall thickness and compared PSLS with the percentage of area with LGE. We defined LGE as signal intensity (SI) 6 or more standard deviations (SDs) above the mean SI of normal myocardium, defined as the normal range of segmental PSLS as the average segmental LS ± 2 SD in controls, and used an expression of reduction of PSLS when the absolute value of PSLS was reduced more than 2 SD of that of controls.

RESULTS
The average segmental PSLS was significantly reduced (HCM, -14.8%; control, -19.5%; P < 0.0001) and significantly more inhomogeneous (SD of average PSLS: HCM, 6.2%; control, 3.3%; P < 0.0001) in the HCM group than controls. We identified LGE in 28 of 31 patients with HCM (90.3%) and 253 of 496 segments (51.0%). In HCM group, the PSLS correlated moderately with myocardial wall thickness (R = 0.53, P < 0.0001) and weakly with the percentage of area of LGE (R = 0.30, P < 0.0001). Defining the normal range of segmental PSLS as above, PSLS in the HCM group was reduced in segments with and without LGE (PSLS was reduced in 80 of 243 segments with no LGE).

CONCLUSION
The average PSLS was significantly reduced and inhomogeneous in those with HCM despite a normal LVEF. Segmental PSLS correlated moderately with wall thickness, and weak correlation with segmental LGE percentage was probably due to the presence of segments with reduced PSLS and no LGE.

CLINICAL RELEVANCE/APPLICATION
In patients with HCM and normal LVEF, peak systolic longitudinal strain was reduced and inhomogeneous compared to controls and reduced in thick myocardium and myocardium with and without LGE.

Relationship between Myocardial Markers and Myocardial Fibrosis of Hypertrophic Cardiomyopathy: Accessed by 3.0T Cardiac Magnetic Resonance

PURPOSE
To quantitatively detect myocardial fibrosis of hypertrophic cardiomyopathy (HCM) by 3.0 T cardiac magnetic resonance(CMR) Late gadolinium enhancement (LGE) technology, and get the relationship of LGE and myocardial markers, to investigate whether HCM patients' elevated myocardial markers are associated with myocardial fibrosis.

METHOD AND MATERIALS
34 HCM patients and 20 healthy volunteers were enrolled in this research. HCM patients and 20 healthy volunteers were underwent 3.0 T Cardiac Magnetic Resonance scanning, including short axis cine sequences and LGE sequences. Left ventricular function was obtained on short axis cine sequence. LGE parameters, including total LGE rate, total LGE volume and total LGE mass were detected on LGE sequences by commercial available software(cm42, Circle Cardiovascular Imaging Inc., Calgary, Canada) . Myocardial marker, including creatine kinase isoenzyme and troponin were detected. Independent sample t-test and Pearson correlation were used.

RESULTS
All myocardial markers of HCM patients were greater than clinical normal range. By LGE detection, LGE parameters of HCM group, including total LGE rate, total LGE volume and total LGE mass, were greater than normal control group (18.95±9.87 vs. 50.82±14.18; 8.50±4.50 vs.4.30±4.11; 9.00±4.80 vs.90.58±44.11, all P<0.05). Pearson correlation has been proved that creatine kinase isoenzyme of HCM patients were positively correlated to LGE rate and LGE volume (r=0.759, P=0.000; r=0.448, P=0.008). Troponin of HCM patients were also positively correlated to LGE rate and LGE volume (r=0.647, P=0.000; r=0.578, P=0.000).

CONCLUSION
Myocardial fibrosis of Hypertrophic Cardiomyopathy was quantitatively accessed by 3.0 T cardiac magnetic resonance late
gadolinium enhancement technologies. Creatine kinase isoenzyme and troponin of HCM patients were positively correlated to LGE. Myocardial fibrosis may induce myocardial markers in the myocardial cells releasing, which affect the myocardial metabolic function further and induced heart function damage eventually.

**CLINICAL RELEVANCE/APPLICATION**

CMR-LGE is a well-established tool for the assessment of myocardium fibrosis in patients with HCM. Creatine kinase isoenzyme and troponin of HCM patients were positively correlated to LGE. Myocardial fibrosis may induce myocardial markers in the myocardial cells releasing, which affect the myocardial metabolic function further and induced heart function damage eventually.

**SSC01-06** Magnetic Resonance Feature Tracking Derived Myocardial Strain Parameters: The Discriminative Power of Right Ventricular Strain Analysis in the Diagnosis of Acute Myocarditis

**METHOD AND MATERIALS**

CMR cine data of 34 patients with clinically suspected ACM and confirmation of diagnosis by CMR according to the Lake Louise criteria were retrospectively analyzed. 20 age-matched healthy volunteers (HV) served as a control. Analysis of global longitudinal, circumferential (circ.) and radial strain and strain rate (SR) of both ventricles was performed in one long-axis and three short-axis slices using a dedicated FT-software (TomTec). Statistical analysis was conducted using independent t-test, one-way ANOVA with tukey-type comparisons, multiple and multinominal logistic regression analyses, and ROC-analyses.

**RESULTS**

ACM patients showed significantly reduced LV longitudinal strain (-12.7 ± 1.1 vs. -16.8 ± 1.3 %, p = .022) and LV circ. strain (-22.9 ± 1.0 vs. -27.8 ± 1.0 %, p = .001) compared to HV. Conversely, they showed improved basal RV circ. SR (-0.70 ± 0.04 vs. -0.47 ± 0.07 s⁻¹, p = .008). In a multiple logistic regression model, LV circ. strain and RV basal circ. SR proved to be the best independent predictors of ACM with an AUC of 0.87 in ROC-analysis. In ACM patients with preserved LV ejection fraction (LV-EF), RV basal circ. SR (-0.76 ± 0.05 vs. -0.47 ± 0.07 s⁻¹, p = .005) was significantly increased compared to HV while LV strain parameters showed no significant differences between both groups. In multinominal logistic regression analysis, again LV circ. strain and RV basal circ. SR proved to be the best independent predictors of ACM when LV-EF is preserved with an AUC of 0.82 in ROC-analysis.

**CONCLUSION**

A combination of LV circ. strain and RV basal circ. SR is the best predictor for the presence of ACM, even in patients with preserved EF. Concurrently, the RV basal circ. SR appears to be particularly sensitive to alterations caused by ACM hinting at a potentially compensatory mechanism of basal RV hyperkinesia. Taken together, our results point to a discriminative power of RV strain analysis in the CMR-based diagnosis of ACM.

**CLINICAL RELEVANCE/APPLICATION**

ACM represents one of the most frequent causes of sudden cardiac death in young patients. Therefore, an improvement of the currently still challenging noninvasive diagnosis of ACM is highly desirable.

**SSC01-07** Quantification of Myocardial Fibrosis by LGE, Pre- / Post-contrast T1 and ECV in Patients with Hypertrophic Cardiomyopathy Referenced to Normal Appearing Myocardium and Healthy Volunteers

**METHOD AND MATERIALS**

CMR cine data of 34 patients with clinically suspected ACM and confirmation of diagnosis by CMR according to the Lake Louise criteria were retrospectively analyzed. 20 age-matched healthy volunteers (HV) served as a control. Analysis of global longitudinal, circumferential (circ.) and radial strain and strain rate (SR) of both ventricles was performed in one long-axis and three short-axis slices using a dedicated FT-software (TomTec). Statistical analysis was conducted using independent t-test, one-way ANOVA with tukey-type comparisons, multiple and multinominal logistic regression analyses, and ROC-analyses.

**RESULTS**

ACM patients showed significantly reduced LV longitudinal strain (-12.7 ± 1.1 vs. -16.8 ± 1.3 %, p = .022) and LV circ. strain (-22.9 ± 1.0 vs. -27.8 ± 1.0 %, p = .001) compared to HV. Conversely, they showed improved basal RV circ. SR (-0.70 ± 0.04 vs. -0.47 ± 0.07 s⁻¹, p = .008). In a multiple logistic regression model, LV circ. strain and RV basal circ. SR proved to be the best independent predictors of ACM with an AUC of 0.87 in ROC-analysis. In ACM patients with preserved LV ejection fraction (LV-EF), RV basal circ. SR (-0.76 ± 0.05 vs. -0.47 ± 0.07 s⁻¹, p = .005) was significantly increased compared to HV while LV strain parameters showed no significant differences between both groups. In multinominal logistic regression analysis, again LV circ. strain and RV basal circ. SR proved to be the best independent predictors of ACM when LV-EF is preserved with an AUC of 0.82 in ROC-analysis.

**CONCLUSION**

A combination of LV circ. strain and RV basal circ. SR is the best predictor for the presence of ACM, even in patients with preserved EF. Concurrently, the RV basal circ. SR appears to be particularly sensitive to alterations caused by ACM hinting at a potentially compensatory mechanism of basal RV hyperkinesia. Taken together, our results point to a discriminative power of RV strain analysis in the CMR-based diagnosis of ACM.

**CLINICAL RELEVANCE/APPLICATION**

ACM represents one of the most frequent causes of sudden cardiac death in young patients. Therefore, an improvement of the currently still challenging noninvasive diagnosis of ACM is highly desirable.
Can Native T1 Mapping Distinguish between Infarct Area and Area-at-Risk in Patients between Acute ST-elevation Myocardial Infarction?

**PURPOSE**

Cardiac Magnetic Resonance (CMR) has been established as the reference standard for in vivo identification and assessment of myocardial damage in acute myocardial infarction (AMI). Conventional CMR approach required a combined evaluation of myocardial edema and necrosis by using respectively T2-weighted sequences and late gadolinium enhanced (LGE) imaging. However the standard acquisition protocol for AMI is time-consuming (about 40-50 minutes), poorly tolerated by patients in inadequate clinical conditions and needs of the administration of contrast agent. Novel T1 mapping technique offers a pixel-by-pixel calculation of tissue T1 relaxation time determined by water content and cellularity. Our purpose was to investigate the capability of native T1 mapping to differentiate infarcted area, healthy myocardium and area-at-risk using conventional CMR sequences as reference in patients with AMI.

**METHOD AND MATERIALS**

Twenty consecutive patients performed CMR within the first 7 days following STEMI. CMR protocol included MOLLI, STIR T2w and cineMR sequences. IR-TSE T1w images were acquired for LGE after gadobenate dimeglumine (Gd-BOPTA, Bracco) administration. MOLLI images were analyzed with a dedicated software (Cvi42, Circle) by placing four ROIs within necrotic areas (LGE area, excluding microvascular obstruction area), area-at-risk (hyperintense area on STIR images without LGE) and in the remote myocardium. Acquisition time of each sequence was measured. Results are expressed on mean±SD and compared with Student’s t test.

**RESULTS**

The mean T1 native value of all patients (age 54±9yrs, 68% male) was 1317±66ms in the necrotic area (LGE+/MVO-), 1149±57ms in the area-at-risk (LGE-/STIR+) and 952±76ms in remote myocardium (LGE-/STIR-). Significant differences were found in the comparison of T1 values between all regions (p<0.01 for all). Infarct size was 25±12% of left ventricular mass. Acquisition time of CMR protocol including only localizer, native MOLLI sequence and cineMR was 22.4±8.7min; acquisition time of standard CMR protocol (including localizer,STIR,cineMR and LGE) was 45.4±9.5min; p<0.01.

**CONCLUSION**

Native T1 mapping may reliably distinguish between necrotic area and area-at-risk after AMI.

**CLINICAL RELEVANCE/APPLICATION**

Native T1 mapping might offer a complete assessment of myocardial injury after AMI in shorter time and without contrast injection compared to conventional CMR approach.
Dynamic CT myocardial perfusion (CTP) uses a consecutive series of acquisitions in which the distribution of the contrast media over the myocardium is measured. By measuring time-attenuation curves and the arterial input function, the myocardial blood flow (MBF) can be computed. The examination is performed in a pharmacological hyperemic state. The subendocardium is known to be more susceptible for ischemia due to the wavefront phenomenon. One of the advantages of CTP compared with other modalities is the high spatial resolution, allowing for distinguishing the subendocardium and subepicardium. In this study the subendocardial and subepicardial perfusion are investigated for normal and ischemic territories, defined by invasive fractional flow reserve (FFR).

**METHOD AND MATERIALS**

For this study 43 patients, 94 vessels territories were analyzed. Short axis slices of MBF were reconstructed from dynamic CTP. Blinded to the invasive FFR outcomes the MBF was measured in the subendocardium and subepicardium within the suspected perfusion defect. Ischemic and normal territories were defined by invasive FFR, applying a threshold of ≤0.80 for ischemic territories.

**RESULTS**

Of the 94 vessels 48 were ischemic with an invasive FFR ≤0.80. The mean subendocardium MBF was 67 ±30 in the ischemic and 88 ±38 ml/100ml/min in the normal territories. Compared with a subepicardium MBF of 80 ±22 in the ischemic and 92 ±29 ml/100ml/min in normal territories (figure 1). The area under the receiver operator curve for MBF as a diagnostic determinant for ischemia was larger for the subendocardium (0.71) compared with subepicardium (0.63).

**CONCLUSION**

Dynamic CT perfusion allows for measurement of the MBF in the subendocardium and subepicardium. The subendocardium is more susceptible for ischemia and MBF measurements in that region perform better for the detection of hemodynamically significant coronary artery disease.

**CLINICAL RELEVANCE/APPLICATION**

The susceptibility of the subendocardium for ischemia could be utilized by dynamic CT myocardial perfusion.

**S6C02-03 Myocardium: Dynamic CT Perfusion Imaging: A Comparison to Coronary Angiography/FFR and to MR First Pass Perfusion Imaging**

**METHOD AND MATERIALS**

This study was approved by the institutional review board and the Federal Radiation Safety Council (Bundesamt für Strahlenschutz). All patients provided written informed consent. Thirty-two consecutive patients in adenosine stress conditions underwent dynamic CT perfusion imaging (14 consecutive data sets) performed by using a 256-section scanner with an 8-cm detector and without table movement. Myocardial blood flow (MBF) was determined quantitatively. Results were compared with those of coronary angiography and FFR measurement by using a receiver operating characteristic (ROC) analysis. In addition results were compared to MR first pass perfusion imaging under adenosine and at rest. For evaluation of MR perfusion imaging the myocardial perfusion reserve index was calculated derived from the ratio of the parameter upslope determined under the stress and the rest conditions. In addition, threshold values based on the Youden index and sensitivity and specificity were calculated.

**RESULTS**

The comparison of CTP with the invasive reference method coronary angiography and FFR showed an area under the ROC curve, a sensitivity, and a specificity of 0.86, 75.9% (95% CI: 56.5%, 89.7%), and 100% (95% CI: 94.6%, 100%) for the quantitative parameter MBF. The thresholds determined by using the Youden index was 1.64 mL/g/min. The comparison to MR perfusion imaging showed an area under the ROC curve, a sensitivity and a specificity of 0.90, 83.3 % (95% CI: 63.5%, 92.7%), 86.6 % (95% CI: 70.2 %, 93.2 %).

**CONCLUSION**

Dynamic CT perfusion imaging of the myocardium using the quantitative parameter MBF shows a similar diagnostic accuracy, when
compared to the invasive reference methods coronary angiography and FFR and when compared to MR first pass perfusion imaging of the myocardium.

**CLINICAL RELEVANCE/APPLICATION**

Dynamic CT Perfusion imaging shows a high diagnostic accuracy and may be used in addition to CTA in order to improve the specificity and/or the positive predictive value in patients with a high pretest probability.

**SSC02-04 Diffusion Weighted Images: New Application in the Evaluation of Myocardial Infarction and Microvascular Obstruction**

**PURPOSE**

CMR is one of the most accurate tool for myocardial damage evaluation after STEMI; LGE and STIR sequences are routinely used, even if STIR may suffer from some limitations. Aim of our study is to explore the potential role of Diffusion Weighted Imaging(DWI), in the detection of myocardial infarction and microvascular obstruction(MVO), in comparison with standard-reference sequences.

**METHOD AND MATERIALS**

STEMI patients underwent PCI and CMR within 5 days from the acute event with DWI(b= 0, 100, 300, 500), perfusion, LGE and STIR.Infarction walls involvement(apex, septal, anterior, lateral and inferior wall) and MVO presence were analyzed by two blinded observers; inter-observer reproducibility was assessed. DWI findings were compared to LGE as standard reference for the detection of the infarcted area, STIR for edema and perfusion for MVO. DWI sensitivity(Se) and specificity(Sp) in MVO detection were calculated; DWI-MVO was related with others CMR parameters.

**RESULTS**

51 pts were enrolled. Infarcted areas were hyperintense at DWI, and matched with hyperintensity at LGE and STIR, except for inferior and anterior wall infarctions, which couldn’t be detected by axial DWI. Inter-observer reproducibilities for the detection of different walls infarctions were: septum k=0.75; apex k=0.80; lateral wall k=0.52. ADC maps showed different intensity between normal and infarcted myocardium: ADCNormal Myocardium= 2.96 ± 0.78 x 10^-3 mm2/sec, ADCInfarcted Myocardium = 4.75 ± 0.76 x 10^-3 mm2/sec (p<0.001). Comparing DWI and LGE positive findings: septum 33vs34 pts; apex 35vs37; lateral wall 14vs13. Similarly, comparing DWI and STIR positive findings: septum 35vs38 pts; apex 35vs37; lateral wall 14vs14.31 pts had perfusion-MVO, 28 showed corresponding hypointensity within the hyperintensity at DWI (p=0.005), with good inter-observer reproducibility (k=0.71), Se=0.80 and Sp=0.70. Pts with DWI-MVO had higher LGE MVO% (Early-MVO%: 5.39 vs 1.62, p=0.011; Late-MVO% : 3.04 vs 0.54, p=0.019), larger and more edematous infarctions(LGE%: 38.36 vs 21.42, p<0.001; Oedema%: 44.57 vs 29.92, p<0.001).

**CONCLUSION**

ADC is a sensible technique in revealing the presence of myocardial infarction. DWI may also detect MVO, when more represented.

**CLINICAL RELEVANCE/APPLICATION**

DWI is a promising CMR tool in pts with acute STEMI. DWI may became an alternative to traditional STIR, when Diffusion Imaging reliability will be confirmed on larger groups.

**SSC02-05 Inversion Time Dependence of the Accuracy of Late Gadolinium Enhancement Quantification Using T1 Map Based Synthetic Inversion Recovery Imaging**

**PURPOSE**

To investigate the influence of inversion time (TI) on the accuracy of myocardial late gadolinium enhancement (LGE) quantification using synthetic inversion-recovery (IR) imaging.

**METHOD AND MATERIALS**

Thirty-eight patients with suspected myocardial infarction underwent 1.5T MR imaging. Twelve minutes after the administration of 0.1mmol/kg gadobenate-dimeglumine, conventional single-shot magnitude and phase-sensitive inversion-recovery (MagIR, PSIR) LGE imaging and fast myocardial T1-mapping were performed in a single short axis plane. Based on the T1 maps, synthetic magnitude (MagIRsy) and PSIR (PSIRsy) images were calculated in a TI range of -100 and +150ms relative to the most optimal TI (T0) with 5ms increments, using an in-house developed application integrated in the Research Mass Software. LGE was quantified.
using two binary methods: applying thresholds of 5 standard deviations (SSD) above the average signal of the normal myocardium, and using the lower threshold of the full width at half maximum (FWHM) of the signal of the infarcted myocardium. LGE area was compared within the TI range.

RESULTS

LGE was observed in 15 (39.4%) patients. LGE area quantified by SSD thresholding in MagIRsy, PSIR sy (at TI0), and conventional MagIR, and PSIR techniques were 5.29±1.39, 4.44±1.35, 5.71±1.88, and 4.72±1.49cm², respectively, while the same parameter with FWHM was 3.46±2.39, 3.10±1.18, 4.01±2.16, and 3.32±1.43cm², respectively. LGE areas obtained by the synthetic and the conventional methods were in agreement at TI0. The SSD method showed significantly larger infarct areas than FWHM (P<0.05) in both synthetic and conventional images. LGE area was essentially constant over the TI range in the PSIRsy images. The MagIRsy technique provided accurate LGE area at TIs beyond TI0, while the accuracy was compromised for TIs below TI0.

CONCLUSION

The accuracy of LGE area quantification using MagIRsy images is constant over a wide TI range above TI0, while the accuracy using PSIRsy images is constant over the entire clinically relevant TI range (250-400ms).

CLINICAL RELEVANCE/APPLICATION

Synthetic T1-based IR images are reliable for infarct quantification and may provide a benefit over conventional LGE methods by eliminating the operator dependence (i.e. selection of optimal TI).

SSC02-06 Improved Detectability of Myocardial Delayed-Enhancement Using a Subtraction Myocardial Computed Tomography

Monday, Nov. 30 11:20AM - 11:30AM Location: S504AB

Participants
Takayoshi Yamaguchi, Sapporo, Japan (Presenter) Nothing to Disclose
Tepe Fugaya, MD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Jungo Furuya, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Kichi Igarashi, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Katsuhiro Ichikawa, PhD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

Subtraction coronary computed tomography (CT) angiography is effective for assessing calcified lesions in coronary arteries, enhancing visibilities of the enhanced coronaries. If this subtraction technique can be applied to delayed enhancement (DE) for assessing myocardial viability, the detectability of myocardial delayed enhancement might be improved. We propose the new subtraction technique, which removes coronary CTA images from DE CT images. The obtained images are similar to black blood delayed gadolinium enhancement images of magnetic resonance imaging (MRI). The purpose of this study is to evaluate the effectiveness of the subtraction myocardial CT (SMCT), compared with a myocardial MRI (MMRI).

METHOD AND MATERIALS

18 patients (mean age 62.6±14.7 years) with suspected coronary artery disease underwent DE imaging with a 320-slice CT and a 1.5-T MRI. SMCT images were obtained using dedicated software. We assessed DE transmurality per segment on a five-point scale (0 = 0%; 1 = 1- 25%; 2 = 26-50%; 3 = 51-75% and 4 = 76-100% transmurality), contrast-to-noise ratios (CNRs) in infarct and healthy myocardiums and left ventricular blood pools for MMRI, non-subtracted myocardial CT (NSMCT), and SMCT.

RESULTS

81/306 (26.5%) segments showed DE in MRI. Using MRI DE detection in the transmurality scores as the reference standard, the kappa value of SMCT was higher than that of NSMCT (0.775 vs. 0.646). CNRs at myocardiums for MRI, NSMCT and SMCT were 31.7 ±18.2, 3.15 ±2.58, and 5.15 ±2.16, respectively, while CNRs based on the blood pool were 11.9 ±14.7, -0.85 ±1.77, and 36.0 ±11.4, respectively.

CONCLUSION

DE imaging using SMCT technique showed better CNR compared with NSMCT, and comparably reasonable detectability of DE with MMRI.

CLINICAL RELEVANCE/APPLICATION

Conventional delayed enhanced CT imaging of myocardial infarction suffers from low contrast, especially between the area of infarction and the blood pool. The SMCT technique would contribute to improve the detectability of myocardial DE.

SSC02-07 Development of Infarct and Edema Size in the Course of the First 6 Months after Acute Myocardial Infarction Measured by LGE- and T2w-CMR Imaging

Monday, Nov. 30 11:30AM - 11:40AM Location: S504AB

Participants
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Gunnar K. Lund, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this study was to serially analyze the development of infarct and edema size over 6 months after first acute
myocardial infarction (AMI) using late gadolinium enhancement (LGE)- and T2-weighted (T2w)-CMR imaging, respectively.

METHOD AND MATERIALS
Consecutive baseline (BL) at 7 ±4.9 days and follow-up (FU) imaging at 1.2 ±0.3 months (FU1), 3.3 ±0.6 months (FU2) and 6.3 ±0.7 months (FU3) was performed on 25 patients with first-time AMI using a 1.5 Tesla MRI machine (Achieva, Philips). Short-axis LGE- and T2w-images of the entire left ventricle were acquired with a slice thickness of 8 mm and a gap of 2 mm. CMR studies were quantitatively evaluated by two experienced observers in respect to infarct and edema size using a threshold method with the dedicated HeAT-Software. Infarct and edema size were measured on LGE- und T2w-images as gram (g) of infarcted left ventricular myocardium. Statistical analysis was performed using GraphPad Prism 5 and Excel, Microsoft.

RESULTS
Mean size of infarcted myocardium was 26 ±21.9 gram (gr) at BL and decreased on FU1 and FU2 to 20.7 ±16.4 gram (P< 0.04) and 18.8 ±14.6 gram (P< 0.03), respectively. FU3 did not show further decline in infarct size. Infarction was present in all 25 patients on BL and FU imaging, whereas edema was present in 88% of the patients at BL, in 72% of patients on FU1, in 32% of patients on FU2 and only in 8% of patients on FU3. Mean myocardial edema was 41 ±28.3 gram at BL and decreased to 21 ±16.2 gram (P= 0.001) on FU1 and 13.7 ±13 gram (P= 0.005) on FU2, respectively. On FU3 edema was detected in two patients and measured 3.9 ±2 gram.

CONCLUSION
After first AMI a continuous decrease in the size of gadolinium enhancing infarcted area is observed during the first 3.3 ±0.6 months and remains constant afterwards, whereas main edema decrease occurs during the first 1.2 ±0.3 months. Nevertheless, in 32% of patients edema is still present after 3.3 ±0.6 months and can even persist in 8% after 6.3 ±0.7 months.

CLINICAL RELEVANCE/APPLICATION
Infarct healing, defined as edema resorption, mainly occurs between 6 weeks and 3 months after AMI. However, in 1/3 of patients edema still persists after 3 months indicating prolonged infarct healing.

SSC02-08 Serial Native T1 and T2 Mapping for Quantitative Monitoring of Myocardial Edema Resorption after Acute Myocardial Infarction

Monday, Nov. 30 11:40AM - 11:50AM Location: S504AB

Participants
Enver G. Tahir, MD, Hamburg, Germany (Presenter) Nothing to Disclose
Martin Sinn, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Maxim Avanesov, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Joshua Wien, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Dennis Saring, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Christian Stehning, Hamburg, Germany (Abstract Co-Author) Employee, Koninklijke Philips NV
Ulf K. Ruduski, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Kai Muellerleile, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Gunnar K. Lund, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Currently, myocardial edema monitoring after acute myocardial infarction (AMI) is based on visualization of the region with increased signal-intensity on T2-weighted (T2w) images. Native T1 and T2 mapping are promising novel cardiac magnetic resonance imaging (CMR) techniques to quantitatively assess edema. The purpose of the study was to evaluate resorption of myocardial edema following AMI by native T1 and T2 mapping.

RESULTS
Edema size continuously decreased from BL with 29.9%LV to 19.6%LV at FU1, to 8.6%LV at FU2 and to 5.6%LV at FU3 using T2w-CMR. An identical decrease of edema size was observed using native T2 and T1 mapping. T2 times decreased between BL from 83±8 ms to 76±7 ms at FU1 (P<0.05), but no further change was observed later with 73±7 ms at FU2 and 72±5 ms at FU3. The T2 times of remote normal myocardium were about 55±3 ms at all times and significantly lower compared to the edema zone. Native T1 time within the edema was with 1253±103 ms significantly increased compared to remote normal myocardium with 1018±43 ms and remained constantly high in the edema zone throughout all follow-ups.

CONCLUSION
Edema size continuously decreased within the following months after AMI, but was still present at low levels after 6 months. Additionally, quantitative mapping showed increased T2 and T1 values within the edema zone indicating prolonged presence of edema up to 6 months after AMI.

CLINICAL RELEVANCE/APPLICATION
T2 and T1 mapping may improve the ability to differentiate edematous myocardium over T2w techniques allowing a more precise determination of area at risk after AMI.

SSC02-09 Integrating Anatomical and Functional Assessment of Coronary Artery Disease Using Single-scan Stress Computed Tomography Perfusion: A Comparison with Combined Invasive Coronary Angiography and Cardiac Magnetic Resonance Imaging

Monday, Nov. 30 11:50AM - 12:00PM Location: S504AB

Participants
Sung Min Ko, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

PURPOSE
This study was aimed to determine diagnostic performance of single-scan stress computed tomography perfusion (CTP) for
This study was aimed to determine the diagnostic performance of single-scan stress computed tomography perfusion (CTP) for identifying hemodynamically significant coronary artery disease (CAD).

**METHOD AND MATERIALS**

Twenty-nine (21 men, 63.9±9.1 years) patients with suspected or known CAD underwent single-scan CTP, stress perfusion cardiovascular magnetic resonance (SP-CMR), and invasive coronary angiography (ICA). Dual-source CT was performed as follows: 1) coronary calcium scan: non-enhanced, prospectively ECG-triggered scan; 2) single-scan CTP for coronary artery anatomy (coronary CT angiography, CCTA) and inducible myocardial perfusion (CTP): contrast-enhanced, retrospectively ECG-gated scan during adenosine infusion; 3) delayed scan: acquired 5 min after single-scan CTP using prospectively ECG-triggered scan. Diagnostic values of CCTA for detecting hemodynamically significant stenosis were assessed before and after CTP on a per-vessel basis compared with combined ICA and SP-CMR as reference standard. A coronary vessel was considered to be significantly stenosed if there was at least 1 segment with ≥ 50% lumen reduction.

**RESULTS**

By ICA, 26 (90%) patients had 57 (66%) significantly stenotic vessels. By SP-CMR, perfusion defects were noted in 23 (79%) patients with 48 (55%) vessel territories. Ten (34%) patients had old myocardial infarction. Combined ICA/SP-CMR showed hemodynamically significant stenoses in 23 (79%) patients with 47 (54%) vessel territories. The performance of sing-scan CTP for detecting perfusion defects compared with SP-CMR on per-vessel (segment) basis was sensitivity, 88% (78%); specificity, 92% (84%); positive predictive value, 94% (76%); negative predictive value, 85% (86%). Compared to ICA/SP-CMR, per-vessel territory sensitivity, specificity, positive predictive value, and negative predictive value of CCTA were 75%, 93%, 96%, and 63%, respectively, those by using CTP were 86%, 92%, 94%, and 83%, respectively, and those by using single-scan CTP (CCTA and CTP) were 90%, 90%, 91%, and 88%, respectively. The area under the receiver operating characteristic curve increased from 0.79 to 0.90 (p=0.013) using single-scan CTP compared with CCTA.

**CONCLUSION**

Single-stress CTP allows for the detection of hemodynamically significant coronary stenosis.

**CLINICAL RELEVANCE/APPLICATION**

Single-stress CTP has the potential to become the preferred CT technique for identifying hemodynamically significant CAD at a single-examination.
PURPOSE

Although Iodine quantification is possible on DECT scans, it remains unclear if the measurements are specific to scanners from different vendors. The purpose of our study is to compare the accuracy of Iodine quantification between single-source and dual-source DECT.

METHOD AND MATERIALS

An anthropomorphic CT colonography phantom with capacity for 500ml of fluid, and two iodinated solutions with known concentrations were used: 1) 9mg/ml, 2) 12mgI/ml. Each solution was diluted with water to obtain 75% (7 and 9mg/ml), 50% (4.5 and 6mg/ml), and 25% (2 and 3mg/ml) of the known concentration. The phantom was filled up serially with 400 ml of each dilution, from the lowest to the highest concentration, and scanned on DECT mode of ssDECT (Discovery CT750 HD, GE Healthcare) (140/80 kVp and tube current of 375 mA), and dsDECT (Somatom Definition Flash, Siemens Healthcare) (140/100 kVp and 180 Ref mA) scanners. MD-Iodine images were generated from the DECT scans in vendor specific workstations. A total of 16 datasets were obtained (4 for each solution on each scanner), 8 for ssDECT and 8 for dsDECT. Twenty regions of interest (ROIs) were placed at multiple levels of the gastrointestinal lumen. Iodine values (mg/ml) were measured and recorded for all the different dilutions. Iodine values were compared with the known concentration of iodine. Statistical analysis was conducted with t-test.

RESULTS

Spectrally calculated iodine concentration showed minimal discrepancy compared to the known iodine concentration on ssDECT and dsDECT scanners (± 0.4 and 0.6 mg/ml, respectively) (p>0.05). The variability was the same for high and low iodine concentrations.

CONCLUSION

Despite the differences in approach for material separation between dsDECT (Image based) and ssDECT (raw data based) techniques, Iodine quantification is accurate, robust and reproducible for both scanners. Presence of image artifacts negatively
impacts the iodine quantification.

**CLINICAL RELEVANCE/APPLICATION**

CT Attenuation values are used for clinical diagnosis and decision-making. The results of this study reassure the availability of an additional parameter (DECT-iodine quantification) for clinical use.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Dushyant V. Sahani, MD - 2012 Honored Educator
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**SSC03-03 Evaluation of a Low Iodine Concentration Contrast Media in Abdominal Multiphasic Computed Tomography Examinations Using Spectral Imaging (SI): A Prospective Study on 300 Patients**

**PURPOSE**

Demonstrate the non-inferiority of a low iodine concentrated contrast media for abdominal CT examinations acquired with Spectral Imaging in comparison with the usual single-energy injected CT examinations.

**METHOD AND MATERIALS**

300 patients (BMI<35) with clinically indicated multiphasic abdominal CT were prospectively randomized in three groups of 100 patients. Examinations were performed on a single-source dual-energy CT (GE Discovery 750HD). Two reference groups underwent a conventional single-energy CT acquisition using 1.5mL/kg of Iomeprol 400mgI/ml and Iomeprol 350mgI/ml, respectively. The study group was acquired with 1.5mL/kg of Iobitridol 250 mgI/ml using Spectral acquisition with monochromatic images at 75 keV, 65 keV and 60 keV. Quantitative analysis was performed on arterial (30s) and portal phases (70s) by recording HU +/- SD values by mean of ROI in aorta, hepatic parenchyma, portal vein and muscle.Image quality was independently assessed by two radiologists on a four-point scale. Quantitative statistical analysis was performed using Bayesian method with a 95% credibility interval CI to assess for non-inferiority with an arbitrary HU thresholds set at 20% for the arterial phase and 10% for the portal phase of our reference groups. Radiation doses (DLP) were also recorded.

**RESULTS**

Spectral data revealed an excellent image quality (3.2 +/- 0.5). For quantitative evaluation, at 60keV in aorta, arterial phase differences between Io250, Io350, and Io400 and Io250 were estimated to 17.97(CI=99.99%) and 36.5 (CI= 99.06%), venous phase difference between Io350, Io400 and Io250 were estimated to 3.13(CI=99.99%) and 11.87(CI= 99.99%). At 60 keV, at portal phase Io250 was superior to Io350 vs Io400 for hepatic parenchyma and portal vein, respectively. At 65 keV, Io250 revealed no significant differences with others contrast agents for all sites. At 75 keV, Io250 was inferior to others contrast agent for all sites. The radiation dose was increased at less than 10%; DLP: 489 mGy.cm(spectral) vs 513 mGy.cm(conventional).

**CONCLUSION**

Spectral imaging allows iodine dose reduction up to 37.5% for arterial and portal phase, better information at 60 keV, excellent image quality and no increased radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

Iodine dose is reduced by using spectral CT imaging, with better results at 60keV in terms of UH, without degradation of image quality or increased radiation dose for abdominal applications.

**SSC03-04 Assessment of Radiation Dose, Image Quality and Accuracy of Virtual Non-Contrast Images in Thoracoabdominal CT Acquired with a Novel Single-source Dual-Energy Technique Using a Split Filter**

**PURPOSE**

To assess the radiation dose, image quality and accuracy of virtual non-contrast images with a novel single-source dual-energy technique using a split filter (TwinBeam Dual-Energy, Siemens) compared with a single-energy CT scan.
METHOD AND MATERIALS

50 patients received a CT of the thorax and abdomen for oncologic staging on a single-source scanner (SOMATOM Edge, Siemens) either with (A) single-energy mode with automatic tube voltage modulation and 130 ref mAs or with (B) split filter dual-energy mode at AuSn120 kVp and 420 ref. mAs. Radiation dose was estimated by CTIDivol and DLP. Objective image quality was assessed by measuring image noise and calculating CNR. Subjective image quality was evaluated by three radiologists independently (one resident and two board-certified). The attenuation in the liver, spleen and muscle were measured on the true non-contrast premonitoring scan and at the same location on the virtual non-contrast image of protocol B. Descriptive statistics and Mann-Whitney-U-test were used.

RESULTS

The mean CTIDivol was 15% and the mean DLP was 20% lower with the dual-energy compared to the single-energy protocol (11.2 mGy (A) vs. 9.5 mGy (B) and 700 mGy*cm (A) vs. 558 mGy*cm (B)). No significant difference in objective image quality (image noise: 7.4HU (A) vs. 7.1HU (B); CNR: 29.2 (A) vs. 28.5 (B); p=0.43 and 0.88, respectively) and subjective image quality was found between the two protocols. The mean error of measurement for the virtual non-contrast images was 6.2%, 12.7% and 16.3% for the liver, spleen and muscle, respectively.

CONCLUSION

Dose-neutral dual-energy CT scans are possible with a single-source CT scanner using a novel split filter technique compared to a single-energy mode with similar objective and subjective image quality. The dual-energy CT protocol also offers accurate attenuation measurements on the virtual non-contrast images.

CLINICAL RELEVANCE/APPLICATION

Since the split filter dual-energy technique on a single-source CT scanner benefits from the added information like virtual non-contrast, iodine quantification or stone characterization and the dose-neutral aspect, it can replace single-energy protocols in clinical routine.

SSC03-05 Differentiation of Mass Type Colorectal Adenocarcinoma from Colorectal Adenoma on Spectral CT: Preliminary Research

Monday, Nov. 30 11:10AM - 11:20AM Location: E353A

Participants
Xiaodong Liu, Dalian, China (Presenter) Nothing to Disclose
Ailian Liu, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Meiyu Sun, Dalian, China (Abstract Co-Author) Nothing to Disclose
Jinghong Liu, MD, PhD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Li Ye, Dalian, China (Abstract Co-Author) Nothing to Disclose
Chen Anliang, Dalian, China (Abstract Co-Author) Nothing to Disclose
Shifeng Tian, Dalian, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To assess the value of spectral CT imaging in distinguishing mass type colorectal adenocarcinoma from colorectal adenoma.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board and informed consent was waived. Twenty-seven patients with colorectal masses were scanned with spectral CT scanner (GE Discovery HD 750) from January 2012 to April 2015, including 15 mass type colorectal adenocarcinomas and 12 colorectal adenomas proven by pathology. Bowel cleaning was performed until no excrement in 8-12h before examination including pre-contrast and three-phase dynamic enhancement. The mean CT value of 68 kVp images (minic conventional polychromatic images) and monochromatic images (40-140) keV, effective atomic number(eff-Z) and iodine(water),fat(water) and the slope of spectral curve from 4 phases were measured using the GSI General MD analysis software equipped at an Advantage Workstation (ver.4.5, GE, USA). These parameters from mass type colorectal adenocarcinomas and adenomas were compared using the nonparametric rank sum test.

RESULTS

In the arterial phase of 68 KVp, the mean CT value was 88.45±22.15 HU for adenocarcinoma group, and 61.03±27.54 HU for the adenoma group. The mean CT value for adenocarcinoma was significantly higher than that of adenoma on 68 KVP images in arterial phase (p<0.05). There were statistically significant differences of the CT value between two groups at low energy keV(40-90keV) in the arterial phase. The slope of spectral curve was -1.70±0.62 for adenocarcinoma group and -1.03±0.55 for the adenoma group in arterial phase. The mean slope of spectral curve of adenocarcinoma group was significantly steeper than that of adenoma group (p<0.05). The mean CT value and slope of spectral curve in venous and delayed phases did not differ significantly between these two groups. The eff-Z and iodine(water),fat(water) were not significantly different between adenocarcinoma and adenoma groups.

CONCLUSION

The mean CT values and slope of spectral curve in arterial phase derived from spectral imaging is a potential quantitative parameters to distinguish mass type colorectal adenocarcinoma from adenoma. There was certain guiding significance in colorectal adenoma and mass type colorectal adenocarcinoma for spectral CT multi-parameter analysis.

CLINICAL RELEVANCE/APPLICATION

It’s important to figure out the type of colorectal disease to provide more reference for clinical treatment.

SSC03-06 Noninvasive Liver Iron Content Quantification and Grading Based on Dual-Source Dual-Energy CT: An Iron Overload Rabbit Model Study

Monday, Nov. 30 11:30AM - 11:40AM Location: E353A

Participants
Xianfu Luo, Yangzhou, China (Presenter) Nothing to Disclose
**Purpose**
To assess the accuracy of dual-source dual-energy (DSDE) CT in liver iron content (LIC) quantification and grading at different clinically significant LIC thresholds.

**Method and Materials**
Fifty-one rabbits of iron-loaded model were established by intravenous injection of iron dextran. DSDE CT was performed at 80 kVp and 140 kVp with tin filter. Hepatic attenuation difference (ΔH) between 80 kVp and 140 kVp was calculated. Postmortem assessments of LIC were conducted on inductively-coupled plasma (ICP) spectrometer. The correlation between ΔH and LIC was analyzed. Diagnostic performance of ΔH in discriminating different LIC thresholds was evaluated by receiver operating characteristic (ROC) analysis.

**Results**
The LIC of our models was from 0.2 to 39.6 mg Fe/g measured by ICP. ΔH was highly correlated with LIC and the Spearman's coefficient was 0.975. For discriminating clinically significant LIC thresholds (1.8, 3.2, 7.0, 15.0 mg Fe/g dry tissue), ROC analysis revealed that the corresponding optimal cutoff value of ΔH was 13.1, 16.2, 23.1, 39.4 HU, respectively. For the lowest threshold of discriminating iron accumulation from normal storage, ΔH had a sensitivity of 86% and a specificity of 100%. With the cutoff value of ΔH = 39.3 HU, the highest sensitivity (100%) and specificity (100%) were obtained at LIC threshold of 15.0 mg Fe/g dry tissue.

**Conclusion**
ΔH has a strong linear association with titrated LIC in the iron- overloaded rabbits. DSDE CT has the potential for liver iron content quantification and grading.

**Clinical Relevance/Application**
DSDE CT has the potential to guide iron chelation therapy and to monitor chelation effect.

**SSC03-07 Benefit of Iodine Maps to Reduce Out-of-Field Image Artifacts at Rapid kVp Switching Dual Energy CT**

**Method and Materials**
This retrospective study was approved by our institutional review board and informed consent was not required. We retrospectively viewed 246 consecutive rsDECT thoracoabdominal scans to identify those with out-of-field image artifacts. The field of view, thickness and subjective severity of the out-of-field artifacts were recorded for the 40, 65 and 140 keV virtual monochromatic images and on the, iodine and water maps. Image artifact severity was rated on a 5 point scale from 0=not seen to 4=obscures all tissue detail. The thickness of artifacts and severity scores were compared between image reconstructions by t-test and Wilcoxon tests, respectively.

**Results**
In 20 of 246 scans (8.1%), body parts extended past the CT’s maximum field of view (FOV), 500 nm. The mean BMI of these 20 patients was 40 (range, 29 to 61), and out-of-field artifacts occurred for all 20. The mean maximal out-of-field artifact height was 167.4 cm. The mean artifact thickness was significantly less for iodine map (0.67 mm) than for the 65 keV and water map images (8.43 and 13.5 mm, respectively, p<0.001 each comparison). The mean artifact severity score was significantly lower for iodine map (0.23) than for the 65 keV and water map images (2.3 and 2.7, respectively, p<0.00X).

**Conclusion**
Iodine maps substantially reduce out-of-field image artifact at rsDECT and may assist in the evaluation of peripheral tissues that extend beyond the maximal CT field of view in obese patients.

**Clinical Relevance/Application**
Obese patients with concern for peripheral tissue injury may benefit from rsDECT iodine maps to minimize out-of-field image artifact.
PURPOSE

Dual energy CT (DECT) is sensitive for detection and quantification of iodine in tissue. We aimed to evaluate the correlation between iodine uptake in the inflamed bowel wall in Crohn’s disease (CD) and the need for surgery and create an inflammatory index.

METHOD AND MATERIALS

IRB approved prospective double-blind study. 36 patients (mean age 38.6 years, 20 males) with Crohn's disease (CD) underwent a DECT (Somaton Flash) for acute abdominal symptoms. Study protocol: abdominal-pelvic CT using DE mode (100 and 140kV), IV contrast and negative oral contrast contrast. The DECT was interpreted by a radiologist blinded to the clinical outcome. The referring physicians were blinded to DECT interpretation. Studies were interpreted by a radiologist on a dedicated software (syngo.CT dual energy, syngo.via). Enhancement (HU) was measured for each bowel lesion in both low and mixed images. Inflammatory enhancement index (IEI) was defined as the ratio between the inflamed segment and the stomach (HU on mixed images). Patients were followed for 3 months for an outcome of surgery.

RESULTS

A total of 63 intestinal lesions were demonstrated (1-3 per patient). Eleven patients underwent surgery, 7 within 3 months after the CT and 4 within 1 month after the CT. Higher attenuation on 100kV and mixed images correlated with increased risk of surgery within 3 month: 92.2 vs. 66.6 for 100kV (p=0.01) 82.7 vs. 59.5 for mixed images (p=0.01) as well as for surgery within 1 month 105.2 vs. 67.04 (p=0.05) and 93.8 vs. 59.7 for the mixed images (p<0.05). AUROC analysis for the IEI achieved negative predictive value of 98% for the need for surgery.

CONCLUSION

DECT is a reliable tool in assessment of inflammation in patients with CD and can predict the need for surgery. The IEI has a high negative predictive value.

CLINICAL RELEVANCE/APPLICATION

Our study demonstrates that DECT is a possible novel decision making tool (surgery vs. conservative surgery) applicable also to acute settings.

Comparison between Spectral Imaging Scan Mode on Fast kVp-Switching Single-Source Dual-Energy Scan and Conventional Helical Scan Mode for CT Scan DOSE in 259 Abdomen Cases: Body Mass Index Factor

PURPOSE

On fast kvp-switching single-source dual-energy (ssDE) CT scan (gemstone spectral imaging: GSI), automatic exposure control (AEC) remains unavailable. The purpose of this paper is to compare DOSE between GSI scans and conventional helical scans about the DOSE and image quality in different body mass index (BMI) group.

RESULTS

CTDIvol (mGy) values between MONO mode and POLY mode at each BMI group were A: 13.4 ± 1.3 and 9.1 ± 2.5; B: 13.5 ± 1.0 and 11.2 ± 2.0; C: 14.3 ± 2.4 and 12.8 ± 2.9; D: 15.8 ± 2.6 and 15.6 ± 3.3; E: 18.3 ± 4.3 and 17.7 ± 4.3; F: 22.3 ± 5.6 and 21.3 ± 3.6; G: 29.1 ± 4.9 and 27.4 ± 2.1, respectively. The CTDIvol with MONO scan mode was significantly higher than conventional POLY scan mode at each BMI group (A: 55.6%; B: 22.9%; C: 14.2%; D: 2.5%; E: 4.9%; F: 6.3%; and G: 8.8%), but the results were not statistical significantly (P > 0.05) in D, E, F and G BMI group. The image quality with MONO scan mode (66keV) was significantly higher than FBP, similar to ASIR30%, poorer than ASIR50% with POLY-120kVp scan mode at gall bladder, muscular and liver.

CONCLUSION

From this study, we can conclude that GSI scan mode without automatic exposure control has similar DOSE level with normal helical (120kVp) scan mode in large BMI group (BMI>26).

CLINICAL RELEVANCE/APPLICATION

In this study, we have demonstrated that GSI images reconstructed at MONO-66keV can achieve similar DOSE level as conventional helical (120kVp) scan.
The Incidental Splenic Lesion: Does It Need to be Worked Up?

PURPOSE
The purpose of this study is to evaluate whether an incidentally noted splenic lesion on abdominal computed tomography (CT) requires further imaging work-up.

METHOD AND MATERIALS
In this HIPAA compliant retrospective study, we performed a search of our CT database for patients with splenic lesions who underwent imaging from 2002 to 2008. Online medical records were reviewed for a history of malignancy and the indication for the CT examination. Patients were divided into 3 groups: 1. patients with a history of malignancy, 2. patients without a history of malignancy and no symptoms related to the left upper quadrant, 3. patients without a history of malignancy, but constitutional symptoms such as weight loss or fever or pain related to the left upper quadrant or epigastrium. Final diagnosis of the etiology of the lesion was confirmed by surgery, image guided biopsy or clinical and/or imaging follow-up. A lesion was considered benign on follow-up if it was stable by imaging for 2 years and by clinical follow-up for 5 years.

RESULTS
Our search revealed 525 patients, 57 patients needed to be excluded due to insufficient follow-up data. 468 patients were included in this study (294 women, 174 men, mean age = 58 years, age range 21-97 years). 154 of 468 (32.9%) patients had a history of malignancy (group 1), 279 of 468 (59.6%) patients had no history of malignancy and no symptoms related to the left upper quadrant (group 2). 35 of 468 (7.4%) patients had no history of malignancy, but constitutional symptoms or symptoms related to the left upper quadrant (group 3). The number of malignant lesions was as follows: group 1: 43 of 154 (27.9%), group 2: 2 of 305 (0.7%), group 3: 6 of 35 (17.1%). Patients with malignant lesions in group 2 consisted of new diagnoses of lymphoma (n=1) with extensive lymphadenopathy as well as metastatic ovarian carcinoma (n=1). Patients with malignant lesions in group 3 were diagnosed with lymphoma (n=6).

CONCLUSION
In a patient with no history of malignancy, no fever, weight loss or pain in the left upper quadrant or epigastrium, the likelihood of malignancy is very rare (0.7%). Patients who are diagnosed with a malignancy in this group have other lesions that allow for this diagnosis to be made. Therefore in patients with no evidence of previous or newly diagnosed malignancy, follow-up of splenic lesions may not be indicated.

CT Signs Predictive of Internal Hernia or Volvulus after Roux-en-Y Gastric Bypass in a Consecutive Surgical Cohort

PURPOSE
To evaluate CT predictors of small bowel volvulus/internal hernia (VIH) after Roux-en-Y gastric bypass surgery (RYGB) in a consecutive, heterogeneous surgical cohort.
100 consecutive RYGB patients with abdominal pain and preoperative CT of abdomen/pelvis were retrospectively reviewed in consensus by 2 radiologists blinded to surgical outcomes for two 1º signs of VIH: mesenteric swirl and shift of jejunal anastomosis and 7 2º signs: dilated, ischemic or clustered small bowel; mesenteric edema; stretching of mesenteric vessels; SMA/SMV vascular narrowing; and mesenteric adenopathy. Alternative diagnoses, (related and unrelated to RYGB) and negative studies were tallied. Results included SEN, SPEC, PPV and NPV for VIH. Stepwise logistic regression analysis determined predictors of VIH amongst the 9 CT signs.

RESULTS
Patient age: 41 ± 12.6 (range 22-68) years, 85 females. 1 day (range 0-10) between CT and operation. Surgical results: 33 VIH (21 due to mesenteric defect and 12 to an adhesive band), 28 other diagnoses (intussusception, small bowel obstruction, adhesions) and 18 non-RYGB related diagnoses (acute cholecystitis, other hernias, cecal and sigmoid volvulus, perforated duodenal ulcer, ruptured ovarian cyst, appendicitis, omental infarct, PID). and 21 had no pathology. CT was 97% SEN, 78% SPEC for diagnosis of VIH with, NPV = 98%, PPV = 68 %. Presence of volvulus alone or IH alone on CT had numerically lower predictive value for surgical VIH than presence of either one: corresponding C-statistics 0.82, 0.75, 0.87. Of 9 predictors of VIH, only mesenteric swirl (odd ratio [95%CI] 7.46 (2.5-22.2) and vascular narrowing (12.0[2.3-62.5]) predicted VIH (p<.0001, C-statistic 0.843). Review of single FN showed subtle mesenteric swirl and 15 FPs showed 4 SBO and 1 adhesion all requiring surgery and 10 negative cases in which swirls were overcalled and other findings were minimal. CT correctly identified 83% of non-RYGB related operative diagnoses (missed 2 cholecystitis and 1 leaking ovarian cyst).

CONCLUSION
Mesenteric swirl and vascular narrowing on CT predict surgical VIH. FP cases occurred because SBO 2º adhesions may appear similar to VIH and simple adhesions can cause appearance of a mesenteric swirl.

CLINICAL RELEVANCE/APPLICATION
CT can predict volvulus/internal hernia after RYGB amongst a cohort of all cases taken to surgery for abdominal pain.

METHOD AND MATERIALS
335 abdominal CT scans at a tertiary care ER between September and October 2012 was retrospectively reviewed. The following data was collected: a) clinical history provided on CT requisition, b) lab work-up ordered prior to CT request, c) impression by ER CT radiologist, d) final disposition diagnosis by ER physician, and e) microbiology, surgical or pathology results. The quality of the clinical histories collected were evaluated by two blinded staff radiologists and two radiology residents. A 5-point Likert scale based on 4 categories of history criteria was used (presenting complaint, past medical history or symptom evolution, objective laboratory data was collected: a) clinical history provided on CT requisition, b) lab work-up ordered prior to CT request, c) impression by ER CT radiologist, d) final disposition diagnosis by ER physician, and e) microbiology, surgical or pathology results. The quality of the clinical histories collected were evaluated by two blinded staff radiologists and two radiology residents. A 5-point Likert scale based on 4 categories of history criteria was used (presenting complaint, past medical history or symptom evolution, objective laboratory data was collected: a) clinical history provided on CT requisition, b) lab work-up ordered prior to CT request, c) impression by ER CT radiologist, d) final disposition diagnosis by ER physician, and e) microbiology, surgical or pathology results. The quality of the clinical histories collected were evaluated by two blinded staff radiologists and two radiology residents. A 5-point Likert scale based on 4 categories of history criteria was used (presenting complaint, past medical history or symptom evolution, objective laboratory data was collected: a) clinical history provided on CT requisition, b) lab work-up ordered prior to CT request, c) impression by ER CT radiologist, d) final disposition diagnosis by ER physician, and e) microbiology, surgical or pathology results. The quality of the clinical histories collected were evaluated by two blinded staff radiologists and two radiology residents. A 5-point Likert scale based on 4 categories of history criteria was used (presenting complaint, past medical history or symptom evolution, objective laboratory data was collected: a) clinical history provided on CT requisition, b) lab work-up ordered prior to CT request, c) impression by ER CT radiologist, d) final disposition diagnosis by ER physician, and e) microbiology, surgical or pathology results. 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A 5-point Likert scale based on 4 categories of history criteria was used (presenting complaint, past medical history or symptom evolution, objective lab work, reports) in addition to CT requisition clinical history changed the radiological diagnosis for 8.0% (27/335) of cases. 8.4% (28/335) of cases had misleading history that could have led to interpretation error. No statistically significant correlation (P=0.589) was found between graded quality of the clinical history provided and CT diagnosis accuracy.

CONCLUSION
CT clinical history quality does not correlate with CT diagnosis accuracy. However, a misleading history could alter CT case interpretation. Increased access to ancillary patient information can improve interpretation accuracy.

CLINICAL RELEVANCE/APPLICATION
Increased access to ancillary patient information can improve interpretation accuracy.
The results of our study could lead to greater live-access in electronic medical systems of more patient information and of increased quality for ER radiologists to improve interpretation accuracy.

**SSC04-04  Body Packing: Which Modality to Choose in the Initial Evaluation? A Comparative Study of X-ray versus CT**

**Participants**
Robin F. Gohmann, MD, Aachen, Germany (Presenter) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Sebastian Reinartz, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The purpose of this study was to evaluate the diagnostic performance of plain film and CT in the detection of internally concealed drugs, frequently referred to as body packing.

**METHOD AND MATERIALS**
The study was approved by the local ethics committee and performed retrospectively. Between July 2009 and June 2013, 142 consecutive X-ray (n=98) and CT (n=44) examinations on medically asymptomatic suspects where included (107 men, 25 females, mean age 35±8).

**RESULTS**
In a total of 40 cases (40 %) authorities ascertained intracorporally concealed drugs with a prevalence of 35 % in the group examined with X-ray and 14 % in the group examined with CT. In 85 % of those cases heroin was found. The rate of radiologically detected cases of body packing in either modality (X-ray: 79 %, CT: 82 %) did not vary statistically significantly (p>0.05). Both the NPV of X-ray (83 %) and CT (94 %) as well as the PPV of X-ray (68 %) and CT (40 %) were statistically equivalent (p>0.05).

**CONCLUSION**
As body packing is not limited to a single substance or mode of packaging and therefore presents with differing imaging characteristics, diagnostic performance of X-ray and CT may vary. Because CT and X-ray were statistically equivalent in our cohort, and body packing sometimes can be invisible on plain film and other times is very easily picked up we emphasise a stepwise approach with a careful interpretation of the CT-scout view and to only secondarily proceed to CT.

**CLINICAL RELEVANCE/APPLICATION**
Hard ray CT-scout view in body packing should be viewed as a diagnostic image with the potential of rendering the planned CT of the abdomen not necessary in selected cases.

**SSC04-05  Pelvic Artifacts in Material Decomposition Images from Dual Energy CT: A Phantom and Patient Study**

**Participants**
Sebastian Winkhofer, MD, San Francisco, CA (Presenter) Nothing to Disclose
Jack Lambert, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Yuxin Sun, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Zhen J. Wang, MD, Hillsborough, CA (Abstract Co-Author) Nothing to Disclose
Benjamin M. Yeh, MD, San Francisco, CA (Abstract Co-Author) Research Grant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextrast, Inc;

**PURPOSE**
Aim of the study was to describe the frequency, appearance and severity of pelvic beam hardening artifacts on material decomposition images from rapid-kV switching Dual-Energy Computed Tomography (rsDECT).

**METHOD AND MATERIALS**
Monochromatic (70keV, 52keV, 120keV) and material decomposition images (iodine(-water), water(-iodine)) reconstructed from pelvic rsDECT scans of 41 patients (22 male, mean age 57±6 years, range 22-86 years) were retrospectively evaluated. We qualitatively analyzed the presence, type (hyperdense vs. hypodense) and severity of artifacts and the diagnostic capability of anatomic details (5-point scales). Quantitative measurements included CT numbers, iodine and water concentrations, grayscale values (GY), and standard deviations (SD) of the artifact-affected regions, compared with corresponding unaffected reference tissue. A pelvic phantom was constructed and scanned to validate the presence of artifacts. Wilcoxon signed-rank and paired t-tests were used to compare results between the different image reconstructions.

**RESULTS**
Beam hardening artifacts were seen in all 41 patients in all datasets. The median artifact severity score was higher in water(-iodine) and iodine(-water) images (3, each) compared to 70keV (1), 52keV (2), and 120keV (1) (P<0.001, each). The diagnostic capability for pelvic organ depiction was lower (P<0.001) in water(-iodine) and iodine(-water) images compared to monochromatic images. Higher SD values of CT number, concentrations, and GY value were revealed for areas affected by artifacts compared to reference tissues in all data sets (each P<0.001). Similar results were seen in the phantom study.

**CONCLUSION**
Beam hardening artifacts are prevalent in pelvic material decomposition rsDECT images, show inverted high and low signal and should not be misinterpreted as disease in the pelvis.

**CLINICAL RELEVANCE/APPLICATION**
It is important for the radiologist to know that the accuracy of pelvic material decomposition images might be impaired by artifacts...
and that the diagnosis of frequently seen pathologies such as urinary bladder cancer or wall thickening, intravesicular calculi, enlargement of the prostate gland or ovarian cancer might be impeded.

**SSC04-06  The Clinical Value of MR Gadolinium Colonic Transit Test in Patients with Constipation**

**Participants**
Dan Liang, Guangzhou, China (Presenter) Nothing to Disclose
Wuteng Cao, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Mingyue Luo, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Zhiyang Zhou, PhD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To establish a new and non-invasive methodology of MR gadolinium transmission test and assess its clinical feasibility by comparing with conventional X-ray barium transmission test.

**METHOD AND MATERIALS**
According to Rome III clinical diagnostic criteria, eight patients, 1 male, 7 female, aged 15-48 with a mean of 34.3, with a history of functional constipation from 1 to 10 years, with a mean of 5.4 years were chosen to undergo both traditional barium X-ray and MR gadolinium colonic transit test at the same time. 20 barium tablets and 5 gadolinium grains were taken orally at the same time by each patient, then rechecked after 24h, 48h, 72h to count the residual barium tablet and gadolinium markers in X-ray and MRI respectively. The results, advantages and disadvantages of the two methods were compared.

**RESULTS**
All of the eight patients successfully underwent both X-ray and MR colonic transit tests. X-ray transmission test showed 5 cases residual barium strip markers ≥ 20% (4 tablets) after 48h, 3 cases ≥ 20% (4 tablets) after 72h; MR transmission test showed 5 cases residual gadolinium markers ≥ 20% (1 grain) after 24h, 3 cases ≥ 20% (1 grain) after 48h. The residual barium tablet markers ≥ 20% (4 tablets) after 72h in X-ray test was set as a positive standard of slow colonic transit. All 3 positive patients in X-ray test showed residual gadolinium markers ≥ 20% (1 grain) after 48h in MR colonic transit tests; All 5 negative patients in X-ray test showed no residual gadolinium grain after 48h in MR tests.

**CONCLUSION**
MR transmission test can clearly demonstrate the location and quantify the remaining markers in the colon with fast scan sequences. The exact location of the residual markers can be observed by using 2D combined with 3D technology. MR has no ionizing radiation which is very important for multiple follow-ups. Our preliminary results indicate that it is feasible to consider the residual markers ≥ 20% (1 grain) in the colon after 48h as the diagnostic criteria of slow transit constipation time by MRI.

**CLINICAL RELEVANCE/APPLICATION**
It is expected that MR gadolinium transmission test to replace the X-ray colon transmission test due to its accurate positioning and without radiation.

**SSC04-07  Quantification of Inflammation with Ultrasound Molecular Imaging Following Automated Imaging Fusion with CT/MRI: A Pilot Study in a Porcine Model of Acute Ileitis**

**Participants**
Hualun Wang, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose
Stephen A. Felt, DVM, MPH, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Ismayil Guracar, Mountain View, CA (Abstract Co-Author) Employee, Siemens AG
Poonam Gwalani, MS, Mountain View, CA (Abstract Co-Author) Nothing to Disclose
Juergen K. Willmann, MD, Stanford, CA (Abstract Co-Author) Research Consultant, Bracco Group; Research Consultant, Triple Ring Technologies, Inc; Research Grant, Siemens AG; Research Grant, Bracco Group; Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company

**PURPOSE**
Most patients with inflammatory bowel disease (IBD) undergo anatomical CT and MR imaging to assess the location and extent of inflammation as part of their routine clinical workup; however, both techniques are limited in terms of quantification of inflammation which is critically needed for proper patient management. Molecular imaging including ultrasound molecular imaging using targeted contrast agents is currently explored to quantify inflammation in IBD at the molecular level. However, localizing the inflamed bowel segment and imaging the entire bowel with ultrasound can be time consuming. The purpose of this study was to explore feasibility of real-time image fusion of CT and MRI data sets with ultrasound molecular imaging in an acute terminal ileitis model in pigs.

**METHOD AND MATERIALS**
An acute terminal ileitis model was established in 3 female pigs by intraluminal exposure of a segment of terminal ileum with 2,4,6-trinitrobenzene sulfonic acid (TNBS in ethanol). All pigs were imaged at 48 h after induction of acute ileitis. Pigs were either imaged with a clinical CT (Zeego, Siemens) or MR (Discovery MR750w; GE) enterography protocol and data sets were uploaded onto a clinical ultrasound machine (Acuson S3000; Siemens). Using an anatomical landmark-based approach, inflamed bowel segments were localized in real-time on subsequent ultrasound molecular imaging of the bowel using eSie Fusion auto registration software (Siemens). Inflammation of the bowel wall was quantified using dual P- and E-selectin-targeted ultrasound molecular imaging and compared with histology.

**RESULTS**
Real-time image fusion was successful in all 3 animals. Using anatomical CT and MR road mapping, the inflamed bowel segment could be identified quickly and inflammation of the bowel segment could be assessed within 10 minutes. Selectin-targeted ultrasound molecular imaging signal correlated well with the grade of inflammation on histology.
CONCLUSION
Automatic fusion of volumetric CT and MRI datasets with ultrasound imaging in real time is feasible and allows rapid anatomical localization of inflamed bowel segments for further quantification of inflammation using ultrasound molecular imaging.

CLINICAL RELEVANCE/APPLICATION
Anatomical road mapping by fusing volumetric CT or MRI data sets with ultrasound in real time improves the work flow of ultrasound molecular imaging for grading inflammation in IBD.

SSC04-08  CT after Pancreateicoduodenectomy with Portal Vein and/or Superior Mesenteric Vein Reconstruction: Review of Current Surgical Techniques and Associated Post Surgical Imaging Findings

METHOD AND MATERIALS
We reviewed our database of patients who underwent PV-SMV reconstruction from 2004-2014 and identified patients who met the following criteria: 1. CT available within 60 days following surgery, 2. pathologic R0 or R1 resection. We restricted our analysis to cases with relevant post-operative CT and complete surgical resection because recurrent malignancy is highly unusual in the immediate post-operative period in patients for whom a complete surgical resection has been achieved; therefore the observed CT findings could be attributed to post-surgical changes rather than to recurrent or residual disease. 71 patients in the database met the inclusion criteria. Two radiologists and two surgeons reviewed the CTs and the operative notes. The configuration and caliber of the post-reconstruction portal vein and SMV (referred to as the PV-SMV complex) were analyzed, and the perivenous tissue was characterized. The findings were correlated with the details of the type of venous reconstruction.

RESULTS
There are four patterns of the PV-SMV complex following reconstruction: concentric smooth narrowing, eccentric/irregular narrowing or defect, thrombosis, and changes in venous configuration without significant caliber change. There are two patterns of the perivenous tissue: soft tissue density thickening, and a range of low attenuation induration/inflammation/fluid. The post-operative imaging findings can be correlated with the type of venous reconstruction performed. Some of the post-operative imaging appearances overlap with findings considered suspicious for recurrent malignancy.

CONCLUSION
There are specific patterns of imaging findings after portal venous reconstruction. In some cases, the normal post-surgical findings mimic recurrent disease. Knowledge of the expected post-surgical appearances may allow for more accurate interpretation of follow-up CT.

CLINICAL RELEVANCE/APPLICATION
Recognition of the patterns of the PV-SMV complex after pancreateicoduodenectomy with venous reconstruction may prevent erroneous diagnosis of recurrent/residual disease.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Elliott K. Fishman, MD - 2012 Honored Educator
Elliott K. Fishman, MD - 2014 Honored Educator

SSC04-09  Evaluation of Splenic Stiffness in Patients of Extrahepatic Portal Vein Obstruction Using Shear Wave Elastography: Comparison with Intra-Operative Portal Pressure

PURPOSE
To compare splenic stiffness (SS) measured by shear wave elastography (SWE) in patients of extrahepatic portal vein obstruction.
To compare splenic stiffness (SS) measured by shear wave elastography (SWE) in patients of extrahepatic portal vein obstruction (EHPVO) with intra-operative portal system pressures (PP)

**METHOD AND MATERIALS**

21 patients (14 males; 7 females) of mean age 20.4 years (range: 13 - 34 years) with clinical and sonographic diagnosis of EHPVO were included in this prospective study after obtaining approval from institute ethics committee. Endoscopy for esophageal varices was done in all patients. Splenic stiffness was measured using shear wave elastography (SWE) on Aixplorer Supersonic Imagine ultrasonography scanner. Three values were taken three different region of interests drawn at different areas of spleen avoiding major vessels and mean was calculated. Intra-operative PP was measured from an omental vein in all these patients during proximal spleno-renal shunt surgery. The PP was compared and correlated with SS along with other parameters. A p-value of < 0.05 was considered significant.

**RESULTS**

The mean SS was 46.04 ± 8.0 kPa and the mean PP was 33.29 ± 4.1 mm of Hg. Although there was negative correlation between PP and SS (Pearson correlation coefficient: minus 0.119), this was not statistically significant (p=0.607). There was no significant correlation between grades of esophageal varices (EV) and SS (p=0.375) and between EV and PP (0.06). PP also did not show significant difference between patients with and without portal biliopathy (p=0.14).

**CONCLUSION**

There was no significant correlation between SS and PSP, EV grading and PSP, and EV grading and SS. Thus SS measured by SWE may not help in predicting gastrointestinal bleed in patients of EHPVO.

**CLINICAL RELEVANCE/APPLICATION**

Assessment of splenic stiffness by SWE is a simple technique giving absolute values of stiffness in kilopascals. Although, SS should indirectly reflect portal pressure, we did not find this in our study. The results of our study indicate that simple measurement of SS may not be sufficient to predict portal pressure and thus variceal bleeding.
**SSC05**

**ISP: Health Service, Policy and Research (Evidence-based Medicine/Guidelines/Outcomes)**

Monday, Nov. 30 10:30AM - 12:00PM Location: S102D

**Health Service, Policy and Research Keynote Speaker: How to Establish a New Imaging Modality with Decent Evidence in Clinical Practice: What the Radiology Community Can Learn from Cardiac CT**

Monday, Nov. 30 10:30AM - 10:40AM Location: S102D

Participants
Marta E. Heilbrun, MD, Salt Lake City, UT (Moderator) Nothing to Disclose
Paul P. Cronin, MD, MS, Ann Arbor, MI (Moderator) Nothing to Disclose

Sub-Events

**SSC05-02**  **Is There an Association between STARD Statement Adherence and Citation Rate?**

Monday, Nov. 30 10:40AM - 10:50AM Location: S102D

Participants
Fabian Bamberg, MD, MPH, Munich, Germany (Presenter) Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG; Research Grant, Bayer AG; Research Grant, Siemens AG;

Purpose
To determine if adherence to the STARD checklist is associated with post-publication citation rates.

Method and Materials
A comprehensive search of multiple databases including PubMed, EMBASE and Cochrane was performed in order to identify published studies that have evaluated adherence of diagnostic accuracy studies to the Standards for Reporting of Diagnostic Accuracy (STARD) statement. Each study was searched in PubMED and Reuters Web of Science to yield a date of publication, journal impact factor (IF), and a citation rate (citations/month). Univariate correlations were performed to identify any association between post publication citation rate and STARD score as well as impact factor. A multivariate analysis was performed to explore the effect of journal impact factor.

Results
Our search included 1002 eligible articles from 8 studies. The median journal IF was 3.97 (IQR: 2.32-6.21), the median STARD score was 15 (IQR 12-18), and the median citation rate was 0.0073 citations/month (IQR 0.0032-0.017). A weak positive correlation of STARD score with citation rate was identified (r=0.096, p=0.0024). There is a moderate positive correlation between impact factor and citation rate (r=0.58, p=0.0001). A weak positive correlation of impact factor with STARD score was identified (r=0.13, p<0.0001). A multivariate analysis revealed that when the effect of impact factor is partialed out, the positive correlation of citation rate with STARD score does not persist (r=0.026, p=0.42).

Conclusion
There is a positive correlation between journal impact factor and citation rate as well as impact factor and STARD score. When adjusted for journal impact factor, the positive correlation of citation rate with STARD score does not persist.

Clinical Relevance/Application
The variation in journal citation rate is influenced primarily by journal impact factor and to a lesser degree by STARD score.

**SSC05-03**  **Carotid Imaging in Canada: A Cost-Effectiveness Analysis**

Monday, Nov. 30 10:50AM - 11:00AM Location: S102D

Participants
Eli Lechtman, PhD, MSc, Toronto, ON (Presenter) Nothing to Disclose
Alan R. Moody, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Kevin Chen, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Sylvia Urbanik, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Pascal N. Tyrrell, PhD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Diagnosing carotid artery disease relies on accessible and cost effective imaging to provide an accurate measure of stenosis. Currently, doppler ultrasound (DUS) is considered the first line modality of choice for suspected stenosis, while MR angiography (MRA) is often used to confirm the diagnosis and plan surgical interventions. In this simulation study, we explored the cost effectiveness of MRA alone vs DUS followed by MRA, for diagnosing suspected stenosis.

METHOD AND MATERIALS
Cost effectiveness analysis (CEA) was conducted using TreeAge Pro. Decision trees were modeled for three populations: those with stenosis less than 50%, those with stenosis between 50-69%, and those with stenosis above 70%. Based on the imaging findings, the decision trees included surgical intervention, medical management, or standard care arms. Effectiveness was measured in terms of quality adjusted life years accounting for surgery and complications, stroke, and medical management. Values for the relevant input variables were extracted from the literature, except the cost of imaging, which was reported from our institution.

RESULTS
Based on the CEA, MRA as a first line modality was more cost effective in populations with a high pretest probability of severe stenosis >70%. In a clinical setting, this would reflect patients with multiple risk factors for carotid disease, or patients presenting with symptoms of carotid stenosis such as a transient ischemic attack (TIA). While DUS as a first line modality was more cost effective for imaging the majority of patients suspected of having carotid stenosis <70%, CEA sensitivity analysis indicated that reducing MRA costs by shortening MRA protocol time and increasing effectiveness of information reported, MRA as a first line modality could be cost effective for an even larger portion of the at-risk population.

CONCLUSION
MRA alone may be more cost effective for patients with a high pretest probability of severe stenosis. Future simulations will explore the effect of wait times on cost effectiveness, as well as the cost effectiveness of emerging MR imaging techniques to identify plaque characteristics for stroke risk stratification and treatment decision making.

CLINICAL RELEVANCE/APPLICATION
Magnetic resonance angiography is shown to be a cost effective first line imaging modality to assess carotid disease, provided there is a high pretest probability of finding severe carotid stenosis.
**SSC05-05**  
**Computed Tomography (CT) in the Emergency Department: A Real-Time Study of Changes in Physician Decision-Making**  
Monday, Nov. 30 11:10AM - 11:20AM Location: S102D

**Participants**  
Part Pandharipande, MD, MPH, Boston, MA (Presenter) Nothing to Disclose  
Andrew T. Reisner, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
William D. Binder, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose  
Atif Zaheer, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose  
Martin L. Gunn, MBChB, Seattle, WA (Abstract Co-Author) Research support, Koninklijke Philips NV; Spouse, Consultant, Wolters Kluwer NV; Medical Advisor, TransformativeMed, Inc;  
Ken F. Linnau, MD, MS, Seattle, WA (Abstract Co-Author) Speaker, Siemens AG; Royalties, Cambridge University Press;  
Chad M. Miller, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose  
Laura L. Avery, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Maurice S. Herring, San Francisco, CA (Abstract Co-Author) Nothing to Disclose  
Angela C. Tramontano, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Emily C. Dowling, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Hari H. Abujudeh, MD, MBA, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Jonathan D. Eisenberg, BA, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Elkan F. Halpern, PhD, Boston, MA (Abstract Co-Author) Research Consultant, Hologic, Inc  
Karen Donelan, DSc, Boston, MA (Abstract Co-Author) Nothing to Disclose  
G. Scott Gazelle, MD, PhD, Boston, MA (Abstract Co-Author) Consultant, General Electric Company Consultant, Marval Biosciences Inc

**PURPOSE**  
To determine how physicians' diagnoses, diagnostic uncertainty, and management decisions are affected by CT in emergency department (ED) settings.

**METHOD AND MATERIALS**  
In this prospective, four-center study, ED patients referred to CT with abdominal pain, chest pain/dyspnea, or headache were identified. Before CT, physicians were surveyed to obtain their leading diagnosis, diagnostic confidence (0-100%), an alternative 'rule out' diagnosis, and management plan (were CT not available). After CT, surveys were repeated. Primary measures included proportions of patients for which leading diagnoses or admission decisions changed, and median changes in diagnostic confidence. Secondary measures addressed alternative diagnoses and return-to-care visits (e.g. to the ED) at one-month follow-up. Regression analysis identified associations between primary measures and site and participant (physician and patient) characteristics.

**RESULTS**  
Paired surveys were completed for 1503 patients by 265 physicians. For abdominal pain, chest pain/dyspnea, and headache, leading diagnoses changed in 51% (278/545), 44% (208/471), and 25% (122/487) of patients. Pre-CT diagnostic confidence was consistently, inversely associated with the likelihood of a diagnostic change (p<0.0001). Median changes in confidence were substantial (+25%, +20%, +13% (p<0.0001)); median Post-CT confidence was high (95%, 93%, 95%) (Fig. 1). When reported, CT helped to confirm or exclude 'rule out' diagnoses in 95% or more of patients (96% (411/428), 97% (382/393), 95% (392/414)). Admission decisions changed in 25% (134/542), 18% (86/471), and 20% (94/480) of patients. During follow-up, 15% (82/545), 14% (64/471), and 10% (50/487) of patients returned for the same indication. Results correlated with site and participant characteristics in isolated circumstances.

**CONCLUSION**  
Physicians' diagnoses and admission decisions changed frequently after CT, and valid diagnostic uncertainty was alleviated. These findings suggest that current ordering practices are clinically justified.

**CLINICAL RELEVANCE/APPLICATION**  
For common referral indications to CT in emergency department settings, physicians' diagnoses and admission decisions change frequently after CT, and valid diagnostic uncertainty is alleviated; these findings suggest that current ordering practices are clinically justified.

**Honored Educators**  
Atif Zaheer, MD - 2012 Honored Educator

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**SSC05-06**  
**Quenching MRI Anxiety: Complementary Alternative Medicine for Magnetic Resonance Imaging Anxiety**  
Monday, Nov. 30 11:20AM - 11:30AM Location: S102D

**Participants**  
Selena I. Glenn, MA, BSRT, Portland, OR (Presenter) Nothing to Disclose

**PURPOSE**  
Claustrophobia during MRI exams is a problem in imaging departments worldwide causing prematurely cancelled exams with financial losses to medical facilities and delays patient care. A pilot study was conducted hypothesizing complementary alternative medicine (CAM) modalities aromatherapy and breathing techniques would decrease patient anxiety.

**METHOD AND MATERIALS**  
A pilot study was conducted hypothesizing complementary alternative medicine (CAM) modalities aromatherapy and breathing techniques would decrease patient anxiety.
Thirty eight claustrophobic patients participated. They were four study arms, two experimental and two control groups. Experimental arms included participants who used anxiety medication (n=5), and non-medicated (n=13). The control arms included participants who used anxiety medication (n=8) and, non-medicated (n=12). All scans except one were performed on a 1.5T wide short bore scanner, and were of the hip region and above. Aromatherapy and breathing techniques was performed by the experimental groups just before entering scanner bore. The control group was provided standard care and sham aromatherapy. Study theoretical schools of thoughts were integrative medicine and mixing humanistic and cognitive therapy methods. Study design was concurrent triangulation mixed methods. Quantitative data included Likert scales, physiological data and were analyzed using an exact distributions based test, and regression analysis respectively. Qualitative data included open ended questions analyzed by mapping common themes and quantified for histogram analysis.

RESULTS
A 76.5% statistically significant (p = .02 < 0.05) reduction in anxiety from pre scan anxiety to post CAM treatment in experimental groups, while control group experienced a statistically insignificant 66.7% (p = .12 >0.05) anxiety reduction. Likewise there was a 76.5% (p = .02 < 0.05) average anxiety reduction in the experimental group during the MRI compared to pre scan levels, while control group anxiety reduction was not statistically significantly (p = 0.69 > 0.05). Qualitative data findings were 33% of experimental group said their anxiety was reduced, compared to 22% of the control group. Physiological data showed that as the heart rate increased the average anxiety increased.

CONCLUSION
Aromatherapy and breathing techniques may reduce anxiety during MRIs.

CLINICAL RELEVANCE/APPLICATION
Fewer cancelled MRI exams with cost savings to medical facilities. Less interrupted medical treatment increasing patient care quality. A low cost skill based intervention for technologists.

SSC05-07 Quest for More Personalized Lung Cancer Screening Strategy: Proximity of Smoking Cessation as a Predictor of Lung Cancer Events in High-risk Individuals Selected for Screening, Analysis with Propensity Score

Monday, Nov. 30 11:30AM - 11:40AM Location: S102D

Participants
Recai Akty, MD, Pepper Pike, OH (Presenter) Nothing to Disclose
Pingfu Fu, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Thomas Love, Cleveland, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
Purpose: To determine if proximity of smoking cessation (PoSC) is a predictor of incremental lung cancer events (LCE) among those already selected for lung cancer screening (LCS).

METHOD AND MATERIALS
Methods and Materials: We stratified National Lung Screening Trial (NLST) cohort by PoSC (time from SC to randomization) into three groups (>10 yrs and <5 identifying "remote-" and "recent-quitters respectively). For each case, we estimated the propensity (PS) for remote-quitter using multivariable logistic regression (LR) -with 34 variables. From remote- (n=8,361) and recent-quitters (n=9,435), we produced 6,866 unique pairs of "remote-" and "recent-quitter" cases using PS matching. In the matched, and the entire groups of former smokers (FS) (n=27,692), we estimated the association between PoSC and incidences of LC and LC-death (LCD) using LR and restricted spline fit (RSF) of PoSC. We tested the models' goodness of fit (GOF) in quantiles of predicted probabilities and calculated the area-under-the-curve (AUC) in ROC analysis for predictive performance.

RESULTS
Results: In the FS group, there were 149:331 respective LCD:LC cases of recent- and 98:205 cases of remote-quitters compared to 102:244 and 69:145 LCD:LC cases respectively in the matched group. Recent-quitters were 71% more likely to have LC (OR=1.71;95%CI=1.39-2.12) and 50% more LCD (OR=1.50;95%CI=1.10-2.06) in the follow-up. Each proximate yr of SC is associated with 4.8% increased risk for LC (OR=1.048;95%CI=1.032-1.056) and 4.5% for LCD (OR=1.045;95%CI=1.021-1.070). On RSF, PoSC had significant (P=.001 for LC and LCD), and linear associations with LC (P=.788) and LCD (P=.086). Validated and calibrated LR models predicted LC and LCD with AUCs of 0.64 and 0.66 respectively with favorable GOF (P=.0739 for LC and 0.095 for LCD).

CONCLUSION
Conclusion: In those already selected for LCS, the proximity of SC is linearly associated with increased risk for LCEs. Time-to-event analyses would explore the clinical usefulness of these relationships.

CLINICAL RELEVANCE/APPLICATION
Clinical Relevance: A personalized LCS strategy may be devised through a second-round of risk profiling of those selected for LCS and PoSC may be used as one of the risk predictors in this endeavor.

SSC05-08 Quest for More Personalized Lung Cancer Screening Strategy: Age Older Than 54 Years as a Predictor of Lung Cancer Events in Individuals Selected for Screening

Monday, Nov. 30 11:40AM - 11:50AM Location: S102D

Participants
Recai Akty, MD, Pepper Pike, OH (Presenter) Nothing to Disclose
Pingfu Fu, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Thomas Love, Cleveland, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
Purpose: To determine if age can increment the prediction of lung cancer events (LCE) in individuals who are already selected for lung cancer screening (LCS).

METHOD AND MATERIALS

Methods and Materials: We stratified the National Lung Screening Trial cohort by age into three groups (>=64 years and 54-59 identifying “senior-” and “young-group” respectively). For each case, we estimated the propensity (PS) for senior-group using multivariable regression (LR) - with 34 variables such as socio-demographic, exposure history,... From senior- (n=16,958) and young-groups (n=18,844), we produced 12,034 unique pairs of "senior" and "young" cases using PS matching. In the matched, and the entire cohort (n=53,452), we estimated the association between participants’ age and incidences of LC and LC-death (LCD) using LR and restricted spline fit (RSF) of age. We tested the models’ goodness of fit (GOF) in quantiles of predicted probabilities and calculated the area-under-the-curve (AUC) in ROC analysis for predictive performance.

RESULTS

Results: In the entire group, there were 519:1016 and 203:422 respective LCD:LC cases in the senior- and the young-group respectively and in the matched group, 356:712 cases were senior and 129:286 cases were young. Seniors were more likely -than youngs- to have LC (OR=2.58;95%CI=2.24-2.97) and LCD (OR=2.78;95%CI=2.27-3.42) in the follow-up. In the entire group, LR showed 8.7% increased risk of LC (OR=1.087; 95%CI=1.077-1.096) per year of age, however, this relationship was non-linear (P=0.0237) on RSF. For LCD, the risk increment was 8.9% per year (OR=1.089;95%CI=1.076-1.103) and this was linear (P=0.842) and significant (P<0.001). Calibrated LR with RSF predicted LC and LCD with AUCs of 0.63 and 0.68 respectively. GOF test was favorable with P-value of 0.421 for LC and 0.760 for LCD.

CONCLUSION

Conclusion: In those selected for LCS, age is a predictor of incremental LCEs. However, further time-to-event analyses are needed to determine the method for its potential clinical use.

CLINICAL RELEVANCE/APPLICATION

Clinical Relevance: In those already selected for LCS, a second-round of risk profiling may allow the LCS strategy to be personalized and age may be used as one of the predictors of LCEs in this process.

Participants

Marta E. Heilbrun, MD, Salt Lake City, UT (Presenter) Nothing to Disclose
**SSC06**

**Informatics (Image Processing and Analysis)**

Monday, Nov. 30 10:30AM - 12:00PM Location: S402AB

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credit: 0

**FDA** Discussions may include off-label uses.

**Participants**

Asim F. Choudhri, MD, Memphis, TN (Moderator) Nothing to Disclose
Srini Tridandapani, MD, PhD, Atlanta, GA (Moderator) Nothing to Disclose

**Sub-Events**

**SSC06-01 Radiogenomics Mapping of Non-Small Cell Lung Cancer Identifies Prognostic Relationships between Semantic Image Features and Metagenes Captured Using RNA Sequencing**

Monday, Nov. 30 10:30AM - 10:40AM Location: S402AB

Participants

Olivier Gevaert, PhD, Stanford, CA (Presenter) Nothing to Disclose
Sandy Napel, PhD, Stanford, CA (Abstract Co-Author) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc
Sebastian Echegaray, MS, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Chuong D. Hoang, MD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Amanda Khuong, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Sylvia K. Plevritis, PhD, Stanford, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To build a radiogenomic map linking RNA sequencing data with semantic image features for non-small cell lung cancer patients for non-invasive precision medicine.

**METHOD AND MATERIALS**

Under IRB approval, we studied 81 cases of NSCLC who had preoperative CT scans and tumor tissue collected between 4/7/2008 and 09/15/2014 at two medical centers. A radiologist annotated the CT of each tumor with semantic image features using a template with a controlled vocabulary. Next, total RNA was extracted from these tissue samples and converted into a library for paired-end RNA sequencing on Illumina Hiseq. The RNA sequencing data were summarized into 56 high quality metagenes and filtered for metagene homogeneity in five external gene expression cohorts totaling 1227 NSCLC patients. We built a radiogenomics map between metagenes and semantic image features by using Significance Analysis of Microarrays (SAM) analysis including multiple testing corrections using the False Discovery Rate (FDR). We correlated the metagenes with clinical outcome using Cox proportional hazards modeling in the five external cohorts to establish the prognostic relationship of each metagene.

**RESULTS**

We focused on the top ten metagenes with the highest cluster homogeneity in five external cohorts and correlated them with 89 semantic image features. We found 48 significant associations (Q-value <0.05) defining a radiogenomics map between semantic features and molecular pathways. These metagenes capture intriguing pathways including early and late cell cycle, the T-cell immune response and hypoxic inflammation and link these with semantic image features capturing emphysema severity. Similarly the LRIG1-EGF pathway defines peripheral ground glass lesions that have a high proportion of airway abnormalities or an internal air bronchogram. Six of these metagenes are significantly correlated with prognosis in five external cohorts. The most prognostic metagene contains genes related to extra-cellular matrix processing and is significantly correlated with spiculated margins.

**CONCLUSION**

We defined ten high level metagenes capturing canonical pathways of NSCLC and linked them with a large collection of semantic image features realizing a radiogenomics map for NSCLC.

**CLINICAL RELEVANCE/APPLICATION**

Semantic image features mirror molecular properties of NSCLC with prognostic implications.

**SSC06-02 Prenatal Computer-Aided Diagnosis of Craniosynostosis Using Shape Analysis**

Monday, Nov. 30 10:40AM - 10:50AM Location: S402AB

Participants

Jie Ying Wu, Providence, RI (Presenter) Nothing to Disclose
Christopher A. DeFreitas, BA, Providence, RI (Abstract Co-Author) Nothing to Disclose
Stephen Carr, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose
Derek Merck, Barrington, RI (Abstract Co-Author) Nothing to Disclose
Margaret M. Byrne, Providence, RI (Abstract Co-Author) Nothing to Disclose
Olivia E. Linden, BA, Providence, RI (Abstract Co-Author) Nothing to Disclose
Stephen R. Sullivan, MD, MPH, Providence, RI (Abstract Co-Author) Nothing to Disclose
Helena O. Taylor, MD, PhD, Providence, RI (Abstract Co-Author) Nothing to Disclose

**Background**
Craniosynostosis is the premature fusion of cranial sutures, affecting approximately 1/2500 births. Surgical correction within first year of life generally leads to the best outcomes, so early detection is helpful for treatment planning. It is typically diagnosed during post-natal clinical examination secondary to the abnormal head shape. Some studies show that craniosynostosis is detectable on prenatal ultrasound (US), but a systemic, clinical screening methodology remains elusive.

Evaluation

Our goal is to quantitatively evaluate prenatal US to determine whether children with craniosynostosis can be identified in utero. We collected prenatal US images from 22 children with a CT-confirmed post-natal diagnosis, as well as 22 age-matched controls. On the standard cross-sectional image used to measure biparietal diameter, we manually measured the vectors to the outer cortical boundaries. We train two machine learning algorithms, support vector machine and random forest, with these 6 parameters and the known diagnosis. Testing with leave-one-out cross-validation, we obtained 89% and 84% accuracy, and 95% and 86% specificity respectively. Sensitivity was 82% for both. For comparison, two blinded craniofacial surgeons scored each image as normal, or synostotic.

Discussion

We present a reliable tool for quantitatively assessing prenatal US images for craniosynostosis. The surgeons' accuracies were 40-50%, compared to the program's 89%. Our program can identify suspected cases for more dedicated imaging, and prenatal counseling. Since we collected the images routinely, and reviewed them retrospectively, our methodology can easily be integrated into the current clinical pipeline.

Conclusion

Our results show that a formal shape analysis of prenatal US identifies craniosynostosis with high accuracy. With more training cases and further refinement of the procedure, we hope to include this as a standard routine in the clinic. Future work includes automatic detection of skull boundary and radii measurement.

SSC06-03 A Novel 3D User Interface with 6 Degrees of Freedom for Analysis of Volumetric Computed Tomographic Images: A Pilot Study Evaluating Feasibility and Efficiency in the Diagnosis of Pulmonary Embolism

Monday, Nov. 30 10:50AM - 11:00AM Location: S402AB

Participants
Jad M. Bou Ayache, MD, New York, NY (Presenter) Nothing to Disclose
Michael Teistler, PhD, Flensburg, Germany (Abstract Co-Author) Nothing to Disclose
Pattanasak Mongkolwat, PhD, Bangkok, Thailand (Abstract Co-Author) Nothing to Disclose
Ian Murphy, MBBCch, MRCS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Jeremy D. Collins, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

Background

The aim of this pilot study is to evaluate the clinical utility of a novel 3D user interface approach that provides 6 degrees of freedom(6 DOF) input with the help of a motion sensitive game controller for evaluation of pulmonary embolism at computed tomography angiography(CTA).

Evaluation

Retrospective analysis of 36 patients (13M,23F;mean age 53+/−13 yrs) referred for CTA to rule out PE over one year. 11 of 36 patients had PE. The 6DOF tool was used to create on-the-fly oblique reformations and compared to conventional Radiology PACS with multplanar reformatted images (MPR) and advanced visualization workstation with real-time MPR manipulation capabilities (Vitrea, Vital Images, Minneapolis, MN). Time to diagnosis and diagnostic confidence were recorded separately for each interface by a single observer starting with the 6 DOF tool. A second observer used the 6 DOF tool on two occasions 3 weeks apart. The final radiologic report was considered the gold standard. Time to diagnosis was compared using a Wilcoxon rank sum test comparing the 6 DOF tool, PACS, and 3D post-processing software(Vitrea). A two-tailed t-test was used to compare times recorded by the second observer.

Discussion

The 6 DOF tool enabled review of all datasets and detection of all PE. There was a temporal advantage of the 3D tool (41.7+/−15.6 s) over standard PACS (83.9+/−30.7 sec,p<0.05) and 3D post-processing software (66.6+/−17.7 s, p<0.05). There was a significant reduction in time to diagnosis by the second reviewer upon second attempt(46.26+/−27.1 s, improving to 36.47+/−18.8 s, p<0.05). Diagnostic confidence was similar among the different viewing interfaces.

Conclusion

The novel 6DOF technology has the ability to save time in CT diagnosis of PE without compromising diagnostic confidence. Time to diagnosis is further improved with repeated use of the tool. Applications of the new 3D user interface tool are not limited to CT angiography and include any volumetric cross-sectional data sets. This may be useful in reducing the burden of reformats on PACS and improve clinical throughput. Potential applications include teaching anatomy, procedural planning, and interrogation of large time-resolved volumetric data.

SSC06-04 A New Saliency Metric for Precise Denoising PET Images for Better Visualization and Accurate Segmentation

Monday, Nov. 30 11:00AM - 11:10AM Location: S402AB

Participants
Nasim Souly, Orlando, Fl (Abstract Co-Author) Nothing to Disclose
Georgios Z. Papadakis, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Ulas Bagci, PhD, MSc, Orlando, Fl (Presenter) Nothing to Disclose

Background

We present a reliable tool for quantitatively assessing prenatal US images for craniosynostosis. The surgeons' accuracies were 40-50%, compared to the program's 89%. Our program can identify suspected cases for more dedicated imaging, and prenatal counseling. Since we collected the images routinely, and reviewed them retrospectively, our methodology can easily be integrated into the current clinical pipeline.

Evaluation

Retrospective analysis of 36 patients (13M,23F;mean age 53+/−13 yrs) referred for CTA to rule out PE over one year. 11 of 36 patients had PE. The 6DOF tool was used to create on-the-fly oblique reformations and compared to conventional Radiology PACS with multplanar reformatted images (MPR) and advanced visualization workstation with real-time MPR manipulation capabilities (Vitrea, Vital Images, Minneapolis, MN). Time to diagnosis and diagnostic confidence were recorded separately for each interface by a single observer starting with the 6 DOF tool. A second observer used the 6 DOF tool on two occasions 3 weeks apart. The final radiologic report was considered the gold standard. Time to diagnosis was compared using a Wilcoxon rank sum test comparing the 6 DOF tool, PACS, and 3D post-processing software(Vitrea). A two-tailed t-test was used to compare times recorded by the second observer.

Discussion

The 6 DOF tool enabled review of all datasets and detection of all PE. There was a temporal advantage of the 3D tool (41.7+/−15.6 s) over standard PACS (83.9+/−30.7 sec,p<0.05) and 3D post-processing software (66.6+/−17.7 s, p<0.05). There was a significant reduction in time to diagnosis by the second reviewer upon second attempt(46.26+/−27.1 s, improving to 36.47+/−18.8 s, p<0.05). Diagnostic confidence was similar among the different viewing interfaces.

Conclusion

The novel 6DOF technology has the ability to save time in CT diagnosis of PE without compromising diagnostic confidence. Time to diagnosis is further improved with repeated use of the tool. Applications of the new 3D user interface tool are not limited to CT angiography and include any volumetric cross-sectional data sets. This may be useful in reducing the burden of reformats on PACS and improve clinical throughput. Potential applications include teaching anatomy, procedural planning, and interrogation of large time-resolved volumetric data.
**Background**

Our purpose in this study is to design an automated, accurate, robust, and efficient image denoising and algorithm for PET images in diagnostic tasks. For this purpose, we define a new metric for saliency definition in PET imaging. Existing denoising methods take a few hours for a single PET volume if optimal results are desired. Briefly, saliency definition aims to detect the regions of an image that stands out from the rest of the image. Hence, those regions are considered redundant. First, we build pyramids of the image with different resolution and contrast map. Then, we use a sliding window across the image and compute the Euclidean distance of each pixel from its neighbor in the window. Next, for each pixel, by accumulating the distances to all pixels in the neighborhood, a contrast value is obtained. Finally, all contrast maps are combined to form the denoised images. We retrospectively analyzed 20 PET-CT images of NEMA phantoms where ground truths are available as CT correspondence.

**Evaluation**

We compared our method with the state of the art non-local means based denoising method and have observed that there is no statistically significant difference (via t-test) in terms of SNR, relative contrast ratio, and measured SUV levels. On average, more than 30% improvement was observed in SNR, and 100% of SUVmax was preserved at the end of denoising. While the state of the art method produces a denoised PET image within 3-4 hours on average, our method produces the same/similar quality images only in seconds. Figure 1 shows improvement of the PET images for a given phantom image.

**Discussion**

Confounding factors such as noise should be removed from the PET images for (1) better visualization and (2) more accurate quantification. Our proposed method removes noise from PET images and simplifies the segmentation and quantification of radiotracer uptake regions only within seconds as opposed to standard methods that may take hours.

**Conclusion**

The proposed comprehensive automated algorithm helps to achieve better quantification of PET images in an efficient and robust manner. It provides an effective tool (saliency metric) for PET image enhancement.

**SSC06-05  Applying Deep Machine Learning Algorithms for Automated Detection of Abnormalities on Chest Radiographs**

**Monday, Nov. 30 11:10AM - 11:20AM Location: S402AB**

**Participants**

Mark D. Cicero, Toronto, ON (Presenter) Co-founder, 3BC Inc
Taha Bandukwala, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Timothy R. Dowdell, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Joe J. Barfett, MD, London, ON (Abstract Co-Author) Nothing to Disclose
Kuhan Perampaladas, Toronto, ON (Abstract Co-Author) Nothing to Disclose

**Background**

Since 2011, deep learning algorithms have been gaining more attention within the machine learning community, as their success rates on certain recognition tasks have been competitive with humans. In 2012, researchers from the University of Toronto trained a deep convolutional neural network (CNN) using the largest tagged dataset available, ImageNet, which consists of 15 million high-resolution images tagged in over 22,000 categories. They achieved object recognition top-1 and top-5 error rates of 37.5% and 15.3% respectively.

**Evaluation**

We trained a convolutional neural network with 10,000 chest radiographs which were tagged as either normal (absence of any clinically relevant pathology) or abnormal based on the final radiology report. This was performed using a single 2 GB nvidia GTX 770 graphics processing unit (GPU) and an open-source deep learning software package (convnet). The performance of the neural network was tested using an untrained dataset consisting of 500 radiographs and characterized using receiver-operating curve analysis at different output probability thresholds. It achieved a maximum sensitivity of 95% with a corresponding specificity of 85%.

**Discussion**

Advancements in machine learning have been possible due to improvements in computation power through the use of GPUs and the access to large quantities of data. The current success and future developments of these algorithms will have a profound effect on the interpretation of medical images. We have proven that with adequate data, these algorithms can be used to help automate and speed up medical diagnosis. With more data, we expect further improvement in performance. Furthermore, more experimentation is required to determine if diagnostic subcategories could be classified with this same approach.

**Conclusion**

Convolutional neural networks can be trained using a modestly sized medical dataset to screen chest radiographs as normal or abnormal. Deep learning will play an integral role in advancing computer-aided diagnosis which will enhance and speed up the workflow of the radiologist. Further experimentation is required using larger datasets as well as different types of imaging studies.

**SSC06-06  Computer-aided Diagnosis of Ground Glass Opacity Lung Nodules: Quantitative Analysis of 248 Nodules**

**Monday, Nov. 30 11:20AM - 11:30AM Location: S402AB**

**Participants**

Ming Li, MD, ShangHai, China (Abstract Co-Author) Nothing to Disclose
Vivek Narayan, Boston, MA (Abstract Co-Author) Nothing to Disclose
Maria F. Barile, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ritu R. Gill, MBBS, Boston, MA (Abstract Co-Author) Nothing to Disclose
Raphael Bueno, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Clare M. Tempany-Afdhal, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Jayender Jagadeesan, PhD, Boston, MA (Presenter) Research Grant, Siemens AG
Lung adenocarcinoma's new classification is based on histologic criteria. There is a need to develop image-based classification of GGNs into AAH, AIS, MIA and IAC. We propose a Support Vector Machine (SVM) algorithm with input as tumor heterogeneity metrics obtained from CT images to predict the lesion type.

Evaluation

Non-contrast CT (NonC) images were obtained for 248 lung nodules and loaded in 3D Slicer software, along with the corresponding pathology reports. An experienced radiologist segmented the lesions on 3D Slicer. Thereafter, using the open-source HeterogeneityCAD module in 3D Slicer, 58 quantitative metrics that describe the distribution statistics, shape, morphology, Renyi dimensions, geometrical measure and texture were obtained for each segmented lesion on the NonC. Statistical correlation of the metrics with the four classes of GGOs, determined by pathology, was performed using the Kruskal-Wallis test. A SVM based algorithm was also developed to train the algorithm and predict the lesion type based on the quantitative metrics. The accuracy of prediction of the lesion type by the SVM algorithm was compared to the classification done by two fellowship trained thoracic radiologists (Manual-class). The accuracy of differentiating between AIS and MIA, and indolent (AAH and AIS) and invasive (MIA and IAC) was determined.

Discussion

All 58 metrics showed significant difference (p<0.05) between the four groups on NonC. The accuracy of classifying AIS and MIA on NonC was: SVM = 88.24%, Manual-class = 38.07%, accuracy of classifying indolent and invasive lesions was: SVM = 90%, Manual-class = 64.75%, accuracy of classifying the lesions into the four groups was: SVM = 64%, Manual-class = 44.26%. The agreement between the two expert raters for classifying the lesions into the four categories was 38.52% with a kappa of 0.1376 corresponding to slight agreement.

Conclusion

In this preliminary study, the SVM based computerized algorithm appears to demonstrate significantly higher accuracy in classifying GGOs than manual classification. This may be a useful tool to determine the lesion type on CT images and could provide accurate guidance in determining the optimal therapeutic options.

SSC06-07 Automated Classification of Spectral Quality and Metabolic Abnormality in Volumetric MR Spectroscopic Imaging Using a Web-Based Evaluation Platform

Background

MR spectroscopic imaging (MRSI) is able to assess treatment response in gliomas by imaging metabolites without exogenous tracer. Whole-brain volumes can be constructed using spectral components, including choline (Cho), creatine (Cr), and N-acetylaspartate (NAA) signal. Accuracy of these volumes depends on spectral quality (SQ) with poor SQ leading to erroneous volumetry. We developed an automated method for determining SQ based on curve-fitting metrics using machine-learning methods to create a data-driven model for SQ filtering.

Evaluation

A 3D MRSI sequence at 3T was used to generate whole-brain volumetric maps with 108 mm³ resolution. A spectral analysis tool was used to review and label each spectrum as having adequate (A) or inadequate (I) SQ. MRS curve-fitting measures describing 115 features (e.g. full-width, half max values) from each spectrum were used to train a random forest classifier to determine SQ and discriminate normal tissue vs. tumor in 6243 voxels (n=7 patients) as a pilot run by one reader. Strict cross-validation was performed by training a classifier on 6 patients and evaluating on the 7th in a rotating manner. Classifier performance was evaluated using ROC analysis and feature salience was evaluated by summing split criterion over all trees in each forest.

Discussion

Pilot-study area-under-the-curve (AUC) values for classifying SQ and tumor (in A voxels) were 0.94 and 0.79 respectively. The most salient features for SQ included the Cramer-Rao bounds for Cho peak frequency and area, and the Lorentzian and Gaussian components of the NAA peak. The most salient features for tumor classification included Cho/NAA, Cho/Cr, and NAA/Cr: ratios used for tumor evaluation clinically.

Conclusion

High AUCs for SQ and tumor classification suggests training random forests with curve-fit metrics results in an accurate classifier in a small sample. A web-based spectral evaluation tool to generate consensus measures between multiple experts (3 readers per spectrum) in a randomized, double-blinded fashion is currently being developed to mitigate bias in class labeling. We will report the outcomes using 20,000 voxels (n=20 patients) reviewed by ~ 10 MR spectroscopists and/or radiologists.

SSC06-08 Predictive Modeling of Microvascular Invasion Using Triphasic Quantitative Imaging of Hepatocellular
CONCLUSION

The method of mVI detection.

Identifying mVI, which indicates poor prognosis and survival for patients with HCC, is undetectable by the human eye on standard imaging, and hence only determined on pathological diagnosis. Quantitative image features could provide a non-invasive method of mVI detection.

RESULTS

We evaluated our models.

We used concordance analysis to select only features robust to inter-reader variability using Lin's concordance correlation (LCC) coefficient with a correlation threshold of at least 0.8 between readers. We evaluated our model using a combined leave-one-reader and leave-one-patient out cross validation analysis (LOR-LOO-CV), whereby we train a model on three readers on 28 patients and test on the fourth reader annotations of the left out patient. We used the area under the ROC curve (AUC) to evaluate our models.

CLINICAL RELEVANCE/APPLICATION

Quantitative changes of texture and intensity features between the arterial and venous phases can be used to predict mVI in HCC.

Identification of Molecular Phenotypes by Integrating Radiomics and Genomics

PURPOSE

To uncover the mechanistic connections between radiomic features, molecular pathways, and clinical outcomes, to develop radiomic-based predictors of pathway activation states in individual patients, and to assess whether combining radiomic with clinical and genomic data improves prognostication.

METHOD AND MATERIALS

We analyzed two independent lung cancer cohorts totaling 351 patients, for whom diagnostic computed tomography (CT) scans, gene-expression profiles, and clinical outcomes were available. The tumor phenotype was characterized based on 636 radiomic features describing tumor intensity, texture, shape, and size. We performed an integrative analysis by developing and independently validating association modules of coherently expressed radiomic features and molecular pathways. These modules were statistically tested for significant associations to overall survival (OS), TNM stage, and pathologic histology.

RESULTS

We identified thirteen radiomic-pathway association modules (p < 0.05), the most prominent of which were associated with the immune system, p53 pathway, and other pathways involved in cell cycle regulation. Eleven modules were significantly associated with clinical outcomes (p < 0.05). Strong predictive power for pathway activation states in individual patients was observed using radiomics; the strongest per module predictions ranged from an intra-tumor heterogeneity feature predicting RNA III polymerase transcription (AUC 0.62, p = 0.03), to a tumor intensity dispersion feature predicting pyruvate metabolism and citric acid TCA cycle (AUC 0.72, p < 1E-6). Stepwise combinations of radiomic data with clinical outcomes and gene expression profiles resulted in consistent increases of prognostic power to predict OS (concordance index max = 0.73, p < 1E-9).

CONCLUSION

We identified thirteen radiomic-pathway association modules (p < 0.05). Strong predictive power for pathway activation states in individual patients was observed using radiomics; the strongest per module predictions ranged from an intra-tumor heterogeneity feature predicting RNA III polymerase transcription (AUC 0.62, p = 0.03), to a tumor intensity dispersion feature predicting pyruvate metabolism and citric acid TCA cycle (AUC 0.72, p < 1E-6). Stepwise combinations of radiomic data with clinical outcomes and gene expression profiles resulted in consistent increases of prognostic power to predict OS (concordance index max = 0.73, p < 1E-9).
This study demonstrates that radiomic approaches permit a non-invasive assessment of molecular and clinical characteristics of tumors, and therefore have the unprecedented potential to cost-effectively advance clinical decision-making using routinely acquired, standard-of-care imaging data. We show that prognostic value complementary to clinical and genomic information can be obtained by radiomic strategies.

CLINICAL RELEVANCE/APPLICATION

Advance decision-making by radiomic predictions of tumor phenotype. These predictions are complementary to clinical and genomic data, and are generated based on existing standard-of-care images.
SSC07

**ISP: Musculoskeletal (Cartilage: Mechanics, Quantitative MRI and Repair)**

Monday, Nov. 30 10:30AM - 12:00PM Location: E450B

**Participants**
Daniel B. Nissman, MD, MPH, Raleigh, NC (Moderator) Royalties, John Wiley & Sons, Inc
Michael P. Recht, MD, New York, NY (Moderator) Nothing to Disclose

**Sub-Events**

**SSC07-01**  **Musculoskeletal Keynote Speaker: Cartilage: Understanding Quantitative Evaluation through Structure and Biomechanics**

Monday, Nov. 30 10:30AM - 10:50AM Location: E450B

**Participants**
Michael P. Recht, MD, New York, NY (Presenter) Nothing to Disclose

**SSC07-03**  **Weight Loss Is Associated with Slower Cartilage Degeneration Over 48 Months in Obese and Overweight Subjects: Data from the Osteoarthritis Initiative**

Monday, Nov. 30 10:50AM - 11:00AM Location: E450B

**Participants**
Alexandra S. Gersing, MD, San Francisco, CA (Presenter) Nothing to Disclose
Martin Solka, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Gabby B. Joseph, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Benedikt J. Schweiger, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Ursula R. Heilmeier, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Georg Feuerriegel, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
John Mbapte Wamba, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Charles E. McCulloch, San Francisco, CA (Abstract Co-Author) Instructor, F. Hoffmann-La Roche Ltd Expert Witness, Mallinckrodt plc Consultant, Mallinckrodt plc
Michael C. Nevitt, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Thomas M. Link, MD, PhD, San Francisco, CA (Abstract Co-Author) Research funded, General Electric Company; Research funded, InSightec Ltd; Royalties, Springer Science+Business Media Deutschland GmbH; Research Consultant, Pfizer Inc;

**PURPOSE**

To investigate the association of different degrees of weight loss with progression of knee cartilage degeneration in overweight and obese subjects.

**METHOD AND MATERIALS**

In this study, 290 subjects (age 61.7±9.1y; 171 females) with a BMI>25kg/m2 from the Osteoarthritis Initiative (OAI) with risk factors for OA or radiographically mild to moderate OA were included. Subjects with weight loss were categorized into groups with a large (≥10%, n=36) or moderate amount of weight loss (5-10%, n=109) over 48 months, and were frequency matched to a group with stable weight (BMI change <3%, n=145). Changes of focal cartilage defects assessed with 3T MRI cartilage WORMS (Whole-Organ Magnetic Resonance Imaging Score) and T2 maps of the right knee for five cartilage compartments (patella, medial and lateral femur, medial and lateral tibia) including laminar and texture analysis, were analyzed using multivariate regression models adjusting for age, sex, baseline BMI and KL.

**RESULTS**

Overall cartilage WORMS showed significantly less progression in both weight loss groups compared to the stable weight group (5-10% weight loss, P=0.035; >10% weight loss, P<0.0001) over 48 months and changes were associated with changes of BMI (r=0.31, P=0.02). Subjects with >10% weight loss showed significantly less T2 value increase in the bone layer averaged over all compartments compared with stable weight subjects (mean diff. 1.0msec [95%CI 1.3, 0.6] P=0.01), suggesting slower cartilage deterioration, yet no significant change in T2 was found between 5-10% weight loss and stable weight group. In the medial compartment of the >10% weight loss group, overall T2 and cartilage WORMS changes were significantly less (P<0.0001, for each) and homogeneity was increased (P=0.004), compared to the group with stable weight.

**CONCLUSION**

While changes in cartilage defects were significantly associated with the amount of weight loss in all subjects, only subjects with >10% weight loss showed significantly reduced cartilage deterioration measured with T2. Our data show evidence that weight loss has a protective effect against cartilage degeneration and that a larger amount of weight loss is more beneficial.

**CLINICAL RELEVANCE/APPLICATION**

MR-based knee cartilage T2 measurements and semiquantitative grading allow monitoring of the protective effect of weight loss on joint health and are useful to determine which amount of weight loss is most beneficial in overweight and obese patients.

**SSC07-04**  **The TEFR Field Study: Results of Continuous Biochemical and Morphological Cartilage Analysis of Hindfoot, Ankle, and Knee Joints in Course of a 4,500 km Ultramarathon Race throughout Whole Europe Using T2*-mapping on a Mobile MRI Truck Trailer**
This work compared a newly developed 3D-TESS sequence with a CPMG method to evaluate T2-mapping of human articular cartilage. It was hypothesized that 3D TESS would provide a faster and more efficient way to measure T2 relaxation times compared to the standard CPMG method.

**METHOD AND MATERIALS**

MRI data were acquired with a mobile 1.5T scanner travelling with 44 participants of the TransEurope FootRace (TEFR) for 64 days. Repeated follow-up scans were obtained using a T2* GRE-, a TIRM-, and a fat-saturated PD-sequence. T2* values were obtained from inline reconstructed T2* maps by using a pixelwise, monoexponential nonnegative least squares fit analysis. Statistical analyses regarding cartilage T2* and thickness changes and influencing factors were done on the finishers of the race.

**RESULTS**

With exception of the patellar joint, nearly all cartilage segments showed a significant initial mean T2* signal increase within the first 1500km run: ankle 25.6%, subtalar joint 20.9%, midtarsal joint 26.3%, femorotibial Joint (FTJ) 25.1 to 44.0%. Interestingly, an unexpected secondary T2* decrease was observed in ankle (-30.6%) and hindfoot joints (-28.5% and -16.0%), but not in the FTJ. A significant loss of cartilage thickness was detected in the FTJ, but not in the other joints. A side dependent, positive relationship between muscle volumes of the thigh and cartilage T2* at baseline could be found in the FTJ. Osteochondral lesions were detected, however all were already present at baseline and showed no changes throughout TEFR. Reasons for stopping the race were not associated with joint problems.

**CONCLUSION**

After initial significant intrachondral matrix changes, a subsequent T2* value recovery indicates the ability of the cartilage matrix to regenerate under ongoing running burden in ankle and hindfoot joints. In contrast, for the FTJ no T2* signal recovery could be observed accompanied by loss of cartilage thickness. No new lesions were observed during TEFR. Asymmetry of cartilage T2* behavior is in line with the hypothesis of the "breaking" limb and demonstrates leg-preference even in well-trained ultrarunners.

**CLINICAL RELEVANCE/APPLICATION**

The capability of most parts of human cartilage to recover in the presence of extreme physical stress has not been shown previously indicating a high regenerative potential of human joint cartilage.

**SSC07-05 The Evaluation of Clinical Reliability and Speed of a Triple-echo Steady-state T2 Mapping for in Vivo Evaluation of Articular Cartilage in Comparison to Multi-echo Spin-echo Sequence**

**METHOD AND MATERIALS**

Thirteen volunteers and ten patients with focal cartilage lesions were included in the study. All subjects underwent 3-Tesla MRI consisting of a multi-echo multi-slice spin echo sequence (CPMG) as a reference method for T2 mapping, and 3D TESS with the exact same geometry settings, but variable acquisition times: standard (TESSs 4:35 min) and quick (TESSq 2:05 min). T2 values were compared in six different regions in the femoral and tibial cartilage using a paired t-test and the Pearson correlation coefficient (r).

**RESULTS**

The mean quantitative T2 values measured by CPMG (mean: 46±9ms) in volunteers were significantly higher compared to those measured with TESS (mean: 31±5ms) in all regions. Both methods performed similarly in patients, but CPMG provided a slightly higher difference between lesions and native cartilage (CPMG: 90ms±761ms [31%],p=0.0125; TESS 32ms±24ms [24%],p=0.0039).

**CONCLUSION**

This work compared a newly developed 3D-TESS sequence with a CPMG method to evaluate T2-mapping of human articular cartilage.
CLINICAL RELEVANCE/APPLICATION

3D-TESS T2 mapping provides clinically comparable results to CPMG in shorter scan-time Cartilage loading studies might benefit from high temporal resolution of 3D-TESS. 3D-TESS T2 values are able to differentiate between healthy and damaged cartilage.

SSC07-06  A Comprehensive 7 Tesla Hip Cartilage Protocol Including Morphological and Quantitative MRI Techniques and Its Application in Patients after Acetabular Autologous Chondrocyte Transplantation

METHOD AND MATERIALS

Hips of 11 healthy volunteers were examined to establish a 7T hip cartilage protocol including high-resolution DESS (0.7mm³ isotropic), T1 VIBE (0.4x0.4x0.8mm³) and PDw sequences (sagittal and coronal) for morphological imaging, multi-contrast sequences (5 echoes) for T2- and T2*-mapping and a dual flip angle technique for T1-mapping prior to and after contrast agent administration following a dGEMRIC-protocol. Accurate and reproducible scan-rescan conditions were monitored with a fast B1-mapping technique (DREAM). After reviewing image quality by means of acetabular and femoral cartilage delineation (4-point scale, 4 being best) and comparing relaxation times in correlating regions (Pearson's correlation) this protocol was applied in 9 patients treated by ACT. Here, over-all image quality, delineation of the cartilage transplants and their relaxation times were compared to 3T MRI.

RESULTS

Volunteer study: The delineation of acetabular and femoral cartilage was excellent in T2- (3.2±0.9) and T2*-maps (3.2±0.4). Gadolinium improved cartilage delineation in T1-maps (2.9±0.8 vs. 1.7±0.6) as well as in T1 VIBE (3.3±0.6 vs. 2.2±0.9). T1-, T2- and T2*-relaxation times showed a high correlation in unenhanced and contrast-enhanced sequences (all p<0.001) in volunteers with mean values of 931ms (T1 enhanced), 43ms (T2) and 15ms (T2*). Patient study: Compared to 3T, image quality at 7T was clearly superior in sagittal PDw, T1 VIBE, DESS and T1-mapping with enhanced delineation of the transplants. Mean relaxation times of the cartilage transplants were reduced at 7T compared to 3T for T1 (537 vs. 757ms), T2 (42 vs. 45ms) and T2* (11 vs. 14ms).

CONCLUSION

A comprehensive hip cartilage protocol after contrast agent administration was established at 7T MRI, including morphological sequences as well as T1-mapping for dGEMRIC, T2- and T2*-mapping. The application of this protocol in patients after ACT showed predominantly superior image quality with better evaluation of the cartilage transplants compared to 3T MRI.

SSC07-07  Quantitative T2* Analysis of Articular Cartilage of the Tibiotalar Joint in Professional Soccer Players and Healthy Individuals at 3T MRI

METHOD AND MATERIALS

Using a 3T MRI system both ankles of 20 elite professional soccer players from the highest European level and 20 age-matched healthy individuals were investigated. After resting in supine position for 30 minutes, all individuals were examined applying multiplanar T1w and PDw sequences. For quantitative measurements a 3D T2* (24 echoes ranging from 4.6-52.9ms; image resolution 0.5x2x2mm) sequence was performed in sagittal orientation. Using a dedicated software tool (ImageJ) data were postprocessed and quantitative maps were generated. The articular cartilage was subdivided into 6 areas and regions-of-interest (ROI) were manually placed in all zones of the tibial and talar cartilage. For statistical workup Pearson product-moment correlation coefficients and confidence intervals were calculated.
RESULTS
In professional soccer players the T2* values were significantly higher in all tibial and talar compartments than those in healthy participants (mean, 21.36ms vs. 16.44ms; p<0.001). This difference was most evident in the posterior zones of the tibiotalar cartilage. In the athletes, there was a trend towards higher T2* values at the anterior medial compartments of the articular cartilage, however, compared to the healthy control group this was not statistically significant (p=0.08).

CONCLUSION
Based on these initial results, T2* values of the tibiotalar joint seem to be elevated in professional soccer players compared to an age-matched control group indicating cartilage degeneration. T2* measurements might potentially serve as a quantitative noninvasive tool for the detection of articular cartilage lesions at early stage.

CLINICAL RELEVANCE/APPLICATION
Quantitative MR imaging of tibiotalar articular cartilage using T2* measurements could serve as a complementary tool for early detection of subtle cartilage defects and further investigation should be encouraged.

PURPOSE
To confirm the feasibility of osteoarthritis treatment with mesenchymal stem cells (MSCs) in humans, and to demonstrate its efficacy on MRI and clinical outcome on a larger population with osteoarthritis of the knee

METHOD AND MATERIALS
Fifty patients with clinical and radiologic diagnosis of osteoarthritis of the knee (graded according to the ICRS (International Cartilage Repair Society) were treated with autologous MSCs by intrarticular injection. Clinical outcomes were followed for 1 year (including pain, disability, and quality of life). Cartilage assessment was performed using MRI T2-mapping at 88 pre-determined anatomical regions previous to treatment at 12 months after treatment; by determining the T2 relaxation values (RV) in each region of the knee. Inter, intraobserver and equipment errors were calculated for reproducibility, and for the statistical analysis to determine significant differences on T2 RV's before and after treatment. Statistical analysis was performed by Students t-test or by one-way analysis of variance (ANOVA) and the corresponding non-parametric tests

RESULTS
The mean T2 RV's (ms) previous to treatment (mean±SD) (60.3±6.1) was significantly higher than at 12 months (53.1±6.2) (p<0.04). A positive correlation was identified between the baseline mean average T2 RV and the mean final average (ms) improvement T2 RV's score (r=0.38; p<0.05). T2 RV's decreased in 37 of 50 patients, 10 remained the same and 3 worsened between 7 and 10%. The median pain reduction was 60% for daily activities and 63% for sport activities. A good positive correlation was observed between the amount of clinical improvement and the initial score (r=0.49), (P<0.001)

CONCLUSION
Non-invasive technique MRI T2-mapping is a valuable tool to assess the follow up of cartilage after MSC therapy for knee osteoarthritis

CLINICAL RELEVANCE/APPLICATION
Stem cell therapy could be an effective, feasible and safe treatment for knee osteoarthritis; and MRI T2-mapping can be a useful imaging biomarker tool to correlate and assess the clinical outcome

PURPOSE
To assess if depth of focal cartilage damage affects the risk of incidence and progression of cartilage loss in the tibiofemoral joint (TFJ).

METHOD AND MATERIALS
Fifty patients with clinical and radiologic diagnosis of osteoarthritis of the knee (graded according to the ICRS (International Cartilage Repair Society) were treated with autologous MSCs by intrarticular injection. Clinical outcomes were followed for 1 year (including pain, disability, and quality of life). Cartilage assessment was performed using MRI T2-mapping at 88 pre-determined anatomical regions previous to treatment at 12 months after treatment; by determining the T2 relaxation values (RV) in each region of the knee. Inter, intraobserver and equipment errors were calculated for reproducibility, and for the statistical analysis to determine significant differences on T2 RV's before and after treatment. Statistical analysis was performed by Students t-test or by one-way analysis of variance (ANOVA) and the corresponding non-parametric tests

RESULTS
The mean T2 RV's (ms) previous to treatment (mean±SD) (60.3±6.1) was significantly higher than at 12 months (53.1±6.2) (p<0.04). A positive correlation was identified between the baseline mean average T2 RV and the mean final average (ms) improvement T2 RV's score (r=0.38; p<0.05). T2 RV's decreased in 37 of 50 patients, 10 remained the same and 3 worsened between 7 and 10%. The median pain reduction was 60% for daily activities and 63% for sport activities. A good positive correlation was observed between the amount of clinical improvement and the initial score (r=0.49), (P<0.001)

CONCLUSION
Non-invasive technique MRI T2-mapping is a valuable tool to assess the follow up of cartilage after MSC therapy for knee osteoarthritis

CLINICAL RELEVANCE/APPLICATION
Stem cell therapy could be an effective, feasible and safe treatment for knee osteoarthritis; and MRI T2-mapping can be a useful imaging biomarker tool to correlate and assess the clinical outcome

PURPOSE
To assess if depth of focal cartilage damage affects the risk of incidence and progression of cartilage loss in the tibiofemoral joint (TFJ).
Persons with or at high risk of knee OA with MRI readings at baseline and 30-month were included. Semiquantitative MRI analysis was done using the Whole Organ MRI Score (WORMS) for cartilage damage, meniscal damage and extrusion, bone marrow lesions (BMLs), effusion and synovitis. Baseline focal cartilage damage was defined as grade 2 (partial-thickness) or grade 2.5 (full-thickness). In a subregion-based analysis, we assessed the risk of cartilage loss over 30 months comparing subregions of TFJ with baseline cartilage grade 2.5 vs grade 2. In the compartment-based analysis, we included only knees with a solitary grade 2 or 2.5 lesion at baseline and all other subregions in the same compartment having no cartilage damage. We estimated the risk of incident cartilage loss (grade≥2) in any non-damaged subregions for compartments with baseline full-thickness and partial thickness defects. In addition knees or compartments with grade 2 and 2.5 cartilage damage at baseline were compared to those without. Logistic regression was used to account for correlations among multiple subregions/compartments within a knee.

RESULTS
927 subregions (683 knees) were included in the subregion-based analysis. Risk of cartilage damage progression for grade 2.5 lesions compared to grade 2 lesions were comparable. However, compared to subregions with no cartilage damage, subregions with grade 2 or 2.5 cartilage defects had higher risk for cartilage loss (aOR 8.2, 95%CI 6.7-10.0). 374 compartments were included in the compartment-based analysis. There was no significant difference in regard to risk of incident damage between compartments that had grade 2 and grade 2.5 cartilage defects at baseline. However, compared to compartments with no baseline cartilage damage, those with grade 2 or 2.5 cartilage defects in a subregion had higher risk for incident cartilage damage in other subregions at follow-up (aOR 1.7, 95%CI 1.2-2.5).

CONCLUSION
Prevalent focal cartilage defects are a risk factor for local cartilage damage progression in the same subregion and increase risk for development of incident cartilage damage in the same TFJ compartment regardless of defect depth.

CLINICAL RELEVANCE/APPLICATION
Even small superficial cartilage lesions are relevant for cartilage damage progression.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Ali Guermazi, MD, PhD - 2012 Honored Educator
Neuroradiology (Traumatic Brain Injury)

**SSC08**

**Neuromodulation and Neuromodulation**

Monday, Nov. 30 10:30AM - 12:00PM Location: N226

**NR **

**MR **

**ER **

**AMA PRA Category 1 Credits ™: 1.50**

**ARRT Category A+ Credits: 1.50**

**FDA** Discussions may include off-label uses.

**Participants**

Pratik Mukherjee, MD, PhD, San Francisco, CA (Moderator) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company

Michael M. Zeineh, PhD, MD, Stanford, CA (Moderator) Research funded, General Electric Company

**Sub-Events**

**SSC08-01 The Association between Football Exposure, Position, and Concussion History on White Matter Integrity**

Monday, Nov. 30 10:30AM - 10:40AM Location: N226

**Participants**

Allen A. Champagne, BS,BA, Chapel Hill, NC (Presenter) Nothing to Disclose

Michael D. Clark, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose

Feng Shi, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose

Dinggang Shen, PhD, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose

Kevin Guskiewicz, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Diffusion tensor imaging has emerged as an important tool for quantitative analysis of white matter (WM) integrity following sport-related concussion. The primary purpose of this project was to investigate the variances in WM integrity in retired college and professional football athletes based on concussion history, duration of playing career, and playing position.

**METHOD AND MATERIALS**

32 former college and 31 former professional players were matched on age, concussion history, and playing position. All subjects were cognitively normal for age on a battery of neuropsychological tests. MRI scans were obtained and all diffusion-weighted images were analyzed using Tract Based Spatial Statistics. Our primary outcomes were fractional anisotropy (FA) and mean diffusivity (MD). A permuted, voxel-wise 3x2 ANOVA was performed on the WM skeleton to investigate the main and interaction effects of three fixed variables on WM integrity. These variables were concussion history (3+ vs. 0-1), football exposure (College vs. Professional), and playing position (Speed vs. Non-speed). Threshold-free cluster enhancement was used to identify clusters of significantly different FA or MD and post-hoc univariate analyses were used to determine the direction of interaction effects. Our a priori α was set at 0.05 after correction for multiple comparisons.

**RESULTS**

Three clusters in the forceps minor and genu of the corpus callosum were identified as having significant differences in FA for the concussion by position interaction. Post-hoc analysis of the peak voxels within each of the three clusters revealed consistently lower FA in non-speed players with 3+ concussions as compared to those with 0-1 concussions (Cohen's d: 0.89, 0.95, and 1.29; P<0.05). No other main effects or interaction effects were observed for FA or MD.

**CONCLUSION**

Our results suggest a history of multiple concussions is associated with lower FA in former non-speed position players compared to speed players, particularly in frontal white matter tracts. Additionally, we did not observe main or interaction effects of football exposure, suggesting that without concussive injuries, added football exposure does not account for variances in FA or MD. A limitation of these results is the lack of a control group without history of football participation.

**CLINICAL RELEVANCE/APPLICATION**

Multiple concussions and playing a non-speed position are associated with lower FA in frontal white matter tracts.

**SSC08-02 Reduced Cerebral Blood Flow Detected after Clinical Recovery in Acute Sports-related Concussion**

Monday, Nov. 30 10:40AM - 10:50AM Location: N226

**Participants**

Yang Wang, MD, Milwaukee, WI (Presenter) Research Grant, Siemens AG; Research Grant, General Electric Company

Lindsay D. Nelson, PhD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose

Ashley A. LaRoche, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose

Adam Y. Pfaller, BS, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose

Andrew S. Nencka, PhD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose

Michael A. McCrea, PhD, Milwaukee, WI (Abstract Co-Author) Research Grant, General Electric Company

**PURPOSE**

Sport-related concussion (SRC) is a major health problem, affecting millions of people each year. While the clinical effects of SRC (e.g., symptoms and impairments in neuropsychological functioning) typically resolve within several days, increasing evidence suggests persistent neurophysiological abnormalities beyond the point of clinical recovery after injury. This study was aimed to evaluate cerebral blood flow (CBF) changes in acute SRC, as measured using advanced arterial spin labeling (ASL) MRI.
METHOD AND MATERIALS

We compared CBF maps assessed using 3D pCASL (pseudo continues ASL) MRI in 18 concussed football players (age 17.8 ± 1.5 years) obtained within 24 hours and at 8 days after injury, in comparison to a control group of 19 matched non-concussed football players at the same interval. Clinical assessments including the Sport Concussion Assessment Tool 3 (SCAT3) and Standardized Assessment of Concussion (SAC) were obtained at each time point.

RESULTS

While the control group did not show any changes in CBF between the two time points, concussed athletes demonstrated a significant decrease in CBF at 8 days relative to 24 hours (p<0.01, FWE corrected). Moreover, scores on the clinical symptom (SCAT3) and cognitive (SAC) measures demonstrated significant impairment (versus pre-season baseline levels) at 24 hours (SCAT p < 0.0001, SAC p < 0.01) but returned to baseline levels at 8 days.

CONCLUSION

Our preliminary results suggest that advanced ASL MRI method might be useful for detecting and tracking the longitudinal course of underlying neurophysiological recovery from concussive injury.

CLINICAL RELEVANCE/APPLICATION

Abnormal CBF was found using 3D pCASL MRI in acute concussed patients even after clinical recovery, which might have important implication for clinical decisions on return-to-play after concussion.

SSC08-03 Abnormal Radial Diffusivity Predicts Worse Cognitive Function One Year Following Concussion (Mild Traumatic Brain Injury)

Monday, Nov. 30 10:50AM - 11:00AM Location: N226

Participants
Sara B. Rosenbaum, MD, Bronx, NY (Presenter) Nothing to Disclose
Namhee Kim, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Margo Kahn, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Hannah Scholl, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Jennifer Provataris, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Craig A. Branch, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Michael L. Lipton, MD, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

Abnormally low FA is related to worse cognitive outcomes in concussion (mild traumatic brain injury; mTBI). Some studies demonstrate that diffusion perpendicular to the principal direction of the diffusion tensor, or radial diffusivity (RD), may largely drive changes in FA, reflecting more severe transaxonal pathology such as axotomy. The purpose of this study is to examine the relationship between regional abnormalities of RD within 2 weeks of mTBI and cognitive function 1 year later.

METHOD AND MATERIALS

31 uncomplicated mTBI subjects were recruited from a local emergency center. 3T DTI was performed within 2 weeks of injury, and cognition was tested at 1 year post-injury. Voxelwise assessment was used to identify clusters of voxels demonstrating abnormally high RD (p(individual voxel)<0.05, p(cluster size corrected for multiplicity)<0.01) in each subject by comparing each subject to a cohort of 40 healthy controls. Each subject was then classified according to presence or absence of abnormally high RD within the following regions: left frontal, right frontal, left temporal, right temporal and corpus callosum. T-tests were used to compare cognitive outcomes between subjects with or without abnormally high RD in each region.

RESULTS

Subjects with abnormally high RD in the left temporal and right temporal lobe performed worse on tasks of executive function at 1 year (t(18)=-2.607, p=0.018 and t(18)=-2.495, p=0.023, respectively). There were no significant differences in cognitive function between those with and without abnormally high RD in the frontal lobes or corpus callosum.

CONCLUSION

Abnormally high RD in the temporal lobes within two weeks of injury is significantly associated with worse executive function 1 year following uncomplicated mTBI. RD, a putative imaging correlate for transaxonal injury, may reflect more severe early axonal or myelin pathology, which heralds persistent deficits in mTBI patients.

CLINICAL RELEVANCE/APPLICATION

These preliminary findings suggest that RD might provide an early imaging biomarker for worse long-term outcomes in mTBI, to guide patient management and inform treatment trials.

SSC08-04 Diffusion Tensor MRI Reveals Gender-based Risk for Traumatic Brain Injury in Soccer Players

Monday, Nov. 30 11:00AM - 11:10AM Location: N226

Participants
Eva Catenaccio, BA, Bronx, NY (Presenter) Nothing to Disclose
Roman Fleysher, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Namhee Kim, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Weiya Mu, BA, New York, NY (Abstract Co-Author) Nothing to Disclose
Liane Hunter, BA, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Molly Zimmerman, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Mark E. Wagshul, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Tamar Glattstein, BA, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Malika Zughaf, BA, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Walter Stewart, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
PURPOSE
Female athletes are thought to be at increased risk for sports-related mild traumatic brain injury (mTBI) and worse mTBI outcomes, relative to males. Heading in soccer represents a source of repetitive subconcussive head impacts. Previous research shows that heading exposure above a threshold of approximately 1000 headers/year is associated with microstructural brain damage (lower fractional anisotropy; FA) detectable on diffusion tensor imaging (DTI). This study assesses the role of gender as a predictor of mTBI-associated changes in white matter in a cohort of amateur soccer players.

METHOD AND MATERIALS
Forty-one females and 41 age- and educated-matched males (ages 18-52) were drawn from an ongoing longitudinal study of mTBI in amateur soccer players. Number of prior concussions and frequency of heading in the prior 12 months was quantified. Subjects underwent 3.0T DTI. After registration to the Johns Hopkins University template, we analyzed the results with a voxelwise general linear model with 3 predictors of interest: (1) gender to assess baseline gender differences in FA, (2) reported heading to assess heading-related declines in FA and (3) a term representing the interaction of gender and heading to assess for gender-dependent sensitivity to heading. Nuisance covariates for the analysis included age, education, and number of prior concussions. Significance was determined by a statistical threshold of p<0.01 and a cluster size of 100 voxels.

RESULTS
The analysis revealed regions showing statistically significant effects from all 3 predictors of interest in the bilateral corona radiata and right frontal lobe white matter, in which (1) women had lower baseline FA, (2) where both genders showed heading-related declines in FA and (3) where there was a differential gender-based sensitivity to heading-related changes in FA.

CONCLUSION
Our finding of significant overlapping changes in white matter abnormalities may indicate that baseline sexual dimorhisms in brain microstructure are the basis for a gender-specific response to repetitive trauma. Future work should focus on associating these imaging findings with gender-specific clinical outcomes.

CLINICAL RELEVANCE/APPLICATION
Gender-based vulnerability of amateur athletes to TBI pathology, revealed through DTI, may provide new bases for the development and implementation of preventive interventions.

SSC08-05 Quantitative Assessment of Optic Nerve Injury Longitudinally Using Manganese-enhanced MRI

Participants
Jun Yang JR, BA, Kunming, China (Presenter) Nothing to Disclose
Yingying Ding, MD, Kunming, China (Abstract Co-Author) Nothing to Disclose
Chengde Liao, MD, Kunming, China (Abstract Co-Author) Nothing to Disclose
qing q. Li, Kunming, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate manganese (Mn2+)-enhanced MRI(MEMRI) in a longitudinal quantitative study of rat optic nerve injury.

METHOD AND MATERIALS
Forty Sprague Dawley rats were divided into 3 group: Group A / with manganese-enhanced MRI (n=15), Group B / with retrograde labeled fluoro-gold and pathology (n=15), and control group C (n=10). Group A and B were underwent left optic nerve crush (ONC) at 2mm back to the eyeball. Using fluoro-gold from superior colliculus and lateral geniculate nucleus to retrograde label RGCs was performed before ONC 7days. A total of 3 mL of 90 nmol MnCl2 was unilaterally injected into the vitreous body 24h before MRI. MEMRI (group A) and retinal ganglia cells (RGCs) count (group B) were performed at 3, 7 and 14 day-post-lesion (dpl). Each 5 rats in group C were underwent the same process as group A and B respectively, but no ONC. The contrast-to-noise ratio (CNR) of retina and optic nerve, the results of RGCs count were compared between groups at different time points.

RESULTS
In the control groups, the intact visual pathway, from the retina to the contralateral superior colliculus, was visualized by MEMRI. The overall impression of ONC group at the different time point (3, 7, 14dpl) after the injury was that Mn2+ enhancement was seen in the retina and ON proximal to the lesion site. No Mn2+ enhancement was observed distal to the lesion site at 3, 7 and 14 dpl. The Mn2+ enhanced signal was reduced from 3dpl to 14dpl in the ON proximal to the lesion site. In the ONC group at 3dpl, there was an increased Mn2+ signal in the ON proximal to the lesion site compared to that seen in the control group (P<0.05), while no signal was detected distal to the ONC. At 7 and 14dpl, the Mn2+-enhanced signal was decreased significantly in the ON proximal to the crush site, compared to the signal observed at 3dpl (P<0.05). The RGCs drop rate was 6.84%, 45.31%, and 72.36% at 3dpl, 7dpl and 14dpl, respectively. The apoptosis of RGCs was most obvious after ONC at 14dpl.

CONCLUSION
MEMRI in the rat optic injury has a certain value in vivo experimental research, it can be used to observe the structure and function changes of optic nerve after injury. It is possible to detect the severity of the optic nerve by MEMRI examination.

CLINICAL RELEVANCE/APPLICATION
It is possible to use MEMRI to monitor the severity of the optic nerve injury in human by injecting mico-MnCl2 in the future.

SSC08-06 'Black Dipole' or 'White Dipole': Using Susceptibility Phase Image to Differentiate Cerebral Microbleed from Intracranial Calcification

Participants
The purpose of the study was to evaluate the role of susceptibility phase image in differentiation of cerebral microbleed (CMB) from intracranial calcification.

METHOD AND MATERIALS

The study was conducted upon 21 patients who received both brain CT and MRI within 3 days after acute infarct. MRI was performed in a 3T scanner, with susceptibility weighted angiography (SWAN) and susceptibility phase image generated from SWAN. Lesions that were 1) black, 2) round or ovoid, 3) less than 5 mm in SWAN were included. Two radiologists independently categorized each lesion, based on the SWAN phase image, into six axial patterns (1: total black, 2: total white, 3: black with white core, 4: white with black core, 5: heterogeneous black, 6: heterogeneous white) and two coronal patterns (1: black dipole, 2: white dipole). Agreement of phase pattern was determined, including kappa statistics. Each lesion was interpreted as CMB or calcification based on coronal (pattern1 as CMB; 2 as calcification) and axial (pattern 1,3,5 as CMB; 2,4,6 as calcification) phase image respectively. In all the cases, CT was used as the gold standard for the presence/absence of calcification.

RESULTS

A total of 141 lesions were included. 60, 15, 17, 5, 32, 12 lesions were classified into axial phase pattern 1, 2, 3, 4, 5, 6, respectively, while 97 and 44 lesions into coronal phase pattern 1 and 2, respectively. The interobserver agreement was perfect (κ = 1) in coronal pattern, while moderate (κ=0.73; 95% CI, 0.65-0.81) in axial pattern. CT confirmed 97 lesions as CMBs and 44 as calcifications. The sensitivity and specificity for detecting calcification were 91.8% and 54.6% for axial phase image and 99.0% and 93.2% for coronal phase image. Among lesions < 2mm, the sensitivity and specificity for detecting calcification increased to 97.3% and 80.0% for axial phase image, while 88.3% and 47.1% among lesions > 2mm.

CONCLUSION

Coronal phase image better demonstrated the susceptibility property of the paramagnetic CMBs as black dipoles, which expanded along the direction of the main magnetic field, and the diamagnetic calcifications as white dipoles, with higher diagnostic accuracy than axial phase image.

CLINICAL RELEVANCE/APPLICATION

The ability of susceptibility phase image to differentiate cerebral microbleed from calcification in MRI study is gaining clinical importance, especially in patients with cerebrovascular disease.

SSC08-07 Correlation between Optic Nerve Sheath Diameter Measured Using Computed Tomography and Marshall's Scale in Adult Patients with Acute Traumatic Brain Injury

Monday, Nov. 30 11:30AM - 11:40AM Location: N226

Participants

Haider N. Al-Tameemi, MBChB, MD, Al-Najaf, Iraq (Presenter) Nothing to Disclose
Sahtar R. Al-Esawi, MBChB, PhD, Najaf, Iraq (Abstract Co-Author) Nothing to Disclose
Ali Alyassari, Al-Dywania, Iraq (Abstract Co-Author) Nothing to Disclose

PURPOSE

To study the correlation between ONSD measurements using CT scan with the severity of TBI according to Marshall's scoring system.

METHOD AND MATERIALS

A cross-sectional analytic study was conducted on 60 adult patients (52 males, 8 females) with acute TBI referred by the neurosurgeon for brain CT examination over period of 8 months between February 2014 and September 2014. Children (<18 years), patients with orbital pathology and orbital trauma were excluded. After initial general evaluation of brain CT images, the score of TBI was assessed according to Marshall's scale (I to VI). The transverse ONSD of both right and left sides was then manually measured on axial CT image at 3mm distance behind eye globe. Statistical analysis was done using scientific package of social statistics (SPSS) with the correlation was considered significant if P value less than 0.05. The Institutional Ethical Review Committee approved the study.

RESULTS

The means of all, right-sided and left-sided ONSD were 4.695mm, 4.606mm and 4.785mm respectively. There was statistically significant and a strongly positive linear correlation (p value <0.001, r = 0.594 for the right side and p value <0.001, r = 0.699 for the left side). ONSD showed weakly negative and statistically not significant correlation (p value = 0.571, r = - 0.075) with the duration between onset of the trauma and time of CT examination. There was no significant difference between mean ONSD measurements when correlated with the laterality of TBI, age or gender (p values 0.392 0.328 and 0.462 respectively).

CONCLUSION

ONS measured on CT scan is strongly correlated with the severity of TBI as assessed by Marshall's scale. Because Marshall's scale has prognostic implication, ONSD may also have a prognostic value during assessment of patients with TBI.

CLINICAL RELEVANCE/APPLICATION

Measurement of ONSD using CT scan is correlated with higher scores of Marshall's classification of acute TBI and may be an indirect indicator of raised ICP. It is recommended to be included in the routine evaluation of patients with acute TBI.
METHOD AND MATERIALS

Sixteen patients with mTBI and 16 matched control subjects were enrolled. Longitudinal and cross-sectional cortical thickness group analysis was performed on T1WI-3D-MPRAGE images obtained at 3.0Tesla using Freesurfer. A statistical threshold of p<0.001 was used following which clusterwise correction for multiple comparisons was applied. Z-score analyses were also done to assess individual differences in cortical thickness at both time-points.

RESULTS

The longitudinal analysis of mTBI subjects yielded a decrease in cortical thickness over the 1st year in the following areas: superior temporal gyrus, precentral gyrus, precuneus, etc. on the left; calcaneus sulcus, paneo-occipital sulcus, inferior parietal lobule, middle occipital gyrus, etc. on the right. There was increased cortical thickness in the right temporal pole. The cross-sectional analysis showed greater cortical thickness in the mTBI group compared with normal controls at the 1st scanning in precentral gyrus, postcentral gyrus, supramarginal gyrus, paracentral gyrus, etc. bilaterally; superior temporal gyrus, middle temporal gyrus on the right; inferior temporal gyrus on the left. Right superior parietal gyrus demonstrated decrease in cortical thickness. None of these differences survive clusterwise multiple comparisons correction. Comparing to controls, Z-score analysis showed scattered differences in cortical thickness across individual patients at both 1st and 2nd scanning without definite consistent pattern.

CONCLUSION

The uncorrected pilot data suggest areas with predominantly decrease in cortical thickness of patients in the first year after mTBI; however, at the 1st scanning there is a trend towards areas of greater cortical thickness compared with controls. This could be due to a transient conformational change in regional thickness such as evolving gliosis or edema. There is, however, no clear pattern of cortical thickness change observed after multiple comparisons correction. Groupwise analysis insensitivity to morphometric alterations in this cohort may be due to heterogeneity of injury as is supported by variable differences seen after Z-score analysis.

CLINICAL RELEVANCE/APPLICATION

Cortical thickness analysis is helpful in detecting subtle morphometric changes of brain trauma.

SCCO8-08  Cortical Thickness Analysis in Patients with Mild Traumatic Brain Injury

Participants
Yadi Li, New York, NY (Abstract Co-Author) Nothing to Disclose
Xuyuan Wang, New York, NY (Abstract Co-Author) Nothing to Disclose
Thomas Thesen, New York, NY (Abstract Co-Author) Nothing to Disclose
Sohae Chung, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Yvonne W. Lui, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Joanne Rispoli, MD, New York, NY (Presenter) Nothing to Disclose

Purpose
It is known that brain atrophy can occur after traumatic brain injury (TBI) including changes in cross-sectional and longitudinal cortical thickness which have been documented in moderate to severe TBI patients. Alterations in cortical thickness after mild traumatic brain injury (mTBI) have not been previously examined. The purpose of this study is to investigate longitudinal changes in cortical thickness in mTBI patients from average 22 days to 1 year after injury and compare to controls.

Method and Materials

Participants
Sixteen patients with mTBI and 16 matched control subjects were enrolled. Longitudinal and cross-sectional cortical thickness group analysis was performed on T1WI-3D-MPRAGE images obtained at 3.0Tesla using Freesurfer. A statistical threshold of p<0.001 was used following which clusterwise correction for multiple comparisons was applied. Z-score analyses were also done to assess individual differences in cortical thickness at both time-points.

Results

The longitudinal analysis of mTBI subjects yielded a decrease in cortical thickness over the 1st year in the following areas: superior temporal gyrus, precentral gyrus, precuneus, etc. on the left; calcaneus sulcus, paneo-occipital sulcus, inferior parietal lobule, middle occipital gyrus, etc. on the right. There was increased cortical thickness in the right temporal pole. The cross-sectional analysis showed greater cortical thickness in the mTBI group compared with normal controls at the 1st scanning in precentral gyrus, postcentral gyrus, supramarginal gyrus, paracentral gyrus, etc. bilaterally; superior temporal gyrus, middle temporal gyrus on the right; inferior temporal gyrus on the left. Right superior parietal gyrus demonstrated decrease in cortical thickness. None of these differences survive clusterwise multiple comparisons correction. Comparing to controls, Z-score analysis showed scattered differences in cortical thickness across individual patients at both 1st and 2nd scanning without definite consistent pattern.

Conclusion

The uncorrected pilot data suggest areas with predominantly decrease in cortical thickness of patients in the first year after mTBI; however, at the 1st scanning there is a trend towards areas of greater cortical thickness compared with controls. This could be due to a transient conformational change in regional thickness such as evolving gliosis or edema. There is, however, no clear pattern of cortical thickness change observed after multiple comparisons correction. Groupwise analysis insensitivity to morphometric alterations in this cohort may be due to heterogeneity of injury as is supported by variable differences seen after Z-score analysis.

Clinical Relevance/Application

Cortical thickness analysis is helpful in detecting subtle morphometric changes of brain trauma.

SCCO8-09  Small Traumatic Subarachnoid Hemorrhages: Is Routine ICU Admission Necessary?

Participants
Paul J. Albertine, MD, Washington, DC (Presenter) Nothing to Disclose
Samuel Borofsky, MD, Washington, DC (Abstract Co-Author) Nothing to Disclose
Derek Brown, MS, Washington, AR (Abstract Co-Author) Nothing to Disclose
Smita Patel, Washington, DC (Abstract Co-Author) Nothing to Disclose
Woojin Lee, Washington, DC (Abstract Co-Author) Nothing to Disclose
Anthony Caputy, MD, Washington, DC (Abstract Co-Author) Nothing to Disclose
M. Reza Taheri, MD, PhD, Washington, DC (Abstract Co-Author) Nothing to Disclose

Purpose

Traumatic subarachnoid hemorrhages (tSAH) are a common type of intracranial hemorrhage that occurs in the setting of acute traumatic brain injury (TBI). It is estimated that more than 1.5 million Americans suffer from a TBI per year resulting in over 300,000 hospital admissions and an estimated financial cost of 17 billion dollars. In our current clinical setting, any form of intracranial hemorrhage requires both neurologic consultation and mandatory observation in an intensive care unit for close neurological monitoring. It has been suggested that the clinical impact of these small subarachnoid hemorrhages may be minimal; however, few studies exist that compare the size of a subarachnoid hemorrhage with patient outcome and rates of medical and neurological decline.

Method and Materials

This retrospective cohort study is based on 63 patients evaluated between 2011-2014 who presented to a Level I trauma center emergency room for acute traumatic injuries that were found to have tSAH on CT examination. Results were obtained through medical records and imaging results. Blood volumes of the subarachnoid hemorrhages were evaluated using Fisher, Modified Fisher and Claassen classification systems. Data gathered on the hospital course included several neurological and medical complications that have been associated with tSAH. Information regarding patient outcomes was based chart review.

Results

Of the 63 total patients, 33 (52%) patients had low-grade tSAH which were classified as Fisher grade ≤ 2, 40(63%) Modified Fisher grade ≤ 2, and 41(65%) Claassen grade ≤ 2. None of these patients with low-grade tSAH demonstrated neurological decline, medical decline, or seizures while they were hospitalized (all findings are significantly lower [p<.05] when compared to the patients...
with higher grade tSAH). Patients with low grade tSAH had significantly shorter stays in the ICU (p<.05) and better clinical outcome based on GOS compared to the other patients (p<.01).

**CONCLUSION**

In this study, none of the patients with small low-grade tSAH demonstrated neurological decline, seizures, or medical decline during their hospitalization. All of these patients spent significantly less time in the intensive care unit and had good clinical outcomes.

**CLINICAL RELEVANCE/APPLICATION**

Patients with small low-grade tSAH rarely experience medical decline, neurological decline or seizures as a result of their injuries and may not necessitate intensive care unit admission.
Neuroradiology/Head and Neck (Thyroid and Parathyroid Imaging)

**PURPOSE**

To evaluate the role of core-needle biopsy (CNB) as a first-line diagnostic tool for initially detected thyroid nodules.

**METHOD AND MATERIALS**

This observational study was approved by the institutional review board and informed consent was obtained from all patients. From October 2008 to December 2011, we evaluated 632 initially detected thyroid nodules from 632 consecutive patients who underwent CNB. CNB readings were categorized into the same six categories of the Bethesda System. Final malignant results were diagnosed after surgery or CNB. Final benign results were diagnosed by surgery, twice of benign biopsy results, or benign cytology with a stable size at one year follow-up. The incidences of non-diagnostic, inconclusive results, diagnostic performance, unnecessary surgery, and complications were evaluated. Subgroup analysis according to nodule size was performed. The risk factors of inconclusive results were evaluated by multivariate logistic regression analysis.

**RESULTS**

CNB achieved 1.3% of non-diagnostic and 5.9% of inconclusive results. The diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value for diagnosis of malignancy were 97.6%, 90.5%, 100%, 100% and 92.7%, respectively. The unnecessary surgery was 0.6% and complication rate was 0.2%. Subgroup analysis showed that diagnostic performance was not significant according to nodule size. There were no independent risk factors associated with inconclusive results.

**CONCLUSION**

Our study demonstrated that CNB achieved low non-diagnostic, inconclusive results and high diagnostic accuracy for patients with initially detected thyroid nodules. CNB also minimize unnecessary surgery. Therefore, CNB seems to be a promising diagnostic tool for patients with initially detected thyroid nodules.

**CLINICAL RELEVANCE/APPLICATION**

CNB can be an alternative to FNA for patients with initially detected thyroid nodules to minimize non-diagnostic, inconclusive results and unnecessary surgery. CNB seems to be a promising diagnostic tool for patients with initially detected thyroid nodules.

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Optimal Follow-up Interval and Follow-up Management of Initial Non-diagnostic Thyroid Nodules 10 mm or Larger in Size

**PURPOSE**

To evaluate the optimal follow-up interval in initial non-diagnostic thyroid nodules 10 mm or larger on ultrasonography-guided fine needle aspiration (US-FNA).

**METHOD AND MATERIALS**

This retrospective study was approved by the Institutional Review Board, and informed consent was waived. A total 228 nodules were classified into the 3, 6, and 12 months groups according to when the first follow-up US was performed or the length of the
US-FNA intervals, within 3 months, from 3 to 9 months, and 9 months after initial US-FNA. Nodules were classified according to size change. US features were reassessed using the Thyroid Imaging Reporting and Data System (TI RADS). Malignancy detection rate, malignancy risk, and clinico-pathological characteristics were compared among 3, 6, and 12 months groups and according to size change.

RESULTS

Seven (3.1%) were malignant. Malignancy detection rates, extrathyroidal extension and lymph node metastasis were not significantly different among the three groups. 13 (5.7%) of 228 showed increased size at least 10.7 months after initial US-FNA. One (7.7%) of the 13 was minimally invasive follicular carcinoma without lymph node metastasis found at 63.2 months. Of 177 without change, six papillary thyroid carcinomas less than 20 mm (3.4%) were found at a mean 10.4 months. The malignancy risks of 177 nodules with TI RADS category 3, 4a, 4b, and 4c were 1.7%, 0%, 3.3%, and 21.4%. None of the 38 nodules with decreased size were malignant. and 9 months after initial US-FNA.

CONCLUSION

The follow-up of initial non-diagnostic thyroid nodules 10 mm or larger in size can be performed around 12 months with US. The decision to perform repeat US-FNA can be made based on initial and follow-up US features.

CLINICAL RELEVANCE/APPLICATION

dealing with non-diagnostic thyroid nodules) 'The follow-up of initial non-diagnostic thyroid nodules 10 mm or larger in size can be performed around 12 months with US'
METHOD AND MATERIALS

The data of 61 patients with > 1 cm FVPTCs diagnosed between November 2000 and April 2011 were reviewed retrospectively. The patients were divided by mutation status into 3 groups: (1) BRAF positive group, (2) RAS positive group and (3) mutation negative group. Two radiologists with more than 10 years of thyroid sonography experience reviewed the sonographic characteristics of the FVPTC nodule while blinded to the results of the genetic analysis. Ultrasound features and patient demographics were compared.

RESULTS

The BRAF mutation was detected in 16 (26.2%) patients. The RAS mutation was detected in 25 (41%) patients. Patients with RAS positive FVPTC were significantly younger than patients in the BRAF mutation group (p=0.022) and the no mutation group (p=0.034). The nodule longest dimension of the BRAF group was smaller than the RAS group (p=0.036) and no mutation group (p=0.002). An indistinct nodule border was more common in the BRAF group than in the RAS group in both radiology assessments (p=0.002, p=0.002 respectively, Kappa value 0.610, p=0.000). An indistinct nodule border was more common in the BRAF group than in the no mutation group too (p=0.030, p=0.030 respectively, Kappa value 0.468 p=0.005). One of the two Radiologists found the BRAF group to appear spiculated more commonly than the other groups (BRAF group (6/16) vs. the RAS group (0/25) p=0.002; BRAF group (6/16) vs. no mutation group (0/20) p=0.004), and one of the two Radiologists found echogenicity to be significantly lower in the BRAF group (BRAF group vs. RAS group p=0.000; BRAF group vs. no mutation group p=0.007). No significant differences were found between gender, tall/wide, halo sign, heterogeneity, calcification in nodule, or vessel in and around the nodule.

CONCLUSION

An indistinct sonographic boundary is associated with the BRAF mutation, and larger nodule size is associated with the RAS mutation in FVPTCs.

CLINICAL RELEVANCE/APPLICATION

Demography and ultrasound features may be helpful to differentiate BRAF and RAS positive in FVPTC.

PURPOSE

Objective : To evaluate the role of screening ultrasonography (US) in healthy population and analyze the US features of screening-detected thyroid cancer (SDTC).

METHOD AND MATERIALS

A total of 1845 persons participated in the study among 1923 healthy population who underwent screening thyroid US from March through August 2012 at our screening center; those who were lost to follow up (n=60) and those who underwent the previous operation on thyroid (n=18) were excluded. We evaluated detection rate of thyroid cancer and the average cost for detecting each cancer patient. (Presumed cost: $100 for thyroid US and $150 for fine-needle aspiration). We also analyzed the US features of screening-detected thyroid cancer.

RESULTS

Among 1845 participants 973 had benign disease (52.74 %, 63 by FNA and 910 with no change in 2 year-follow-up); 29 had thyroid cancer (1.57 %, 27 proven by FNA and 2 by surgery); 28 had PTC and 1 had follicular carcinoma. The cancer patients were predominantly women (69.0 %) and the mean age was 50.9±9.825. Imaging features that significantly differentiated malignant nodules from benign nodules were solid composition (100 % in malignant nodules), hypoechogenicity (100 %), taller than wide axis (82.8 %) and indistinct margin (86.2 %). Among 18 patients who underwent thyroidectomy, 14 (77.8 %) had pathologic tumor staging of T1 and 12 (85.71 %) had nodal staging of N0. The estimated average cost for detecting each cancer patient was $6,838.

CONCLUSION

Screening thyroid US enables detection of early stage thyroid cancer in asymptomatic healthy population. The majority of screening-detected thyroid cancer was micropapillary carcinoma and showed solid and hypoechoic nodule on US.

CLINICAL RELEVANCE/APPLICATION

The majority of screening-detected thyroid cancer was micropapillary carcinoma. Screening thyroid US enables detection of early stage thyroid cancer in asymptomatic healthy population.

PURPOSE

The detection and diagnosis of thyroid cancer can be more difficult in patients with chronic lymphocytic thyroiditis (CLT). The aim of this study is to compare the diagnostic accuracy of fine-needle aspiration biopsy (FNAB) and core-needle biopsy (CNB) for malignant thyroid nodule in CLT patients.
SSC09-07  Three-Dimensional Sonography more Accurately Localizes Preoperative Parathyroid Adenomas than Conventional 2D Sonography and Sestamibi

METHOD AND MATERIALS

Institutional review board approved and waived informed consent for this retrospective study. From January 2010 to April 2014, 1815 CLT patients (183 men, 1632 women; mean age, 53.6 years; age range, 11-87 years) who underwent ultrasound-guided FNAB (FNAB group, 993 nodules in 970 patients; 90 men, 880 women; mean age, 55.5 years; age range, 18-87 years) or CNB (CNB group, 912 nodules in 845 patients; 93 men, 752 women; mean age, 52.1 years; age range, 11-86 years) for thyroid nodule were included. Final diagnosis with surgical resection was obtained for 353 nodules. Chi-square test was used to compare the inconclusive results from both groups. Diagnostic accuracy, sensitivity, specificity, positive predictive value, and negative predictive value for the diagnosis of thyroid cancer were calculated on the basis of binomial probabilities.

RESULTS

The rate of inconclusive results (nondiagnostic specimen or atypia of unknown significance) were significantly lower in CNB group (FNAB group, n=306 (30.8%); CNB group, n=33 (3.6%); p<0.001). With correlation to final surgical pathology, the sensitivity and negative predictive value of FNAB were lower than CNB (49.5%, 18.9% vs. 83.5%, 63.6%)

CONCLUSION

Inconclusive results were significantly lower with CNB. CNB showed better diagnostic accuracy for thyroid cancer in patients with CLT.

CLINICAL RELEVANCE/APPLICATION

CNB can reduce the rate of inconclusive result in patients with CLT.

SSC09-08  Most Thyroid Cancers Lack Intranodular Vascularity on Color Doppler

PURPOSE

Intranodular hypervascularity has been reported to be associated with thyroid cancers in radiology literature. The aim of this study is to test this assumption with detailed pathology follow-up.
slides for review. Color Doppler images were reviewed and intranodular vascularity was graded from 0 to 3+ (0:no color). Recuts from index nodule were reviewed and divided into malignant and benign categories and tumor subtype recorded.

RESULTS

There were 99 thyroid cancers (size: 0.6-7 cm, mean 2.1, medium 1.8 ), and 50 benign nodules (size 0.4-9 cm, mean 3.06, medium 2.9). The malignant nodules from 22 males and 77 females included 78 papillary carcinomas (PTC), 6 medullary carcinomas (MTC), 6 Hürthle cell carcinomas (HTC), 5 follicular carcinomas (FTC), and 4 poorly differentiated thyroid carcinomas (PDTC). Benign nodules from 11 males and 39 females included 32 follicular adenoma/adenomatoid nodules (FA), 13 Hürthle cell adenoma/adenomatoid nodules (HA) and 5 hyalinizing trabecular adenomas (HHA). As shown in Table 1, there were 58 (93.5%) cancers (50 PTC, 5 MTC, 2 PDTC, 1 FTC) and 4 (6.5%) benign nodules (3 HA, 1 FA) with no intranodular vascularity; 15 (88.2%) cancers (9 PTC, 1 MTC, 4 FTC, 1 PDTC) and 2 (11.8%) benign nodules (2 HA) had 1+ intranodular vascularity; 14 (93.3%) cancers (10 PTC, 2 HTC, 2 FTC) and 1 (0.7%) benign nodules (1 HA) had 2+ intranodular vascularity; 12 (21.8%) cancers (9 PTC, 2 FTC, 1 PDTC) and 43 (78.2%) benign nodules (31 FA, 7 HA, 5 HHA) had 3+ intranodular vascularity.

CONCLUSION

Most thyroid cancers have no intranodular vascularity and most hypervascular thyroid nodules are benign. This finding is not surprising, since most thyroid cancers are PTC, which is a tumor rich in lymphatic vessels. Follicular tumors are rich in blood vessels, but FTC is much less common than PTC.

CLINICAL RELEVANCE/APPLICATION

'Absence of intranodular vascularity' is recommended as one of the suspicious features of thyroid ultrasound that include 'hypoechoic', 'taller than wide', 'blurred margins' and 'microcalcifications'.

SCS09-09  Role Played by Elasticity Imaging in the Evaluation of the Thyroid Nodule

Monday, Nov. 30 11:50AM - 12:00PM Location: N229

Participants
Francisco J. Campoy-Balbontin, MD, PhD, Seville, Spain (Presenter) Nothing to Disclose
Carmen Jurado-Gomez, MD, Bellavista, Spain (Abstract Co-Author) Nothing to Disclose
Jose-Carlos Perez-Tejada, MD,PhD, Sevilla, Spain (Abstract Co-Author) Nothing to Disclose
Carmen Almeida, BMedSc, Seville, Spain (Abstract Co-Author) Nothing to Disclose
Rafael Aznar Mendez, Sevilla, Spain (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate conventional ultrasonography (US) including color doppler and elasticity imaging (EI) in thyroid nodule malignancy prediction.

METHOD AND MATERIALS

This prospective study included 399 patients (mean age, 51.9 years; range 13-83 years), 294 women (86.7%) and 45 men (13.3%). In 426 nodules (N) US, doppler color, EI and fine needle acquisition (FNA) were performed. The cytological results were classified according to the Bethesda System. No-apt sample and atypia or follicular proliferation of uncertain origin, were excluded (60N). 339 nodules in 335 patients were studied, divided in a non-surgical group (benign or T2, 292N) and a surgical group (follicular neoplasm-T4, 33N; suspicious for papillary carcinoma-T5, 9N; and Papillary carcinoma-T6, 5N). Comparison among US, vascularization, EI and cytology was performed, by using the χ2 tests and the non-parametric Mann-Whitney U test, for categorical variables (statistical significance <0.05). Multivariate logistic regression analysis was performed to assess the independent variables for surgical group prediction.

RESULTS

Findings associated to surgical nodules are heterogeneity (24/51%; odds ratio (OR):2.584), very hypoecoic (4/8.5%; OR:5.195), Hypoecoic (24/51.1%; OR:4.160), increased vascularization (12/27.9%; OR:3.233), infiltrative margin (8/17%; OR:6.450), irregular border (5/10.6%; OR:4.211), hard in EI (19/40.4%; OR:2.073). Findings linked to benignity are to be isoechoic (197/67.5%) and spongiform (153/52.4%). In the multivariate regression analysis only very hypoechoic and hypoechoic are independent criteria related for the surgical group (p<0.05), whereas spongiform is the only independent criteria associated to benignity.

CONCLUSION

EI could help in combination with the other US features to choose the nodule to perform FNA, but it does not seem to be independent criteria to indicate FNA

CLINICAL RELEVANCE/APPLICATION

EI properly used is a helpful tool, to be considered always in combination with US features, to indicate FNA.
**Physics (CT II-Radiation Dose)**

**Monday, Nov. 30 10:30AM - 12:00PM Location: S504CD**

**SSC10-01**  
Size-Specific Fetal Dose Estimates in Tube Current Modulation CT Examinations of Pregnant Patients  
**Monday, Nov. 30 10:30AM - 10:40AM Location: S504CD**

**Participants**  
Cynthia H. McCollough, PhD, Rochester, MN (Moderator) Research Grant, Siemens AG  
Robert G. Gould, DSc, San Francisco, CA (Moderator) Research Grant, Koninklijke Philips NV

**Sub-Events**

**SSC10-01**  
**Size-Specific Fetal Dose Estimates in Tube Current Modulation CT Examinations of Pregnant Patients**  
**Wednesday, Nov. 30 10:30AM - 10:40AM Location: S504CD**

**Participants**  
Kyle McMillan, Los Angeles, CA (Presenter) Institutional research agreement, Siemens AG; Research support, Siemens AG;  
Maryam Bostani, PhD, Los Angeles, CA (Abstract Co-Author) Research support, Siemens AG  
Erin Angel, PhD, Tustin, CA (Abstract Co-Author) Employee, Toshiba Corporation  
Christopher H. Cagnon, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose  
Michael F. McNitt-Gray, PhD, Los Angeles, CA (Abstract Co-Author) Institutional research agreement, Siemens AG; Research support, Siemens AG;  
Christopher H. Cagnon, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose  
Michael F. McNitt-Gray, PhD, Los Angeles, CA (Abstract Co-Author) Institutional research agreement, Siemens AG; Research support, Siemens AG;  
Christopher H. Cagnon, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Fetal dose estimates have previously been limited to fixed tube current CT exams of pregnant patients. However, in current clinical practice, nearly all CT exams are performed using tube current modulation (TCM). The purpose of this work is to develop patient size-specific CTDIvol-to-fetal-dose conversion coefficients for TCM CT examinations of pregnant patients of various gestational ages.

**METHOD AND MATERIALS**

For 18 IRB approved pregnant patients of gestational age ranging from 12 to 36 weeks who underwent clinically-indicated CT examinations, models of maternal and fetal anatomy were created from the image data, and fetal dose was estimated using Monte Carlo simulation of TCM scans of the abdomen and pelvis for a 64-slice MDCT scanner. Predicted TCM schemes were generated for each pregnant patient model using a validated method that accounts for patient attenuation and scanner limits to determine TCM functions for each voxelized model. Fetal doses were normalized by scan-specific 32 cm CTDIvol values based on the average tube current across the entire scan (scanner-reported CTDIvol) to obtain scan technique-independent CTDIvol-to-fetal-dose conversion coefficients for each patient. Patient size was described using water equivalent diameter (WED) measured at the image containing the three-dimensional geometric centroid of the fetus. The relationship between the WED patient size metric and CTDIvol-to-fetal-dose conversion coefficients was then examined to determine if a correlation exists.

**RESULTS**

An exponential relationship between CTDIvol-to-fetal-dose conversion coefficients and patient size was observed with a coefficient of determination of 0.81.

**CONCLUSION**

For TCM examinations, strong correlation exists between CTDIvol-normalized fetal dose and WED. These results indicate that fetal dose from TCM CT examinations of pregnant patients of various gestational ages may be reasonably estimated with: (a) fetal dose normalized by scanner-reported CTDIvol to account for scan technique variation and (b) a WED patient size metric to account for patient size variation.

**CLINICAL RELEVANCE/APPLICATION**

Results from this work can be used to readily estimate fetal dose for TCM CT exams of pregnant patients given only the scanner-reported CTDIvol and an attenuation-based estimate of patient size.

**SSC10-02**  
How Low Can We Go in Radiation Dose for the Data Completion Scan on a Prototype Whole-Body Photon-Counting CT System  
**Monday, Nov. 30 10:40AM - 10:50AM Location: S504CD**

**Participants**  
Zhicong Yu, Rochester, MN (Presenter) Nothing to Disclose  
Shuai Leng, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose  
Ahmed Halaweish, PhD, Rochester, MN (Abstract Co-Author) Employee, Siemens AG  
Zhoubo Li, Rochester, MN (Abstract Co-Author) Nothing to Disclose  
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Erik L. Ritman, MD, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose  
Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG

**PURPOSE**

Participants

Cynthia H. McCollough, PhD, Rochester, MN (Moderator) Research Grant, Siemens AG  
Robert G. Gould, DSc, San Francisco, CA (Moderator) Research Grant, Koninklijke Philips NV

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Zhoubo Li, Rochester, MN (Abstract Co-Author) Nothing to Disclose  
Steffen Kappler, Dipl Phys, Forchheim, Germany (Abstract Co-Author) Researcher, Siemens AG  
Erik L. Ritman, MD, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose  
Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG

**PURPOSE**

Fetal dose estimates have previously been limited to fixed tube current CT exams of pregnant patients. However, in current clinical practice, nearly all CT exams are performed using tube current modulation (TCM). The purpose of this work is to develop patient size-specific CTDIvol-to-fetal-dose conversion coefficients for TCM CT examinations of pregnant patients of various gestational ages.

**METHOD AND MATERIALS**

For 18 IRB approved pregnant patients of gestational age ranging from 12 to 36 weeks who underwent clinically-indicated CT examinations, models of maternal and fetal anatomy were created from the image data, and fetal dose was estimated using Monte Carlo simulation of TCM scans of the abdomen and pelvis for a 64-slice MDCT scanner. Predicted TCM schemes were generated for each pregnant patient model using a validated method that accounts for patient attenuation and scanner limits to determine TCM functions for each voxelized model. Fetal doses were normalized by scan-specific 32 cm CTDIvol values based on the average tube current across the entire scan (scanner-reported CTDIvol) to obtain scan technique-independent CTDIvol-to-fetal-dose conversion coefficients for each patient. Patient size was described using water equivalent diameter (WED) measured at the image containing the three-dimensional geometric centroid of the fetus. The relationship between the WED patient size metric and CTDIvol-to-fetal-dose conversion coefficients was then examined to determine if a correlation exists.

**RESULTS**

An exponential relationship between CTDIvol-to-fetal-dose conversion coefficients and patient size was observed with a coefficient of determination of 0.81.

**CONCLUSION**

For TCM examinations, strong correlation exists between CTDIvol-normalized fetal dose and WED. These results indicate that fetal dose from TCM CT examinations of pregnant patients of various gestational ages may be reasonably estimated with: (a) fetal dose normalized by scanner-reported CTDIvol to account for scan technique variation and (b) a WED patient size metric to account for patient size variation.

**CLINICAL RELEVANCE/APPLICATION**

Results from this work can be used to readily estimate fetal dose for TCM CT exams of pregnant patients given only the scanner-reported CTDIvol and an attenuation-based estimate of patient size.
Conventional estimates of effective dose do not account for patient size or the effects of tube current modulation (TCM). The purpose of this study was to extend that work by developing size-specific effective dose estimates for both fixed tube current (FTC) and TCM abdominal and chest CT scans.

METHOD AND MATERIALS

Using detailed Monte Carlo simulations of a 128-slice multi-detector row CT scanner, doses to all radiosensitive organs for eight patient models from the GSF family of voxelized phantoms and the male and female ICRP adult reference computational phantoms were determined for both FTC and TCM abdominal and chest CT examinations. Patient-specific TCM schemes were generated using a validated method that accounts for patient attenuation and scanner limits to determine TCM functions for each voxelized model. For abdominal scans, the scan range was set from the top of the liver to the sacroiliac joint. For chest scans, the scan range was set from the top of the lungs to the top of the kidneys. A summation of organ dose values weighted by the appropriate ICRP 103 tissue weighting factors produced an estimate of effective dose for each simulated scan. Effective dose estimates were normalized within regions-of-interest (ROIs) in the iodine and bone-like inserts, and the water-equivalent material at top, left, center, and right of the PCD FOV. These data were used for CT number accuracy and uniformity analyses. The lowest mAs of the DCS that maintained CT number accuracy and uniformity was determined, and further validated with an anthropomorphic torso phantom.

RESULTS

For all scan scenarios, an exponential relationship between CTDIvol-to-effective-dose conversion coefficients and patient size was observed with coefficients of determination ranging from 0.76 to 0.88. When all scan scenarios were evaluated collectively, an exponential relationship was observed with a coefficient of determination of 0.76.

CONCLUSION

Strong correlation exists between CTDIvol-normalized effective dose and WED. Results suggest that a general relationship between CTDIvol-to-effective-dose conversion coefficients and patient size may be sufficient to estimate size-specific effective dose for both FTC and TCM routine body CT examinations.

CLINICAL RELEVANCE/APPLICATION

Results from this work provide a reasonable estimate of effective dose that accounts for patient size and can be applied for FTC and TCM abdominal and chest CT examinations.
Automatic exposure control (AEC) techniques vary across different CT vendors. Some keep image noise constant across all patient sizes, while some allow more noise in larger patients. The variability of vendor-dependent AEC scheme puts a challenge in designing CT protocols across diverse CT systems for consistent image quality and dose. We aim to match the AEC exposure output between two manufacturers by utilizing patient dose metric information.

**Evaluation**

CT scanner exposure output (CTD_iVol), AEC settings (QRM for Siemens CareDose4D or Noise index for GE SmartmA) and patient weight of all adult chest-abdomen-pelvis (CAP) CT scans in one calendar year 2014 were accumulated for three CT scanners (Siemens Definition Flash, GE CT750 HD, and GE LightSpeed VCT) using commercial dose tracking software (DoseWatch, GE). The AEC driven relationship between CTD_iVol and body weight was modeled using patient dose metrics data. The patient population was divided into three weight groups: less than 150lbs, 150 to 200lbs, and 201 to 265lbs. For each weight group, the AEC models were used to determine the optimized noise index settings on GE scanners that match CTD_iVol from Siemens CareDose4D.

**Discussion**

Using dose metric data from a large patient population, AEC from two vendors were modeled to explore the dependence of CTD_iVol on patient weight. Model predicted AEC settings provide consistent dose performance between different vendors across a wide body weight range.

**Conclusion**

A model driven relationship between CTD_iVol and body weight was modeled using patient dose metrics data. The patient population was divided into three weight groups: less than 150lbs, 150 to 200lbs, and 201 to 265lbs. For each weight group, the AEC models were used to determine the optimized noise index settings on GE scanners that match CTD_iVol from Siemens CareDose4D.
We found it is still feasible to establish a new noise index system for MBIR using an empirical power-law relationship between noise and mAs.

CLINICAL RELEVANCE/APPLICATION

With the increasing popularity of MBIR in clinical CT, there is an urgent need to develop a new Noise Index system that can prospectively determine the noise magnitude of MBIR images at reduced dose levels.

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Meghan G. Lubner, MD - 2014 Honored Educator
Meghan G. Lubner, MD - 2015 Honored Educator
Perry J. Pickhardt, MD - 2014 Honored Educator

SCOPE

Participants

Kyle McMillan, Los Angeles, CA (Presenter) Institutional research agreement, Siemens AG; Research support, Siemens AG;
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Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG
Michael F. McNitt-Gray, PhD, Los Angeles, CA (Abstract Co-Author) Institutional research agreement, Siemens AG; Research support, Siemens AG; ;

PURPOSE

AAPM Report 204 demonstrated that size-specific dose estimates (SSDE) are a reasonable estimate of mean dose in the center of the scan range for fixed tube current (FTC) body CT examinations. The purpose of this work is to determine if that concept extends to tube current modulation (TCM) CT examinations of the chest and abdomen.

METHOD AND MATERIALS

For eight patient models from the GSF family of voxelized phantoms, and the male and female ICRP adult reference computational phantoms, SSDE and mean dose in the center of a scan range were calculated for both abdominal and chest CT examinations under the conditions of FTC and TCM. TCM schemes were generated using a validated method that accounts for patient attenuation and scanner limits to determine TCM functions for each voxelized phantom. Using Monte Carlo simulations of a 128-slice multi-detector row CT scanner, mean dose in the center of the scan range was calculated as the average dose to all voxels of a patient model over five slices (approximately 25-50 mm depending on the model) in the center of the scan range. Using the methodology outlined in AAPM Report 204, SSDE was calculated using the CTDIvol value based on the average tube current across the entire scan (scanner-reported CTDIvol), a conversion factor based on the 32 cm diameter body CTDI phantom and a measurement of patient size in the center of the scan range (water equivalent diameter (WED), calculated according to AAPM Report 220). SSDE and mean dose in the center of the scan range were then compared for all combinations of anatomy and tube current type.

RESULTS

For abdominal scans, the average absolute difference between SSDE and mean dose in the center of the scan range for FTC and TCM was 3.46% and 7.12%, respectively. For chest scans, the average absolute difference was 5.51% and 7.48%, respectively.

CONCLUSION

For both abdominal and chest CT examinations using FTC and TCM, SSDE calculated using scanner-reported CTDIvol and an estimate of patient size in the center of the scan range closely matched detailed simulations of mean dose in the center of the scan range.

CLINICAL RELEVANCE/APPLICATION

For both FTC and TCM, SSDE provides an estimate of mean dose in the center of the scan range. This work extends the use of SSDE as a reasonable estimate of patient dose for FTC and TCM body CT exams.
dosimetry methodology performed on patient-specific computational phantoms (based on segmented patient images) to equivalent
dosimetry performed on patient-dependent (matched) phantoms, and reference (50th percentile height and weight) phantoms.

METHOD AND MATERIALS
Twenty-seven patient-specific computational phantoms were created based on CT images sets of adult patients (14 male and 13
female). Each patient-specific phantom had organ doses calculated based on a previously validated CT dosimetry methodology for
four torso exams (chest-abdomen-pelvis, chest, abdomen, and pelvis) with tube current modulation (TCM). Additionally, organ
doses were calculated on five computational phantoms (three size-specific and two reference) and compared, per patient. The
three matching criteria were: height and weight, effective diameter (AAPM Report No. 204), and water equivalent diameter (AAPM
Report No. 220). The two reference phantoms were hybrid computational and stylized (ORNL 2006).

RESULTS
The average magnitude of percent difference in organ dose calculations across all patients and organs was 11.1% for the height
and weight matched phantoms, 12.3% for the effective diameter matched phantoms, 29.2% for the hybrid computational reference
phantom, and 35.5% for the stylized reference phantom.

CONCLUSION
Although an inherent error exists in matching a patient to a computational phantom for CT dosimetry, matching the patient to a
size-specific phantom has a clear increase in organ dose certainty.

CLINICAL RELEVANCE/APPLICATION
Matching a patient to a size-specific computational phantom will allow for a more accurate assessment of organ doses from a
computed tomography examination.

SSC10-08  Breast and Lung Dose in Chest CT: A Comparison between Standard, Organ-based TCM and Flash
Speed Protocols in Cadavers

Monday, Nov. 30 11:40AM - 11:50AM Location: S504CD

Participants
Xochitl Lopez-Rendon, MSc, Leuven, Belgium (Presenter) Nothing to Disclose
Guozhi Zhang, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
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Wim Develder, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
Raymond H. Oyen, MD, PhD, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
Hilde Bosmans, PhD, Leuven, Belgium (Abstract Co-Author) Co-founder, Qaelum NV Research Grant, Siemens AG
Federica Zanca, PhD, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare breast and lung dose associated with three chest CT protocols with different tube current modulation techniques.

METHOD AND MATERIALS
Three female cadavers with different BMI (underweight, normal and overweight) were scanned with a Siemens Definition Flash CT
scanner using a Standard chest protocol (3D TCM), XCare (organ-based TCM) and Flash (3D TCM flash speed), all at 120 kVp and
with the CTDIvol of all protocols matched to the patient specific CTDIvol of the Standard examination. The doses to the lungs and
breasts were calculated with a MC simulation framework (EGSnrc) for each voxel model of the cadavers, created by segmenting the
CT images. To obtain the tube current modulation information for the different protocols, the raw projection data were collected
(xyz modulation). Tube current modulation curves were compared and the dose percentage differences between the standard
(reference) and the two other protocols (XCare and Flash) were calculated.

RESULTS
Tube current modulation profiles showed large differences between the three protocols and depended on patient BMI. Both breast
and lung doses associated with the XCare and Flash protocols were lower than the doses associated with the Standard protocol for
underweight and normal size. The maximum dose reductions for the lungs for the XCare and Flash protocols were respectively 8.3%
and 39.3%; dose reductions for the breast were 13.8% and 45.3%. For the overweight size, we observed a reduction in lung dose
for both protocols with a maximum of 37.2%. Breast dose reduction was 41.8% for the Flash protocol but we found an increase of
3.6% for XCare.

CONCLUSION
The tube current modulation scheme of each protocol, as well as the patient habitus, have a strong impact on organ doses. The
Flash protocols reduced dose to the lungs and breast for all sizes and with the highest percentage (max 39.3% and 45.3%,
respectively). This is related to the fact that the total mAs used for the examination is lower (34% on average) for the same
CTDIvol. XCare slightly reduced breast dose for underweight and normal size patients but increased it for the overweight patient.

CLINICAL RELEVANCE/APPLICATION
Flash protocol reduces lung and breast dose more than XCare when compared to the standard protocols. Depending on the clinical
indication and image quality needed Flash protocol might be preferred.

SSC10-09  Development of a Computational Adult Brain Model and Applications to Radiation Dosimetry of Brain
Structures during Computed Tomography Examinations

Monday, Nov. 30 11:50AM - 12:00PM Location: S504CD

Participants
Nelia Long, PhD, Victor, NY (Presenter) Nothing to Disclose
Elliott J. Stepusin, MS, Gainesville, FL (Abstract Co-Author) Nothing to Disclose
Daniel J. Long, PhD, Gainesville, FL (Abstract Co-Author) Nothing to Disclose
PURPOSE
The purpose of this study was to calculate sub-region radiation doses within the brain for an array of head/brain CT imaging protocols. Although methods that use an estimated average whole brain dose may be sufficient to estimate risks using the current stochastic risk models, they may not be sufficient in future radiation epidemiology risk studies that require absorbed radiation doses to specific brain sub-regions thought to be associated with brain cancer induction.

METHOD AND MATERIALS
Computational brain models of reference adult male and female patients were constructed. A total of 43 different brain sub regions separated by hemisphere were created. Radiation doses to the different sub regions in the brain during CT examinations were calculated using computational models of three CT scanners of varying manufacturer using Monte Carlo particle transportation methods. Considerations were made for simulation settings regarding gantry angle, scan length, beam energy, filtration, collimation, pitch, and starting angle.

RESULTS
Differences between an individual brain sub-region and the averaged brain dose can be substantial (up to 140%) depending upon the protocol being studied. Depending on the exam taking place some brain structures may not be included in the primary x-ray beam. As a result, out-of-field structures receive doses that are lower than given by the average brain dose. On the other hand, structures that are entirely in the primary beam and therefore receive the bulk of the radiation field energy deposition receive doses that are significantly higher than the calculated whole brain dose.

CONCLUSION
The average brain dose, depending on the application, may not always be a true representation of the dose to the tissues from which glioma, meningioma, or other types of central nervous system cancers arise. The moderate dose gradients across the brain, as well as the anatomical coverage during a CT exam are two of the main factors that influence these differences. The dose database developed in this study can be used in future epidemiology studies that require estimates of absorbed radiation doses to specific brain structures rather than to the entire brain.

CLINICAL RELEVANCE/APPLICATION
Average brain dose may not be sufficient for radiation epidemiology studies that require absorbed radiation doses to specific brain sub-regions thought to be associated with brain cancer induction.
Between 2010 and 2014, 17 patients ages 18 years and younger were treated with PT for HL and enrolled on a prospective institutional review board-approved outcomes tracking protocol. Age distribution was as follows: 6-8 years, 3 patients (18%); 12-14 years, 3 patients (18%); and relapsed, 3 patients (18%). Thirteen (76%) had bulky mediastinal disease (≥ X). The median axial bulky disease was 9 cm and the median cranio-caudal bulky disease was 13 cm.

Participants
Ralph P. Ermoian, MD, Seattle, WA (Moderator) Nothing to Disclose
David B. Mansur, MD, Cleveland, OH (Moderator) Nothing to Disclose

Sub-Events

SSC11-01 Radiation Oncology Keynote Speaker: Perspectives in Lymphoma

Participants
Martin Colman, MD, Houston, TX (Presenter) Nothing to Disclose

SSC11-02 A Comparison Between VMAT, IMRT and GAP Techniques on the Meduloblastoma Approach: Different Technologies Aiming Better Patient Care

Participants
Daniel Przybysz, MD, RIO DE JANEIRO, Brazil (Presenter) Nothing to Disclose
Felipe Erlich, rio de janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Maira Fabiana Neves, rio de janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
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Celia Maria Paes Viegas, MD, rio de janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Denise Magalhaes, MD, rio de janeiro, Brazil (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): To compare and analyze different types of treatment delivery (VMAT, IMRT and conventional 3D with GAP) to Meduloblastoma patients, intending to maximize disease's site proper dose without compromising noble structures that usually share boundaries with the tumor. Materials/Methods: 12 patients (age range 2-45 years old, mean 14 years) with biopsy proven diagnosis of Meduloblastoma were assigned to Radiation Therapy with three different treatment techniques (VMAT, IMRT and conventional 3D with GAP) and planned to be treated with 36 Gy @ 20 fractions. The following organs at risk (OAR) were delineated: optic chiasm, optic nerves, lens, retinas, jaw, kidneys and vertebrae. All OARs doses were optimized on IMRT and VMAT to be as low as possible, respecting the Quantec tolerance doses guidelines. PTV was set to be an outer margin of 5mm from CTV. We here used Varian's planning system Eclipse to delineate and establish treatment properties, along with the linear accelerator Trilogy (equipped with MLC Millennium 120) to deliver treatment. 6 MV photon energy was the standard for all patients.

Conventional 3D technique used two fields on the spinal cord area, separated by a 1cm gap and two cranial fields with angulated collimator. Pencil Beam Convolution was the algorithm used. Sliding window technique was used for IMRT, where 3 fields were used on each superior and inferior site of the spinal cord. VMAT plans used a 359.8º arc. Collimator rotated to a 5º angle (355º). Standard doses were set up to treat 98% of PTV volume with 100% of the prescribed dose. We also used a heterogeneity index for all cases. Results: Data showed that 3D conventional technique and VMAT had a lower mean monitor unity (MU), meeting the recent literature published. 3D technique showed the highest homogeneity index, bringing a higher dose gradient variation to our patient. Mean dose values were in general lower for the VMAT technique. IMRT showed to be the safest treatment on delivery high doses without damaging vertebrae, lungs and/or the heart. Although, no significant difference was observed among patient's breasts regarding doses delivered. Conclusion: High technology treatment options have shown to be significantly important on the matter of delivering the correct dose to tumor area, preserving with a considerable safe margin noble tissues. New and upcoming techniques such as VMAT and IMRT should be strongly recommended in order to treat Meduloblastoma, having in mind that this disease has a great incidence in children and young adults - where aiming for the right target could mean better quality of life, overall survival and less toxicities.

SSC11-04 Proton Therapy for Pediatric Hodgkin Lymphoma

Participants
Justin Wray, MD, Gainesville, FL (Presenter) Nothing to Disclose
Bradford Hoppe, MD, Jacksonville Beach, FL (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The Children's Oncology Group upcoming protocol, AHOD1331, for pediatric high-risk Hodgkin lymphoma (HL) allows the use of proton therapy (PT). PT reduces the radiation dose to organs at risk, which should translate into fewer long term side effects, yet minimal data exist on the use of PT in HL. The purpose of this study is to determine whether PT is an effective and safe treatment for pediatric HL. Herein, we present our institutional experience treating pediatric HL with PT. Materials/Methods: Between 2010 and 2014, 17 patients ages 18 years and younger were treated with PT for HL and enrolled on a prospective institutional review board-approved outcomes tracking protocol. Age distribution was as follows: 6-8 years, 3 patients (18%); 12-15 years, 5 patients (29%), and 16-18 years, 9 patients (53%). Nine patients (53%) were male and 8 (47%) were female. Stage distribution was as follows: stage I, 0 patients; stage II, 4 patients (23%); stage III, 7 patients (41%); stage IV, 3 patients (18%); and relapsed, 3 patients (18%). Thirteen (76%) had bulky mediastinal disease (≥ X). The median axial bulky disease was 9 cm and the median cranio-caudal bulky disease was 13 cm. Eleven patients (65%) had high-risk disease (stages IIIB, IIIIB, IVA, or B). All patients were evaluated using the Childhood Hodgkin International Prognostic Score (CHIPS) class 0-4. The CHIPS score
distribution consisted of 3 (18%) class 0, 4 (23%) class 1, 6 (35%) class 2, 3 (18%) class 3, and 1 (6%) class 4 patients. Total PT dose was a median of 21 Gy (RBE) (range, 15-36 Gy[RBE]), including 7 patients (41%) treated with a sequential boost. Of 14 de novo patients, we obtained 11 PET and 12 CT images after 2 or 3 cycles of chemotherapy (mid-point). Seven patients (64%) had a partial response (PR) and 3 (36%) had a complete response (CR) on PET. Nine (75%) had a PR and 3 (25%) had CR on CT. Two of 3 (67%) recurrent patients achieved a PR on CT and PET and 1 patient achieved a CR before stem cell transplantation. Median follow-up for the cohort was 24 months (range, 4-52 months).Results: The 2-year overall survival rate was 93% and the progression-free survival rate was 80%. Three high risk patients recurred; 1 with an isolated in-field cervical lymph node and 2 recurred both in field and out of field. All recurrences were discovered within 5 months from completing PT. One patient with stage IIBX, CHIPS 4 died of a recurrence 7 months after treatment. The 2 other patients had stage IIBX and stage IVA disease, and both had mid-treatment PET-positive disease. No PT-related grade 3 or higher acute or late complications were observed according to CTCAEv4.Conclusion: Our results indicate that PT for pediatric HL is safe and effective in our generally unfavorable cohort of patients. In future studies, considerations will include increasing doses for patients with PET-positive disease at the midpoint of chemotherapy.

**SSC11-05** Risk Factors and Patterns of Lymph Node Involvement in Gastric Large B Cell Lymphoma: Implications for Target Definition

**Participants**

ximei zhang, Oak Brook, IL (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): To identify the appropriate radiation field in primary gastric diffuse large B-cell lymphoma (PG-DLBCL). Materials/Methods: The clinical and pathological findings of 48 PG-DLBCL patients treated with total gastrectomy and D2 lymphadenectomy were retrospectively analyzed. In addition, factors associated with lymph node involvement were also analyzed. Results: There were 26 patients with stage I disease, 14 patients with stage II and 8 patients with stage III disease. Lymph node involvement was identified in 37.5% of the whole series. Primary location, as well as the depth of invasion was significantly associated with lymph node involvement. The rate was rather low when gastric antrum was involved whereas when the whole stomach was involved, the rate could be as high as nearly 70%. The rate increased with the depth of invasion into stomach. Tumors invading into mucosa and submucosa, serosa and adjacent organs had a lymph node involvement rate of 0, 55.6% and 70%, respectively. When tumor was limited to the deep muscularis, the involved lymph nodes were all perigastric nodes. For tumors invading upon muscularis, the involved lymph nodes were regional nodes. With a median follow up of 35 months, eight patients had developed progressive disease or a relapse, however, none of the patients who underwent adjuvant radiotherapy had disease progression or relapse. Conclusion: The radiation field for patients with PG-DLBCL is largely dependent on the primary location and depth of invasion. Large series as well as longer follow up are needed to further demonstrate the appropriateness of radiation volumes for PG-DLBCL.

**SSC11-06** Hypofractionated Radiation Therapy in the Evolving Paradigm of Treating Nasal-Type Extranodal Natural Killer/T-CELL Lymphoma

**Participants**

Amandeep Taggar, Oak Brook, IL (Presenter) Nothing to Disclose

Douglas Stewart, MD,FRCP, Calgary, AB (Abstract Co-Author) Nothing to Disclose

Theresa Trotter, Calgary, AB (Abstract Co-Author) Nothing to Disclose

Alexander G. Balogh, MD, MSC, London, ON (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): Extranodal natural killer/T-cell lymphoma (ENKTL) is a rare and lethal malignancy with no consensus on its optimal management. External beam radiation (RT) is often used in its treatment with dosages of 45-50 Gy in 1.8-2.0Gy fractions delivered over 5 weeks. At our institution, a RT dose of 30 Gy in 3 Gy fractions over 2 weeks was introduced in 2006. Adjuvant therapies and autologous stem cell transplant (ASCT) were later introduced. It was hypothesized that this hypofractionated regimen would offer similar outcomes to the standard regimen, while shortening the duration of RT, because patients were progressing while on or shortly after the 5-week regimen. We look to describe our results by reporting on disease/treatment characteristics and survival outcomes in a cohort of patients treated in the era of 45-50 Gy and then with 30 Gy. Materials/Methods: The clinical records of patients presenting with ENKTL at our tertiary institution between 1999 and 2013 were retrospectively reviewed. Demographics, vital statistics, tumour characteristics and treatment parameters were extracted from the medical records. Results were examined using SPSSv.22 for both the descriptive analysis and survival. Non-parametric approaches including the Mann-Whitney U test was used to compare differences in outcomes between both groups. Results: The records of n=13 with nasal-type ENKTL were identified. Median age was 58.7 years. Median follow-up was 10.8 months (range(R): 4.4-43.9 months). Stage at presentation: 14 - stage I/II, 2 - stage IV and 3 - stage unknown. The observed median survival was 10.8 months. 2 year overall survival was 36%. N=17 received RT; n=10 received 30Gy in 10 fractions, n=1 received 35 Gy in 20 fractions and n=6 received 45 Gy in 25 fractions (of which 2 patients did not complete due to disease progression, and received 41.4 Gy in 25 and 36 Gy in 18 fractions). Among those patients who died, median time to death (MTD) was 7.2 months (R:5.4-29.8 months) for patients receiving the 30 Gy regimen versus 1.5 months (R:0.4-6.9 months) for those receiving standard dose-fractionation (p=0.05). In total, 12 patients received chemotherapy and 4 out of 12 subsequently received ASCT. All patients who proceeded to ASCT were treated with hypofractionated regimen. All patients who treated with RT plus ASCT are alive at a median follow-up of 42.4 months. N=7 of those receiving adjuvant chemotherapy relapsed, of which 2 had "in-field" recurrences. Median time to relapse was 12.4 months (R:6.5-19.4m) from diagnosis and 8.9 months (R:5.4-16.8 m) from the date RT. Conclusion: Patients treated in the post 2006 era of our hypofractionated regimen with 30Gy/10 fractions had improved OS outcomes compared to traditional dose fractionations. There remains a role for dose escalation to minimize in-field recurrences and more effective systemic agents to further delay relapses.

**SSC11-07** Prospective Absorbed Dose Based Combined Treatment Planning and Therapy Using 153Sm-EDTMP Radiopharmaceutical with External Beam Radiation Therapy in Metastatic Osteosarcoma Patients

**Participants**

Nothing to Disclose
Evaluation of the Response to Intratumor Implantation of Nanoparticles Activated by External Beam Radiation Therapy in Sarcoma by DCE-US and MRI: Radiologic-Pathology Correlation

**PURPOSE**

Nanoparticles activated by external beam radiation therapy (EBR) are new drugs and RECIST1.1 is not a good predictor of the response to treatment. New biomarkers thresholds might be necessary.

**METHOD AND MATERIALS**

14 patients with a histological diagnosis of sarcoma received an injection of nanoparticles in a phase I study with NBTXR3. Once implanted in the tumor, they were activated by EBR (Day 2 until day 37). DCE-US and MRI (T1, T2, gadolinium) were performed at baseline and prior to the surgery (realized at 5 weeks). Biomarkers tested on MRI were: RECIST, WHO, Volumetric approach. Biomarkers tested on DCE-US were: Area Under Curve (AUC, quantitative) and DCE (Contrast enhancement in %, qualitative). A new biomarker: the percentage of tumor volume with increased T2-weighted signal (iT2%) or cystic on DCE-US was evaluated: Percentage of Cystic Volume (CV%). The reference standard for pathological response was based on the parameter of tumor cell viability expressed as a percentage of viable cells (PVC) in the global cell mass in the post-operative surgical specimen.

Furthermore, the percentage of necrosis was evaluated. A p<.05 was considered as statistically significant.

**RESULTS**

At baseline 14MRI and only 12 DCE-US were analyzed. The estimation of the tumor volume by US (r=.85) and MRI (r=.75) was significantly correlated with the pathology specimen. CV% was significantly correlated with the PVC (r=.57) and the percentage of necrosis (r=.65). RECIST and the relative variation of volume were correlated with the PVC: r=.63 and .57. The other biomarkers were not significantly correlated with the percentage of VC or of necrosis within the tumor volume.

**CONCLUSION**

The response to a treatment with nanoparticles activated by EBR lead to the apparition of a cystic portion within the overall tumor volume (CV%) that may be evaluated non-invasively by either MRI or US. and is a good predictor of the percentage of tumor necrosis and of viable cells. Changes in volume (US and MRI) are correlated with the PVC and it suggests that an adaptation of volume (CV%) that may be evaluated non-invasively by either MRI or US. and is a good predictor of the percentage of tumor necrosis and of viable cells. Changes in volume (US and MRI) are correlated with the PVC and it suggests that an adaptation of volume (CV%) that may be evaluated non-invasively by either MRI or US.

**CLINICAL RELEVANCE/APPLICATION**

Nanoparticles activated by EBR are new drugs and RECIST1.1 is not a good predictor of the response to treatment. New biomarkers are needed.
To evaluate outcomes of patients treated with adjuvant radiation therapy (RT) for retroperitoneal soft tissue sarcomas (RP STS) at our institution.

The medical records of 34 consecutive patients with RP STS treated definitively between 1998-2013 were reviewed. Survival analyses were conducted using the Kaplan-Meier method and subsets of patients were compared using the log rank test.

Eighteen men and 16 women were included with a median age of 56 years (range 30-80). The most common histologies were liposarcoma (53%) and leiomyosarcoma (21%). The majority of patients had tumors >10 cm in size (53%). 26% of patients were stage III and 38% of patients were high grade. 21% of patients were treated for recurrent disease and 18% were treated for persistent disease after initial non-oncologic resection. All patients underwent resection and received RT as part of their treatment. 68% of patients had positive or close (<2 mm margins). 76% of patients completed external beam radiation therapy (EBRT). 62% of patients had RT delivered post-operatively with a median total dose of 45 Gy (range 39.5-54) and 38% of patients had pre-operative RT with a median total dose of 45 Gy (range 45-55). Intraoperative radiation therapy (IORT) was delivered in 82% of patients with 8 patients treated with IORT alone without EBRT. The median IORT dose was 12.5 Gy (range 10-15). At a median follow-up of 48 months (range 3-172), the 5-year LC, DFS, and OS rates were 62%, 50%, and 67%, respectively. 47% of patients ultimately failed with 35% failing locally, 15% failing distantly, and 3% failing both locally and distantly. RT timing delivered either pre- or post-operatively did not impact LC (p=0.68), DFS (p=0.65), or OS (p=0.46). Patients with recurrent disease had reduced LC (p<0.0001) and DFS (p<0.0001) but no effect on OS (p=0.48) was observed. There were no adverse effects on LC (p=0.23), DFS (p=0.10), or OS (p=0.27) in patients who were treated after initial non-oncologic resection as long as they received definitive treatment afterwards.

Patients with RP STS are most likely to fail locally. Based on our data, pre- vs. post-operative radiation and treatment following initial non-oncologic resection had no impact on outcomes. However, patients with recurrent disease were more likely to have a local or distant failure.

Patients with RP STS fail locally with worse outcomes for recurrent disease.
**Histological Evaluation of Intraarterial SN-38-incorporating Micellar Nanoparticle in a Rabbit Tumor Model**

**PURPOSE**
Micellar nanoparticle is an innovative drug delivery system, which can effectively accumulate in tumor tissue, due to enhanced permeability and retention effect. In addition, micellar nanoparticle can directly deliver SN-38 which is a biological active metabolite of irinotecan. The purpose of this study was to evaluate the histological findings after intraarterial SN-38-incorporating micellar nanoparticle injection compared with intravenous injection in a rabbit liver tumor model.

**METHOD AND MATERIALS**
Eighteen rabbits with VX2 liver tumors were divided into two groups, IA group (9 rabbits) and IV group (9 rabbits). Micellar nanoparticles incorporating SN-38 (30mg/kg) were intraarterially injected through the left hepatic artery in the IA group or intravenously injected in the IV group. Immuno-histochemical analysis using TUNEL staining was conducted at 2 hours to identify apoptotic cells. Coagulative necrosis was examined by Hematoxylin-Eosin stain at 24 hours. Further, SN-38 concentrations in the tumor tissues were measured within 24 hours.

**RESULTS**
Apoptotic cells had already been detected at 2 hours in the IA group, while no apoptotic cells were detected in the IV group. The mean tumor necrosis ratios were 80% in the IA group, while 50% in the IV group. The IA group showed significantly higher free SN-38 concentrations in tumor tissues at all measurement points (P=0.003 at 3 minutes, 0.012 at 2 hours and 0.048 at 24 hours).

**CONCLUSION**
Intraarterial SN-38-incorporating micellar nanoparticle can induce apoptosis of the tumor cells at 2 hours and achieve high tumor necrosis rate at 24 hours with high SN-38 concentration in the tumors.

**CLINICAL RELEVANCE/APPLICATION**
In this study an innovative drug delivery system was evaluated using a rabbit liver tumor model. Intraarterial SN-38-incorporating micellar nanoparticle can induce apoptosis of the tumor cells and achieve high tumor necrosis rate in the tumors.

**EW-7197, a Novel ALK5 Kinase Inhibitor, Prevents Tissue Hyperplasia after Bare Metallic Stent Placement in a Urethra Rat Model**

**PURPOSE**
To evaluate the efficacy and safety of an activin receptor-like kinase 5 inhibitor, EW-7197, in the prohibition of granulation tissue hyperplasia after bare metallic stent placement.

**METHOD AND MATERIALS**
Twenty-four male Sprague-Dawley rats were randomly divided into four groups and underwent bare metallic stent placement in the urethra. Then, the rats were injected intraperitoneally per day with 0.3 ml of saline in group A and with EW-7197 at a dose of 5 mg/kg in group B, 10 mg/kg in group C, and 20 mg/kg in group D for 8 weeks. Retrograde urethrographies were performed at 4
weeks and 8 weeks after the stent placement. The body weight of each rat was measured and blood samples were obtained from the inferior vena cava for the evaluation of serum ALT and AST levels at 8 weeks. A histologic examination regarding the number of epithelial layers, percentage of granulation tissue area, thickness of submucosal fibrosis, and inflammatory cell infiltration grade was performed in each rat. We further investigated the reduction of transforming growth factor (TGF)-β.

**RESULTS**

The follow-up urethrographies performed at 4 and 8 weeks after stent placement shows the stented urethra in groups C and D had larger lumens than in the control group A ($p<0.001$, $p<0.05$). The average numbers of epithelial layers and the mean percentage of granulation tissue area in groups C and D were significantly lower than in control group A ($p<0.001$). The average thickness of submucosal fibrosis was less in the 3 treated groups than in the control group A ($p<0.001$). The mean percentage of granulation tissue was significantly lower in group C and D, when compared with the control group A ($p<0.05$). The inflammatory cell infiltration was significantly higher in group C and D, when compared with the control group A ($p<0.05$). However, there was no significant difference among the four groups in terms of body weight and liver enzymes ($p>0.05$).

**CONCLUSION**

Intraperitoneal administration of EW-7197 was effective and safe for the prevention of granulation tissue hyperplasia after bare metallic stent placement in a rat's urethra. Our study provided a basis for future clinical studies of patients with restenosis.

**CLINICAL RELEVANCE/APPLICATION**

EW-7197 is effective for the prevention of granulation tissue formation after bare metallic stent placement in a rat urethral model.

**ERSC12-03 Electrolytic Electroporation - E2 — A New Tissue Ablation Technology; Early Results and Clinical Implications**

**Presenters**

Michael K. Stehling, MD, PhD, Offenbach, Germany (Presenter) Nothing to Disclose
Enric Guenter, Dipl Phys, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Liel Rubinsky, PhD, Berkeley, CA (Abstract Co-Author) Nothing to Disclose
Pedro Torrecillas, MD, Malaga, Spain (Abstract Co-Author) Nothing to Disclose
Franco Lugnani, MD, Trieste, Italy (Abstract Co-Author) Nothing to Disclose
Paul Mikus, DPhil, Coto De Caza, CA (Abstract Co-Author) Consultant, Interscience
Boris Rubinsky, PhD, Berkeley, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

We explore the hypothesis that combining reversible electroporation (RE) to permeabilize the cell membrane with electrolysis to electrochemically produce compounds that destroy permeabilized cells (combination abbreviated as - E2) is an effective new tissue ablation technique with the ability to spare extracellular matrix and sensitive structures like irreversible electroporation (IRE) but with significantly lower energy and much larger maximum ablation volumes.

**METHOD AND MATERIALS**

E2 studies on nine pigs were done with open surgery under ultrasound (US) imaging, with and without paralyzing anesthetics. Delivered with two electrodes, we tested the effects of different electroporation parameters and various doses of electrolysis on cell death. Treatment was administered to the liver, gall bladder, kidney, rectum and nerves. HandE and Mason's trichromatic stained tissues were histologically examined.

**RESULTS**

E2 protocols produce a variety of cell death forms depending on dose and combination of electroporation and electrolysis parameters. For instance, the cell death modality at the anode is different from that at the cathode. We find that we could repeatedly ablate volumes of up to 200 cm³ with two electrodes with a treatment time of less than five minutes and no use of muscle relaxants. E2 ablation can be monitored with ultrasound. The signature of tissue affected by reversible electroporation is different from that ablated by electrolysis, hypoechoic and hyperechoic, respectively.

**CONCLUSION**

The combination of electrolysis with reversible electroporation is a highly flexible, cellular-level, low energy tissue ablation method suitable for the creation of large and reproducible ablation. Compared to electrolysis alone, it is faster and has lower toxicity. Compared to IRE, it affords larger ablation zones, has comparable toxicity and lower requirements for anesthesia and muscle relaxation. The initial animal studies confirmed the theoretical expectations. Obviously, the studies reported here are firsts of its kind and much research remains to be done.

**CLINICAL RELEVANCE/APPLICATION**

The combination of electrolysis with electroporation (E2) is a novel, low energy, tissue selective ablation method which provides larger tissue ablation zones than IRE with the same low toxicity.

**SSC12-04 MRI Image Guided Nanocarbon-Assisted Microwave Therapy (NAMT) Causing Cytotoxic Thermal Ablation of MK1 Breast Tumor Cells in SCID Mice**

**Presenters**

Mark Desantis, DO, Northport, NY (Abstract Co-Author) Research Grant, Clean Technology International Corporation
Ana M. Franceschi, MD, New York, NY (Presenter) Nothing to Disclose
Wilbur B. Bowne, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Thomas Dalessandro, MD, Northport, NY (Abstract Co-Author) Nothing to Disclose
Jonathan Gross, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Valmore Suprenant, MD, Setauket, NY (Abstract Co-Author) Nothing to Disclose
Atul Kumar, MD, Northport, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

MRI Image Guided Nanocarbon-Assisted Microwave Therapy (NAMT) causing cytotoxic thermal ablation of MK1 breast tumor cells in SCID mice: Implications.
John A. Ferretti, MD, Stony Brook, NY (Abstract Co-Author) Nothing to Disclose
Caitlin Dolan, Stony Brook, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
Evaluation of near real time MRI guided imaging of a spherical nanocarbon (Grafex) injected into MK1 breast carcinoma during microwave ablation. It is known that nanocarbon assisted microwave therapy (NAMT) increases the absorption of microwave energy, specifically into tumor cells. This study evaluated the use of MRI safe microwave probes and NAMT as primary treatment in MK1 breast tumor. Additionally, MRI near Real time imaging was performed during treatment.

METHOD AND MATERIALS
Severe combined immune deficient (SCID) isolated mice were injected with MK1 Breast carcinoma cells introduced into the dermis and allowed to grow to >1cm. In the ‘treatment’ group, nanocarbon and viscous carrier were injected into the tumors. Medwaves Avecur generators with MRI safe temperature sensing microwave probes were used for thermal ablation, with short cycle power using 15 watts at 20 sec as baseline settings. Target temperature within the tumor was 65°C. MRI imaging was simultaneously performed with a 0.6T Fonar MRI using T1, T2 and gradient sequences.

RESULTS
Spherical nanocarbon provides a non toxic method of thermally ablating the tumor utilizing MRI safe microwave probe while allowing for imaging during the treatment. Over 90% of the mice responded to the treatment without significant toxic effects of the retained carbon within the dermis.

CONCLUSION
MRI guided imaging provided continuous monitoring of thermal ablation zones using spherical nanocarbon, with the conversion of microwave energy causing thermal ablation of cancer cells. By using shorter treatment times and lower power output of the microwave generator, NAMT reduces heat sink effect and surrounding tissue damage. Grafex NAMT appears to be not only successful in treatment of breast carcinoma, but also nontoxic in this small animal study. A larger study is under way.

CLINICAL RELEVANCE/APPLICATION
MRI image guided Nanocarbon-assisted microwave therapy using MRI safe microwave probes provides near real time evaluation of ablation zone size, evaluation of contracted tissue, shorter treatment times and apparent non-toxic treatment of human breast tumor cells, and may represent a powerful new tool in cancer therapy with near real time imaging.

SSC12-05 Optical Imaging-Monitored Intra-Esophageal Radiofrequency Hyperthermia-Enhanced Local Chemotherapy of Esophageal Cancers

Monday, Nov. 30 11:10AM - 11:20AM Location: E352

Participants
Yaoping Shi, MD, Seattle, WA (Presenter) Nothing to Disclose
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Longhua Qi, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Yonggang Li, MD, Suzhou, China (Abstract Co-Author) Nothing to Disclose
Xiaoming Yang, MD, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the possibility of using bioluminescent optical imaging to monitor intra-esophageal radiofrequency hyperthermia (RFH)-enhanced local chemotherapy of rat models with orthotopic esophageal squamous cancers (ESCs).

METHOD AND MATERIALS
Human ESC cells were transduced with lentivirus/luciferase. Orthotopic ESC masses were established by inoculating luciferase-ESC cells into cervical esophagus walls of nude rats via a specifically designed transesophageal approach. Twenty four rats with ESC cancers were divided into four study groups (n=6/group) receiving various treatments: i) combination therapy of intraesophageal MR imaging-heating-guidewire (MRHG)-mediated RFH (420°C) plus local chemotherapy (cisplatin and 5-fluorouracil); ii) chemotherapy-only; iii) RFH-only; and (iv) phosphate-buffered saline (PBS). Bioluminescent optical imaging and transcutaneous ultrasound imaging were used to follow up bioluminescence signal and size changes of tumors among the groups over a time period of two weeks, which were correlated with subsequent histology.

RESULTS
Optical imaging demonstrated a significantly decreased bioluminescence signal in the combination therapy group, compared to those in three control groups (0.51±0.18 VS 1.6±0.4 VS 3.18±0.9 VS 3.5±0.96, p<0.05). Ultrasound imaging showed the smallest tumor volumes of the combination therapy group, in comparison to those of other control groups (0.62±0.16 VS 1.25±0.19 VS 2.28±0.25 VS 2.6±0.26, p<0.05). Both imaging findings were confirmed by histologic correlation (Figure).

CONCLUSION
Optical imaging is a useful tool for monitoring intra-esophageal RFH-enhanced chemotherapy of ESCs, which may provide a new opportunity for efficient management of esophageal malignancies.

CLINICAL RELEVANCE/APPLICATION
Intra-esophageal RFH-enhanced chemotherapy of ESCs may provide a new opportunity for efficient management of esophageal malignancies.
In-vitro and In-vivo Feasibility Study of a Glassfiber-Based MR-Safe Guidewire

Monday, Nov. 30 11:30AM - 11:40AM Location: E352

Participants
Alexander Massmann, MD, Homburg/Saar, Germany (Presenter) Nothing to Disclose
Amo Buecker, MD, Homburg, Germany (Abstract Co-Author) Consultant, Medtronic, Inc Speaker, Medtronic, Inc Co-founder, Aachen Resonance GmbH Research Grant, Siemens AG
Quenther K. Schneider, MD, PhD, Homburg, Germany (Abstract Co-Author) Research Grant, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group;

PURPOSE
Evaluation of a dedicated MR-safe glass/aramid-fiber-based guidewire.

METHOD AND MATERIALS
The MR-guidewires (GW) are composed of ultra-thin rod-shaped glass/aramid fibers embedded in epoxy-resin. MRI-visualization is ensured by metal-particles embedded in the epoxy-matrix. The shaft is covered by a PTFE-shrinktube and a hydrophilic surface. The tip is doped with tungsten-particles for X-ray visibility as a back-up option for conventional angiography. The standard/stiff GW measures 0.89 mm (0.035") in diameter and 260 cm in length. The micro-GW 0.36 mm (0.014") and 190 cm. After in-vitro testing in a synthetic abdominal aorta/visceral artery flow-model for visualization and handling, all GWs were used in 9 pigs (mean weight 65+/-5 kg). Catheterization of the iliac arteries, abdominal/thoracic aorta, visceral/renal arteries, iliac and inferior cava vein were performed in a clinical 1.5 T scanner using real-time interactive MR-imaging (temporal resolution 0.2 s; FOV 150 mm; matrix 128x128). MR-guided interventions included balloon-dilatation and arterial/venous stent-deployment via the GWs. Visualization, handling, and time for catheterization of the vessel regions were assessed.

RESULTS
Real-time interactive MRI allowed clear visualization of the GW characterized by a continuous artifact of about 2 mm in diameter along the shaft as well as a tip marker artifact of 4.5 mm. Suitable handling combined with sufficient stiffness, adequate transfer of traction and torsion allowed precise and exact navigation toward target vessels (mean time for abdominal/thoracic aorta 4 s; visceral/renal arteries 10 s, and contralateral iliac arteries 36 s). All procedures were technically successful. No GW-associated complications occurred, esp. no breakage, disruption or thrombosis. Handling regarding stiffness, flexibility and guidance were similar to usual standard angiographic GWs.

CONCLUSION
Initial in-vitro and in-vivo results of a new dedicated MR-safe guidewire are the basis for further clinical application for endovascular MRI-guided interventions in humans.
RESULTS

Accuracy (distance between needle tip and target) and radiation dose (DAP, Gy.cm²) were recorded using each of the 3 modalities.

METHOD AND MATERIALS

Three operators with different experience levels each localized 15 targets (bone fragments) approximately 7 cm deep in the paraspinal muscles of pigs using each of the 3 modalities. Accuracy (distance between needle tip and target) and radiation dose (DAP, Gy.cm²) were recorded for each procedure. Two-way analysis of variance (ANOVA) with interaction including Tukey's multiple comparison correction was used for differentiating accuracy and DAPs across navigation techniques and operator background. The AR system consisted of 4 small video cameras integrated within the frame of the X-ray detector of the C-arm (Philips Allura) as shown in the attached figure.

PURPOSE

Aim of this study was to establish an online reconstruction for real time Magnetic Particle Imaging (MPI) and test it ex-vivo on an angioplasty balloon catheter model. MPI is a new tomographic 4D imaging technique that allows to determine the spatial distribution of SPIOs at a time resolution of up to 46 Frames/s, technically allowing real time imaging. Therefore, in the future MPI might be a radiation free modality for catheter interventions. Until now, data could only be reconstructed and displayed after acquisition, limiting applications requiring direct feedback.

RESULTS

Using the developed online reconstruction framework reconstruction rates of more than 60 frames/s for 3D MPI sequences are achieved. As this is faster than the acquisition rate of 46 frames/s it is possible to follow the object in real time with a latency of about 1s due to a delay in the data acquisition hardware. Even though the overall image quality was better using DSA all relevant image information for balloon catheter intervention could be obtained from MPI data.

CONCLUSION

We demonstrate an online reconstruction framework for 4D MPI Data. Even though image quality was better using DSA, the new framework gives the basis for future radiation free 4D catheter intervention using a static 3D MRI for anatomic information and 4D MPI for intervention guidance.

CLINICAL RELEVANCE/APPLICATION

Magnetic particle imaging is an emerging radiation free method, that in future, might be used for 4D catheter interventions.

SSC12-09 Augmented Reality on a C-arm System: A Preclinical Validation for Percutaneous Interventions

Monday, Nov. 30 11:50AM - 12:00PM Location: E352

Participants

John M. Racadio, MD, Cincinnati, OH (Presenter) Research Consultant, Koninklijke Philips NV; Travel support, Koninklijke Philips NV
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Judy Racadio, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
Dragenko Babic, MD, Best, Netherlands (Abstract Co-Author) Employee, Koninklijke Philips NV

PURPOSE

To compare the navigational accuracy and radiation dose of image-guided percutaneous procedures performed with augmented reality (AR) with and without motion compensation (MC) versus cone beam CT with real-time fluoroscopy navigation (CBCTf) during needle localization of targets in a pig model.

METHOD AND MATERIALS

This was a prospective study in a pig model approved by the Institutional Animal Care and Use Committee. Three operators with different experience levels each localized 15 targets (bone fragments) approximately 7 cm deep in the paraspinal muscles of pigs using each of the 3 modalities. Accuracy (distance between needle tip and target) and radiation dose (DAP, Gy.cm²) were recorded for each procedure. Two-way analysis of variance (ANOVA) with interaction including Tukey's multiple comparison correction was used for differentiating accuracy and DAPs across navigation techniques and operator background. The AR system consisted of 4 small video cameras integrated within the frame of the X-ray detector of the C-arm (Philips Allura) as shown in the attached figure. The 4 cameras pointed towards the isocenter of the C-arm in a pyramidal fashion. The live video streams were augmented with X-ray and CBCT imaging as well as with virtual graphics depicting the planned needle path drawn by the operator. The video cameras were calibrated with respect to the geometrical specifications of the C-arm system so that the acquired CBCT and planned needle path were registered to the optical images. The visualization was displayed on a standard IR monitor.

RESULTS

There was no significant difference in accuracy between the three modalities (mean distance: 3.0±1.9 mm for CBCTf, 2.5±2.0 mm for MC, 2.6±2.2 mm for AR).
for AR, and 3.2±2.7 mm for AR with MC (P=0.33)). There was, however, a significant difference in fluoroscopy radiation dose (2.3±2.4 Gy.cm² for AR, 3.3±4.6 Gy.cm² for AR with MC, and 10.4±10.6 Gy.cm² for CBCTf (P<0.05)) and therefore in total procedural radiation dose (12.6±5.3 Gy.cm² for AR, 13.6±7.4 Gy.cm² for AR with MC, and 20.5±13.4 Gy.cm² for CBCTf (P<0.05)).

CONCLUSION

Use of an AR system reduces radiation dose while maintaining navigational accuracy compared to CBCTf during image-guided percutaneous procedures in a pig model.

CLINICAL RELEVANCE/APPLICATION

Use of an augmented reality system reduces radiation dose while maintaining navigational accuracy compared to CBCT with real-time fluoroscopy guidance during image-guided percutaneous procedures in a pig model.
Breast Imaging (MR Response to Tx)

Monday, Nov. 30 3:00PM - 4:00PM Location: Arie Crown Theater

SSE01-01 DCE-MRI Early Predict Pathological Complete Response to Neoadjuvant Chemotherapy in Resectable Primary Breast Cancer

Participants
Nola M. Hylton, PhD, San Francisco, CA (Moderator) Nothing to Disclose
Constance D. Lehman, MD, PhD, Seattle, WA (Moderator) Research Consultant, General Electric Company;

Sub-Events

PURPOSE
To establish a predictive model using dynamic enhanced MRI multi-parameters for early predicting pathological complete response (pCR) to neoadjuvant chemotherapy (NAC) in breast cancer.

METHOD AND MATERIALS
In this prospective cohort study, 170 breast cancer patients treated with NAC were enrolled and were randomly grouped into training sample (136 patients) and revalidation sample (34 patients). DCE-MRI parameters achieved before the start of the NAC and at the end of the first cycle of NAC were screened to establish the predictive model by using multivariate logistic regression model according to pCR status. Receiver operating characteristic curves were conducted to assess the predictive capability. The association between MRI-predicted pCR status and survival outcomes was estimated by using the Kaplan-Meier method.

RESULTS
Multivariate analysis showed ΔAreamax, ΔI and ΔSlopemax were independent predictors for pCR, OR were 0.939(95%CI, 0.915 to 0.964), and 0.966(95%CI, 0.947 to 0.986), respectively. A predictive model was established “Y=-0.089*ΔAreamax - 0.022*ΔSlopemax”, a cut-off point of 2.8 was determined. The AUC for training and revalidation sample were 0.908 (95%CI, 0.844 to 0.972) and 0.884 (95%CI, 0.772 to 0.998), respectively. MRI-predicted pCR status showed significant association with DFS (P=0.045), nearly significant association with RFS (P=0.086) and no significant association with OS (P=0.23).

CONCLUSION
The multi-parameter MRI model can be potentially used for early predicting pCR status and especially be used for accurately finding out patients not achieving pCR. MRI-predicted pCR status achieved at an early stage of NAC allows regimen refinement before definitive surgical treatment.

CLINICAL RELEVANCE/APPLICATION
This is the first time that a prospective study has constructed a multi-parameter MRI model for early predicting pCR to neoadjuvant chemotherapy in breast cancer patients. The pCR status achieved at an early stage of NAC before surgical resection allows in time regimen alteration and give an opportunity to refine treatment plans before definitive surgical treatment. This might also serve as an early indicator for predicting comparative effectiveness in clinical trials.

SSE01-02 Multiparametric Breast Magnetic Resonance Imaging (MRI) in Patients Eligible for Neoadjuvant Chemotherapy (NAC): Can We Predict Tumor Response According to Baseline Features?

Participants
Marta Maria Panzeri, Milan, Italy (Presenter) Nothing to Disclose
Francesco Ballati, Milano, Italy (Abstract Co-Author) Nothing to Disclose
Claudio Losio, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
NAC is the standard treatment of locally advanced breast cancer, but only a minority of the patients obtain a complete pathologic complete response (pCR), which correlates with prognosis. Identification of potential responders could avoid ineffective toxic treatment and delay in surgery. Breast MRI is considered the best technique for monitoring NAC, but there is no consensus on its predictive role. We evaluated the potential role of morphological, dynamic and functional tumor features, assessed with baseline MRI, as markers of tumor response to NAC.

METHOD AND MATERIALS
Seventy-two patients with histopathologically proven locally advanced breast cancer underwent baseline MRI (1.5T) before starting...
T2 TSE sequences, diffusion-weighted imaging (DWI) and dynamic gadolinium-enhanced studies were performed. Morphological parameters included tumor size, morphology, presence or absence of pseudocapsule, oedema, rim enhancement, necrosis and vascular map. T2 signal intensity and Apparent Diffusion Coefficient (ADC) obtained from DWI were assessed. Dynamic parameters included kinetic curve patterns and contrast enhancement data (Maximum relative enhancement, Wash-in and wash-out rates, brevity of enhancement [BOE]). Final response to NAC was histopathologically defined. Univariate and multivariate analysis using logistic binary regression were performed.

**RESULTS**

All women completed NAC and 40% achieved a pCR. At univariate analysis, presence of peritumoral oedema was significantly associated with pCR (OR 3.33 [IC95%: 1.13-9.82], p=0.029). Chemosensitive tumors showed higher ADC values [OR 1.03 (IC95%: 1.01-1.07), p=0.032]. BOE was higher in patients who achieved pCR [OR 1.06 (IC95%: 1.01-1.11), p=0.015]. At multivariate analysis, BOE [OR 1.06 (IC95%: 1.01-1.16), p=0.025] and mean ADC values [OR 1.03 (IC95%: 1.01-1.07), p=0.049] were significantly associated with pCR.

**CONCLUSION**

Some tumor features at baseline MRI are reflective of growth patterns and aggressiveness, influencing the response to NAC in different ways. BOE and ADC seem the strongest predictors of responsiveness.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative DWI and Brevity of enhancement assessed with baseline Breast MRI can potentially predict chemosensitivity to NAC.

**SSE01-03 Tumor Heterogeneity Patterns on DCE-MRI Parametric Response Maps May Augment Early Assessment of Neoadjuvant Chemotherapy in Locally Advanced Breast Cancer: A Pilot Study of ACRIN 6657/I-SPY 1**

**Monday, Nov. 30 3:20PM - 3:30PM Location: Arie Crown Theater**

**Participants**

Jia Wu, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Susan Weinstein, MD, Philadelphia, PA (Abstract Co-Author) Consultant, Siemens AG
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Yangming Ou, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Mark A. Rosen, MD, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Angela DeMichele, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Christos Davatzikos, Philadelphia, PA (Abstract Co-Author) Shareholder, Gliomics LLC
Despina Kontos, PhD, Philadelphia, PA (Presenter) Nothing to Disclose

**PURPOSE**

To investigate the performance of tumor heterogeneity metrics derived from parametric response mapping (PRM), in their capacity to predict early pathologic complete response (pCR) to neoadjuvant chemotherapy (NAC) in women with locally advanced breast cancer, based on longitudinal assessment of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI).

**METHOD AND MATERIALS**

A subset 27 patients from ACRIN 6657/I-SPY 1 TRIAL were retrospectively analyzed. Four kinetic features (i.e., signal enhancement ratio, peak enhancement, wash-in and wash-out slope) were computed separately from DCE-MRI acquired before chemotherapy and at the first post treatment visit. For each feature, voxel-wise measures of variation during chemotherapy were assessed via PRM, and the degree of spatial heterogeneity for these voxel-level variations were quantified by selected statistical texture-based indices. The resulting heterogeneity-based PRM-index was compared with current standard measures in predicting pCR using logistic regression, where each model was also adjusted for age and tumor subtype. Performance was assessed via receiver operating characteristic (ROC) analysis.

**RESULTS**

After adjusting for patient’s age and tumor subtype (ER/PR+, Her2+, TN), the heterogeneity-based PRM-index outperformed all current standard measures (AUC = 0.93 (95% CI: 0.83 - 1.00), PRM-index p-value = 0.08), including the “hot spot” signal enhancement ratio (SER) (AUC = 0.87 (95% CI: 0.71 - 1.00), SER p-value = 0.76), tumor longest diameter (LD) (AUC = 0.89 (95% CI: 0.67 - 1.00), LD p-value = 0.13), and tumor volume (AUC = 0.87 (95% CI: 0.71 - 1.00), volume p-value = 0.34). A similar trend was observed for unadjusted models, although classification performance was generally lower across all models.

**CONCLUSION**

Our study provides preliminary evidence that metrics of spatial tumor heterogeneity are valuable in revealing patterns of early tumor response to breast NAC, and could augment pCR prediction based on standard MRI measures, age and tumor subtype.

**CLINICAL RELEVANCE/APPLICATION**

Patterns of quantitative tumor heterogeneity analysis based on voxel-level DCE-MRI kinetic feature changes may augment early prediction of tumor pathologic response to breast neoadjuvant chemotherapy.

**SSE01-04 Texture Analysis of Magnetic Resonance Images Predicts Ultimate Residual Cancer Burden (RCB) Scores in Patients Undergoing Neoadjuvant Chemotherapy for Breast Cancer**

**Monday, Nov. 30 3:30PM - 3:40PM Location: Arie Crown Theater**

**Participants**

Shelley Waugh, PhD, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose
Sarah J. Vinnicombe, MRCP, FRCR, Dundee, United Kingdom (Presenter) Nothing to Disclose
Colin Purdie, MBChB, PhD, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose
Richard A. Lenski, PhD, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose
To evaluate whether lesion heterogeneity, as measured using texture analysis on Magnetic Resonance Imaging (MRI), is associated with residual cancer burden in patients receiving neoadjuvant chemotherapy (NAC) for primary breast cancer.

METHOD AND MATERIALS

IRB approval was waived for this retrospective study of anonymised data. T2-weighted images (voxel size: 1.1 mm³) from 61 consecutive patients undergoing a total of 6 cycles of anthracycline based NAC. All patients underwent baseline (pre-NAC) and interim (post 3-cycles of NAC) MRI examinations on a 32-channel 3.0T MRI scanner (Trio; Siemens, Erlangen) using a 7 element open breast biopsy coil. Texture analysis was performed using MaZda (University of Lodz, Poland) with manually placed regions of interest within the lesion on one slice matched between each imaging time-point. Lesion heterogeneity was assessed using the entropy feature as derived from the co-occurrence matrix. Final pathological response on the resected cancer was assessed using the Residual Cancer Burden (RCB) (calculated from tumour bed dimensions, cellularity and axillary node burden).

RESULTS

Patients who ultimately achieved a pathological complete response (pCR; RCB-0) or who had minimal residual disease (RCB-I) demonstrated a greater reduction in lesion heterogeneity between baseline and interim examinations compared with those who ultimately went on to have moderate (RCB-II) or extensive (RCB-III) disease at surgical resection (Figure 1). Average reduction in entropy values between baseline and interim examinations were as follows: pCR:20.0%, RCB-I:10.6%, RCB-II:6.8% and RCB-III: 3.4%. Differences in entropy change were highly significant (p<0.001; Mann-Whitney U) between the good responders (pCR and RCB-I) and the poor responders (RCB-II and RCB-III).

CONCLUSION

Changes in lesion T2 heterogeneity between baseline and interim MR examinations, as measured using texture analysis of T2-weighted images, can predict residual cancer burden after NAC for breast cancer.

CLINICAL RELEVANCE/APPLICATION

Changes in lesion T2 heterogeneity on MR imaging between baseline and 3 cycles of NAC are strongly associated with ultimate pathologic response and could therefore facilitate timely surgical planning.

SSE01-05 Higher Background Parenchymal Enhancement at Preoperative MRI: Association with Poor Prognosis in Breast Cancer Patients Treated with Neoadjuvant Chemotherapy

Monday, Nov. 30 3:40PM - 3:50PM Location: Arie Crown Theater

Participants

Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Eun Sook Ko, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ga Ram Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To retrospectively investigate whether background parenchymal enhancement (BPE) of the contralateral breast at preoperative dynamic contrast material-enhanced magnetic resonance imaging (DCE-MRI) is associated with therapy outcome in patients with unilateral invasive breast cancer after neoadjuvant chemotherapy (NAC).

METHOD AND MATERIALS

The institutional review board approved this retrospective study. Between 2009 and 2011, 170 women with unilateral invasive breast cancers had undergone NAC, and pre- and post-treatment DCE-MRI before curative breast surgery. Among these, 93 women (43 premenopausal women who performed pretreatment MRI between day 7 and 20 of the menstrual cycle, 50 postmenopausal women) were finally included in this study. MRI features (BPE grade [minimal, mild, moderate, severe] of contralateral breast, size and number of lesions, lesion kinetics, and the percent change of lesion size between pre- and post-treatment MRI) and clinicopathologic features (age, menopausal status, clinical tumor and nodal stages, pathologic response to NAC, tumor size, nuclear grade, immunohistochemical subtype, presence of lymphovascular invasion, and adjuvant therapy) were analyzed. Patients were grouped according to BPE grade (high [moderate or severe], low [minimal or mild]) of contralateral breast. A Cox regression model was used to determine the association between MRI features and disease-free survival after controlling for clinicopathologic variables.

RESULTS

Median follow-up was 46 months. There were 23 recurrent cases (2 ipsilateral breast, 6 regional, 15 distant). Multivariate analysis showed that high BPE of contralateral breast at pretreatment DCE-MRI (hazard ratio [HR]=4.242, P=0.005), lower change of lesion size between pre- and post-treatment MRI (HR=1.024, P=0.002), presence of lymphovascular invasion (HR=10.194, P<0.001), and triple negative cancer (HR=4.820, P=0.006) were independent factors associated with poor disease-free survival.

CONCLUSION

BPE of contralateral breast is significantly associated with long-term outcome of patients with unilateral invasive breast cancer who had undergone NAC. This study suggests that higher BPE at pretreatment DCE-MRI may have potential as a predictor for relatively poor outcome in breast cancer patients who undergo NAC.

CLINICAL RELEVANCE/APPLICATION

Higher BPE at pretreatment DCE-MRI may have potential as a predictor for relatively poor outcome in breast cancer patients who undergo NAC.
**PURPOSE**

To evaluate DCE-MRI analysis and PET-CT at baseline for prediction of pathological response to neoadjuvant chemotherapy (NAC) in patients with locally advanced breast cancer.

**METHOD AND MATERIALS**

88 patients with locally advanced breast cancer treated with NAC followed in DCE-MRI at 1.5T and PET-CT were included in this retrospectively study. Perfusion parameters (Ktrans, Kep, Ve) and SUVmax were measured at baseline of the NAC. Imaging datas were compared with tumoral and nodal pathologic response and histopathological tumor characteristics (SBR, Ki67, Hormonal Receptors (HR), HER2, and p53).

**RESULTS**

Response were observed in 54 patients (61%) and non-response in 34 patients. Low Ve and high SUVmax were significatively associated with tumoral response to NAC (Ve, t-test, p = 0.0035 ; SUVmax, t-test, p = 0.0265). Other perfusion parameters were not significatively associated to pathological response. Low Ve and high SUVmax were significantly associated with histopathological aggressivity markers (SBR III, Ki67 > 15%, negative HR, p53 muted). Only low Ve was associated with nodal response (t-test, p = 0.048).

**CONCLUSION**

Ve and SUVmax before NAC were associated with tumoral response and histopathological aggressivity markers.

**CLINICAL RELEVANCE/APPLICATION**

Ve and SUVmax before NAC can predict tumoral response and histopathological aggressivity markers.
**Evolution of a Breast Screening Program: Indicators of Efficacy**

**Purpose**
The purpose of this study is to evaluate how changes in practice and technology have impacted upon indicators of program efficacy in a regional breast screening program, including cancer detection rates (CDR), invasive versus in situ disease detection rates, repeat operation rates, and age adjusted mortality.

**Method and Materials**
This retrospective audit adheres to local policy on confidentiality: Breast screening database was interrogated from March 1995 to April 2014. Number of women screened, recall rates, short term follow-up rates, overall CDR, invasive cancers, in situ cancers, interval cancers, and repeat operation rates were identified and compared for early versus later years of the screening program.

**Results**
834,201 women were invited for routine screening over the study period, and 587,648 (70%) attended with 5021 cancers detected. Over study period, national screening age range has broadened (50-70 vs. 50-64) and many more women are screened per year (39,506 vs. 23,934). There has been an increase in CDR (0.97% vs. 0.83) with an increase in detection of in situ disease (0.267% versus 0.167%) and a decrease in interval cancer rate (0.15% versus 0.20%). There has also been a decrease in repeat operation rate (15.7% versus 21.7%). Finally, there has been a decrease in regional age adjusted mortality (16.81/100,000 vs. 26.95/100,000) (see Table 1).

**Conclusion**
Over the time period of the screening program, multiple improved performance indicators are noted, including increased CDR, decreased interval cancer rate, and decreased repeat operation rate. This is thought to be multifactorial, secondary to technological and quality assurance factors, including core biopsy versus fine needle aspiration (FNA), adoption of bilateral whole breast ultrasound/bilateral axillary ultrasound in the context of newly diagnosed cancer, use of digital mammography, and vacuum assisted excision versus surgical excision. We also find an age-adjusted decrease in regional mortality from breast cancer, but it is difficult to prove that this is related to screening alone.

**Clinical Relevance/Application**
This study evaluates changing factors contributing to improvements in our breast screening program. Results put into question negative evaluations of breast screening's efficacy based only on studies from early days of practice.

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**The Inevitable Proportion of Overdiagnosis in the Norwegian Breast Cancer Screening Program**

**Purpose**
To estimate the number of overdiagnosed women, defined as those diagnosed with breast cancer and who die within the lead-time period.

**Method and Materials**
In this modeling cohort study, we used incidence- and death statistics available online and published estimates of lead-time. Postulated cohorts of screened and not screened women aged 50-51 were followed for a period corresponding to ten biennial screening exams during 20 years, and further ten years, to age 78-79. The increase in breast cancer incidence due to screening was estimated based on lead-time. The proportion of women diagnosed with breast cancer who died within the lead-time period...
was assessed based on the differences in the cumulative number of breast cancer diagnosed in the non-screened and screened cohort.

**RESULTS**

The proportion of overdiagnosed women in screened compared to non-screened cohort was 1.8%. Sensitivity analyses using various assumptions increased the estimates up to a maximum of 4%.

**CONCLUSION**

The proportion of women with breast cancer diagnosed after participation in a screening program and who died within the estimated lead-time period was less than 4%. This inevitable proportion of overdiagnosis, should be emphasized in the definition and communication of the issue.

**CLINICAL RELEVANCE/APPLICATION**

Approximately 2% of women with breast cancer diagnosed in a screening program are estimated to die within the lead-time period.

**SSE02-03 The False Negative Rate of Annual Screening Mammography at an American Academic Institution Using Digital Technology**

**Monday, Nov. 30 3:20PM - 3:30PM Location: E450A**

Participants
Hannah Perry, MD, MS, Boston, MA (Presenter) Nothing to Disclose
Jordana Phillips, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Shambhavi Venkataraman, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Vandana M. Dialani, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Valerie J. Fein-Zachary, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Tejas S. Mehta, MD, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The majority of published data on the Breast Imaging medical audit is not based on current American practice and includes programs that screen biennially or used film-screen mammography (MG). Current practice data is needed as performance metrics become more transparent. We determine the false negative rate at an American academic institution that screens annually using digital MG, and evaluate the MG features of these cases.

**METHOD AND MATERIALS**

Patients diagnosed with breast cancer (BC) between 1/1/12 and 9/30/12 with a negative MG within 15 months prior to diagnosis (index MG) were included. Those with index MGs from outside institutions were excluded. Index MGs were reviewed by three breast imagers in two phases (initially blinded followed by non-blinded) according to the European Guidelines for Quality Assurance in BC Screening and Diagnosis. MGs were classified as true negative (TN) if initially correctly interpreted as negative and included true interval cancers, MG occult cancer, or minimal signs. MGs were classified as false negative (FN) if initially incorrectly interpreted due to reader or technical error and represented missed BC. Abnormalities were recorded as calcifications, mass/focal asymmetry, asymmetry, or distortion.

**RESULTS**

71 of 220 BC cases met inclusion criteria. Average age was 60.5 years (range 38.5 - 87.6, SD 10.4). 33/71 (46%) had fatty or scattered fibroglandular tissue and 38/71 (54%) were heterogeneous or extremely dense. There were 13/71 (18%) in situ and 58/71 (82%) invasive cancers. 57/71 (80%) were TN and 14/71 (20%) were FN (95% CI: 12-31%). Of the 57 TN, there were 33 (58%) interval cancers, 3 (5%) MG occult cancer and 21 (37%) minimal signs. Of 21 minimal signs, 6 were calcifications, 9 asymmetries, and 6 mass/focal asymmetry. Of the FN, all cases were due to reader error, with 5 calcifications, 2 asymmetries and 7 mass/focal asymmetry. Imaging presentation of the index MG was not different between the TN and FN groups.

**CONCLUSION**

Our American academic institution annual digital screening mammogram (MG) program had a false negative (FN) rate of 20%, compared to 20-30% reported for film-screen or biennial MG. FN cases had no distinguishing MG features.

**CLINICAL RELEVANCE/APPLICATION**

Our annual digital screening mammogram (MG) program had a false negative (FN) rate of 20%, compared to 20-30% reported for film-screen or biennial MG. FN cases had no distinguishing MG features.

**SSE02-04 Balancing the Benefits and Harms Among Women Targeted by the Norwegian Breast Cancer Screening Program**

**Monday, Nov. 30 3:30PM - 3:40PM Location: E450A**

Participants
Solveig S. Hofvind, Oslo, Norway (Presenter) Nothing to Disclose
Marta Roman, Oslo, Norway (Abstract Co-Author) Nothing to Disclose
Sofie Sebuøedgard, Oslo, Norway (Abstract Co-Author) Nothing to Disclose
Ragnhild Falk, Oslo, Norway (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The balance between benefits and harms of mammographic screening is debated. Our purpose was to estimate a balance sheet of benefits and harms for the NBCSP.

**METHOD AND MATERIALS**

Data from published studies using individual level data from the NBCSP were used to assess the reduction in breast cancer mortality...
versus over-diagnosis. The program invites all Norwegian women aged 50-69 years to biennial mammographic screening. The mortality reduction in the studies varied from 36.8% to 43.0% among screened women, with an average estimate of 39.9%. Estimates of over-diagnosis ranged from 1.8% to 19.6%, with an estimated average of 10.7%. The cumulative risk of a false positive result was 15.9% for additional imaging and 4.1% for an invasive assessment. The benefit-detriment ratio was computed for different scenarios of mortality reduction and over-diagnosis.

RESULTS

For every 10,000 women screened according to the invitations and followed until age 79 we estimated that 54-63 women are saved from breast cancer death, 11-126 are over-diagnosed, 1590 have a false positive result with non-invasive assessment and 410 have a false positive result with invasive procedures. The benefit-harm ratio between mortality reduction and over-diagnosis was 0.4, 0.8, and 5.7 under the less favorable, average and most favorable estimates, respectively.

CONCLUSION

Using average estimates showed that about one woman is saved from breast cancer death for each woman over-diagnosed. The ratio estimates varied substantially and should be interpreted with care before it is communicated to women targeted by the screening program.

CLINICAL RELEVANCE/APPLICATION

Approximately one woman is estimated to be saved from breast cancer death for each woman over-diagnosed in the Norwegian Breast Cancer Screening Program, although estimates varied substantially.

SSE02-05  Is One Prior Enough: Does Comparing with Multiple Prior Examinations Impact Recall Rates at Screening Mammography?

Monday, Nov. 30 3:40PM - 3:50PM Location: E450A

Participants
Jessica H. Hayward, MD, San Francisco, CA (Presenter) Nothing to Disclose
Kimberly M. Ray, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Dorota J. Wisner, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Edward A. Sickles, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Bonnie N. Joe, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the impact of comparison with multiple prior mammograms on the screening mammography recall rate (RR) relative to comparison with a single prior mammogram.

METHOD AND MATERIALS

We performed a retrospective search of our institutional mammography database for screening mammograms performed at our facility between 6/14/2010 and 3/3/2015. This yielded a dataset of 46,317 consecutive screening mammograms performed in 22,792 women. We collected data on patient age, dates of mammograms recorded as comparisons in the clinical report and recommendations for recall. Generalized estimating equation logistic model was used to determine the relative odds of recall as a function of the number of comparison exams without and with adjustment for age as a confounding variable.

RESULTS

A total of 3,845 screening mammograms were interpreted with no prior comparison mammograms, 5,749 exams were interpreted with a single prior and 36,723 exams were interpreted with two or more priors. Screening recall rates for mammograms interpreted with no priors, one prior and two or more priors were 16.6%, 7.8%, and 6.3%, respectively. The unadjusted odds ratio (OR) of recall for mammograms compared with multiple priors versus one prior was 0.789 (95% CI: 0.711, 0.877; p<0.0001). After adjusting for patient age, the OR of recall for the multiple prior group relative to the single prior group was 0.864 (95% CI: 0.776, 0.962; p=0.0074).

CONCLUSION

Comparison with two or more prior mammograms resulted in a statistically significant 14% reduction in the screening mammography recall rate relative to comparison with a single prior.

CLINICAL RELEVANCE/APPLICATION

Comparison with multiple prior mammograms is a more effective strategy for reducing the screening mammography recall rate than comparison with a single prior.

SSE02-06  Is it Necessary to Perform Standard (Implant-full) Views in Screening Mammography for Women with Breast Implants?

Monday, Nov. 30 3:50PM - 4:00PM Location: E450A

Participants
Gun Ha Kim, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Eun Young Chae, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate the necessity of standard (implant-full) views in screening mammography for women with breast implants.

METHOD AND MATERIALS

1441 mammograms with 838 silicone and 603 saline breast implants performed between January 2009 and September 2014 were...
1441 mammograms with 838 silicone and 603 saline breast implants performed between January 2009 and September 2014 were evaluated by two radiologists in consensus. Of the 1441 mammograms, 1328 were screening mammograms. Implant ruptures and breast cancer with regard to the incidence, detection rate by implant-displaced (ID) and implant-full (IF) views, mean age of ruptured implants, mean average glandular dose were assessed. Implant ruptures were confirmed by US, MRI or surgery and breast cancer were proven by pathology.

RESULTS
In 1328 screening mammograms, implant ruptures were found in 14 (14/1328, 1%): 12 were intracapsular and the remaining two were extracapsular ruptures. Intracapsular ruptures were detected with indirect sign in 7 (7/12, 58.3%) on IF views and 1 (1/12, 8.3%) on ID views. All extracapsular ruptures (2/2, 100%) were demonstrable on both views. Incidental detection of implant ruptures on mammograms which could not be demonstrable on US or MRI was absent. The mean age of the ruptured implants was 16 years (range, 6 - 30 years). Breast cancer were found in 3 (3/1328, 0.2%); two cases were found only on ID views and the other one was demonstrable on both views. The mean average glandular dose per breast was 3.42 mGy for IF views and 1.88 mGy for ID views.

CONCLUSION
The diagnostic gain of IF views in screening of implant ruptures and breast cancer was low. The mean average glandular dose for IF views was 1.8 times higher than for ID views. Considering clinical low impact and cumulative radiation, routine performance of IF views for screening mammography need to be reconsidered.

CLINICAL RELEVANCE/APPLICATION
The number of women with breast augmentation is increasing, but there are no widely accepted imaging guidelines. Routine performance of IF views for screening mammography need to be reconsidered.
**SSE03**

**Cardiac (TAVR and Other Nonsurgical Interventional Procedures)**

Monday, Nov. 30 3:00PM - 4:00PM Location: S502AB

**CA CT IR**

AMA PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00

**FDA** Discussions may include off-label uses.

**Participants**
Jonathon A. Leipsic, MD, Vancouver, BC (Moderator) Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc
Lynne M. Hurwitz, MD, Durham, NC (Moderator) Research Grant, Siemens AG Research Grant, General Electric Company

**Sub-Events**

**SSE03-01 Comparison of Three Dimensional Echocardiography with ECG-Gated Cardiac Tomography for Assessment of the Aortic Annulus Prior to Percutaneous Aortic Valve Replacement (TAVR)**

Monday, Nov. 30 3:00PM - 3:10PM Location: S502AB

**Participants**
Gilda Boroumand, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Howard M. Julien, MD,MPH, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Nicholas J. Ruggiero II, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Praveen Mehrorada, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Ethan J. Halpern, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The morphology and size of the aortic annulus are critical factors for preprocedural planning of percutaneous aortic valve replacement (TAVR). We have previously demonstrated that the oval shape of the aortic annulus results in underestimation of annular area based upon anteroposterior (AP) measurements on 2D echocardiography relative to area measurements on ECG-gated cardiac CTA (cCTA). This study evaluated annular size on 3-dimensional transesophageal echocardiography (3D-TEE) in comparison to cCTA prior to a TAVR procedure.

**METHOD AND MATERIALS**
3D-TEE and ECG-gated cCTA measurements of the aortic annulus were compared from preprocedural studies on 25 consecutive TAVR patients. 3D-TEE measurements were obtained during mid-systole, while cCTA measurements were obtained at late-systole (40% of the R-R interval) and late-diastole (80% of the R-R interval). Annular area was measured by manual planimetry. Pearson correlation coefficients were computed and paired t-tests were performed to compare AP (short axis) and transverse (long axis) diameters of the annulus, as well as annular area as measured by echocardiography and by cCTA.

**RESULTS**
cCTA measurements in systole and diastole were highly correlated: \( r = 0.83 \) for short axis diameter, \( r = 0.87 \) for long axis diameter, \( r = 0.98 \) for annular area. Good correlation was observed between 3D-TEE and cCTA for short axis diameter (\( r = 0.73-0.87 \)), long axis diameter (\( r = 0.72 \)) and annular area (\( r = 0.87-0.88 \)). Long axis diameter and annular area measurements obtained by 3D-TEE were significantly smaller than those obtained by cCTA: Short axis diameter - 3D-TEE: 21.3mm; cCTA systole: 21.9mm; cCTA diastole: 20.7mm (\( p>0.05 \)). Long axis diameter - 3D-TEE: 24.8mm; cCTA systole: 27.2mm; cCTA diastole: 26.4mm (\( p<0.001 \)). Annular area - 3D-TEE: 413mm\(^2\); cCTA systole: 463mm\(^2\) (\( p=0.0001 \)); cCTA diastole: 435mm\(^2\) (\( p=0.034 \)).

**CONCLUSION**
Although all cCTA measurements of the aortic annulus are highly correlated with measurements by 3D-TEE, diastolic phase cCTA measurements tend to be closer to standard mid-systolic 3D-TEE measurements. This is especially true for measurement of aortic annular area which is over measured by an average of 50mm\(^2\) on cCTA during systole relative to 3D-TEE.

**CLINICAL RELEVANCE/APPLICATION**
cCTA measurements of the aortic annulus are highly correlated between systole and diastole, but diastolic phase measurements provide a better match with 3D-TEE, especially with respect to annular area.

**SSE03-02 Low-Contrast-Medium-Volume Low-Tube-Voltage Computed Tomography for Planning Transcatheter Aortic Valve Replacement**

Monday, Nov. 30 3:10PM - 3:20PM Location: S502AB

**Participants**
Julian L. Wichmann, MD, Charleston, SC (Presenter) Nothing to Disclose
Lloyd Felmy, Charleston, SC (Abstract Co-Author) Nothing to Disclose
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Stefanie Mangold, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (Abstract Co-Author) Research Grant, Bracco Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; ;
Giuseppe Muscogiuri, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Andrew D. McQuiston, BS, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Stephen R. Fuller, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Incidence of Contrast Induced Nephropathy in Patients Undergoing TAVR Evaluation

Participants
Alice Wang, Durham, NC (Presenter) Nothing to Disclose
Matthew Ellis, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose
J. Kevin Harrison, Durham, NC (Abstract Co-Author) Nothing to Disclose
Todd Kiefer, Durham, NC (Abstract Co-Author) Nothing to Disclose
Hanghang Wang, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Lynne M. Hurwitz, MD, Durham, NC (Abstract Co-Author) Research Grant, Siemens AG Research Grant, General Electric Company

PURPOSE
To prospectively evaluate the feasibility, diagnostic quality, and safety of low-tube-voltage, low-contrast-volume comprehensive cardiac and aortoiliac computed tomography angiography (CTA) for planning transcatheter aortic valve replacement (TAVR).

METHOD AND MATERIALS
Forty consecutive TAVR candidates prospectively underwent combined contrast-enhanced (270mgI/mL iodixanol) CTA of the aortic root complex and aortoiliac vascular access route. Patients were assigned to group A (2nd generation dual-source CT [DSCT], 100 kV, 60 mL contrast material, 4.0 mL/s flow rate, iodine-delivery rate [IDR] 1.08 g/s) or group B (3rd generation DSCT, 70kV, 40 mL contrast material, 2.5 mL/s flow rate, IDR 0.675 g/s). Mean vascular attenuation, image noise, signal-to-noise ratio (SNR), and contrast-to-noise ratio (CNR) were measured. Subjective image quality was independently assessed by two blinded readers using five-point Likert scales. Patient creatinine levels on the day of the exam and during short- and long-term follow-up were measured.

RESULTS
Except for a higher body mass index in group B (24.8 ± 3.8 vs 28.1 ± 5.4 kg/m2, P = 0.0339), no significant differences in patient characteristics between both groups were observed. Mean aortoiliac SNR (P = 0.0003) and CNR (P = 0.4761) were 13.1 ± 6.8 and 24.3 ± 11.9 (group A), and 15.4 ± 6.7 and 24.9 ± 12.3 (group B), respectively. Mean cardiac SNR (P = 0.0003) and CNR (P = 0.0181) were 15.6 ± 9.0 and 20.2 ± 13.4 (group A) and 12.2 ± 4.5 and 15.3 ± 6.7 (group B), respectively. Subjective image quality did not significantly differ (P = 0.213) except for lower aortoiliac image noise in group B (4.42 vs 4.12, P = 0.0374). TAVR planning measurements were successfully obtained in all studies. There were no significant changes in creatinine levels among and between patient groups during short- and long-term follow-up (P ≥ 0.302). Four patients expired during the study period because of unrelated causes, but no adverse events attributable to the use of iodinated contrast media were observed.

CONCLUSION
TAVR candidates can be safely and effectively evaluated by a comprehensive CTA protocol with low contrast volume using low-tube voltage acquisition.

CLINICAL RELEVANCE/APPLICATION
CTA imaging with reduced contrast volume in pre-TAVR evaluation may improve safety in multimorbid patients considered for this procedure.

SSE03-04 Prediction of Transcatheter Aortic Valve Replacement (TAVR) Paravalvular Leak Diagnosed on Post-
Accurate sizing of TAVR prostheses is necessary to minimize post-procedural aortic regurgitation (PPAR or 'leak'), which is associated with adverse outcomes. We hypothesized that 3D-printed models of the aortic valve (AV) complex derived from pre-TAVR cardiac CT (CCT) could be used to determine whether the implanted valve would have an appropriate fit and thus predict which patients are more likely to develop PPAR.

**METHOD AND MATERIALS**

This retrospective study included 8 patients with pre-TAVR CCT and post-TAVR TTE who developed PPAR and 8 age, sex and valve size-matched controls. The aortic root, annulus and left ventricular outflow tract were segmented from pre-TAVR CCT (Vitrea 6.7, Vital Images) by a radiologist blinded to TTE findings and exported as 3D-printable (STL) files into CAD software (3matic, Materialise) for post-processing. Aortic models were 3D-printed using flexible stereolithography material; valve models meeting Sapien size specs (26 & 29mm) and a closed base were printed on a material extrusion 3D printer in hard plastic. The valve model corresponding to the implanted valve was carefully positioned in each aortic model and the presence of leak was determined via projection of light through the LVOT onto a thin film, captured with a digital camera. The presence of leak (defined as any paravalvular light transmission) was made by consensus of 2 readers blinded to TTE results.

**RESULTS**

Six out of 8 paravalvular leaks were accurately predicted and 6 out of 8 patients without leaks were correctly ruled out (2 false negatives and false positives, respectively). The shape and location of light crescents predicting leaks matched PPAR location on post-procedure TTE.

**CONCLUSION**

Use of pre-TAVR 3D-printing provides a unique assessment of the 3D relationship between the AV complex and implanted valves, and may predict which patients are more likely to develop paravalvular leaks. This technology may assist in the development of future generations of transcatheter valves, with potential to improve outcomes. Given these initial results, further studies focusing on both clinical outcomes and 3D-printed model optimization are needed.

**CLINICAL RELEVANCE/APPLICATION**

Flexible 3D-printed models of the AV complex may allow for better TAVR patient selection, procedural planning, and valve size selection. If verified in future studies, this technology has the potential to lead to better patient outcomes.

**SSE03-05 The Prevalence and Clinical Impact of CTA Incidental Findings in TAVI Work-up**

**METHOD AND MATERIALS**

Single center retrospective analysis including patients who underwent a CTA (64 slice scanner) in TAVI work-up between 2009 and 2014. Experienced radiologists reviewed all examinations prospectively. Incidental findings were classified as (1) clinical significant findings limiting eligibility for TAVI due to poor prognosis or requiring immediate action, including additional diagnostic testing or treatment, (2) findings requiring follow-up after TAVI and (3) findings without consequences.

**RESULTS**

A total of 623 patients were included, 354 (56.8%) were female. Mean age was 79.8 +/- 8.8 years. Clinical significant findings limiting TAVI or requiring immediate action were reported in 57 patients (9.1%), including; suspected malignancy (n=40, 6.4%), aortic aneurysm >5 cm (n=13, 2.1%), diverticulitis (n=2, 0.3%), cardiac thrombi (n=2, 0.3%) and suspected colitis (n=1, 0.2%). Malignancy and diverticulitis were confirmed in 13 and 2 patients (32.5% and 100%, respectively). Findings requiring follow up after TAVI were found in 78 patients (12.5%) including probably benign tumors (n=72, 11.6%) and aneurysms with follow up requirement (n=7, 1.1%). Non-significant findings were reported in 581 patients (93.3%). Patients with clinical significant findings requiring...
immediate action were more frequently rejected for TAVI than patients without those findings (n=12, 21.1% vs n=51, 9.0%; p=.004). There was no significant delay between CTA and the TAVI procedure between the groups (median 43.0 [14.5-86.5] vs 29.0 [14.0-63.5] days; p=.105).

CONCLUSION
The prevalence of incidental findings is high in elderly TAVI patients. Incidental findings significantly influence patient management due to an anticipation on poor prognosis and may lead to treatment delay.

CLINICAL RELEVANCE/APPLICATION
CTA prior to TAVI reveals incidental findings, leading to recurrent discussions in Heart Team meetings. Our results show that incidental findings are frequent and may influence the clinical course.

SSE03-06 A Strategy of Underexpansion and Ad Hoc Post-dilation of Balloon-Expandable Transcatheter Aortic Valves in Patients with Borderline Annular Dimensions: Favorable Midterm Outcomes

Participants
Jonathon A. Leipsic, MD, Vancouver, BC (Presenter) Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc
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John Webb, MD, FRCP, Vancouver, BC (Abstract Co-Author) Consultant, Edwards Lifesciences Corporation

PURPOSE
To evaluate one year outcomes with a strategy of intentional underexpansion of balloon expandable transcatheter heart valves (THVs) in terms of clinical outcomes, valve function, and frame durability at one year.

METHOD AND MATERIALS
We evaluated 47 patients at risk of annular injury who underwent TAVR with a deliberately underexpanded THV, followed by post-dilation if required. Clinical evaluation, echocardiography and cardiac CT were obtained pre-TAVR, post-TAVR, and at one year.

RESULTS
Deployment of oversized THVs with modest underfilling of the deployment balloon (<10% by volume) was not associated with significant annular injury. Paravalvular regurgitation was mild or less in 95.7% of patients, with post-dilation required in 10.7%. THV hemodynamic function was excellent and remained stable at one year. CT documented stent frame circularity in 87.5%. Underexpansion was greatest within the intra-annular THV inflow (stent frame area 85.8% of nominal). Progressive stent frame recoil, deformation, or fracture were not observed at one year.

CONCLUSION
In carefully selected patients with a borderline annulus dimensions and in whom excessive oversizing is a concern, a strategy of deliberate underexpansion, with ad hoc post-dilation if necessary, may reduce the risk of annular injury without compromising valve performance.

CLINICAL RELEVANCE/APPLICATION
We present the first intermediate term clinical and imaging follow up data on intentionally underfilled balloon expandable TAVR.

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Jonathon A. Leipsic, MD - 2015 Honored Educator
**SSE04**

**Cardiac (Acute Chest Pain in the Emergency Department Patient)**

Monday, Nov. 30 3:00PM - 4:00PM Location: S504AB

*CA*  *ER*

**AMA PRA Category 1 Credit ™: 1.00**  
**ARRT Category A+ Credit: 1.00**

**Participants**

Karen G. Ordovas, MD, San Francisco, CA (Moderator) Nothing to Disclose  
Travis S. Henry, MD, San Francisco, CA (Moderator) Spouse, Medical Director, F. Hoffmann-La Roche Ltd  
Karin E. Dill, MD, Evanston, IL (Moderator) Nothing to Disclose

**Sub-Events**

**SSE04-01**  

Monday, Nov. 30 3:00PM - 3:10PM Location: S504AB

**Participants**

Amelia Wnorowski, MD, Philadelphia, PA (Presenter) Nothing to Disclose  
Ethan J. Halpern, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Triple-rule-out (TRO) CT examines the coronaries, aorta and pulmonary arteries in a single scan. Compared to coronary CTA (cCTA), TRO CT includes anatomic structures above the carina and requires contrast opacification of both right and left sided circulations. The purpose of this study is to determine the added value of TRO CT for evaluation of chest pain in the emergency department.

**METHOD AND MATERIALS**

All TRO studies performed at our institution from 2006 to 2015 were reviewed. Scans were performed on a 256 slice iCT (Philips Medical Systems), using ECG-gating and a biphasic injection with 60 mL of Optiray 350 followed by 60 mL of a 1:1 mixture of contrast and saline. Scans extended from just above the aortic arch through the base of the heart. Reports were reviewed for diagnoses that could explain chest pain and significant incidental findings.

**RESULTS**

There were 1196 total cases. Four were excluded for inadequate image quality. 651 patients (54.6%) were female. Average age was 51 years. 81.4% of patients could be safely discharged without a significant coronary or non-coronary diagnosis. 139 patients (11.7%) had significant coronary artery disease (50% stenosis or greater) while 106 patients (8.9%) had a non-coronary diagnosis that could explain chest pain (p<0.02)' including pulmonary embolism (28 cases)' aortic aneurysm (24) and other aortic pathology (10). 30 cases of pulmonary embolism and aortic pathology would not have been detected with cCTA because of unopacified right sided circulation or limited z-axis coverage. Even if cCTA opacified both right and left sided circulations, 4 patients had segmental upper lobe emboli alone, which would not have been included in the cCTA scan. 418 patients (35.1%) had a total of 528 incidental findings not felt to explain chest pain.

**CONCLUSION**

Although TRO CT identified a greater number of coronary versus non-coronary diagnoses to explain chest pain, 8.9% of patients had an unsuspected non-coronary explanation for chest pain, and 30/106 of these non-coronary diagnoses would have been missed on dedicated cCTA. Thus, TRO CT adds value in the evaluation of acute chest pain, particularly in the identification of significant non-coronary diagnoses.

**CLINICAL RELEVANCE/APPLICATION**

TRO CT can identify non-coronary diagnoses in acute chest pain patients and is appropriate when there is suspicion for acute coronary syndrome along with other diagnoses, such as pulmonary embolism.

**SSE04-02**  
**Incidence of ACS, MACE, and Positive ICA after Acute Chest Pain cCTA in Real World Clinical Practice: A Clinical Registry Comparison versus Published Trials**

Monday, Nov. 30 3:10PM - 3:20PM Location: S504AB

**Participants**

Sumbal A. Janjua, MD, Boston, MA (Presenter) Nothing to Disclose  
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Udo Hoffmann, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Brian B. Ghoshhajra, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Multiple randomized controlled trials have established the safety and efficacy of coronary CT angiography (cCTA) in evaluating low-to intermediate risk emergency department (ED) patients with acute chest pain. However, concerns have been raised that results may vary outside the confines of a trial setting. We report our initial clinical experience at a large-volume tertiary center, and compare the results to published trials.
METHOD AND MATERIALS
We included all consecutive ED patients presenting with acute chest pain undergoing cCTA between October 2012 and July 2014. Medical records were reviewed and adjudicated for acute coronary syndrome (ACS) during index hospitalization and for major adverse cardiac events (MACE) at up to 60 days after discharge. ACS was defined as myocardial infarction (MI) and unstable angina pectoris requiring hospitalization (UAP) while MACE included MI, UAP and urgent coronary revascularization. We also determined the positive predictive value (PPV) of cCTA (defined as the rates of invasive coronary angiography (ICA) confirming >50% luminal narrowing). Results were compared with the published results of the ROMICAT II, ACRIN-PA and CT-STAT trials.

RESULTS
399 patients with a mean age of 51+/-11 years were included. The rate of ACS was 9.5% (n: 38/399), the rate of MI: 1% (n: 4/399) and UAP: 8.5(34/399). The rates of ACS were comparable to other published randomized trials. The rate of ICA was 6.2% (n: 25/399) with 92% (n: 23/25) of ICA confirming stenosis >50% by cCTA (PPV of cCTA) as compared to a PPV of 76.9% in CT-STAT, 76% in ACRIN PA and 78% in ROMICAT II. There were no undetected ACS and 60-day MACE rate after negative cCTA was 0%, with 0.25% MACE overall (n: 1/399; in a patient with severe stenosis managed medically), in keeping with other published trials.

CONCLUSION
Our unrestricted clinical registry confirmed similar rates of ACS and MACE to large randomized published trials. There were no undetected ACS nor MACE after negative cCTA. The positive predictive value of cCTA for ICA stenosis >50% was 92%, slightly higher than published randomized trials.

CLINICAL RELEVANCE/APPLICATION
An ED cCTA clinical registry confirms similar rates of ACS and MACE compared to large published trials, reinforcing the effectiveness of cCTA in an acute chest pain population.

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Udo Hoffmann, MD - 2015 Honored Educator

SSE04-03 Radiation Exposure of Acute Chest Pain Coronary CTA at a Tertiary Center Versus Recently Published Studies

Participants
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Udo Hoffmann, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Brian B. Ghoshnajra, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Coronary CT angiography (CCTA) accurately stratifies patients with acute chest pain into low or increased risk of infarction, allowing rapid disposition from the emergency department (ED). We report the radiation doses of emergency department (ED) CCTAs in a tertiary center and compare them with recent studies.

METHOD AND MATERIALS
We included all consecutive ED patients with acute chest pain that presented for CCTA between October 2012 and January 2015. We compared the mean estimated effective doses of our registry patients versus the published MonashHEART, San Antonio Military Medical Center, ROMICAT II, and CT-STAT studies.

RESULTS
Our registry comprised 629 patients. Prospective ECG-triggering utilized in 91% of cases; median tube potential was 100 kV (80-120 interquartile range); mean estimated effective dose was 4.5 ± 2.9 mSv; and median estimated effective dose was 3.7 (2.4-5.7) mSv. MonashHEART reported 585 patients with a mean estimated effective dose of 6.4 ± 2.8 mSv. San Antonio study reported median 6.7 (4.9-9.1) mSv. ROMICAT II reported 473 CCTA patients with a mean cumulative dose for all patients of 11.3 ± 5.3 mSv, whereas in the subset of 78 patients who underwent 128-slice dual source CCTA (identical to our site’s equipment) dose was 6.2 ± 3.8 mSv. CT-STAT reported 361 patients, with a median cumulative estimated effective dose of 11.5 (6.8-16.8) mSv.

CONCLUSION
Radiation exposure at CCTA can be decreased in ED patients versus larger trials, with our site noting a median effective dose of 3.7 (2.4-5.7) mSv. This was likely due to increased use of prospective ECG-triggering and tube potential lowering.

CLINICAL RELEVANCE/APPLICATION
CCTA is reliable to assess coronary disease in the setting of acute chest pain. Efforts are made to decrease radiation exposure, including prospective ECG-triggering and tube potential lowering.

Honored Educators
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Discharge Times of Emergency Department Patients Evaluated with Coronary CT Angiography: Effect of Observation Unit Utilization and Hours of Scan Availability

Tuesday, Nov. 30 3:30PM - 3:40PM Location: S504AB

Participants
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Brian B. Ghoshhajra, MD, Boston, MA (Presenter) Nothing to Disclose

PURPOSE
Recent trials have established that the use of coronary CT angiography (CCTA) to evaluate low- to intermediate risk emergency department (ED) patients with acute chest pain leads to shorter discharge times for those without significant coronary artery disease (CAD). Emergency departments are increasingly utilizing observation units (EDOUs) to address issues of health care cost and ED overcrowding. We evaluated the effect of hours of scan availability and utilization of an EDOU on disposition times of patients without significant CAD.

METHOD AND MATERIALS
684 total ED patients were referred for CCTA between October 2012 and March 2015. 134 patients were excluded, 116 (17%) with significant CAD (>50% luminal stenosis) and 18 (3%) admitted as inpatients. The remaining 550 patients without significant CAD were subdivided into three groups. Group 1 included 301 patients scanned October 2012 - June 2014 with "banker's hours" of scan availability from 8am-3pm non-holiday weekdays only on a hospital-based scanner. Group 2 included 57 patients scanned July 2014 - September 2014 with "extended hours" of availability from 8am-7pm weekdays and 8am-12pm weekends and holidays on a hospital-based scanner. Group 3 included 192 patients scanned September 2014 - March 2015 with "extended hours" but on a scanner newly located physically in the ED. EDOU utilization and time from triage to discharge was compared.

RESULTS
281 patients (51%) were discharged directly from the ED and 269 (49%) via an EDOU. Statistical analysis was made using Wilcoxon rank sum test and reported as median values with interquartile range (Figure 1). Time to discharge did not increase significantly in either group with increased hours of scan availability. Discharge times for patients treated in an emergency department observation unit were significantly longer than those treated in the emergency department only.

CONCLUSION
Regardless of hours of scan availability or physical location of scanner, nearly all ED patients without significant CAD evaluated with CCTA were discharged within 24 hours of triage. Utilization of an ED observation unit, however, significantly increased time to discharge.

CLINICAL RELEVANCE/APPLICATION
Nearly all ED patients without significant CAD evaluated with CCTA are discharged within 24 hours of triage, although utilization of an ED observation unit significantly increases time to discharge.

Coronary computed tomographic angiography (CCTA) improves triage efficiency of patients with acute chest pain; however its impact on the Emergency Department (ED) performance for non-cardiac patients is unknown.
We reviewed two consecutive years of ED visits at our tertiary care hospital to identify chest pain visits with chest pain suspicious for ACS but without known CAD who were suitable for CCTA. To determine the impact of CCTA on the ED, we identified our comparator group to be all non-cardiac patients who were placed in observation status. We developed a System Dynamics model to simulate patient flow through the ED, incorporating patient’s characteristics, imaging use, and daily/hourly trends in ED visit volumes. The model considered two strategies (1) Standard of care as observed at our institution and (2) CCTA triage after 1st negative Troponin and discharge of patients without CAD on CCTA. Different CCTA availabilities were considered.

RESULTS
Among 9,400 patients who received serial troponin measurements to assess chest pain in the ED, we identified 3,594 visits (38%) eligible for CCTA (age: 56±15 years, 52% male), accounting for 24% of all observation admissions. 3% of the patients were ultimately diagnosed with ACS. 52% of the patients with negative serial troponin had further CAD workup, among which 16% had obstructive CAD. The comparator cohort included 8,848 ED visits (age: 55±19 years, 47% male). 23% required cross-sectional CT imaging including head (37%), abdominal/pelvis (21%), and CTA-PE (8%). The model predicted well the length of stay (LOS) (model vs. observed in hours) for the current standard of care (target: 21 vs. 19, comparator: 22 vs. 25). The LOS was reduced to 14.8 hours (29%) when CCTA was available 24/7 and 10.8 (48%) when it was available M-F 7AM-4PM. At the same time, observation unit capacity for non-cardiac patients was increased by 7% and 11%, respectively.

CONCLUSION
About one third of all ED visit for chest pain could benefit from a CCTA work up. This would not only reduce the length of stay for cardiac patients but also increase capacity for non-cardiac patients, improving overall ED performance.

CLINICAL RELEVANCE/APPLICATION
To our knowledge, this is the first study to assess CCTA in the broader ED context beyond the impact on cardiac patients.

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Udo Hoffmann, MD - 2015 Honored Educator

SSE04-06 Culprit Lesions of Acute Coronary Syndrome are Characterized by the Presence of Stenosis and High-risk Plaque, But Not Higher Segmental Coronary Artery Calcium Score: Results from the ROMICAT II Trial

Participants
Stefan Puchner, MD, Boston, MA (Presenter) Nothing to Disclose
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Michael T. Lu, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Pal Maurovich-Horvat, MD,PhD, Budapest, Hungary (Abstract Co-Author) Nothing to Disclose
Kristine Ghemigian, BA, Boston, MA (Abstract Co-Author) Nothing to Disclose
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Udo Hoffmann, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Maros Ferencik, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The amount of coronary artery calcium (CAC) predicts cardiovascular events and correlates with plaque burden. However, CAC may represent advanced stage of atherosclerosis and is not directly related to high-risk plaque. We determined the association of stenosis, high-risk plaque and segmental CAC score with culprit lesions of ACS.

METHOD AND MATERIALS
We studied 501 patients with acute chest pain from the coronary CT angiography (CCTA) arm of the ROMICAT II trial. CCTA was assessed for the presence of >=50% stenosis and high-risk plaque (positive remodeling, low HU plaque, napkin-ring sign, spotty calcium) in all 17 coronary segments. Total and segmental CAC Agatston score was measured on non-contrast CT scans. Culprit lesions were determined in subjects with ACS by the review of available records.

RESULTS
Subjects with ACS (n=37) had higher prevalence of >=50% stenosis (78% vs. 7%, p<0.001) and high-risk plaque (95% vs. 59%, p<0.001), and higher total CAC score (median 229, 25th-75th percentile 75-517 vs. 27, 25th-75th percentile 0-99). High-risk plaques were more frequent in segments with lower segmental CAC score (Figure, p<0.001). In subjects with ACS, culprit (n=41) vs. non-culprit (n=200) plaques had higher prevalence of >=50% stenosis (81% vs. 11%, p<0.001) and high-risk plaque (76% vs. 51%, p=0.005), but not higher segmental CAC score (median 22, 25th-75th percentile 4-71 vs. 14, 25th-75th percentile 0-51; p=0.37). In multivariable multilevel mixed-effects logistic regression, >=50% stenosis (OR 40.2, 95%CI 15.6-103.9, p<0.001) and high-risk plaque (OR 3.4, 95%CI 1.3-9.1, p=0.02), but not segmental CAC score (OR 1.0, 95%CI 1.0-1.0, p=0.47) were associated with culprit lesions of ACS.

CONCLUSION
Prevalence of high-risk plaque is inversely related to segment amount of CAC. Culprit lesions of ACS are characterized by >=50% stenosis and high-risk plaque, but not by higher segmental CAC. These findings suggest that local advanced calcification may represent more stable stage of atherosclerosis, while the culprit lesions are characterized by smaller amounts of CAC.

CLINICAL RELEVANCE/APPLICATION
High calcium score indicates a higher risk for acute coronary syndrome, however the culprit lesions are characterized by smaller...
amounts of coronary artery calcium.

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Udo Hoffmann, MD - 2015 Honored Educator
PURPOSE
Comparison of tumor response with volumetric assessment for tumor size after treatment of primary or secondary lung tumors with microwave ablation (MWA), radiofrequency ablation (RFA) and laser-induced interstitial tumor therapy (LITT).

METHOD AND MATERIALS
Between 04/2002 and 09/2013 165 patients (70 males, 95 females) suffering from 263 lesions (primary or secondary lung tumor) were treated with thermal ablation (MWA, RFA and/or LITT). Patients with colorectal carcinoma with lung metastases were not included in this study. At 24-hour; 3-, 6-, 12-, 18- and 24-month intervals diagnosis and follow-up were accomplished using magnetic resonance imaging (MRI), unenhanced and contrast-enhanced computed tomography (CT). The results were evaluated in a retrospective study according to the RECIST criteria and survival data were assessed. Patients treated with more than one method of thermal ablation (n=10) were excluded from patient-related analysis. Patients without follow-up data were excluded from relapse analysis.

RESULTS
In 19 patients with 25 lesions treated with LITT recurrent foci were found in 27.3% of lesions. Average tumor volume of lesions with complete response (CR) was 6.1 ml before therapy, in lesions with recurrent foci 15.39 ml. Recurrence rate (RR) for 3, 6, 12, 18, 24 months was 16.7%, 7.1%, 0%, 10% and 11.1%. In 40 patients with 65 lesions treated with RFA recurrent foci were found in 20.4% of lesions. Average tumor volume of lesions with CR was 2.82 ml before therapy, in lesions with recurrent foci 16.73 ml. RR for 3, 6, 12, 18, 24 months was 2.1%, 7.7%, 12.5%, 11.1% and 0%. 106 patients with 173 lesions were treated with MWA. Average tumor volume of lesions with CR was 5.52 ml before therapy, in lesions with recurrent foci 19.14 ml. RR for 3, 6, 12, 18, 24 months was 1%, 5.1%, 0%, 2.9% and 11.1%. There was a significant difference in rates of recurrent foci between LITT, RFA and MWA (P=0.038, Fisher test) with the lowest RR in the MWA group. Mean survival was 983 days in patients treated with LITT, 899 days with MWA and 690 days with RFA using the Kaplan-Meier method (P= 0.003).

CONCLUSION
In conclusion LITT, RFA and MWA showed a significant difference in the treatment of primary and secondary lung metastases regarding CR, RR and mean survival.

CLINICAL RELEVANCE/APPLICATION
MWA showed the best results concerning RR, LITT concerning mean survival.
METHOD AND MATERIALS

In this retrospective study data on 109 patients (71 males/38 females; mean, 68.6±11.2 years; range, 34-94) were collected in 231 CT-guided ablation sessions from 05/2000-12/2013. 47 patients (125 ablations) underwent MWA, 21 patients (31 ablations) LITT and 41 patients (75 ablations) RFA. CT was performed at 24 hours and at 3, 6, 12, 18 and 24 months post ablation. Survival rates were calculated from first ablation using Kaplan-Meier and log-rank test. Volume changes were measured by the Kruskal-Wallis method.

RESULTS

Local tumor control was achieved in MWA in 91/103 (88.3%) lesions, in LITT in 17/25 (68%) lesions, and in RFA in 45/65 (69.2%) lesions with significant differences in MWA vs. LITT at 18 months (p=0.01) and in MWA vs. RFA at 18 (p=0.004) months. Median time-to-progression was 7.5 months in MWA, 10.4 months in LITT and 7.2 months in RFA with no significant difference. 1, 2- and 4-year overall survival was 82.7%, 67.5% and 16.6% for MWA (median: 32.8 months), 95.2%, 47.6% and 23.8% for LITT (median: 22.1 months), and 76.9%, 50.8% and 8% for RFA (median 24.2 months) with no significant difference. 1-, 2- and 4-year progression-free survival was 54.6%, 29.1%, 10.0% and 1% for MWA, 96.8%, 52.7%, 24% and 19.1% for LITT, and 77.3%, 50.2%, 30.8% and 16.4% for RFA with no significant difference.

CONCLUSION

MWA, LITT and RFA are effective therapeutic options for CRC lung metastases with differences documented in local tumor control and no significant differences in progression time, overall survival and progression-free survival rates.

CLINICAL RELEVANCE/APPLICATION

LITT, RFA and MWA in the treatment of colorectal lung metastases can be used with similar results concerning progression time, overall survival and progression-free survival rates. MWA, however, results in better local tumor control.

SSE05-03 CT-Guided Hook-Wire Localization Prior to Video Assisted Thoracoscopic Surgery (VATS) of Suspected Pulmonary Metastases: Safety, Efficacy and Outcome

Monday, Nov. 30 3:20PM - 3:30PM Location: S402AB

Participants
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Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To assess the feasibility, safety and efficacy of CT-guided pulmonary nodule localization using hooked guide wire before thoracoscopic surgical resection.

METHOD AND MATERIALS

The study included 79 consecutive patients with a history of malignancies outside the lung associated with suspected pulmonary nodules. The CT-guided-hook wire localization procedures were performed under aseptic conditions and local anesthesia. Mean lesion size was 0.7 cm (range 0.5 - 1.8 cm) and the mean lesion distance to the pleural surface was 1.5 cm (range 0.2 - 5 cm). All lesions (n=82) were marked with a 22-G hook-wire. The technique was designed to insert the tip of hook-wire within or maximally 1 cm from the edge of the lesion.

RESULTS

The hooked-guide wire was positioned successfully in all 82 pulmonary nodules within mean time of 9 min (8-20 min, SD: 2.5). The procedure time was inversely proportional to the size of the lesion (Spearman correlation factor 0.7). The mean total radiation dose associated with the procedure was 336 mGy.cm from which the mean DLP of the guide-wire localization was 31 mGy.cm (9.2%). Minimal pneumothoraces were observed in 5 patients (7.6%) without requirement for chest tubes. Pneumothorax was not correlated to the histopathology of the pulmonary nodules (p value > 0.09). Pneumothorax was significantly correlated to emphysema (p value: 0.02). Focal perilesional pulmonary hemorrhage was developed in 4 patients (5%). Both hemorrhage and pneumothorax were significantly correlated to lesion < 10 mm (p value: 0.02 and 0.01 respectively). The resected volume of lung tissue was significantly larger in lesions in which the guide wire was inserted at 1 cm distance from the lesion; in comparison to lesions in which the guide-wire was positioned within the lesion (p= 0.01). Additionally, the volume of resected lung tissue was significantly correlated to lesion of increased distance from the pleural surface > 2.5 cm in comparison to lesions of less than the 2.5 cm from the pleural surface.

CONCLUSION

CT-guided pulmonary nodule localization prior to thoracoscopic resection could allow a safe and accurate surgical guidance for the localization of small pulmonary nodules during thoracoscopic resection.

CLINICAL RELEVANCE/APPLICATION

This technique facilitates the identification and allows adequate resection of small pulmonary nodules during thoracoscopic resection.

SSE05-04 Pneumothorax Complicating Coaxial and Non-Coaxial CT-Guided Lung Biopsy: Comparative Analysis of Determining Risk Factors

Monday, Nov. 30 3:30PM - 3:40PM Location: S402AB

Participants
Nour-Eldin A. Nour-Eldin, MD, PhD, Frankfurt Am Main, Germany (Presenter) Nothing to Disclose
Pulmonary nodules (PNs) in patients (pts) with non-pulmonary solid tumors present a diagnostic challenge; comprising other possibilities than metastatic disease, such as primary lung cancers, infectious diseases and scar tissue. The precise diagnosis will ultimately impact in treatment decisions and prognosis. This study aimed to determine variables correlated with finding metastatic disease on a pulmonary biopsy, helping the decision process of indicating a PN biopsy in this scenario.

**PURPOSE**

To assess the scope and determining risk factors related to the development of pneumothorax throughout CT-guided biopsy of pulmonary lesions in coaxial and non-coaxial techniques

**METHOD AND MATERIALS**

The study included CT-guided percutaneous lung biopsies in 650 consecutive patients (407 males, 243 females; mean age 54.6 years, SD: 5.2) from November 2008 to June 2013 in a retrospective design. Patients were classified according to lung biopsy technique into coaxial-group (318 lesions) and non-coaxial-group (332 lesions). Exclusion criteria for biopsy were: lesions < 5 mm in diameter, uncorrectable coagulopathy, positive-pressure ventilation, severe respiratory compromise, pulmonary arterial hypertension or refusal of the procedure.

**RESULTS**

The incidence of pneumothorax complicating CT-guided lung biopsy was less in the non-coaxial group (23.2%, 77 out of 332) than the coaxial-group (27.9%, 86 out of 318). The difference in incidence between both groups was statistically insignificant (p = 0.14). Significant risk factors for the development of pneumothorax in both groups were emphysema (p < 0.001 in both groups), traversing a fissure with the biopsy needle (p-value = 0.007 in non-coaxial group and 0.01 in coaxial group), small lesion, less than 2 cm in diameter (p-value = 0.02 in both groups), location of the lesion in the basal or mid sections of the lung (p = 0.033 and < 0.001 in non-coaxial and coaxial groups respectively), and increased needle track path within the lung tissue of more than 2.5 cm (p-value = 0.01 in both groups). Simultaneous incidence of pneumothorax and pulmonary hemorrhage was 27.3% (21/77) in non-coaxial group and in 30.2% (26/86) in coaxial-group. Conservative management was sufficient for treatment of 91 out of 101 patients of pneumothorax in both groups (90.1%).

**CONCLUSION**

Pneumothorax complicating CT-guided core biopsy of pulmonary lesions, showed insignificant difference between coaxial and non-coaxial techniques. However both techniques have the same significant risk factors including small and basal lesions, increased lesion’s depth from pleural surface, increased length of aerated lung parenchyma crossed by biopsy needle and passing through pulmonary fissures in the needle tract.

**CLINICAL RELEVANCE/APPLICATION**

Significant risk factors of pneumothorax complicating lung biopsy in both coaxial and non-coaxial techniques are similar and include: technical risk factors, patient related risk factors, and lesion associated risk factors.

**SSE05-05**

**Appearances Can be Deceiving: Pulmonary Nodules in Non-pulmonary Solid Tumor Bearing Patients are not Always Metastatic**

**Monday, Nov. 30 3:40PM - 3:50PM Location: S402AB**

**Participants**

Mauricio R. Moura SR, MD, MD, Sao Paulo, Brazil (Presenter) Nothing to Disclose
Publio C. Viana, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Marcos R. Menezes, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Milena Mak, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Rafael Bitton, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Olavo Feher, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Pulmonary nodules (PNs) in patients (pts) with non-pulmonary solid tumors present a diagnostic challenge; comprising other possibilities than metastatic disease, such as primary lung cancers, infectious diseases and scar tissue. The precise diagnosis will ultimately impact in treatment decisions and prognosis. This study aimed to determine variables correlated with finding metastatic disease on a pulmonary biopsy, helping the decision process of indicating a PN biopsy in this scenario.

**METHOD AND MATERIALS**

In this single-institution retrospective study, we included consecutive pts with non-pulmonary solid malignancies that presented PN and no extra pulmonary metastases. Pts were submitted to a computed tomography (CT) guided biopsy from January 2011 to December 2013. Exclusion criteria are as follows: presence of lung primary, hematologic malignancies, or extra pulmonary metastatic disease. Correlation between imaging and clinical characteristics that yielded higher probability of finding metastatic disease on biopsy was determined by logistic regression analysis.

**RESULTS**

From a total of 487 pts submitted to pulmonary biopsy, 228 were included in the final analysis. Metastatic disease to the lungs was confirmed in 63.1%. Lung primaries were found in 26.3%. Other findings included infectious diseases (7.4%) and benign lesions (2.6%). On multivariate analysis, presence of multiple PNs was associated with higher odds of metastatic disease (OR 4.24; 95% CI 1.97–9.14, p < 0.01), as well as nodule cavitation and/or necrosis on CT scan (OR 4.01; 95% CI 1.24–13.01, p = 0.02). Procedure complications demanding active interventions occurred in 6 patients. No procedure-related death occurred.

**CONCLUSION**

Presence of multiple PNs and nodule cavitation were associated with higher odds of finding biopsy-proven metastatic disease. However, a high rate of non-metastatic disease was found in this group of pts. Given that procedural complications were low, we conclude that tissue sample is still essential for accurately diagnosing and treating pts with solid tumors presenting with PNs.

**CLINICAL RELEVANCE/APPLICATION**

Assuming all PN observed in cancer patients as being metastatic disease will lead to high rates of inaccurate diagnosis and...
CT-guided Transthoracic Needle Biopsy of Subsolid Pulmonary Nodules: Technical Feasibility and Diagnostic Yield with Surgical Correlation and Long Term Follow-up.

Monday, Nov. 30 3:50PM - 4:00PM Location: S402AB

Participants
Nantaka Kiranantawat, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Shaunagh McDermott, FFR(RCSI), Boston, MA (Presenter) Nothing to Disclose
Matthew D. Gilman, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Florian J. Fintelmann, MD, FRCPC, Boston, MA (Abstract Co-Author) Nothing to Disclose
Jo-Anne O. Shepard, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Subba R. Digumarthy, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Carol C. Wu, MD, Houston, TX (Abstract Co-Author) Author, Reed Elsevier
Victorine V. Muse, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Milena Petranovic, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Amita Sharma, MBBS, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the technical and diagnostic success of CT-guided transthoracic needle biopsy (TNB) of subsolid pulmonary nodules.

METHOD AND MATERIALS
Retrospective review of 94 TNB of subsolid nodules performed between 2009-2013 with standard co-axial technique using 19 g introducer, 22g fine needle aspirate and 20g core needles and under conscious sedation. Inclusion criteria included surgical correlation or a minimum follow up of 2 years by imaging. There were a total of 94 patients (M:F 29: 65; mean age and range; 70.4 and 33-89 years). The mean size and range of nodule; 25mm; range 7-95mm. Fine needle aspirate was performed in all and core biopsy was done in 21 patients (24 %). Technical success rate for all attempts was calculated. Sensitivity and specificity for malignant and benign diagnoses for successful biopsies was calculated (86/94). The correlation with surgical pathology was available for 69% (59/86) and complication rate of procedure were assessed.

RESULTS
The technical success was 95% (89/94). There were 80 cancers and 6 benign lesions. The overall accuracy of TNB is 93% (80/86). There were 6 false negative malignant nodules on TNB. The sensitivity and specificity on TNB for malignant lesions is 92 and 100%. The concordance with surgery was 90 % (53/59). The sensitivity of biopsy was higher for nodules >20 mm (95% vs. 88%) and for nodules <50% groundglass component (98% vs. 94 %). Core biopsy improved yield in only 5% (1/21). Minor hemoptysis was seen in 7.7%, pneumothorax in 21%. 19 patients had a small pneumothorax on CT (20.9%). No patient required a chest tube.

CONCLUSION
CT-guided transthoracic needle biopsy of subsolid nodules is a safe procedure with a high sensitivity and specificity for diagnosing malignant nodules.

CLINICAL RELEVANCE/APPLICATION
The high sensitivity and specificity of transthoracic needle biopsy in subsolid nodules, supports wider application of this technique, especially in the era of lung cancer screening.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Subba R. Digumarthy, MD - 2013 Honored Educator
PURPOSE
To test the ability of secondary CT findings in patients with T- and L- spine fractures to predict disruption of the posterior ligament complex, a crucial determinant of fracture instability.

METHOD AND MATERIALS
105 consecutive ER patients with thoracic or lumbar spine fracture (fx) who had both CT and MRI from 2008-2012 were included. A composite gold standard was based on disruption of any PLC component by MRI or intraoperative exam findings. 3 blinded readers (2 neuroradiology trained emergency radiologists and 1 spine surgeon) graded CT scans for: VBT vertebral body translation/rotation, FJD facet joint subluxation/dislocation, FJW facet joint widening, FPL facet/pedicle/lamina fx, SPF spinous process fx, ISW interspinous distance widening, PEF posterior endplate corner fx. Analysis included interobserver agreement, and univariate and multivariate logistic regressions (performed separately by reader) to test associations between CT findings and gold standard PLC disruption (PLCD).

RESULTS
53 of the 105 patients had PLC disruption by gold standard. Interobserver agreement (averaged across reader pairs) was good for all CT findings, ranging from 92% for VBT to 72% for ISW. In univariate analysis, the strongest predictors of PLCD were FPL (OR 3.9-5.2, p<0.001 for all readers) and ISW (OR 1.8-3.1, all p<0.05). SPF and VBT showed significant results for 2/3 readers. PEF was not associated with PLCD. The overall presence of at least one of the CT findings had 70% average interobserver agreement, and univariate and multivariate logistic regressions (performed separately by reader) to test associations between CT findings and gold standard PLC disruption (PLCD).

CONCLUSION
Several secondary CT findings can substantially increase suspicion for PLC disruption, with any abnormal CT finding increasing the odds of disruption by 5.4 or greater across all readers.

CLINICAL RELEVANCE/APPLICATION
Close attention to secondary CT findings in patients with T- or L- spine fractures may help radiologists predict PLC disruption and expedite appropriate management.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Bharti Khurana, MD - 2014 Honored Educator
Aaron D. Sodickson, MD, PhD - 2014 Honored Educator
**SSE06-03**

Comparison of Radiation Dose-equivalent Radiography, Multidetector Computed Tomography and Cone Beam Computed Tomography for Fractures of the Wrist

**Methods**
A retrospective observational study in the period January 1st 2012 to December 31st 2013, including all patients aged 15 years and older with a high-energy-trauma (HET). We evaluated the NEXUS-criteria against the outcome of a fracture or no fracture of the cervical spine determined by CT.

**Results**
A total of 875 patients were included, from which 599 patients had a positive- and 276 patients had a negative NEXUS-screening. In the group with the positive NEXUS-criteria 35 fractures were found. One patient with a negative NEXUS-screening had a fracture. This leads to a sensitivity of 0.972 (95% CI: 0.837-0.998) and a negative predictive value of 0.996 (95% CI: 0.976-0.999) of the NEXUS criteria.

**Conclusion**
The NEXUS-criteria have a good sensitivity as well as a good negative predictive value for CT of the cervical spine when injury of the cervical spine is suspected in patients with a high-energy-trauma aged 15 years and older.

**Clinical Relevance/Application**

Daily practice at the emergency room.

**SSE06-04**

Diagnosis of Acute Fractures of the Thoracic Spine Using Bone Marrow Edema Detected by Dual-Energy CT

**Purpose**
To compare the diagnostic quality of radiography, to radiography equivalent dose multidetector computed tomography (RED-MDCT) and to radiography equivalent dose cone beam computed tomography (RED-CBCT) for wrist fractures in phantoms.

**Methods**
As phantoms we chose 10 cadaveric hands from body donors. Distal radius, distal ulna and carpal bones were artificially fractured in a random order. Radiation dose was calculated with Monte Carlo simulations. RED-MDCT and RED-CBCT scans of the wrist were performed with the same radiation dose as combined dorsopalmar and lateral radiographs of the wrist. The gold standard was evaluated by a combination of fracturing protocol and high-dose MDCT. 3 independent raters evaluated the images for fractures, joint involvement and fracture displacement. Raters scored the certainty of their findings on a 5-point Likert Scale. Statistical analysis was performed with calculation of pooled sensitivity, pooled specificity and receiver operating characteristic (ROC). Interrater correlation for all modalities was evaluated by Kendall's coefficient of concordance W. False discovery rate was controlled according to Benjamini and Yekutieli.

**Results**
Pooled sensitivity for fractures was 87% for RED-MDCT, 78% for RED-CBCT and 58% for radiography, being significantly different only between RED-MDCT and radiography (P<0.01). Although sensitivity for joint involvement and fracture displacement was higher in RED-MDCT and RED-CBCT compared to radiography, these differences were not significant. No significant differences were detected concerning the modalities' specificities. Raters' certainty was higher in RED-MDCT and RED-CBCT compared to radiography (P<0.001). The area under the ROC curve for fracture detection was higher for RED-MDCT and RED-CBCT compared to radiography, although this was significant only for one of the three raters. Interrater correlation was 0.93, 0.87 and 0.94 for radiography, RED-MDCT and RED-CBCT, respectively.

**Conclusion**
In this study, the diagnostic quality of RED-MDCT and RED-CBCT for wrist fractures proved to be similar and in some parts even higher compared to radiography.

**Clinical Relevance/Application**
RED-MDCT and RED-CBCT scans have a sufficient potential to improve the diagnostic quality for wrist fractures without raising radiation dose and should be tested in a clinical setting.
SSE06-05 Diagnostic Value of CT in Patients with Suspected Thoracic Spine Fractures Due to Minor Trauma

PURPOSE

To investigate the accuracy of biplane radiography in the detection of thoracic spine fractures in patients with minor trauma using computed tomography (CT) as the reference.

METHOD AND MATERIALS

130 consecutive patients (71 males; 59 females; mean age 69 ± 22.7 years; range 18-95 years) with minor trauma of the thoracic spine and low to moderate back pain on physical examination were included retrospectively. All had undergone biplane radiography first, followed by a CT scan in a time frame of 4 days because of aggravation of their symptoms. A contingency table and the Chi-square test (X2) were used to compare both diagnostic methods.

RESULTS

CT revealed 95 fractures in 71/130 patients (54.6%). Most fractures were diagnosed in the thoracolumbar junction (n=27). Biplane radiography was true positive in 42/130 patients (32.3%), false positive in 20/130 patients (15.4%), true negative in 42/130 (32.3%), and false negative in 26/130 patients (20%), showing a sensitivity of 61.8%, a specificity of 67.7%, a positive predictive value of 67.7%, and a negative predictive value of 61.8%. None of the fractures missed on biplane radiography was unstable. Presence of a fracture on biplane radiography was highly statistical significant, if this was simultaneously proven by CT (X2 = 11.3; p= 0.00077).

CONCLUSION

Sensitivity and specificity of biplane radiography in the diagnosis of thoracic spine fractures in patients with minor trauma are low.

CLINICAL RELEVANCE/APPLICATION

Considering the wide availability of CT that is usually necessary for taking significant therapeutic steps, indication for x-ray in minor trauma patients should be very restrictive.
PURPOSE
Attempts to reduce radiation exposure at the cervical spine are frequently and negatively limited by beam hardening artifact and photon starvation at the cervicothoracic junction. The purpose of this study is to compare image quality and radiation dose of conventional 120kVp CT versus a novel spectral filtration CT (SFCT) mode, which uses 140kVp and an added tin filter to produce small quantities of highly penetrating photons, in acute trauma patients.

METHOD AND MATERIALS
20 consecutive patients underwent SFCT of the cervical spine (Sn140kV, 450mAs, 40×0.6mm) using a dual source 128-slice CT system (Definition FLASH; Siemens Healthcare, Forchheim, Germany) and were compared to 20 patients who underwent conventional 120kVp CT. Attenuation was measured by placing circular regions of interest on the spinal cord at the C2, C5, and C7 levels. Statistical analysis of this data was performed using Mann-Whitney U tests. Image quality was graded by 2 readers using a semi-objective 4-point scoring system at the same spinal levels. These results were subjected to Wilcoxon Signed-Rank Test for statistical analysis.

RESULTS
The findings show a statistically significant decrease in the radiation dose when using SFCT versus conventional 12-kVp CT. SFCT reduced the computed tomography dose index (CTDI) by 47.4% (-12.5, p<0.0022) and the dose length product (DLP) by 43.3% (-246.7, p<0.0022). Moreover, subjective analysis of image quality demonstrated a statistically significant improvement in image quality at both the C5 and C7 level due to reduction of bone hardening artifact (median=3, p<0.0313).

CONCLUSION
The findings show a significant objective decrease in radiation dose as well as a significant subjective improvement in image quality through reduction of bone hardening artifact in spectral CT versus conventional CT. These results indicate that spectral filtration CT shows great promise in imaging of the cervical spine.

CLINICAL RELEVANCE/APPLICATION
Given the large number of C-Spine imaging referrals, a young patient base, and the potentiality of serious injury, there is a necessity for high-quality, reduced-dose C-Spine imaging in the ER setting.
**Objective Image Quality of Best Arterial and Best Portal Venous Phase Images Calculated from Low Dose Dynamic Volume Perfusion CT Datasets in Comparison To Standard Arterial and Portal Venous CT Datasets in Patients with Hepatocellular Carcinoma**

**METHOD AND MATERIALS**

21 dVPCT and standard CT datasets of 13 patients with HCC were analyzed in this study. The scan protocol included a 70kVp/220mAs (n=14) or 80kVp/190 or 200mAs (n=7) dVPCT acquisition for quantitative evaluation of HCC perfusion over 60s with an interscan delay of 2.5s. In addition, the patients underwent a standard dual-energy (90/150 kVp) arterial and PV acquisition 15 minutes after the dVPCT. The 3-5 single phases from all dVPCT datasets in which the abdominal aorta (AA) or the main portal vein (MPV) showed best contrast were manually selected by reviewing all dVPCT datasets. Best temporal arterial and PV images were then reconstructed from the 3-5 single phases to one best arterial and best PV temporal dataset. The standard 120-kVp images were generated from dual-energy CT data. Image noise, SNRs of the liver, AA and MPV as well as CNRs of AA and MPV were measured and compared to the 120 kVp datasets. The results were analyzed using paired-samples t-test.

**RESULTS**

Best temporal arterial and PV images were superior to standard 120-kVp arterial and venous images for all quantitative measurements (all p<0.05) except for image noise within the MPV in the PV phases, which showed no significant differences between the two groups. The SNRs of AA (arterial phase), liver and MPV (PV phase) were 25.4, 5.0 and 7.2 within the best temporal images, which were significantly higher compared to the standard 120-kVp images (8.8, 3.7 and 4.6 respectively) (all p<0.01). Similarly, best temporal images showed higher CNRs of AA (arterial phase; 17.8 vs. 4.7, P=0.018) and MPV (PV phase; 3.2 vs. 1.6, P<0.001) compared to 120-kVp images.

**CONCLUSION**

Best temporal images calculated from low-dose dVPCT datasets can replace additional standard CT acquisitions in patients with HCC that undergo quantitative dVPCT.

**CLINICAL RELEVANCE/APPLICATION**

Low-dose dVPCT datasets can be used to calculate standard arterial and PV phase CT images with even superior image quality when compared to standard 120-kVp arterial and PV images.
In a clinical setup a gbPCCT scanner may have the potential to improve diagnostics and therapy monitoring of chronic liver disease.

**CLINICAL RELEVANCE/APPLICATION**

Grating-based phase contrast computed tomography allows ex vivo quantification of liver fibrosis in human specimens.

**RESULTS**

In phase-contrast images fibrous tissue shows high signal intensity and delineates from surrounding liver tissue. Visual evaluation and software-based tissue decomposition correlated with the histological grading. On the contrary, attenuation-contrast images did not allow quantification of liver fibrosis.

**METHOD AND MATERIALS**

This prospective study was IRB-approved, and written informed consent was obtained. Fifty-eight patients (48 men, 10 women; mean age, 68 years; age range, 23-85 years) with metal implants were imaged at dynamic CE-CT. CT data were reconstructed with and without SEMAR algorithm on axial and coronal planes. To evaluate the metal artifact reduction, CT number and artifact index values within the liver segments, which were affected by metallic artifact, were determined by ROI measurement. Two readers independently evaluated image quality of the liver and pancreas by means of 5-point visual score. To evaluate quantitative image quality improvement on CE-CT with and without SEMAR technique mean CT number and artifact index within liver were compared by t-test. To assess qualitative image quality between two methods, a linear-weighted κ statistic and Wilcoxon signed rank test were performed.

**CONCLUSION**

The mean CT number and artifact index within the liver on CT with SEMAR were significantly lower compared that without SEMAR on both planes (p<0.0001). Inter-observer agreements of image quality assessment of liver and pancreas were substantial or almost perfect (0.61<κ<0.84). Image qualities of the liver and pancreas was significantly improved on CT with SEMAR as compared with that without SEMAR in both planes (p<0.0001).

**CLINICAL RELEVANCE/APPLICATION**

SEMAR is considered as useful for image quality improvement on dynamic CE-CT in patients who had surgical or endovascular treatment for hepatocellular carcinoma (HCC).

**PURPOSE**

To determine the utility of a single-energy metal artifact reduction (SEMAR) algorithm for image quality improvement on dynamic contrast-enhanced CT (CE-CT) in patients who underwent surgical or endovascular treatment for hepatocellular carcinoma (HCC).

**METHOD AND MATERIALS**

This prospective study was IRB-approved, and written informed consent was obtained. Fifty-eight patients (48 men, 10 women; mean age, 68 years; age range, 23-85 years) with metal implants were imaged at dynamic CE-CT. CT data were reconstructed with and without SEMAR algorithm on axial and coronal planes. To evaluate the metal artifact reduction, CT number and artifact index values within the liver segments, which were affected by metallic artifact, were determined by ROI measurement. Two readers independently evaluated image quality of the liver and pancreas by means of 5-point visual score. To evaluate quantitative image quality improvement on CE-CT with and without SEMAR technique mean CT number and artifact index within liver were compared by t-test. To assess qualitative image quality between two methods, a linear-weighted κ statistic and Wilcoxon signed rank test were performed.

**RESULTS**

The mean CT number and artifact index within the liver on CT with SEMAR were significantly lower compared that without SEMAR on both planes (p<0.0001). Inter-observer agreements of image quality assessment of liver and pancreas were substantial or almost perfect (0.61<κ<0.84). Image qualities of the liver and pancreas was significantly improved on CT with SEMAR as compared with that without SEMAR in both planes (p<0.0001).

**CONCLUSION**

SEMAR is considered as useful for image quality improvement on dynamic CE-CT in patients who had surgical or endovascular treatment for HCC.

**CLINICAL RELEVANCE/APPLICATION**

SEMAR is considered as useful for image quality improvement on dynamic CE-CT in patients who had surgical or endovascular treatment for HCC.
**SSE07-04** Evaluation of the Recently Transplanted Liver with Computed Tomography Perfusion Imaging and Correlation with Clinical Outcome

**Participants**
- Nicholas Hilliard, MBBChir, Cambridge, United Kingdom (Presenter) Nothing to Disclose
- Andrew B. Gill, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose
- David Bowden, MBBChir, Toronto, ON (Abstract Co-Author) Nothing to Disclose
- Simon T. Hilliard I, MBBS, BSc, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose
- James Tanner, MBBCHR, MA, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose
- Tristan Barrett, MBBS, BSc, Guildford, United Kingdom (Abstract Co-Author) Nothing to Disclose
- David J. Lomas, MD, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose
- Ashley S. Shaw, MBBCh, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The integrity of vascular anastomoses performed during liver transplantation is critical to the proper function of the graft. In particular, hepatic arterial stenosis or thrombosis has major impact on patient morbidity and mortality. Standard assessment of vascular supply relies upon ultrasound and angiography (both conventional and by computed tomography (CT)), however these may not detect vascular abnormality until graft function has already been compromised. In this study we evaluate a CT perfusion technique to measure blood flow in recently implanted liver grafts.

**METHOD AND MATERIALS**

Patients with a recent liver transplant were imaged between 10-14 days post transplantation with a perfusion CT sequence. A dual-input single-compartment pharmacokinetic model was applied to the tissue uptake curve and the arterial and portal venous input functions to yield standard perfusion indices (total blood perfusion, arterial fraction, mean transit time and distribution volume).

**RESULTS**

34 complete datasets were obtained. Mean total perfusion was 159ml/min/100ml +/- 32, arterial fraction was 17% +/- 14.2, mean transit time was 14.9s +/- 5.8 and distribution volume was 22.5% +/- 2.9. In comparison with previously published data from native normal livers, there was a significant difference in mean transit time and distribution volume (p<0.001). In subgroup analysis, there was no significant difference in results for patients with and without biopsy proven acute rejection. In 6 patients that developed hepatic artery stenosis or thrombosis there was a decreased arterial fraction (mean 7.3%, p<0.06). In 8 patients who developed cholangiopathy the arterial fraction was also decreased (mean 10.1%, p<0.11).

**CONCLUSION**

This study shows that perfusion CT can produce reproducible results in a group of patients post liver transplant. There was a trend of decreased arterial fraction for patients that subsequently developed hepatic artery stenosis or thrombosis; increased recruitment and clinical follow-up is awaited. Further refinement of the technique may provide useful prognostic information for graft arterial function, allowing diagnosis of potentially serious complications at an earlier time point.

**CLINICAL RELEVANCE/APPLICATION**

Development of CT perfusion may allow early prediction of complications following liver transplantation, particularly for problems involving the hepatic artery.

**SSE07-05** Noninvasive Liver Iron Content Determination by Dual-Source Dual-Energy CT: Initial Results in Patients Suspected of Liver Iron-overload

**Participants**
- Xianfu Luo, Yangzhou, China (Presenter) Nothing to Disclose
- Jingtao Wu, Yangzhou, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To prospectively assess the feasibility of dual-source dual-energy (DSDE) CT for evaluation of liver iron content (LIC) in patients suspected of liver iron-overload and to compare its accuracy with magnetic resonance (MR) imaging.

**METHOD AND MATERIALS**

Fifty-eight subjects with elevated ferritin and suspected of liver iron-overload were enrolled in our study. Upper abdomen DSDE CT and MR were then performed. Hepatic attenuation difference between 80 kVp and 140 kVp (ΔH) was calculated. Hepatic R2* and LIC determined by FerriScan (F-LIC) were obtained. The correlations between CT measurement (ΔH) and MR measurements (R2* and F-LIC) were analyzed. Diagnostic performance of ΔH in discriminating different LIC thresholds (1.8, 3.2, 7.0, 15.0mg/g dry tissue) was evaluated by receiver operating characteristic (ROC) analysis.

**RESULTS**

F-LIC was from 0.20 to 39.59mg Fe/g. ΔH was correlated well with F-LIC and the Spearman’s coefficient was 0.975. ΔH showed perfect linear positive with LIC (r2=0.925, P<0.001). For discriminating clinically significant LIC thresholds (1.8, 3.2, 7.0, 15.0mg/g dry tissue) were evaluated by receiver operating characteristic (ROC) analysis. ROC analysis revealed that the corresponding optimal cutoff value of ΔH was 3.15, 3.40, 5.38, 12.50 HU, respectively. With the cutoff value of VIC= 5.38 HU, the highest sensitivity (100%) and specificity (100%) were obtained at LIC threshold of 7.0mg Fe/g dry tissue.

**CONCLUSION**

DSDE CT can accurately quantify liver iron content with similar diagnosis performance with MR for grading clinically significant iron accumulation.
Characterization of Portal Venous Thrombus (Bland vs Neoplastic) on CT Using Software Based Textural Analysis

Monday, Nov. 30 3:50PM - 4:00PM Location: E353A

Participants
Rodrigo Canellas, MD, Boston, MA (Presenter) Nothing to Disclose
Farhad Mehrkhani, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Manuel Patino, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Andrea Prochowski Iamurri, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Avinash R. Kambadakone, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Dushyant V. Sahani, MD, Boston, MA (Abstract Co-Author) Research Grant, General Electric Company; Research Consultant, Allena Pharmaceuticals, Inc

PURPOSE
To investigate the role of textural analysis (CTTA) in distinguishing bland thrombus from neoplastic thrombus in the portal venous system.

METHOD AND MATERIALS
In a IRB approved analysis, CECT scans of 63 patients with reference standard verified PV thrombus (30 bland and 33 neoplastic) were processed for texture features using the CTTA software (TexRAD Ltd). This software works of the DICOM data to generate various parameters: Mean gray-level pixel intensity, Entropy, SD of pixel intensity, mean of positive pixels (MPP), Kurtosis and Skewness. Independent Sample T Test was applied for statistical significance.

RESULTS
There were statistically significant differences between MPP of bland (mean 47.2 ± 12.8) and neoplastic (mean 71.6 ± 16.8) thrombus (P=0.001) and between Mean gray-level pixel intensity of bland (mean 45.4 ± 11.8) and neoplastic (mean 71.2 ± 16.2) thrombus (P=0.001). Other parameters such as SD and Entropy were also statistically different between the two thrombi.

CONCLUSION
A simple software based texture analysis can reliably stratify bland and neoplastic thrombus in the portal venous system on CECT images.

CLINICAL RELEVANCE/APPLICATION
Portal venous thrombus impacts treatment decision and prognosis. Advanced imaging studies such as multiphasic CT or MRI can reliably characterize the venous thrombi into benign and malignant but portal venous CT is less effective. Software based thrombus texture parameter MPP can fulfill this important clinical need thereby potentially eliminating additional imaging studies and interventions.

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Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator
**SSE08**

**Gastrointestinal (Gastrointestinal Bleeding and Ischemia)**

**Diagnostic Yield and Efficacy of Multi-phase CT Enterography (mpCTE) in Patients with Obscure GI Bleeding**

Monday, Nov. 30 3:00PM - 3:10PM Location: E353C

**Participants**

Tracy A. Jaffe, MD, Durham, NC (*Moderator*) Nothing to Disclose
Joel G. Fletcher, MD, Rochester, MN (*Moderator*) Grant, Siemens AG; 

**Sub-Events**

**SSE08-01**  
**Diagnostic Yield and Efficacy of Multi-phase CT Enterography (mpCTE) in Patients with Obscure GI Bleeding**

Monday, Nov. 30 3:00PM - 3:10PM Location: E353C

**Participants**

Krishna Pundi, BS, Rochester, MN (*Presenter*) Nothing to Disclose
Parakkal Deepak, MBBS, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
David Bruining, MD, Rochester, MN (*Abstract Co-Author*) Research Grant, Given Imaging Ltd Consultant, Bracco Group
Jeff L. Fidler, MD, Rochester, MN (*Abstract Co-Author*) Research Grant, Beekley Corporation
John M. Barlow, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Stephanie Hansel, MD, Rochester, MN (*Abstract Co-Author*) Research support, Given Imaging Ltd; Advisory Board, Medtronic, Inc
Michael L. Wells, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Joel G. Fletcher, MD, Rochester, MN (*Abstract Co-Author*) Grant, Siemens AG; 

**PURPOSE**

We sought to estimate the diagnostic yield of multi-phase CT enterography (mpCTE) in patients with obscure GI bleeding (OGIB).

**METHOD AND MATERIALS**

We retrospectively examined medical records for OGIB patients who underwent mpCTE from 2006 to 2014. mpCTE was performed using IV contrast (with arterial, enteric, and delayed phases) and 1850 cc of neutral oral contrast. Clinical mpCTE reports were reviewed and causes of OGIB (small bowel (SB) mass, vascular lesion, inflammation, hemorrhage, or other pathology) were recorded. mpCTE results were compared to further evaluation (surgery (n=108), balloon-assisted endoscopy (BAE, n=247), capsule endoscopy (n=416), angiography (n=31), and other tests (n=171)). In patients with medical follow-up at 1 year, re-bleeding and continued iron supplementation were recorded.

**RESULTS**

1087 patients (90% with prior upper and lower endoscopy) underwent mpCTE for OGIB (486 overt, 601 occult). Total diagnostic yield was 31.6% (344/1087), with 269 patients having small bowel findings (24.7%). Positive exams included 126 SB vascular causes, 72 SB masses, 52 with SB inflammation, 7 SB hemorrhage only and 87 other findings. In 344 patients a definitive cause of GI bleeding established by secondary testing, 187 (54%) had concordant mpCTE diagnoses. In this group, positive predictive value varied by etiology (mass 98% (55/56); inflammation 94% (31/33); vascular 82% (44/54); hemorrhage 100% (3/3); other 76% (31/41); Figure 1). The most common cause of non-SB GI bleeding was cecal and rectal vascular lesions (27%; 24/89). For patients with further clinical testing or intervention and 1 year follow-up (n = 205), the rate of re-bleeding or continued iron independence following positive mpCTE was 43% vs. 69% for those with a negative mpCTE (P < 0.0003).

**CONCLUSION**

mpCTE has an estimated diagnostic yield of 31.6% and a significantly reduced rate of re-bleed or continued iron dependence following a positive exam. It is a reliable screen for causes of SB bleeding in OGIB patients, and identifies many etiologies of GI bleeding outside of the SB.

**CLINICAL RELEVANCE/APPLICATION**

mpCTE has an overall diagnostic yield of 31.6% in OGIB patients, and is an effective screen for small bowel and non-small bowel GI bleeding sources not identified on upper and lower endoscopy.

**SSE08-02**  
**Clinical Significance of Pneumatosis Intestinalis in the Emergency Department - Correlation of MDCT Findings with Patients’ Outcome**

Monday, Nov. 30 3:10PM - 3:20PM Location: E353C

**Participants**

Rafael Duran, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Marc-Olivier Treyvaud, MD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Jean-Francois Knebel, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Re-to A. Meuli, MD, PhD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Sabine Schmidt, MD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the clinical significance of pneumatosis intestinalis (PI) found on multidetector computed tomography (MDCT) in the emergency department.

**METHOD AND MATERIALS**
MDCT scans of 149 consecutive emergency patients (53 women, mean age 64) with PI of the stomach (n=4), small (n=68) and/or large bowel wall (n=96) were evaluated by two radiologists. PI extension, distribution and possible association with portomesenteric venous gas (PMVG) were correlated with other MDCT-findings (e.g. bowel wall thickening, mural contrast-enhancement, target sign, luminal dilation), patients' symptoms, risk factors, clinical management, laboratory, histopathology, final diagnosis and outcome.

RESULTS

The most frequent cause of PI (n=80 [53.7%]) was bowel ischemia, followed by infection (n=18 [12.1%]), obstructive (n=12 [8.1%]) and non-obstructive (n=10 [6.7%]) bowel dilatation, unknown aetiologies (n=8 [5.4%]), drugs (n=8 [5.4%]), inflammation (n=7 [4.7%]), and others (n=6 [4%]). Neither distribution nor extension of PI significantly correlated with underlying ischemia. Overall mortality was 41.6% (n=62), mostly related to intraintestinal ischemia (p=0.033). Associated PMVG or the distribution of PMVG significantly correlated with underlying ischemia (p=0.001 and p=0.004, respectively). Absence of mural contrast-enhancement was the only MDCT-feature significantly associated with ischemia (p=7.484x10^-6). The degree of calcified atherosclerosis, as evaluated by MDCT, significantly correlated with underlying ischemia (p=0.024), unlike other cardiovascular risk factors (p=0.723). Patients with PI due to ischemia had a significantly higher fatal outcome (p=0.003) compared to non-ischemic aetiologies, regardless of their age.

CONCLUSION

PI was caused by various disorders with intestinal ischemia being the most common aetiology with the highest mortality. PMVG and/or absence of mural contrast-enhancement in association with PI may be considered signs of underlying bowel ischemia.

CLINICAL RELEVANCE/APPLICATION

Although intestinal ischemia is the most common aetiology of PI, this sign can be seen with other disorders. Thus it is mandatory to look for other signs such as PMVG and/or absence of mural contrast-enhancement associated with PI to correctly diagnose bowel ischemia in the appropriate clinical context.

SSE08-03  Pneumatosis Intestinalis in Oncology Patients: CT Findings, Clinical Correlates and Outcomes

Monday, Nov. 30 3:20PM - 3:30PM Location: E353C

Participants

Carlton Smith, MD, Baltimore, MD (Presenter) Nothing to Disclose
Lei Zheng, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Karen B. Bleich, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Elliot K. Fishman, MD, Owings Mills, MD (Abstract Co-Author) Research support, Siemens AG Advisory Board, Siemens AG Research support, General Electric Company Advisory Board, General Electric Company Co-founder, HipGraphics, Inc
Pamela T. Johnson, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

PURPOSE

We have observed oncology patients who develop pneumatosis intestinalis without clinical indicators of an acute abdominal process. This study was designed to evaluate these patients in an attempt to guide management.

METHOD AND MATERIALS

A retrospective search of CT reports from 2004-2014 identified 21 adult subjects undergoing cancer treatment with new pneumatosis on CT. Electronic medical records were reviewed to determine underlying malignancy, medications, presentation, lactate level and course. CT images were reviewed for location of pneumatosis, pneumoperitoneum, mesenteric or portal vein gas and follow up CT findings.

RESULTS

Subjects included 15 men and 7 women with mean age 60 years (range 25-79 years). Four subjects with bowel obstruction were excluded. Chemotherapeutic agents in the remaining 17 were: FOLFOX (FU, oxapliatin) FOLFOX (FU, oxapliatin) + bevacizumab irinotibe cisplatin +gemcitabine +etoposide, carboplatin + bevacizumab, then erlotinib + bevacizumab rituximab-ChOP docetaxel + bevacizumab chemoradiation + temozolamide +truximab +methylprednisolone +alimentuzumab ara-C + DLI afatinib + metformin everolimus sunitinib carboplatin, 5FU + cetuximab s/p induction with 7+3 and HiDACIn 17 nonobstructed subjects, pneumatosis involved small bowel in 3, small and large bowel in 2, right colon in 10, left colon in 1, entire colon in 1. Nine of 17 (53%) had localized or free pneumoperitoneum and 1 had mesenteric vein gas. One post-op patient who died likely had ischemic bowel, and the diagnosis was equivocal in a 2nd. A 3rd patient's death was attributed to refractory GVHD. These 3 subjects had elevated lactate. Two others underwent surgery, with surgical diagnosis of no small bowel ischemia in 1 and pathologic diagnosis of colon ulceration and mucosal bacterial overgrowth in the 2nd. A benign clinical course and resolution of pneumatosis on CT was documented in 12 observed patients with adequate clinical follow up, ranging from 2-46 months. Lactate was normal in 6/6 tested.

CONCLUSION

In oncology patients, intestinal pneumatosis without bowel obstruction may be self limited. Lactate level was elevated in life threatening causes in this small series.

CLINICAL RELEVANCE/APPLICATION

Management algorithms should consider that pneumatosis may be a nonsurgical complication of chemotherapy rather than bowel ischemia in the oncology patient population.

Honored Educators

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Elliot K. Fishman, MD - 2012 Honored Educator
SSE08-04 CT Angiography in the Setting of Suspected Acute Mesenteric Ischemia: Prevalence of Ischemic and Alternative Diagnoses

Participants
Frank Oliver G. Henes, MD, Hamburg, Germany (Presenter) Nothing to Disclose
Perry J. Pickhardt, MD, Madison, WI (Abstract Co-Author) Co-founder, VirtuoCTC, LLC; Stockholder, Collectar Biosciences, Inc;
Research Consultant, Bracco Group; Research Consultant, KIT; Research Grant, Koninklijke Philips NV
Toruho Motosugi, MD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose
Meghan G. Lubner, MD, Madison, WI (Abstract Co-Author) Grant, General Electric Company; Grant, NuWave Medical, Inc; Grant, Koninklijke Philips NV
Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Gerhard Schon, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Peter Bannas, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the prevalence of ischemic and alternative diagnoses and the diagnostic accuracy of CT angiography (CTA) in the setting of suspected acute mesenteric ischemia (AMI).

METHOD AND MATERIALS
This retrospective study was HIPAA- and IRB-compliant; informed consent was waived. We included 959 patients that underwent CTA for evaluation of suspected AMI. The final clinical diagnosis as determined by the treating clinician was used to determine the prevalence of ischemic and alternative diagnoses. Prevalence of diagnoses by age, sex and admission status was compared using the Cochran-Armitage Trend-Test. The diagnostic accuracy of CTA was calculated using the final clinical diagnosis as standard of reference.

RESULTS
The prevalence was 18.7% (179/959) for AMI and 62.4% (598/959) for a specific alternative diagnosis, in the remaining 20.7% (198/959) no final clinical diagnoses was established. The most frequent type of AMI was occlusive arterial ischemia (53.3%; 88/179), followed by nonocclusive ischemia (40.6%; 67/179), and mesenteric vein thrombosis (6.1%; 10/179). The most frequent alternative diagnoses were small bowel obstruction (11.6%; 62/598), colitis (10.2%; 54/598), cholecystitis (6.8%; 36/598), diverticulitis (6.6%; 35/598), and pneumonia (6.4%; 34/598). The prevalence of AMI was significantly higher in older patients (P<.001) and the prevalence of specific alternative diagnoses varied significantly according to both age (P<.0001) and admissions status (P=0.0015). CTA had a sensitivity and specificity for diagnosis of AMI of 89%/99% and for alternative diagnoses of 87%/86%.

CONCLUSION
In the vital clinical setting of suspected AMI, the prevalence of ischemic and alternative diagnoses varies significantly by age, sex and admission status. CTA provides for rapid and non-invasive diagnosis with high diagnostic accuracy, allowing for triage of 80% of the patients.

CLINICAL RELEVANCE/APPLICATION
The high diagnostic accuracy for both ischemic and alternative diagnoses demonstrates the high diagnostic yield of CTA and further supports the triage role of CT in the setting of suspected AMI. Knowledge of the prevalence and the demographic distribution of the alternative diagnoses in the setting of suspected AMI may help the radiologist with diagnosis finding and thereby the referring clinicians in their treatment decisions.

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Perry J. Pickhardt, MD - 2014 Honored Educator
Meghan G. Lubner, MD - 2014 Honored Educator
Meghan G. Lubner, MD - 2015 Honored Educator

SSE08-05 Dual-Energy Computed Tomography and Iodine Mapping are Superior to Conventional CT in the Diagnosis of Early and Established Intestinal Ischemia and Infarction

Participants
Pedro Lourenco, MD, Vancouver, BC (Presenter) Nothing to Disclose
Ryan Rawski, BSc, MSc, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Mohammed F. Mohammed, MBBS, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Kathryn Darras, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Savvas Nicolaou, MD, Vancouver, BC (Abstract Co-Author) Institutional research agreement, Siemens AG
Patrick D. McLaughlin, FFRRCSI, Cork, Ireland (Abstract Co-Author) Speaker, Siemens AG

PURPOSE
Acute intestinal ischemia and infarction are devastating abdominal emergencies, with mortality rates up to 93%. Clinical presentation is varied, with significant overlap with other acute abdominal disease. CT sensitivity for detection of acute bowel ischemia is poor, with reported values ranging from 60-80%. CT detection of bowel ischemia is challenging given that CT findings are non-specific. Here, we evaluate the utility of dual-energy CT (DECT) and iodine mapping in the diagnosis of acute intestinal
METHOD AND MATERIALS

64 consecutive patients presented to the emergency department of a quaternary hospital with features of acute intestinal ischemia or infarction between 2013 and 2014. Abdominal DECT (100 and 140 keV) with derived iodine maps (Liver VNC algorithm, Siemens) were reconstructed. An iodine map window of 270/160 was determined optimal for assessment of the intestinal mucosa (data not shown). Laboratory, clinical and pathological outcomes were recorded. Two abdominal trained radiologists were blinded to outcomes and independently rated the concordance of conventional CT and iodine maps with pathological outcomes. Qualitative analysis was also performed.

RESULTS

18 of 64 cases were confirmed to represent intestinal ischemia or infarction on surgical pathology, colonoscopy or due to death from intestinal infarction. Conventional 120 keV CT sensitivity, specificity, PPV and NPV for acute ischemia or infarction were 77.8% (95% CI 52.4-93.5), 89.1% (76.4-96.33), 73.7% (48.8-97.8) and 91.1% (78.8-97.5), respectively. Iodine maps were more robust than conventional 120 keV CT in the diagnosis of this disease entity, demonstrating sensitivity, specificity, PPV and NPV of 94.4% (72.6-99.1), 93.5% (82.1-98.6), 85.0% (62.1-96.6) and 97.7% (87.9-99.6), respectively. Quantitative evaluation showed good intra and inter observer reproducibility. Iodine maps increased interpreter confidence by 20%, and interpreters considered iodine maps useful in 83% of cases.

CONCLUSION

DECT iodine mapping increase conspicuity of ischemic bowel and allow for evaluation of intestinal perfusion. Iodine maps are a reliable and reproducible imaging adjunct, which offer a robust increase in sensitivity and specificity in the diagnosis of acute intestinal ischemia or infarction over conventional CT, up to 94.4% and 93.5%, respectively.

CLINICAL RELEVANCE/APPLICATION

DECT iodine maps are superior to conventional CT in the diagnosis of intestinal ischemia.

SSE08-06  Retrospective Evaluation of Small Bowel Gastrointestinal Stromal Tumors: Impact of CT Enterography

Participants
Rogerio Vasconcelos, MD, Rochester, MN (Presenter) Nothing to Disclose
Steven Dolan, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
John M. Barlow, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Michael L. Wells, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Shannon P. Sheedy, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Jeff L. Fidler, MD, Rochester, MN (Abstract Co-Author) Research Grant, Beekley Corporation
Thomas C. Smyrk, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Joel G. Fletcher, MD, Rochester, MN (Abstract Co-Author) Grant, Siemens AG;

PURPOSE

Small bowel Gastrointestinal Stromal Tumors (sbGISTs) often have an indeterminate malignant potential and can be discovered in the workup of obscure GI bleeding (OGIB) or incidentally at abdominopelvic CT. We sought to determine the impact of CT enterography for sbGIST detection at our institution in a consecutive series of pathologically proven tumors.

METHOD AND MATERIALS

We retrospectively evaluated all histologically proven sbGISTs from 1998 to 2013. We created a biologic Aggressiveness Score (AS) based on initial histologic grading (low, intermediate, or high grade; or malignant) and clinical follow-up. All low to high grade sbGISTs were upgraded to AS category of malignant if local or distant metastases developed during clinical follow-up. Date and findings at clinical presentation, CT protocol (single-phase CTE [spCTE], multi-phase CTE [mpCTE], and other abdominopelvic CT (oAPCT)) were compared with the AS score.

RESULTS

83 patients with proven sbGISTs had low (n=42), intermediate (n=9), high-grade (n=10), or malignant tumors (n=22) AS. 23 patients (28%) had mpCTE, 15 (18%) had spCTE, and 45 (54%) had oAPCT exams. Mean clinical follow up was 36 months (for CTE and oAPCT exams). Over the time interval, the number of malignant sbGISTs remained constant (1-2 per year), but the number of low and intermediate grade tumors increased substantially (mean 0.7 per year from 1998-2005 to mean 5.8 per year from 2006-2013), as did the total number of sbGISTs. 34 pts with sbGISTs underwent CT for OGIB, with 5/27 (19%) of CTE exams identifying malignant sbGISTs, compared to 4/7 (57%) for oAPCT. CTE exams detecting sbGISTs were predominantly performed for OGIB (27/38; 71%), while oAPCT exams identified sbGISTs incidentally for non-OGIB indications (29/45; 64%). The average size of sbGISTs detected by CTE was 3.9 vs. 7.5 cm for oAPCT.

CONCLUSION

The incidence of sbGISTs appears to be increasing, in large part due to the increased detection of these tumors with CTE, usually performed in OGIB patients. The majority of sbGISTs detected with CTE are not malignant.

CLINICAL RELEVANCE/APPLICATION

The incidence of non-malignant small bowel GIST tumors is increasing dramatically, likely due to the use of CTE in OGIB, while the number of malignant GISTs has remained stable since 1998.
**SSE09**

**Gastrointestinal (Liver Functional Imaging)**

**Monday, Nov. 30 3:00PM - 4:00PM Location: E451A**

**GI MR**

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

**FDA** Discussions may include off-label uses.

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**Participants**
Claude B. Sirlin, MD, San Diego, CA (Moderator) Research Grant, General Electric Company; Speakers Bureau, Bayer AG; Consultant, Bayer AG ; ;
Aliya Qayyum, MBBS, Houston, TX (Moderator) Nothing to Disclose

**Sub-Events**

**SSE09-01** MR Elastography in Combination with MRI Proton Density Fat Fraction for Prediction of Advanced Hepatic Fibrosis in Adults with Non-Alcoholic Fatty Liver Disease

**Monday, Nov. 30 3:00PM - 3:10PM Location: E451A**

To determine in adults with non-alcoholic fatty liver disease (NAFLD), whether the combination of magnitude MRI (M-MRI)-estimated proton density fat fraction (PDFF) with MR elastography (MRE)-estimated liver stiffness improves the prediction of advanced fibrosis compared to MRE alone.

**METHOD AND MATERIALS**

This retrospective analysis included 123 adults with confirmed NAFLD (49 men, mean age 52 yrs, range 19-76 yrs) who underwent M-MRI and MRE within 90 days of liver biopsy. Biopsies were scored based on NASH CRN criteria; 46%, 27%, 14%, 9% and 4% of adults had stage 0, 1, 2, 3, and 4 fibrosis, respectively. Fibrosis stages 3-4 were considered to be advanced fibrosis. PDFF was estimated by M-MRI performed with low flip angle to avoid T1 weighting, and with six nominally in- and out-of-phase echoes to correct for T2*. Stiffness was estimated by each of two MRE methods (3D 40Hz, 3D 60Hz). Logistic regression was performed for each MRE method alone, and for each MRE method in combination with PDFF, to predict advanced fibrosis. AUROCs were calculated for each logistic regression model and compared pairwise using chi-squared tests.

**RESULTS**

For 3D MRE 40Hz and 3D MRE 60Hz, AUROCs (95% CI) for predicting advanced fibrosis with MRE alone were 0.960 (0.907, 1) and 0.948 (0.881, 1), respectively. AUROCs (95% CI) for predicting advanced fibrosis with MRE in combination with PDFF for these two methods were 0.970 (0.920, 1) and 0.962 (0.906, 1), respectively. Each of these AUROCs was significantly greater than the corresponding AUROC achieved with MRE alone (p-values 0.007 and 0.012).

**CONCLUSION**

In adults with NAFLD, M-MRI estimated PDFF combined with MRE-estimated liver stiffness provided a small but statistically significant improvement for predicting advanced fibrosis compared to MRE alone.

**CLINICAL RELEVANCE/APPLICATION**

Estimation of both hepatic PDFF and liver stiffness in a single MR examination may improve prediction of advanced fibrosis in adults with NAFLD, but further study is needed to confirm the results.

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**SSE09-02** Liver Hemodynamics Quantification with DCE-MRI for Hepatic Reserve Function Assessment in Patients with Post-hepatic Liver Cirrhosis (PHLC)

**Monday, Nov. 30 3:10PM - 3:20PM Location: E451A**

To determine in adults with post-hepatic liver cirrhosis (PHLC), whether the combination of dynamic contrast-enhanced MRI (DCE-MRI) for liver hemodynamics improves the prediction of hepatic reserve function compared to MRE alone.

**METHOD AND MATERIALS**

This prospective analysis included 20 adults with confirmed PHLC (12 men, mean age 53 yrs, range 26-78 yrs) who underwent DCE-MRI and MRE within 90 days of liver biopsy. Biopsies were scored based on MELD criteria; 40%, 30%, 20%, 10% and 10% of adults had stage 1, 2, 3, 4, and 5 liver function, respectively. Liver function stages 3-5 were considered to be advanced liver function. Hemodynamics were assessed by DCE-MRI using a liver-specific contrast agent, and by MRE using a liver-specific contrast agent. Logistic regression was performed for each hemodynamic parameter alone, and for each hemodynamic parameter in combination with MRE, to predict advanced liver function. AUROCs were calculated for each logistic regression model and compared pairwise using chi-squared tests.

**RESULTS**

For DCE-MRI parameters, AUROCs (95% CI) for predicting advanced liver function with DCE-MRI alone were 0.810 (0.689, 0.931) and 0.825 (0.696, 0.954), respectively. AUROCs (95% CI) for predicting advanced liver function with DCE-MRI in combination with MRE for these two methods were 0.810 (0.689, 0.931) and 0.825 (0.696, 0.954), respectively. Each of these AUROCs was significantly greater than the corresponding AUROC achieved with DCE-MRI alone (p-values 0.007 and 0.012).

**CONCLUSION**

In adults with PHLC, DCE-MRI estimated hemodynamics combined with MRE-estimated liver stiffness provided a small but statistically significant improvement for predicting advanced liver function compared to MRE alone.

**CLINICAL RELEVANCE/APPLICATION**

Estimation of both liver hemodynamics and liver stiffness in a single MR examination may improve prediction of advanced liver function in adults with PHLC, but further study is needed to confirm the results.
To evaluate the value of (dynamic contrast-enhanced magnetic resonance imaging, DCE-MRI) for hepatic reserve function assessment in patients with Post-hepatic liver cirrhosis (PHLC)

**METHOD AND MATERIALS**

Ten normal subjects, ten mild PHLC patients (Child-Pugh score 5-6) and ten moderate PHLC patients (Child-Pugh score 7-9) were prospectively enrolled and underwent DCE-MRI before clinical treatment. All data were calculated with Exchange Model fitting Pharmacokinetic curve and various parameters were measured, including volume transfer constant of the contrast agent (Ktrans), Reverse reflux rate constant (Kep), Volume fraction of EES (Ve), full perfusion (FP), hepatic arterial perfusion index (HPI), blood volume (BV), blood flow (BF) mean transit time (MTT). All data was assessed with ANOVA and LSD test was used to compare the differences between each two groups. P < 0.05 was considered statistically significant.

**RESULTS**

Compared with normal liver, increases of HPI and FP were found significant in mild PHLC group (p<0.05), as well as in moderate PHLC group (p<0.01). MTT was constant between normal group and mild PHLC group, but increased in moderate PHLC group (p<0.05). BV was found no significant difference between normal and mild PHLC group, but decreased in moderate PHLC group (p<0.05). BF was found no significant difference between each two groups of three groups. Compared with normal group, Ktrans, Kep and Ve were found no significant in mild PHLC group (p>0.05), only Ve increased in moderate PHLC group (p<0.05).

**CONCLUSION**

The quantified DCE-MRI parameters, such as HPI, FP, MTT and Ve could be helpful to evaluate hepatic reserve function of PHLC.

**CLINICAL RELEVANCE/APPLICATION**

DCE-MRI suggests that it could be used as an important index for the degree of PHLC and hepatic reserve function assessment.

**SSE09-03**  
**Biliary Tract Enhancement during the Hepatobiliary Phase in Gadoxetic Acid-enhanced MRI: Correlation with Non-invasive Biomarker Associated with Liver Function and Fibrosis**  
Monday, Nov. 30 3:20PM - 3:30PM Location: E451A

Participants  
Yoshifumi Noda, MD, Gifu, Japan (Presenter) Nothing to Disclose  
Satoshi Goshima, MD, PhD, Gifu, Japan (Abstract Co-Author) Nothing to Disclose  
Haruo Watanabe, MD, Gifu, Japan (Abstract Co-Author) Nothing to Disclose  
Hiroshi Kawada, MD, Gifu, Japan (Abstract Co-Author) Nothing to Disclose  
Nobuyuki Kawai, MD, Gifu, Japan (Abstract Co-Author) Nothing to Disclose  
Hiromi Ono, MD, Gifu, Japan (Abstract Co-Author) Nothing to Disclose  
Masayuki Kanematsu, MD, Gifu, Japan (Abstract Co-Author) Nothing to Disclose  
Kyongtae T. Bae, MD, PhD, Pittsburgh, PA (Abstract Co-Author) Patent agreement, Medtronic, Inc; Consultant, Otsuka Holdings Co, Ltd

**PURPOSE**

To evaluate the correlation between the magnetic resonance (MR) imaging measurements and non-invasive biomarker associated with liver function and fibrosis in gadoxetic acid-enhanced MR imaging.

**METHOD AND MATERIALS**

This retrospective study was approved by our institutional review board and written informed consent was waived. One hundred thirty nine consecutive patients (89 men and 50 women, age range 33-87 years, mean age 67 years ± 12.6 [standard deviation]) with suspected a liver disease or liver tumor underwent gadoxetic acid-enhanced MR imaging. Patients were classified into two groups according to the model for end-stage liver disease (MELD) score: MELD group A, MELD score ≤ 10 (n = 129); MELD group B, MELD score > 10 (n = 10). We calculated the following liver function indices: the biliary tract structure-to-muscle signal intensity ratio (SIR), relative enhancement of the liver and, liver-to-spleen ratio. MR imaging measurements and Child-Pugh score or MELD score were then compared.

**RESULTS**

Multiple regression analysis showed that SIR of common bile duct and cystic duct were the most significantly correlated with Child-Pugh score (P < 0.0001) and MELD score (P = 0.0017), respectively. The sensitivity, specificity, and area under the receiver-operating-characteristic curve for the detection of patients with Child-Pugh class B or C, and MELD group B were 74%, 68%, and 0.86 with the SIR of common bile duct and 100%, 87%, and 0.94 with the SIR of cystic duct, respectively.

**CONCLUSION**

The SIRs of cystic duct and common bile duct can be a non-invasive and valuable imaging biomarker for the estimation of liver function.

**CLINICAL RELEVANCE/APPLICATION**

Our study demonstrated the SIRs of cystic duct and common bile duct possibly correlate with non-invasive biomarker associated with liver function and fibrosis. This index may be an important quantitative biomarker for the evaluation of liver function and fibrosis.

**SSE09-04**  
**Multidisciplinary Evaluation of Congestive Hepatopathy after Fontan Procedure - Preliminary Results**

Monday, Nov. 30 3:30PM - 3:40PM Location: E451A

Participants  
Natally d. Horvat, MD, Sao Paulo, Brazil (Presenter) Nothing to Disclose  
Rocha Manoel, MD, PhD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose  
Hilton M. Leao Filho, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose  
Nana Ikari, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
PURPOSE
To analyze the frequency of hepatopathy in a group of patients submitted to Fontan Procedure (FP) at our Hospital.

METHOD AND MATERIALS
In this cross-sectional study, 15 patients from our Hospital Cardiology department were evaluated from August 2014 to December 2014. Inclusion criteria were age above 18 years old and at least 5 years after FP. These patients were submitted to laboratorial tests and to different imaging techniques of the liver: 1) CT with iodinated contrast media (ICM), 2) MRI with hepatobiliary contrast, 3) ultrasound (US) and 4) liver ultrasound elastography (Fibroscan® and ARFI). Three patients did not undergo CT because of history of allergic reaction to ICM.

RESULTS
Patients' mean age was 9 years (range 2 - 15) at the time of the final FP and 24 years (range 18 - 31) at the time of this study. No patients had clinical signs of liver disease or laboratorial findings indicating other hepatic disorders. Radiological features of hepatopathy were found in 14 (93%) patients at US, in 7 patients (73%) at CT and in all 15 (100%) patients at MRI with overall agreement of 94%. Hepatic nodules were detected in 2 patients at US. Among the 12 patients that underwent CT, 3 presented hepatic nodules (25%), with a total of 12 nodules with mean size of 1.2 cm (range 1.1 - 2.2 cm). All nodules were hypervascular on arterial phase and were also characterized on MRI. Hepatic nodules were detected in 4 patients at MRI (27%) with a total of 13 nodules with mean size of 1.3 cm (range 1.1 - 2.2 cm). All nodules presented isointense on T1WI, one was hypointense on T2WI, none presented diffusion restriction and all nodules were hypervascular in the arterial and hepatobiliary phases, except one that was hypovascular in these phases. Small hypervascular foci in the hepatobiliary phase MRI was seen in 11 patients (75%). All patients presented increasing liver stiffness at Fibroscan®, mean 20.0 kPa (range 6.7 - 24.0 kPa) and at ARFI, mean 1.96 (range 0.82 - 3.93).

CONCLUSION
Hepatic complications are frequent in patients who underwent FP including hepatic fibrosis, cirrhosis and hepatic nodules.

CLINICAL RELEVANCE/APPLICATION
A proper evaluation in patients submitted to FP is important to allow early recognition and treatment of liver complications. Hepatic nodules have been observed in FP patients but the nature of these nodules remains uncertain, although there are reports of malignancy.

SSE09-05 Measuring Hepatic Functional Reserve Using T1 Mapping with Gadoxetic Acid Enhanced 3T MR Imaging: A Preliminary Study Comparing 99mTc GSA Scintigraphy with Indocyanine Green (ICG) Retention

Participants
Tomohiro Namimoto, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
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Kie Shimizu, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Masafumi Kidoh, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Seitaro Oda, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Nakaura Takeshi, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Daisuke Utsunomiya, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Yasuyuki Yamashita, MD, Kumamoto, Japan (Abstract Co-Author) Consultant, DAIICHI SANKYO Group

PURPOSE
To test whether T1 mapping of liver parenchyma on gadoxetic acid (Gd-EOB-DTPA) enhanced 3T MRI correlates with the parameters of Technetium-99m galactosyl serum albumin (99mTc-GSA) scintigraphy and indocyanine green (ICG) retention for the measurement of liver functional reserve.

METHOD AND MATERIALS
Sixty-six patients (43 HCC, 18 metastasis, 5 CCC) awaiting liver resection or TACE were included in this retrospective study. T1 relaxation times of the liver post-contrast enhancement images were measured using Look-Locker sequences 20 minutes after Gd-EOB-DTPA administration. For 99mTc-GSA scintigraphy, the blood clearance index HH15 and LHL15 was recorded. ICG retention at 15 min was also recorded. Statistical analysis involved Kruskal-Wallis test and Pearson correlation.

RESULTS
The T1 relaxation times for Gd-EOB-DTPA-enhanced MRI showed significant differences between patients with normal hepatic function (p < 0.01) or mild hepatic functional damage (p < 0.05) and moderate hepatic functional damage defined by HH15. The T1 relaxation times for Gd-EOB-DTPA-enhanced MRI showed a constant increase from normal hepatic function to severe hepatic functional damage (normal, 313 ± 43ms; mild, 349 ± 89 ms; moderate, 489 ± 143 ms; severe, 491 ± 11 ms). Regression analysis showed a correlation between T1 relaxation times for Gd-EOB-DTPA enhanced MRI and other liver functional parameters (T1 versus HH15, R2=0.38; T1 versus LHL 15, R2=0.30; T1 versus ICG clearance R2=0.57; HH15 versus ICG clearance R2=0.48; LHL 15 versus ICG clearance R2=0.45).

CONCLUSION
The T1 relaxation time for Gd-EOB-DTPA enhanced MRI has the potential to serve as a representative of MRI-based liver functional...
reserve. It is strongly correlated with ICG clearance and moderately correlated HH15/LHL15 with 99mTc-GSA.

**CLINICAL RELEVANCE/APPLICATION**
The T1 relaxation time for Gd-EOB-DTPA enhanced MRI has the potential to serve as a representative of MRI-based liver functional reserve.

**SSE09-06 Visual Assessment of Graft Dysfunction in Liver Transplant Recipients Using Gadoxetic Acid-enhanced MRI**

Participants
- Nina Bastati, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
- Andreas G. Wibmer, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
- Dietmar Tamandl, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
- Jacqueline C. Hodge, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
- Henrik Einspieler, Vienna, Austria (Presenter) Nothing to Disclose
- Sarah Poetter-Lang, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
- Ahmed Ba-Ssalamah, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To evaluate whether a qualitative visual scoring system, using specific features of gadoxetic acid-enhanced MRI, could be applied to estimate liver graft (OLT) function and survival probability.

**METHOD AND MATERIALS**
85 patients, 31 females (36.5%) and 54 males (63.5%) with a median age of 54.6 years were examined on a 3 Tesla MR. All patients received a bolus injection of 0.025 mmol/kg body weight of gadoxetic acid at 1 mL/sec. Dynamic imaging was subsequently performed, including a 20 minute hepatobiliary phase (HBP). Two readers independently analyzed the unenhanced and HBP-enhanced MR images qualitatively. The degree of contrast parenchymal enhancement, i.e., enhancement quality score (EnQS) (0-2) and biliary CM excretion, i.e., excretion quality score (ExQS) (0-4) as well as the persistence of signal intensity (SI) in the portal vein, the so-called “portal vein sign (PVS)” quality score (PVSQS) (0-1) on the HBP were assessed. A quantitative measurement on the unenhanced and HBP-enhanced MR images was performed, as well, to measure the relative liver parenchymal enhancement (RLE) at 20 minutes (i.e., HBP). The probabilities of graft survival were calculated by Kaplan-Meier survival estimates and Cox proportional hazard regression models with Firth's correction.

**RESULTS**
The inter-reader agreement for the qualitative assessment of EnQS, ExQS, PVSQS according to the suggested scale was almost perfect (κ: 0.81). Univariate survival analysis showed that the EnQS, ExQS, and PVSQS were independently associated with the probability of graft survival, respectively.

**CONCLUSION**
Qualitative assessment using PVSQS, EnQS, and ExQS on gadoxetic acid enhanced-MRI allows us to estimate the graft survival probability after OLT.

**CLINICAL RELEVANCE/APPLICATION**
Gadoxetic acid-enhanced MRI can be used as a non-invasive imaging biomarker to predict the liver graft survival probability.
SSE10

**ISP: Genitourinary (GU Intervention)**

**SSE10-01** Genitourinary Keynote Speaker: Renal Tumor Ablation—Current Status and Future Directions

**Participants**
Douglas S. Katz, MD, Mineola, NY (*Moderator*) Nothing to Disclose
Cary L. Siegel, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

**SSE10-02** Real-time MR-guided Renal Cryoablation: Technical Feasibility, Complications and Outcomes

**Participants**
Ronald J. Zagoria, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

**SSE10-03** Single Institution Review of Percutaneous Cryoablation in the Horseshoe Kidney: An Initial Experience

**Participants**
Junjian Huang, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Thomas D. Atwell, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Anil N. Kurup, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Stephen Boorjian, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Robert Thompson, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Grant D. Schmit, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To present the initial case series of percutaneous cryoablation of tumors in a horseshoe kidney.

**METHOD AND MATERIALS**
This is a single center retrospective review of 5 consecutive patients with a renal mass in a horseshoe kidney treated with percutaneous image-guided cryoablation from June of 2006 to August of 2013. Patient and tumor characteristics were extracted from the electronic medical record. Oncologic outcomes were defined using standardized criteria.

**RESULTS**
Average age of patient was 59 years old (4M, 1F), tumor size was 3cm (±1cm), and serum creatinine was 1.1±0.4. Of the 5 patients, 4 patients had biopsy proven clear cell renal cell carcinoma, and 1 patient had biopsy proven carcinoid. Technical success was achieved in all patients. The median follow-up duration is 19 months. There were no major complications. Transient elevation of creatinine, not requiring dialysis, occurred following treatment in one patient which has since normalized to baseline. A single patient had inguinal nerve pain that resolved within 3 months. Mean creatinine at follow-up was 1.1±0.3. All patients remain free of local tumor progression. Two patients expired 46 months and 24 months after ablation due to unrelated disease.

**CONCLUSION**
There is a paucity of data with regard to the safety, efficacy, and long term outcome of percutaneous cryoablation in the horseshoe kidney. From our initial series it seems that cryoablation is relatively safe in the treatment of small renal tumors, without impact on renal function. This is the first reported series of cryoablation in the horseshoe kidney and, in select patients, may present an alternative to surgical management.

**CLINICAL RELEVANCE/APPLICATION**
Percutaneous cryoablation represents an alternative treatment modality in patients with a small renal mass on a horseshoe kidney.

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Syed Muhammad Faiq, MBBS, Karachi, Pakistan (Presenter) Nothing to Disclose
Khair Muhammad, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose
Waseem A. Mirza, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Nonsurgical tubal occlusion by Essure coils was FDA (Food and Drug Administration) approved in 2002 for hysteroscopic placement by gynecologists. Occasionally hysteroscopic placement of one or both coils is not possible—or the coil perforates or is expelled from the tube. Fluoroscopic fallopian tube catheterization has been used since 1987 as a nonsurgical method for unblocking proximal tubal occlusion in women with infertility. The feasibility of fluoroscopic fallopian tube catheterization for placement of Essure coils was explored.

**METHOD AND MATERIALS**
Women were referred by their gynecologists because of complications after hysteroscopic placement of the Essure device. No pre-medication, sedation, or anesthesia was given. Commercially available equipment was used to perform hysterosalpingogram, fallopian tube catheterization, and Essure placement. Equipment consisted of a 9 Fr balloon catheter for use in the cervix and uterus (Cook Medical), a 5 Fr catheter and 0.035 inch diameter hydrophilic guidewire for use in the fallopian tube (Cook Medical), and the Essure device and delivery system (Bayer Pharmaceutical).

**RESULTS**
Twelve women had attempt at fluoroscopic Essure placement in 14 tubes. Procedure was successful in 12/14 tubes (86%), including 5 tubes where hysteroscopic placement had failed, 2 tubes where hysteroscopic placement resulted in perforation, 3 tubes in which device was expelled after hysteroscopic placement, and 2 tubes with hydrosalpinx. Fluoroscopic placement failed in 2 tubes, in one because of severe tubal spasm which was also the reason for hysteroscopic failure, and in one tube (in which device had been expelled) because of pain during the procedure attributed to severe endometriosis. There were no complications. Six women have had post-procedure confirmation hysterosalpingograms required by the FDA and all 6 tubes with devices placed fluoroscopically were occluded (100%).

**CONCLUSION**
Ten of 12 high risk women (83%) who had failed Essure placement by hysteroscopy on one or both sides had subsequent successful fluoroscopic procedures allowing them to rely on the Essure devices for tubal occlusion. Twelve of 14 tubes (86%) were amenable to fluoroscopic placement of the Essure device.

**CLINICAL RELEVANCE/APPLICATION**
Ten of 12 women (83%) who would have been considered Essure failures and referred for tubal ligation, were converted to Essure successes by fluoroscopic placement of the device.

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Syed Muhammad Faiq, MBBS, Karachi, Pakistan (Presenter) Nothing to Disclose
Khair Muhammad, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose
Waseem A. Mirza, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Placement of Essure Tubal Occlusion Coils by Fluoroscopy; An Option when Hysteroscopic Placement Fails

Monday, Nov. 30 3:30PM - 3:40PM Location: E351

Participants
Amy S. Thurmond, MD, Portland, OR (Presenter) Nothing to Disclose

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Syed Muhammad Faiq, MBBS, Karachi, Pakistan (Presenter) Nothing to Disclose
Khair Muhammad, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose
Waseem A. Mirza, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Percutaneous Embolization of Varicocele By Steel and Platinum Coils

Monday, Nov. 30 3:40PM - 3:50PM Location: E351

Participants
Syed Muhammad Faiq, MBBS, Karachi, Pakistan (Presenter) Nothing to Disclose
Khair Muhammad, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose
Waseem A. Mirza, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose
The goal of this study was to present our experience with percutaneous treatment of male varicocele in view of procedural, clinical aspects in adult population.

METHOD AND MATERIALS

45 male with clinical moderate to severe varicocele associated with scrotal swelling with "bag of worms" or discomfort in testes, such as heaviness or dull pain after standing all day, referred from urology outpatient department to Radiology Department, where Doppler ultrasound was done which confirms the grade and patient underwent percutaneous varicocele embolization with coil.

RESULTS

The procedural success rate for spermatic vein occlusion was 93%. Follow-up, achieved of every patient after 6 month in urology outpatient department. Forty two patients (93%) reported disappearance of varicocele and as well as pain relief. In two patients percutaneous embolization procedure failed due to internal jugular vein approach and congenital venous abnormality. None of patients reported a reappearance of their varicocele. No significant complications occurred in 42 patients except pain in two patients and hematoma in two patients at femoral punctured site: none had any 6 months sequelae

CONCLUSION

Percutaneous embolization of varicocele carried out as outpatient procedure under local anesthesia and is more beneficial to patient in comparison to surgery. It has high procedural success rates, less recurrence rate, when performed by experience interventional radiologist. We believed primary therapy for varicocele treatment should be embolization if we compared various risk factors associated with surgery.

CLINICAL RELEVANCE/APPLICATION

Procedural and clinical success in elimination of varicocele by steel or platinum coils with low rate of failure and reappearance up to 6 month. High failure rate was seen in our study through internal jugular vein approach for venous access. We believed primary therapy for varicocele treatment should be embolization if we compared various risk factors associated with surgery.

SSE10-06  Hystersalpingo-foam Sonography (HyFoSy): A Prospective Observational Cohort Study of an Innovative, Radiation Free, Safe and Effective, Non(Embryo) Toxic Technique, to Visualize Tubal Patency in an Outpatient / Office Setting

Monday, Nov. 30 3:50PM - 4:00PM Location: E351

Participants
Anurag Singh, MBBS, MD, Sharjah, United Arab Emirates (Presenter) Nothing to Disclose
Tejashree Singh, Dubai, United Arab Emirates (Abstract Co-Author) Nothing to Disclose
Kiran C. Patil JR, MD, Jalgaon, India (Abstract Co-Author) Nothing to Disclose

PURPOSE

This study was conducted to evaluate the efficacy and safety of HyFoSy as a first step routine office procedure for tubal patency testing.

METHOD AND MATERIALS

A prospective observational cohort study was conducted in a medical center from 26/11/2014 - 4/4/2015. 46 patients with subfertility were examined. The mean age of patients was 31 years. The mean duration of subfertility was 2.2 years. The patients were asked to report for the test, on days 7-9 of their menstrual cycle. All patients were at low risk for tubal disease and had no history of tubal surgery. A non(embryo) toxic foam was created by rigorously mixing 10 ml hydroxymethylcellulose glycerol gel (88.25% water) with 10 ml purified water to give a mixture containing 94.10% water in a 20 ml syringe, and was introduced into the uterine cavity with the help of a disposable 5F single balloon catheter. This foam had low viscosity and was sufficiently stable to show echogenicity for at least 5 minutes. Tubal patency was determined by transvaginal ultrasound demonstration of echogenic dispersion of foam through the Fallopian tubes and the peritoneal spillage. The tubal contour, length and relation of spill with respect to ipsilateral ovary, were also noted. The pain score was calculated. No precautions with regard to pregnancy were advised.

RESULTS

In 45/46 (98%) patients (except 1 case of cervical stenosis), a successful procedure was performed. In these cases, there was no further need for a hysterosalpingogram (HSG). 42 patients (94%) had bilateral patent tubes and 3 patients (6%) had unilateral patent tubes. Only 1 patient (1/45; 2%) had mild vasovagal discomfort during the procedure that resolved spontaneously. The average pain score was 2.2. All procedures were uneventful and no serious side-effects were observed. Furthermore, in 10 patients (22%) conception occurred within a median of 3 months after the procedure. Review of literature found our results comparable with other similar studies.

CONCLUSION

Thus, HyFoSy is a successful, less painful and radiatian free technique, easily performed in an office setting as a first step test for tubal patency.Comparison with other tubal patency tests was done as per the literature evaluation and our old experiences. It showed excellent findings in favor of HyFoSy.

CLINICAL RELEVANCE/APPLICATION

HyFoSy is a radiation free, less painful, non(embryo) toxic, effective alternative to HSG and definitely has a potential to be the new generation patient friendly first step office test for tubal patency.
PURPOSE

Ultra-short echo-time (UTE) MRI provides echo times (TE) in the range of tens of microseconds, which allows for effective imaging of tissues that have rapid signal decay, e.g., kidney stones. In this study, we investigate the imaging performance of UTE MRI for stones embedded within their usual milieu, the kidney, thus mimicking the in vivo situation.

METHOD AND MATERIALS

24 kidney stones passed/extracted from patients were obtained. The stones represented 8 different types (confirmed by micro CT): calcium oxalate monohydrate (COM), calcium oxalate dehydrate (COD), brushite, apatite, uric acid (UA), struvite, cystine, and mixed-composition. Each stone type was represented by 3 stones in a range of sizes: small (2-3 mm), medium (4-6 mm), and large (7-10 mm). A total of 8 pig kidneys, purchased from a local meat store, were used in the experiments. Using small cuts, three stones (large, medium, and small) of the same type were inserted into each kidney, each into a different calyx (Fig 1a). The kidneys were arranged in a small plastic container filled with water and covered with a sealed lid (Fig 1b), and then imaged on a Siemens 3T MRI scanner using an 18-channel body surface coil and an optimized 3D UTE pulse sequence.

RESULTS

All stones were successfully visualized. The resulting images clearly showed the stones' shapes with high resolution (Fig 1c). Although efforts were made to expunge air bubbles throughout the pre-scan process, air gaps still existed inside some of the kidneys, which resulted in some artifacts. Using the body surface coil and large FOV did not adversely affect stone visualization, which is promising for future in vivo imaging.

CONCLUSION

This study confirms the potential of MRI for in vitro imaging of stones in kidneys using the body surface coil, which is one step closer to in vivo imaging than phantom experiments with head or knee coils. If successful for true in vivo imaging, the UTE technique could serve as an alternative to CT for imaging patients for whom minimization of radiation exposure is desirable. The sequence could be also added to abdominal MRI protocols for comprehensive evaluation of the genitourinary system.

CLINICAL RELEVANCE/APPLICATION

Although CT is the modality of choice for imaging kidney stones, UTE MRI may provide an effective alternative when there are concerns about radiation exposure.
130 consecutive patients with suspected urolithiasis underwent non-enhanced CT in our department with various techniques: 48 patients were examined with a novel tin filtration (150kV Sn) method (group 1) on a third-generation dual-source-CT, 33 patients were examined with automated kV-selection (80-140kV) based on the scout view with the same CT-device (group 2) and 49 patients were examined on a second-generation dual-source-CT (group 3) also with automated kV-selection (80-140kV) based on the scout view. Automated exposure control was active in all groups. Image quality was subjectively evaluated on a 5-point-likert-scale by two radiologists and interobserver agreement as well as signal-to-noise-ratio (SNR) was calculated. Dose-Length-Product (DLP) and volume based CT weighted Dose Index (CTDIcon) were used to analyze radiation exposure.

RESULTS
Image quality was rated in favour for the tin filter protocol with an excellent interobserver agreement (ICC=0.86-0.91). SNR was significantly better in group 1 and 2 compared to second-generation DSCT (p<0.001). On third-generation dual-source CT, there was no significant difference in SNR between the 150 kV Sn and the CAREkV protocol (p=0.5). DLP of group 1 was significantly lower in comparison to group 2 and 3 by 23% and 27% (93 vs. 122 vs. 127mGy/cm; p<0.002). CTDIcon of group 1 was significant lower compared to group 2 (-36%) and 3 (-32%) (1.95 vs. 3.09 vs. 2.87 mGy; p<0.001).

CONCLUSION
Additional shaping of a 150kV spectrum by a tin filter substantially lowers patient exposure while improving image quality on abdominal Computed Tomography for urinary stone disease.

CLINICAL RELEVANCE/APPLICATION
The novel tin filtered technique reduces radiation exposure and improves image quality in comparison to standard low-dose abdominal CT, thus serving to benefit the patient.

SSE11-03 Predictive Value of Low Dose and Dual-Energy CT for Successful Stone Disintegration in Shock Wave Lithotripsy: An in-Vitro Study

Monday, Nov. 30 3:20PM - 3:30PM Location: E353B

Participants
Sebastian Winkhofer, MD, San Francisco, CA (Presenter) Nothing to Disclose
Lango Remo, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Christian Fankhauser, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Cedric Poyet, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Pirmin Wolfgnugler, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Tullio Sulser, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Hatem Alkadhi, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Paul Stolzmann, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose

PURPOSE
Shock wave lithotripsy (SWL) represents the golden treatment for urinary stone disease. Failure of stone disintegration results in repeated treatments or alternative procedures, thereby not only increasing medical costs. The ability to predict successful SWL will improve the selection of patients suitable for SWL. This study investigates single energy computed tomography (SECT) and dual-energy computed tomography (DECT) to predict numbers of shock waves to stone disintegration in an in-vitro setting.

METHOD AND MATERIALS
A total of 33 human urinary calculi (10 uric acid, 8 hydroxyapatite, 6 calcium oxalate monohydrate, 5 cysteine, 3 struvite, 1 brushite stones, mean size 6±3 mm) were scanned using a 128-slice DECT machine (Somatom Force, Siemens Healthcare, Forchheim, Germany) with single- (120kVp) and dual-energy settings (80/150, 100/150kVp) resulting in 6 different SECT and DECT data sets. Calculi were disintegrated using an electromagnetic Dornier DL50 lithotrypter (Dornier MedTech, Wessling, Germany) over a 2-mm mesh until successful disintegration.

RESULTS
All stones were successfully disintegrated by applying a median of 72 shock waves (interquartile range 343). Regarding logistic regression analysis, CT numbers significantly (p<0.01) predicted fewer or more than median shock waves to successful disintegration and differed among data sets (p<0.05), both adjusted for stone composition (p<0.001) and size (p<0.001). Correlation coefficients ranged from rho=0.36 to 0.68 with best correlation for CT numbers and shock waves at 80 kVp (p<0.001).

CONCLUSION
Lower CT numbers are significantly associated with fewer shockwaves needed which is independent of stone composition and size. Optimal prediction of SWL success may be fascilated on the basis low-dose CT data which is paralleled by a low radiation dose.

CLINICAL RELEVANCE/APPLICATION
Being able to predict the success of shock wave lithotripsy with low-dose computed tomography would be helpful to determine the optimal management in patients with urinary calculi.

SSE11-04 Feasibility of Split-filter Dual-energy CT for in-Vitro Differentiation of Urinary Stones by Using Dose-neutral (Compared with Single-energy CT) Protocol

Monday, Nov. 30 3:30PM - 3:40PM Location: E353B

Participants
Anushri Parakh, MBBS, MD, Basel, Switzerland (Presenter) Nothing to Disclose
Daniel Boll, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Andre Euler, MD, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Caroline Zahringer, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Fabian Morsbach, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Daniel Mueller, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
PURPOSE

The study aimed to examine the efficacy of a novel split-filter (using gold and tin filters) single-source dual-energy CT (sf-DECT) in characterizing renal stones as compared to second-generation dual-source dual-energy CT (ds-DECT) in intermediate-sized phantoms using vendor-suggested and dose-neutral (to single-energy CT) protocols.

METHOD AND MATERIALS

Urinary stones (n=65, size: 2.1-6.4mm) of known chemical composition (15 calcium, 15 struvite, 15 cystine and 20 urate) were embedded in a custom-made kidney model and placed in a 30-cm cylindrical water-containing phantom simulating a medium-sized patient. Scans with vendor-recommended and dose-neutral protocols were performed on ds-DECT (SOMATOM Definition Flash, Siemens; protocol A (vendor-suggested) tube A, 100kVp, 210 reference mAs; tube B, Sn140kVp, 162 reference mAs; protocol B (dose-neutral) tube A, 100kVp, 65 reference mAs; tube B, Sn140kVp, 50 reference mAs) and sf-DECT (SOMATOM Definition Edge, Siemens; protocol C (vendor-suggested) AuSn 120kVp, 640 reference mAs; protocol D (dose-neutral) AuSn 120kVp, 235 reference mAs). Stones were assessed by a dedicated post-processing software. Positive (PPV) and negative (NPV) predictive values were calculated. A comparison of radiation doses between both dual-energy techniques was made using CTDIvol parameter.

RESULTS

The CTDIvol (in mGy) for protocols A to D measured 13.7, 4.3, 11.2 and 4.4 respectively. Presence of all stones was detected by the four protocols. The PPV of protocols A-D to characterize urate stones were 95.2, 95.2, 94.1 and 58.6 and for non-urate stones were 100, 100, 93.6 and 96.9, respectively. For clinically significant stones (>4 mm), the PPV for characterizing urate or non-urate stones (100 for both) by protocols A and B was not affected. For the same stone size, PPV of protocols C vs. D were 100 vs 76.9 for urate and 96.4 vs. 96.0 for non urate stones. Dose-neutral sf-DECT was particularly inferior to ds-DECT in characterizing urate stones and stones which were less than 4 mm.

CONCLUSION

While dose-optimization is feasible in differentiation of urate from non-urate stones by ds-DECT for smaller stones, it is accurate for sf-DECT if they are greater than 4 mm in size.

CLINICAL RELEVANCE/APPLICATION

Sf-DECT is a promising new tool for dual-energy evaluation with a benefit of reduced radiation dose as compared to second-generation dual-energy technique.

SSE11-05 Virtual Non-enhanced Images Generated from Spectral CT: Determinants of Detection of Urinary Calculi in the Renal Collecting System

Monday, Nov. 30 3:40PM - 3:50PM Location: E353B

Participants
Yan Chen, Zhengzhou, China (Presenter) Nothing to Disclose
Peijie Lv, MMed, Zhengzhou, China (Abstract Co-Author) Nothing to Disclose
Jianbo Gao, MD, Zhengzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To determine which features of urinary calculi are associated with their detection on VNE images generated from Spectral computed tomographic(CT) urography.

METHOD AND MATERIALS

This retrospective study was approved by the institutional ethics committee with waiver of informed consent. A total of 53 patients were examined with true nonenhanced (TNE) CT and Spectral CT urography in the excretory phase. The contrast medium was virtually removed from excretory-phase images by using material suppressed iodine(MSI), water-based (WB) and calcium-based (CaB) material decomposition (MD) analysis in the spectral imaging viewer. The sensitivity regarding the detection of calculi on these three groups and the subjective scoring were determined by using true non-enhanced (TNE) images as the reference standard, and interrater agreement was evaluated by using the Cohen k test. By using logistic regression, the influences of image noise, attenuation, and stone size, as well as attenuation of the contrast medium, on the stone detection rate were assessed on VNE images.

RESULTS

169 stones were detected on the TNE images; 149 stones were identified on CaB images (sensitivity, 88.2%), 145 stones on WB images (sensitivity, 85.7%), while 160 stones on MSI images (sensitivity, 94.6%) with significant difference. Compared with the TNE images, the relatively lower subjective scoring of the VNE images (P>0.05) and higher SNR, CNR(P<0.05) were identified. Size (long-axis diameter and short-axis diameter), and attenuation of the calculi, except for the image noise were significantly associated with the detection rate on VNE images (P<0.05). As threshold values on CaB, WB, MSI images, size larger than 2.68 mm, 3.01 mm, 2.03 mm, maximum attenuation of the calculi greater than 223 HU, 312 HU and 203 HU respectively were found.

CONCLUSION

After virtual elimination of contrast medium with material decomposition and MSI, large and high-attenuation calculi can be detected with high reliability.

CLINICAL RELEVANCE/APPLICATION

VNE images generated at excretory-phase Spectral CT can depict calculi larger than 2.03 mm in the presence of contrast medium; however, small and hypodensitening calculi may be missed.

SSE11-06 Improved Differentiation between Uric Acid and Non-uric Acid Renal Stones Using DECT Monoenergetic Imaging
PURPOSE
To evaluate monoenergetic attenuation values of renal stones for discriminating between uric acid and non-uric acid stones.

METHOD AND MATERIALS
IRB-approved retrospective study; need for informed consent was waived. We included in our study 37 patients (23M, 14F; mean age 54y) who underwent CT for symptomatic urolithiasis on our second-generation dual-source scanner. We performed a 120kV single-energy low-dose acquisition of the whole abdomen followed by one or more 100/140kV dual-energy acquisitions limited to the regions in which one or more stones were detected. All patients subsequently underwent stone extraction or they spontaneously expelled the stone within 1 month from the examination; all the obtained stones were analyzed by means of infrared spectroscopy and classified, according to their prevalent composition, as uric acid or non-uric acid stones. When patients had >1 stone, their composition was considered the same for all the stones. Stones largest diameter was noted. One radiologist in training evaluated by means of a round ROI the monoenergetic attenuation values of the stones from 40 to 190 kV. 40/190kV monoenergetic attenuation ratios were calculated. A qualitative analysis on the monoenergetic curves was also performed.

RESULTS
75 stones were detected in 37 patients; 36 stones were located in the urinary calices, 13 in the renal pelvis, 25 in the ureters and 1 in the urinary bladder. Mean diameter was 6.1 mm (range 2-28 mm). At spectroscopy, 16/75 stones were prevalently composed by uric acid and 59/75 by cysteine or calcium oxalates/phosphates. Mean 40/190kV monoenergetic attenuation ratios were 0.82 for uric-acid stones (range 0.30-1.34) and 3.82 for non-uric acid stones (range 2.18-7.35)(p<0.0001). All uric-acid stones were correctly characterized using a cut-off of 1.5. Qualitative analysis of monoenergetic curves showed a different and easily recognizable shape both for uric acid and non-uric acid stones.

CONCLUSION
40/190 kV attenuation ratios accurately differentiate uric acid from non-uric acid stones. Furthermore, qualitative analysis of monoenergetic curves can be an easy method to rapidly assess stone composition.

CLINICAL RELEVANCE/APPLICATION
40/190 kV monoenergetic attenuation ratio accurately predicts renal stone composition, even in small calculi, leading to a more accurate treatment planning.
**SSE12-01 Health Service, Policy and Research Keynote Speaker: Increasing Transparency of Costs and Utilities Used in Cost-effectiveness Analyses**

**Participants**
Christoph I. Lee, MD, Los Angeles, CA (Moderator) Nothing to Disclose
Pari Pandharipande, MD, MPH, Boston, MA (Moderator) Nothing to Disclose

**SSE12-02 Cost-effectiveness of Initial MRCP versus a Risk Stratification Algorithm for Management of Suspected Choledocholithiasis**

**Participants**
David H. Hoffman, MD, New York, NY (Presenter) Nothing to Disclose
Scott Braithwaite, MD,MSc, New York, NY (Abstract Co-Author) Nothing to Disclose
Stella Kang, MD,MSc, New York, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
For symptomatic cholelithiasis, a number of diagnostic strategies with conflicting recommendations for MRCP have been proposed for evaluating suspected common duct (CD) stones. Our purpose was to analyze the cost-effectiveness of the American Society of Gastrointestinal Endoscopy (ASGE) risk stratification guidelines for triage to endoscopy or MRCP, versus uniform MRCP for all patients with suspected CD stones.

**METHOD AND MATERIALS**
A decision-analytic model was constructed to compare cost and effectiveness of three diagnostic strategies for suspected CD stones: non-contrast MRCP for all patients, contrast-enhanced MRCP for all patients, or application of ASGE criteria based on lab values and patient characteristics (contrast-enhanced MRCP for intermediate risk, ERCP for high risk, and no test for low risk of CD stones); analysis was performed from a societal perspective over a 1 year time horizon. The model accounted for benign or malignant causes of biliary obstruction and procedural complications as informed by the literature. Cost information was based on Medicare reimbursements. Sensitivity analysis assessed effects of parameter variability on model results.

**RESULTS**
Using the ASGE algorithm was less costly than initial non-contrast or contrast-enhanced MRCP ($3577 versus $3645, $3767 respectively). Quality adjusted life years in all strategies were similar (0.947-0.949). ASGE guidelines provided the highest net monetary benefit ($181 more than initial non-contrast MRCP). Results were most sensitive to probability of major procedural complication and cost of endoscopic procedures. Initial MRCP strategies were dominated, and initial non-contrast MRCP became the most cost-effective strategy only with probability of major procedural complication of ≥0.4, and concurrent 85% reduction in cost with ≥95% sensitivity and specificity.

**CONCLUSION**
The ASGE risk stratification criteria for suspected choledocholithiasis offers a cost-effective means of triaging patients to ERCP or MRCP, while initial MRCP is not cost-effective unless sensitivity and specificity are excellent at very low cost. Patients at high risk of procedural complication may benefit from initial MRCP regardless of ASGE classification, however.

**CLINICAL RELEVANCE/APPLICATION**
ASGE criteria for risk stratification in suspected choledocholithiasis provide a cost-effective triage tool to determine the need for MRCP versus direct endoscopic evaluation.

**SSE12-03 Defining the Cost of Advanced Imaging Technology in Image-guided Radiation Therapy Using Time-driven Activity-based Costing**

**Participants**
Nikhil G. Thaker, MD, Houston, TX (Presenter) Nothing to Disclose
Tharakeswara K. Bathala, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Deborah A. Kubar, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Rajat Kudchadker, Houston, TX (Abstract Co-Author) Nothing to Disclose
Usama Mahmood, Houston, TX (Abstract Co-Author) Nothing to Disclose
Ankit Agarwal, BS, Boston, MA (Abstract Co-Author) Nothing to Disclose
Decision support systems for ordering providers do not appear to drive imaging referrals out of hospital systems to other providers. Studies were performed outside of our hospital system.

Of the 175 studies, 97.1% (170/175) were ultimately performed within our hospital system, and only 2.9% (5/175) were performed contrary to the decision support recommendation within 60 days of the index order. 74 (3.1%) CTs and 2,350 CTs and 2,516 MRIs. 175 three insurance companies. These patients had 18,008 MRIs and 18,014 CTs over the study period.

RESULTS
The largest cost drivers were the operating room (40-45% of total cost), treatment planning (9%), and consultation (6-8%). The two MRI protocol scans comprised 14% of the full cycle cost. Personnel comprised 72-77% of all costs, including the radiation oncologist (25%), anesthesiologist (11%), dosimetrist (10%), mid-level provider (5%), and radiologist (4%). The MRI scan was 2.4x more costly than the evaluation and planning CT and ultrasound scans. Full cycle cost from consultation through one year of follow-up after implantation was only 9.8% higher for the MRI protocol than the traditional protocol (Figure).

CONCLUSION
TDABC is a powerful cost accounting tool that can measure the true costs of imaging technologies. MRI holds promise of improving outcomes and reducing costs. Effective yet costly imaging technologies, such as MRI, will need to be evaluated in the context of how they improve outcomes or lower costs over the full cycle of care. Although providers have begun to measure outcomes, cost measurement remains a challenge. In this proof-of-principle study, we utilize time-driven activity-based costing (TDABC) to measure the cost of an MRI protocol compared to a traditional CT and ultrasound-based protocol in prostate brachytherapy (PB).

METHOD AND MATERIALS
Process maps of the traditional protocol and the MRI protocol were created from consultation to 1-year after PB. The MRI protocol utilizes one MRI scan for evaluation and treatment planning and a second scan for post-operative dosimetry, rather than CT and ultrasound scans in the traditional protocol. We identified the resource (personnel, equipment, or facility) and time in minutes required for each step in the care cycle. TDABC costs were calculated by multiplying time by the cost per minute at each step.

RESULTS
The risk-contract insurance database contained an average of 63,378 patients/year (2011: 71,233; 2012: 58,644; 2013: 60,258) from three insurance companies. These patients had 18,008 MRIs and 18,014 CTs over the study period. The number of these studies that had a low decision support appropriateness score and were subsequently canceled were 2,350 CTs and 2,516 MRIs. 175 imaging studies were performed contrary to the decision support recommendation within 60 days of the index order, 74 (3.1%) CTs and 101 (4.0%) MRIs. 97.1% (170/175) of these studies were ultimately performed within our hospital system, and only 2.9% (5/175) of studies were performed outside of our hospital system.

CONCLUSION
Decision support systems for ordering providers do not appear to drive imaging referrals out of hospital systems to other providers.
Implementing decision support systems for ordering providers does not drive out-of-network leakage of referred imaging.

**SSE12-05  Impact of Hyperbolic Discounting on Preferences for Screening for Lung Cancer**

**Monday, Nov. 30 3:40PM - 3:50PM Location: S102D**

**Participants**
- Saurabh Jha, MD, Philadelphia, PA (Presenter) Speaker, Toshiba Corporation
- A. C. Powell, PhD, Boston, MA (Abstract Co-Author) President, Payer-Provider Syndicate; Cofounder, ArxViva, Inc.; Researcher, HealthHelp, LLC

**PURPOSE**

To explore how preferences for screening for lung cancer are influenced by hyperbolic discounting. Behavioral economists have shown that individuals do not uniformly discount events in the near and far future. Instead, events in the far future are discounted at a higher rate than events in the near future. This is relevant to screening for lung cancer because the benefit of reduction in mortality from lung cancer is a far event whereas the harms of screening are a near event. The benefit/risk calculus can be affected by hyperbolic discounting.

**METHOD AND MATERIALS**

Time-variant preferences are explored using a decision model. Cohorts of smokers were modeled at ages 55, 65, and 75. A higher discount rate is applied to outcomes further in the future. Sensitivity analysis explores the effect of varying the differential in the discount rate (degree of hyperbolic discounting) and the risk of early complications of screening. Parameters have been extracted from the National Lung Screening Trial which reported an absolute risk reduction in mortality when screened by CT from lung cancer of 0.4% over seven years, and an absolute increase in major complications of 0.24% over sixty days.

**RESULTS**

Hyperbolic discounting affects the decision to be screened and when to be screened. Preferences are most sensitive at the bounds of the current recommended age range for screening. Framing the outcomes can lead to reversal of preferences.

**CONCLUSION**

Hyperbolic discounting affects the decision of smokers to be screened. Physicians counselling patients for screening for lung cancer should elicit this phenomenon and counsel patients about its presence, while respecting patient choice.

**CLINICAL RELEVANCE/APPLICATION**

We present a conceptual framework for understanding when screening might be foregone in order to enhance shared decision making process.

**SSE12-06  Developing an Economic Strategy for Assessing Pregnancy-related Portable Ultrasound Use in Lower-income Countries: Guatemala, Kenya, Democratic Republic of Congo, Pakistan, and Zambia**

**Monday, Nov. 30 3:50PM - 4:00PM Location: S102D**

**Participants**
- Brian W. Bresnahan, PhD, Seattle, WA (Presenter) Stockholder, Johnson & Johnson
- Elisabeth Vodicka, Seattle, WA (Abstract Co-Author) Nothing to Disclose
- Joseph B. Babigumira, PhD, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
- Robert O. Nathan, MD, MPH, Mercer Island, WA (Abstract Co-Author) Nothing to Disclose
- Zoya Bauer, MD, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
- Jonathan Swanson, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
- David Swanson, Seattle, WA (Abstract Co-Author) Nothing to Disclose
- Elizabeth M. McClure, PhD, Research Triangle Park, NC (Abstract Co-Author) Nothing to Disclose
- Robert L. Goldenberg, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
- Louis P. Garrison, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To assess the existing literature and to develop data collection strategies for conducting an economic evaluation alongside a randomized controlled trial studying portable ultrasound use to improve maternal and neonatal health in five lower-income countries.

**METHOD AND MATERIALS**

We assessed the published literature related to portable ultrasound use in lower-income settings and developed a conceptual model for an economic evaluation linked to a cluster-randomized trial conducted by the Global Network for Women's and Children’s Health Research (Democratic Republic of Congo, Guatemala, Kenya, Pakistan, and Zambia). To evaluate resource use associated with sonographer training, antenatal care, and interventions for pregnancy-related complications, we developed a preliminary conceptual model along with use- and cost-targeted data collection forms.

**RESULTS**

Substantial evidence gaps were identified for large, multi-country clinical studies and there were no comprehensive economic evaluations of portable ultrasound use to improve maternal and neonatal health. Our mapping of care-delivery processes identified components for economic data collection: equipment, training and quality controls for sonographers, antenatal provider visits, and referrals to facilities for pregnancy-related complications, such as urgent or hospital-based care. Country characteristics and health system infrastructure, such as transportation, energy, cultural issues, and competing health programs were also deemed essential to consider for robust economic assessments. Resource use and cost-related data forms were developed and reviewed by sites/experts in participating countries to ensure the face validity, consistency, and appropriateness of our approach.
CONCLUSION

Literature reporting clinical or economic implications of maternal health portable ultrasound use in lower-income countries was limited. Economic evaluations should systematically assess clinical and financial impacts of ultrasound training/equipment, antenatal and follow-up care, identification and treatment of complications, as well as country-level infrastructure and burden on patients.

CLINICAL RELEVANCE/APPLICATION

Collecting trial-based clinical and economic data in lower-income countries will allow decision makers to compare costs and consequences of using portable ultrasound screening in maternal health.
SSE13-01 Using Computed Tomography and 3D Printing (Additive Manufacturing) to Aid Construction of Custom Prosthetics and Attachment Devices for Our Wounded Warriors

**Purpose**

The technology in the design and function of the prosthetics the military uses to restore function and mobility to our wounded warriors is highly advanced and in many instances not yet available to the general public. These typically young patients are extremely active and desire to take part in numerous complex activities such as kayaking, skiing, and scuba. While prosthetists can accommodate and manufacture numerous devices with standard materials and limb assemblies currently on the market, patients often may require individualized prosthetic design and/or modification to enable them to participate fully in more complex activities.

**Method and Materials**

Prosthetists, Rehabilitation Therapists, and Assistive Technologists work in collaboration to digitally design the necessary equipment or prosthetic modification necessary for their wounded warrior's rehabilitation needs. These designs are then produced using additive manufacturing from an array of materials. Many of these designs need to be form fitting to a particular prosthetic socket, impression, or thermoplastic mold. These sockets, impressions, and specialty items can be scanned using computed tomography and digitally reconstructed to produce a virtual three-dimensional model the engineer can use to design the necessary complementary features of the desired prosthetic, device, or attachment. Completed devices are tested for fit and function. Some of these designs and devices require multiple interactions to achieve the overall objective(s).

**Results**

Over 20 unique custom prosthetic and attachments were successfully completed, which featured the use of computed tomography (CT) reconstructions. These included: two sets of Bilateral Hockey Skates; multiple wheelchair mushroom adapters, allowing patients to push their wheelchair without changing their terminal device; and a custom weight lifting prosthetic hand.

**Conclusion**

Additive Manufacturing is the most flexible and applicable solution to aid in these limited quantity production needs. CT imaging can be successfully used to provide proper design of custom attachments and assistive technology devices. Even though some of these prosthetics attachments may be relatively simple in design to an engineer, they make a world of difference in the lives of our wounded warriors.

**Clinical Relevance/Application**

Using Computed Tomography and 3D Printing (Additive Manufacturing) to Aid Construction of Custom Prosthetics.

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SSE13-02 The Remnant Standard Tessellation Language (STL) Volume is a Novel Metric for 3D Printing Quality and the Remnant STL Volume Used to Validate 3D Printing from CT Images of Bone at Reduced Radiation Dose

**Purpose**

Most 3D-Printed (3DP) medical models use CT for its high spatial resolution and signal to noise ratio (SNR). To date, there is no...
published data regarding 3D print quality and CT radiation dose. This study (a) defines the remnant Standard Tessellation Language (STL) volume (STLv) as a metric of 3D print quality and, (b) uses it to evaluate simulated tube current reduction and iterative reconstruction for 3D print bone models.

METHOD AND MATERIALS

Raw CT data (1st gen 320x0.5mm, 80kV, 0.5s rot) from 2 pts underwent noise addition (Poisson, photon stats plus Gaussian, electronic) to simulate 50%, 40%, 30%, and 20% of the clinical ref tube current (155 mAs). For all 10 recons per pt (ref mAs + 4 reduced doses, using both FBP and IR), image SNR was calculated from mean and SD regions of interest. Bone segmentation (Mimics, Materialise) was used (HU>226 threshold) to produce 3D-printable STL files. The remnant STL volume (STLv) was defined by topologic subtraction (union subtracted from intersection: Remnant STLv= |(Configuration U Reference) - (Configuration n Reference)|). Reference standard STLv was obtained from the clinical mAs IR recon.

RESULTS

Pt 1: FBP SNR range was 1.23 (20% dose) to 2.83 (100% dose). Remnant STLv was 2.84% of reference STLv at 30% dose (20% dose STL could not be produced) and reduced to 1.43% at 100% dose. With IR, SNR range was 3.38 (20%) to 4.54 (100%); the remnant STLv was 2.65% of reference at 20% dose, and reduced to 1.31% at 50% dose. Pt 2: FBP SNR range was 1.92 (20%) to 4.21 (100%); Remnant STLv ranged from 2.84% at 40% dose (STLs could not be produced at lower doses) to 1.54% at 100% dose. With IR, SNR range was 4.4 (20%) to 6.36 (100%) and remnant STLv range was 3.86% at 20% dose to 1.8% at 50% dose. In all cases, remnant STLv morphology was a 0.08-0.04mm layer at the outer bone surface. For example, 3DP models at 40% dose differ from full dose models by <2.2% by vol and <0.5mm in thickness.

CONCLUSION

The remnant volume is a novel metric for 3DP quality. High inherent SNR of bone supports 3DP at reduced CT radiation doses, particularly with IR. Further testing on soft tissue structures is warranted, given the different noise properties.

CLINICAL RELEVANCE/APPLICATION

This initial study relating 3DP models and patient radiation exposure introduces a novel metric for 3DP quality and supports reduced radiation dose images for high-quality 3DP of bone.

SSE13-03 3D Printing of Complex Oncologic Pelvic Models Using CT and MRI Data for Pre-operative Surgical Planning

Participants
Jonathan M. Morris, MD, Rochester, MN (Presenter) Nothing to Disclose
Peter S. Rose, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Doris E. Wenger, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Franklin Sim, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Michael Yaszezinski, MD, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Jane S. Matsumoto, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose

PURPOSE

To share our experience creating 3D printed individual life size pelvic models to aid in surgical planning for patients with pelvic tumors undergoing resection and reconstruction or revision from previous surgery and radiation.

METHOD AND MATERIALS

After institution IRB approval a retrospective review of our 3D printing experience in complex pelvic oncologic models was reviewed. DICOM imaging data from CT and/or MR was transferred to a dedicated server. Utilizing Mimics software, (Materialize, Leuven, Belgium) the DICOM data was segmented using a combination of thresholding and hand segmentation tools separating and color coding critical anatomy such as bone, vasculature, bladder and ureters, lumbosacral plexus and tumor. Images were converted into STL files and exported into 3matic software. The STL files, was sent to the 3D printer software where materials and colors were assigned. The models were printed on poly jet Connex 350 printer (Stratasys, Eden Prairie MN).

RESULTS

Sixteen 3D printed individualized pelvic models were printed from patient's imaging data. Cases included six chondrosarcomas and single cases each of Ewings, Chondroblastic OGS, Myeloma, Schwannoma, Giant Cell tumor and Synovial Chondromatosis. In addition, two models of the pelvis and two models of the pelvis and lumbar spine, were created in patients needing revision following previous surgery and radiation therapy. All models were created using high resolution CT images. In 10 cases there was contrast enhancement for aid in segmentation of vessels. In 8 cases additional MR imaging data was used and co-registered on the CT data. In 6 cases only CT data was used. MR imaging is essential in evaluating tumor involvement and demonstrating the relationship of the lumbosacral plexus to the tumor.

CONCLUSION

Accurate life size physical models created from CT and MR imaging data aid in surgical planning in complex cases. These models improve comprehension of critical anatomic relationship, focus surgical decision making by multispecialty surgical teams and enhance resident and family education.

CLINICAL RELEVANCE/APPLICATION

Life size anatomic models of complex pelvic tumors using CT and MR imaging data add value by contributing to patient care, safety and education.

SSE13-04 3D Printing in Radiology Using Low Cost 3D Printers and Open-Source Software

Participants
The introduction of cheap 3D printers and open source software decreased the costs associated with owning and using a 3D printer considerably. The purpose of our presentation is to describe a workflow using a cheap 3D printer and free or open source software for 3D printing in radiologic patients.

METHOD AND MATERIALS

A locally manufactured 3D printer kit and a roll of 3D printing filament (made from polylactic acid (PLA)) were bought for approximately 540 USD. Patients with pathological findings in enhanced Computed Tomography (CT) or rotational angiography were selected from the archives. DICOM images were imported and processed with Slicer software (www.slicer.org) for segmentation and 3D object creation. The created objects were post-processed with MeshLab (MeshLab - Visual Computing Lab, meshlab.sourceforge.net ) to correct possible segmentation errors or to remove unwanted segments. The objects were then imported to Meshmixer (Autodesk, www.meshmixer.com) to check for printability and to create supports for overhanging parts. The final object was then loaded to Cura (software.ultimaker.com/), which generated printing instructions (called g-code) and sent them to the printer. All of the used software were free or open source.

RESULTS

Following a short training period, it was possible to segment and postprocess DICOM data to obtain 3D printable objects representing pathologic structures. The material cost per object was very low (1-7 USD per object) compared to professional printers or professional printing services. The printed parts could be used for patient education and training residents. It was also possible to use water soluble filaments (like Polyvinyl Alcohol - PVA) to create dissolvable models, which could be embedded in silicone molds or covered with silicone and then dissolved to create hollow silicone models for training purposes.

CONCLUSION

3D Printing is an important technology which is now accessible and affordable thanks to the lower costs associated with the use of cheaper printers and open source software. This affordability and the ability to create patient or pathology specific models could be beneficial for patient education and resident training.

CLINICAL RELEVANCE/APPLICATION

Thanks to the advances in 3D printing and open source software, it is possible to create patient specific, imaging derived pathologic models with very low initial investment and low running cost.

SSE13-05 Realistic Fabrication of Patient-Specific Tracheo-Bronchial Model with 3D Printing for Pre-interventional Planning

Monday, Nov. 30 3:40PM - 3:50PM Location: S404CD

Participants
Haekang Kim, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Mi Young Kim, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Guk-Bae Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Namkug Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Stockholder, Coreline Soft, Inc
Hyun Jung Koo, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Tai Sun Park, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
So Jung Park, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Chang Min Choi, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Background

3D volumetric tracheobronchial MDCT might not be adequate enough to explain the disease extent and planning the bronchoscopic intervention of the tracheobronchial tree. For obtaining the comprehensive image for tracheobronchial stenosis, this study investigates patient-specific tracheobronchial object using a 3D printing, which has widely used to create fabricated replicas of anatomical structures. To estimate 3D printing application, a patient-specific airway stent model with a formation of tailored side hole for the second airway in geometry is also developed.

Evaluation

We fabricated the 3D models of the 6 patients with tracheobronchial narrowing by a stoma stenosis (n=1), central bronchogenic/adenoid cystic cancers (n=2), endobronchial metastasis (n=2), and trachea-esophageal fistula after radiation (n=1) involving trachea/main stem bronchus based on pre-interventional tracheobronchial MDCT. The airway lumen was segmented by a seeded region growing method in MDCT images without gap (< 1mm reconstruction, conventional kernel). For the 3D modeling from mask images by a marching cubes algorithm and the STL (Standard Tesselation Language) converting, the in-house software was developed. The airway model was generated by the airway lumen model by outside offsetting function of Magics (Materialise Inc., Leuven, Belgium). For 3D printing, we used Object 500 Connex 3 (Stratasys Inc., Eden Prairie, MN). Two radiologists and a bronchoscopy specialist evaluated an optimum condition of material hardness in consensus. In addition, we fabricated a patient-specific modeling having a realistic airway model equipped with cartilage features, which were artificially made by computer-aided design method.

Discussion

By mixing soft and hard materials, we could figure out the optimum softness-to-hardness ratio between 4:5 and 3:7 (Fig. 1). Airway phantom with cartilage features was fabricated for more a realistic phantom study (Fig. 2).

Conclusion
This patient-specific 3D printing is practical application of pre-interventional planning in a variety of complicated patients who have central airway stenosis and subsequent stent developing. Simulation is also promising using the fabricated 3D replica.

**SSE13-06  Quality Control and Spatial Accuracy in Anatomic Modeling Using 3D Printing Techniques**

Monday, Nov. 30 3:50PM - 4:00PM Location: S404CD

**Participants**
- Shuai Leng, PhD, Rochester, MN (Presenter) Nothing to Disclose
- Jane S. Matsumoto, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
- Jonathan M. Morris, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
- Kiaran P. McGee, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
- Joel L. Kuhlmann, Rochester, MN (Abstract Co-Author) Nothing to Disclose
- Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG

**METHOD AND MATERIALS**

A systematic QC program was established to assess each step of the 3D printing: 1) Scan and reconstruction techniques were optimized to meet the need of 3D modeling. All imaging equipment were accredited by American College of Radiology and routinely tested. 2) Image segmentation and modeling were performed by experienced technologists and radiologists using FDA approved software (Mimics, Materialize). The contour of segmented objects was overlaid with original images and the agreement checked in all 3 planes over the whole model. 3) Annual maintenance of the printer was performed by the manufacturer. To assess the accuracy of the whole procedure, a QC phantom was developed that contained 11 groups of line-pairs with different sized air openings. This phantom was 3D printed using the same procedure as clinical models to generate a printed QC phantom. The size of the air opening for each group of bar patterns was then measured with a caliper for both the original phantom and its printed 3D model. After fabrication using the 3D printer, the clinical models were scanned on a CT scanner using a high resolution mode. The images were then registered to the segmented model, and distance between them was calculated on a point-by-point base. The same process was repeated for a radial-ulna clinical data set to compare 3D model scan and the original patient scan.

**RESULTS**

The imaging system provided high geometrical accuracy and spatial resolution (<1mm). For the QC phantom, the size of bar pattern on the 3D model agreed well with that of the original resolution phantom, with the measured differences ranged from -0.32 mm to 0.13 mm. For a radial-ulna clinical data set, the mean distance between the original data set and the scanned printed model was -0.12 mm, with a standard deviation of 0.17 mm. Differences ranged from -0.57 to 0.34 mm.

**CONCLUSION**

A comprehensive QC program has been established to access each step in the 3D printing procedure to ensure the printed anatomic models fulfill quality requirements in medical practice.

**CLINICAL RELEVANCE/APPLICATION**

Quality control is essential in 3D printing to ensure the printed model accurately represents the human anatomy and pathology so that they can be used in medical practice, research and education.
PURPOSE

To describe the association between fluid in the sinus tarsi and fluid about the extensor digitorum longus tendon (EDL) based on MRI and cadaveric studies. The frondiform ligament (FL, also called stem of inferior extensor retinaculum) exits the sinus tarsi to form a sling around the EDL. The sinus tarsi bursa extends between the inferior extensor retinaculum and the dorsolateral talar neck and may communicate with the EDL sheath. We hypothesize that fluid can advance from the sinus tarsi, via the frondiform ligament or sinus tarsi bursa, and surround the EDL, simulating tenosynovitis.

METHOD AND MATERIALS

Patient's MRI studies: All ankle MRIs with key phrases "extensor digitorum longus tenosynovitis" and "sinus tarsi ganglion" as well as 100 consecutive ankle MRIs were retrospectively reviewed. All cases with history of EDL or anterior ankle pathology were excluded.

Cadavers: 2 fresh frozen cadaveric ankle specimen underwent MRI after injection, under ultrasound guidance, of saline solution into EDL tendon sheath and of Gadolinium solution into the sinus tarsi fat.

RESULTS

Patients' MRI studies: Review of 258 MRIs revealed 31 cases (11 males, 20 female, age range 29-83, mean age 54), with sinus tarsi fluid, (15 encapsulated fluid sinus tarsi bursae, 16 non-encapsulated fluid), extending along FL toward EDL. In 30 cases (97%), fluid exited sinus tarsi, along FL, only partially surrounding the EDL. In 1 case fluid encircled the EDL. Most common associated findings included ligamentous injury (n= 10), posterior tibial tendon dysfunction (PTTD) (n = 9), flat-foot (n=6), osteoarthrosis (n= 4).

Cadavers: There was no MR evidence of communication between the EDL tendon sheath, FL or sinus tarsi after saline injection into the tendon sheath. Contrast was noted to exit the sinus tarsi dorsally, along FL, up to the EDL (n=1) and near EDL (n=1) on MRI images obtained after sinus tarsi injection.

CONCLUSION

Fluid within the sinus tarsi can advance via the FL or sinus tarsi bursa and partially or completely surround the EDL. This phenomenon, often seen with ligament injury or PTTD, should not be mistaken for tenosynovitis of EDL.

CLINICAL RELEVANCE/APPLICATION

Learning point: Before making the diagnosis of EDL tenosynovitis, the radiologist should ensure that the fluid is not originating from the sinus tarsi and extending along the FL or sinus tarsi bursa, to simulate tenosynovitis.

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Zehava S. Rosenberg, MD - 2014 Honored Educator
Jenny T. Bencardino, MD - 2014 Honored Educator
Accessory Anterolateral Talar Facet in Symptomatic and Asymptomatic Populations: Prevalence and Relevant Associated Findings on Ankle MRI

Monday, Nov. 30 3:20PM - 3:30PM Location: E450B

Participants
Ustun Aydingoz, MD, Ankara, Turkey (Presenter) Speaker, AbbVie Inc; Spouse, Stockholder, Edita Medical Writing Editing Ltd; Spouse, Employee, Edita Medical Writing Editing Ltd; 
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Fatma Bilge Ergen, MD, Ankara, Turkey (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the prevalence of and relevant findings associated with the accessory anterolateral talar facet (AALTF), which has been reportedly implicated in talocalcaneal impingement under certain conditions, on ankle MRI in symptomatic and asymptomatic persons.

METHOD AND MATERIALS
This is a case-control study with institutional review board approval. Two observers independently reviewed routine 1.5-T or 3-T MRI (that included --but was not limited to-- sagittal T1W and fat-suppressed T2W sequences) of 110 symptomatic ankles (61 right, 49 left) in 100 consecutive patients (54 females, 46 males; age range, 16-79 years [mean, 41.5]) and limited (sagittal T1W and fat-suppressed T2W sequences) 1.5-T MRI of 104 age-, gender-, and side-matched ankles in 104 asymptomatic volunteers for the presence of AALTF (Figure). Exclusion criteria for both symptomatic and asymptomatic groups included history of acute or chronic fracture and/or operation at the ankle, and the presence of a neoplastic bone or soft tissue mass at the ankle. In the asymptomatic group, an additional exclusion criterion was the presence of any injury (including sprain) to the ankle in the last 30 days. Calcaneal cortical thickness, and talar or calcaneal fibrocystic and/or edema-like bone marrow changes at the critical angle of Gissane were noted.

RESULTS
There was no statistically significant difference between the symptomatic and asymptomatic populations with respect to age (mean and distribution), gender, and ankle side. AALTF was present in 36 symptomatic (32.7%) versus 27 asymptomatic (26.0%) ankles (P=0.297). Interobserver agreement was very good (kappa=0.851, 95% CI=0.772-0.929) for the detection of AALTF. Subjacent talar bone marrow edema-like change was significantly more frequent in persons with AALTF (P<0.0001), while chronic reactive osseous changes at Gissane angle were not (P>0.05).

CONCLUSION
Higher prevalence of AALTF on MRI in symptomatic versus asymptomatic ankles is not statistically significant. AALTF may be associated with subjacent talar bone marrow edema-like change.

CLINICAL RELEVANCE/APPLICATION
Accessory anterolateral talar facet, which has been reported to have a role in talocalcaneal impingement, is identified on MRI in one quarter of asymptomatic persons and may be associated with subjacent bone marrow edema-like change in both symptomatic and asymptomatic populations.
hematoma did not correlate with RTP. Normal. No cortical breeches were observed. 3/4 (75%) subjects with grade 1 BME had a RTP within 2 days. Soft tissue edema and (α=.040). Subenthesial lesions had a slightly longer RTP without statistical significance. 6 subjects had CT and all were observed as marrow replacement and grade 3 marrow edema in a weight-bearing location on MRI was 13.5 days vs. 4.2 days those without.

Mean RTP for athletes with T1 was 10.3 days. Mean RTP for athletes with any linear hypointensity on MR was 10.8 days vs. 7.5 days for those without (α=.267 unpaired t-test) and there was no difference in RTP for small vs large or curvilinear hypointensities. Mean interval from injury to MR was 0.8 days and mean interval to follow-up MR was 4.7 days.

RESULTS

Patent agreement, AprioMed AB Consultant, Zimmer Holdings, Inc

Participants
Connie Y. Chang, MD, Boston, MA (Presenter) Nothing to Disclose
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Martin Torriani, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Inversion stress ankle sprain with injury to the lateral collateral ankle ligament complex is one of the most common sports injuries. The superior peroneal retinaculum has a close anatomic relationship to the lateral collateral ankle ligament complex, and chronic inversion stress also leads to laxity and injury of the superior peroneal retinaculum. Therefore, we sought to evaluate whether there is an association between ankle lateral collateral ligament complex injuries and superior peroneal retinaculum injury.

METHOD AND MATERIALS

Our study was IRB approved and complied with HIPAA guidelines. One hundred consecutive ankle MRI cases were obtained from July to September in 2013 and were evaluated for anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), posterior talofibular ligament (PTFL), superior peroneal retinaculum (SPR) sprain and tear by two independent readers. If the SPR was torn, peroneus longus (PL) and peroneus brevis (PB) tendons were also evaluated for subluxation. Chi-squared test was used to evaluate for correlation between abnormalities of these structures. Interobserver agreement was also calculated.

RESULTS

Of the 100 cases, 1 was excluded because of prior lateral ankle ligament reconstruction surgery, and 2 were excluded because of motion leading to poor image quality. Of the 97 remaining cases, the mean age was 50 ± 16 (18-90) years, and there were 35 males and 62 females. Inter-reader agreement was very good for all categories. Among the 97 cases, 69 (71%) had an abnormal ATFL, 62 (64%) had an abnormal ATFL and CFL; 28 (29%) had an abnormal ATFL, CFL, and PTFL; and 47 (48%) had an abnormal SPR. There were three SPR sprains with normal lateral collateral ankle ligaments. All other SPR injuries occurred in the setting of both ATFL and CFL injuries; there were no SPR injuries occurring with isolated ATFL injuries. There was a statistically significant correlation between ATFL and SPR abnormalities (P = 0.0001), ATFL/CFL and SPR abnormalities (P < 0.0001), and ATFL/CFL/PTFL and SPR abnormalities (P = 0.0003).

CONCLUSION

Lateral collateral ankle ligament injuries have a statistically significant correlation with superior peroneal retinaculum injuries.

CLINICAL RELEVANCE/APPLICATION

The SPR are common and should be closely evaluated in the setting of lateral collateral ligament complex injuries.

SSE14-05 Bone Bruise vs. Non-displaced Fracture at MRI: A Novel Grading System to Guide Reporting and Predict Return to Play

Participants
Blake Bowden, Philadelphia, PA (Presenter) Nothing to Disclose
Adam C. Zoga, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Peter F. DeLuca, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Johannes B. Roedl, MD, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
James M. McCrossin, MS, Voorhees, NJ (Abstract Co-Author) Nothing to Disclose
Sandra Rutigliano, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE

MRI is the standard of care imaging modality for suspected radiographically occult fracture from direct trauma. To date, MR criteria for bone contusion vs. fracture are not well established. We sought to generate an algorithm using MR to grade traumatic nondisplaced osseous injury in a cohort of athletes with trauma by correlating specific MR findings and imaging patterns with clinical scenarios and return to play (RTP).

METHOD AND MATERIALS

20 MR exams of the lower extremity (1.5T, extremity coil, 16 initial, 4 follow-up) in 15 professional hockey players with direct trauma and normal radiographs were reviewed by 2 MSK radiologists blinded to additional clinical information. Bone marrow edema (BME) was graded as 1=patchy/ill defined, 2=focal and mild, 3=focal and intense, 4=intense throughout bone. Marrow replacement on T1 weighted sequences was observed along with small and large regions of linear or curvilinear hypointensity. Presence and number of cortical breeches were observed as well as microtrabecular disruption, soft tissue contusion and hematomas. Locations of osseous injury were categorized as weight-bearing or not, and subenthesial or not.

RESULTS

MRIs included 9 foot, 6 ankle and 1 proximal tibia. Mean interval from injury to MR was 0.8 days and mean interval to follow-up MR was 10.3 days. Mean RTP for athletes with any linear hypointensity on MR was 10.8 days vs. 7.5 days for those without (α=.267 unpaired t-test) and there was no difference in RTP for small vs large or curvilinear hypointensities. Mean RTP for athletes with T1 marrow replacement and grade 3 marrow edema in a weight-bearing location on MRI was 13.5 days vs. 4.2 days those without (α=.040). Subenthesial lesions had a slightly longer RTP without statistical significance. 6 subjects had CT and all were observed as normal. No cortical breeches were observed. 3/4 (75%) subjects with grade 1 BME had a RTP within 2 days. Soft tissue edema and hematoma did not correlate with RTP.
CONCLUSION
The MRI constellation of T1 marrow replacement, grade 3 BME and weight-bearing location correlates with a longer return to play than other MRI findings including linear hypointensities and micro trabecular disruption, and can be reported as nondisplaced fracture.

CLINICAL RELEVANCE/APPLICATION
With non-displaced traumatic osseous injury, MRI should be interpreted as non-displaced fracture when focal intense subcortical bone marrow edema is accompanied by T1 marrow replacement.

SSE14-06 Association of Tarsal Tunnel Disease with Medial Hindfoot Coalitions
Monday, Nov. 30 3:50PM - 4:00PM Location: E450B

Participants
Catherine N. Petchprapa, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Zehava S. Rosenberg, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Jenny T. Bencardino, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Ignacio Rossi, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose
Erin FitzGerald, MD, Bronx, NY (Presenter) Nothing to Disclose

PURPOSE
Medial hindfoot coalitions, particularly posterior extra-articular and overlap coalitions, may have large medial and posteromedial osseous excrescences which extend into and produce, in conjunction with flat foot deformity, stretching and mass effect on the tarsal tunnel. Resection of the coalition without addressing pathology of these soft tissue structures can result in surgical failure and continued disability to the patient. Yet, to the best of our knowledge, there is scant information about this topic in the literature. We hypothesize that soft tissue disease in the tarsal tunnel is a frequent phenomenon, in the setting of hindfoot coalitions.

METHOD AND MATERIALS
A search of our ankle MRI data base revealed 88 cases with medial hindfoot coalitions. All cases were independently and retrospectively reviewed by 2 musculoskeletal radiologists for the presence of neuritis, manifested by focally increased nerve caliber and signal, of the posterior tibial nerve and its medial and lateral plantar branches. The posterior tibial (PT), flexor hallucis longus (FHL) and flexor digitorum longus (FDL) were assessed for the presence of tendinosis, tenosynovitis and partial tearing.

RESULTS
The final cohort included 68 cases of medial hindfoot (middle, posterior extra-articular and overlap) coalition (37 men, 31 women, average age 40, range 72-8). Neuritis of the posterior tibial nerve and its branches (n= 18, 26%) was more commonly noted in the medial plantar nerve. Entrapment of FHL by osseous coalition-related posteromedial excrescences was seen in 14 cases (21%). Other tendon disorders such as flattening and stretching against sharp bony edges, tendinosis, partial tearing and tenosynovitis were noted in the FHL (n=30, 44%) and FDL (n=22, 32%). PT tendinosis and tearing was less common (n= 9, 13%).

CONCLUSION
Medial hindfoot coalitions are commonly associated with tarsal tunnel soft tissue abnormalities affecting the posterior tibial nerve and its branches, the FHL tendon and less commonly FDL and PT tendons.

CLINICAL RELEVANCE/APPLICATION
The radiologist should alert the referring physician for the presence of tarsal tunnel abnormalities in the presence of medial hindfoot coalition since these can guide surgical treatment and outcome.

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Zehava S. Rosenberg, MD - 2014 Honored Educator
Jenny T. Bencardino, MD - 2014 Honored Educator
**SSE15**

**ISP: Musculoskeletal (MR Evaluation of Nerves)**

Monday, Nov. 30 3:00PM - 4:00PM Location: E451B

**MR**

AMA PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Gustav Andreisek, MD, Zurich, Switzerland (Moderator) Grant, Holcim Ltd; Grant, Siemens AG; Speaker, Mepha Pharma AG; Speaker, Guerbet SA; Travel support, Guerbet SA; Consultant, Otsuka Holdings Co, Ltd; Travel support, Otsuka Holdings Co, Ltd; Institutional Research Grant, Bayer AG; Institutional Research Grant, Guerbet AG; Institutional research collaboration, Siemens AG; Institutional research collaboration, Koninklijke Philips NV; Speaker, General Electric Company; Speaker, Koninklijke Philips NV; Speaker, Siemens AG; 
Anne Cotten, MD, Lille, France (Moderator) Nothing to Disclose

**Sub-Events**

**SSE15-01 Musculoskeletal Keynote Speaker: MRI Evaluation of Nerves-Application and Implementation**

Participants
Sandip Biswal, MD, Stanford, CA (Presenter) Co-founder, SiteOne Therapeutics Inc; Research Grant, General Electric Company; Stockholder, Atreus Pharmaceuticals Corporation

ABSTRACT
MR imaging of the peripheral nerves and brachial/lumbosacral plexi has become an important tool in the evaluation and workup of the chronic pain patient. High-quality imaging of these structures is now consistently possible due to technical improvements in field strength, coil, and pulse sequence technology. This imaging approach is able to highlight inflammatory (e.g. neuritis) and physical (e.g. impingement, mass lesions) changes in the nerves. We will review the technical requirements for imaging the peripheral nervous system, discuss the imaging findings nerve injury/inflammation and provide examples of normal and pathologic cases.


Participants
Andrei Manoliu, MD,PhD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Micheal Ho, Zurich, Switzerland (Presenter) Nothing to Disclose
Evelyn Dappa, Mainz, Germany (Abstract Co-Author) Nothing to Disclose
Daniel Nanz, PhD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
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Gustav Andreisek, MD, Zurich, Switzerland (Abstract Co-Author) Grant, Holcim Ltd; Grant, Siemens AG; Speaker, Mepha Pharma AG; Speaker, Guerbet SA; Travel support, Guerbet SA; Consultant, Otsuka Holdings Co, Ltd; Travel support, Otsuka Holdings Co, Ltd; Institutional Research Grant, Bayer AG; Institutional Research Grant, Guerbet AG; Institutional research collaboration, Siemens AG; Institutional research collaboration, Koninklijke Philips NV; Speaker, General Electric Company; Speaker, Koninklijke Philips NV; Speaker, Siemens AG; 
Felix P. Kuhn, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose

PURPOSE
Panoramic radiographs or cone-beam CT images are the current standard-of-care to assess teeth, mandibular, and mandibular canal pathologies, but do not allow assessment of the mandibular nerve itself nor of its branches. Most recent MR technologies allow cortical bone imaging as well as dedicated MR neurography of the peripheral nerves. We propose a technique for "MR neurographic orthopantomograms" exploiting UTE imaging of bone and teeth complemented with high-resolution morphological and functional MR neurography.

METHOD AND MATERIALS
IRB approved study in 10 healthy volunteers. The whole mandibles were imaged at 3.0T (Skyra, Siemens Healthcare) using a 64-channel head coil with isotropic spatial resolution (0.9x0.9x0.9mm) for subsequent multi-planar reformatting. Bone images were acquired using a 3D UTE PETRA sequence (echo time, 0.07ms; acquisition time, 4:56min). Morphological nerve imaging was accomplished with a 3D PSIF sequence with diffusion-based suppression of small blood vessel signals (4:16min) and with a 3D SPACE STIR sequence (9:23 min). Functional MR neurography was accomplished using a new accelerated diffusion tensor imaging technique (2D RESOLVE multiband prototype sequence = diffusion-weighted and readout-segmented echo planar imaging with blipped CAIPIRINHA and simultaneous two-slice acquisitions) (9:34min). Qualitative and quantitative image analysis was performed.

RESULTS
Image acquisition and subsequent post-processing into 'MR neurographic orthopantomogram' by overlay of morphological and functional images were feasible in all 10 volunteers without artifacts. All teeth, mandibular bones and mandibular nerves were assessable and normal. Fiber tractography with quantitative evaluation of physiological diffusion properties of mandibular nerves yielded the following mean±SD values: FA, 0.43±0.05; mean diffusivity (mm²/s), 0.0043 ±0.0003; radial diffusivity, 0.0034±0.0002, and axial diffusivity, 0.0021±0.0001.

CONCLUSION
The proposed technique of 'MR neurographic orthopantomogram' exploiting UTE imaging complemented with high-resolution
Clinical indications included trauma (n=4), hereditary neuropathy (n=1), pain (n=7), winged scapula (n=5), Parsonage Turner syndrome (n=1) and mass (n=1). The long thoracic was not confidently identified in all exams in the anterior scalene triangle, retroclavicular space or lateral chest wall. In 3/18, electrodiagnostic studies showed evidence of denervation in the serratus anterior muscle while MRNs revealed denervation in the serratus anterior (44% (8/18)), trapezius (22% (4/18)) and rhomboid (5% (1/18)) muscles. In 5% (1/18) subjects, there was denervation in both trapezius and serratus muscles. In 5% (1/18), an osteochondroma simulated a winged scapula and in 2/18 (10%) MRN showed scapular winging. Concomitant C-spine disease (22% (4/18)) and brachial plexus pathology (22% (4/18)) were also detected.

RESULTS

Of 122 consecutive studies, substantial alteration of the pre-imaging clinical impression was found in 30 cases (24.6%). The therapeutic management was likewise affected substantially in 27 cases (22.1%).

CONCLUSION

No consecutive series of brachial plexus MRN findings this large has been reported. We show that this examination can significantly impact diagnostic evaluation and clinical treatment of patients with upper extremity neurologic lesions.

MRN significantly alters diagnosis and treatment in patients with suspected brachial plexopathies.

MR Neurography (MRN) of the Long Thoracic Nerve: Retrospective Review of Clinical Findings and Imaging Results at Our Institution over 5 Years

METHOD AND MATERIALS

IRB approval was obtained. A keyword search for 'long thoracic nerve' was performed to identify MRN studies performed at our institution for evaluation of the long thoracic nerve. Clinical presentation, electrodiagnostic studies and MRNs of 18 subjects (mean age, 38±13 years; 22% (4/18) female) were reviewed. MRN consisted of cervical spine (3D T2W, TE/TR=1000/97, 1mm slice thickness), brachial plexus (bilateral sagittal STIR; TE/TR/IR=3400/18/220, slice thickness 3mm) and chest (axial STIR; TE/TR/IR=4000/18/220, 4mm slice thickness), coronal T2FS(TE/TR=4940/49, 5mm slice thickness), axial T1W (TE/TR=800/12, 3mm slice thickness) imaging. One observer reviewed MRNs for long thoracic nerve signal intensity on T1 and STIR, size, course, architectural distortion, presence or of mass, and secondary findings including serratus anterior, trapezius and rhomboid muscle denervation and scapular winging. C-spine disease (presence and degree of C4-5, C5-6, C6-7, C7-T1 central and foraminal stenosis) and brachial plexus pathology were also recorded. Descriptive statistics were reported.

RESULTS

Clinical indications included trauma (n=4), hereditary neuropathy (n=1), pain (n=7), winged scapula (n=5), Parsonage Turner syndrome (n=1) and mass (n=1). The long thoracic was not confidently identified in all exams in the anterior scalene triangle, retroclavicular space or lateral chest wall. In 3/18, electrodiagnostic studies showed evidence of denervation in the serratus anterior muscle while MRN revealed denervation in the serratus anterior (44% (8/18)), trapezius (22% (4/18)) and rhomboid (5% (1/18)) muscles. In 5% (1/18) subjects, there was denervation in both trapezius and serratus muscles. In 5% (1/18), an osteochondroma simulated a winged scapula and in 2/18 (10%) MRN showed scapular winging. Concomitant C-spine disease (22% (4/18)) and brachial plexus pathology (22% (4/18)) were also detected.
CONCLUSION

Despite high resolution MRN, the long thoracic nerve is not confidently identified, though secondary signs including denervation are detected and add to EMG findings.

CLINICAL RELEVANCE/APPLICATION

MRN can serve as an adjunct clinical tool to electrodiagnostic testing for the evaluation of secondary signs of long thoracic neuropathy.

SSE15-06 Diffusion Weighted Imaging(DWI) and Neurography(DWN) of Human Lumbar Nerve Roots: Quantitative and Morphological Assessments of Nerve Roots Compression in Lumbar

Monday, Nov. 30 3:50PM - 4:00PM Location: E451B

CONCLUSION

DWI can clearly display the lumbosacral nerves roots and ganglions. The qualitative morphological analysis through 3D MIP reconstruction and the quantitative measurements of the ADC value of nerves ganglions were substantially contributed to the evaluation of the compression of nerve roots and ganglions for the patients with lumbar intervertebral disc herniation.

CLINICAL RELEVANCE/APPLICATION

DWI should be in the setting of the scanning protocol for the diagnosis of the nerve roots and ganglions disorders.
Participants
M. Elizabeth Oates, MD, Lexington, KY (Moderator) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Birmingham, AL (Moderator) Nothing to Disclose

Parathyroid Imaging with Simultaneous Acquisition of Tc-99m-Sestamibi and I-123: The Relative Merits of Pinhole Collimation and SPECT-CT.

PURPOSE
To determine the relative localization utility of three state-of-the-art parathyroid imaging protocols: 1) single time point simultaneous acquisition of Tc-99m-sestamibi and I-123 images with pinhole collimation in the anterior and bilateral anterior oblique projections, 2) single time point simultaneous acquisition of Tc-99m-sestamibi and I-123 images with SPECT-CT, and 3) the combination of protocols one and two.

METHOD AND MATERIALS
Fifty-nine patients with surgical proof of parathyroid adenomas were evaluated retrospectively. All three protocols included perfectly co-registered subtraction images created by subtracting the I-123 images from the Tc-99m-sestamibi images, plus an anterior parallel hole collimator image of the neck and upper chest. The pinhole protocol was performed first followed by the SPECT-CT protocol. Three image sets were derived from each study in each patient according to the above protocols. Two experienced observers recorded the size, location and degree of certainty of any identified lesion.

RESULTS
The 59 patients had sixty-one adenomas. For the two observers combined, the localization success rate was 88% for the pinhole protocol, 69% for the SPECT-CT protocol, and 81% for the combined protocol. The pinhole protocol detected more adenomas than the SPECT-CT protocol and missed fewer adenomas than either the SPECT-CT protocol or the combined pinhole and SPECT-CT protocol (P < 0.01). The two protocols that included SPECT-CT provided superior anatomic information relative to the location and size of the parathyroid adenomas.

CONCLUSION
Overall, the pinhole protocol localized significantly more adenomas than the SPECT-CT protocol. However, the protocols that included SPECT-CT provided more anatomic information than pinhole imaging alone.

CLINICAL RELEVANCE/APPLICATION
Accurate preoperative identification and localization of parathyroid adenoma(s) allows surgeons to perform image guided minimally invasive surgery with improved success rates, shorter operating times, and less morbidity. Consequently, it is important to optimize the accuracy of preoperative imaging in determining the presence, size, and location of parathyroid adenomas. Our hope with this study is to determine the most accurate imaging protocol with current available imaging modalities to overall optimize patient outcomes.
METHOD AND MATERIALS

We retrospectively analyzed 272 pts (220 female pts, 52 male pts, age = 59±13 years) with PHP who underwent preoperative MIBI SPECT/CT. We used surgical and pathology reports to confirm numbers and weights of excised parathyroid lesions. Two experienced physicians read SPECT/CTs on 2 separate occasions without reference to each other's readings or final diagnoses. Lesion certainty was graded on a 5-point scale (0 = normal, 1 = probably normal, 2 = equivocal, 3 = probably abnormal, 4 = definitely abnormal). Mean scores were obtained for the 2 observers. Readings were compared for MGD and SGD lesions matched by weight and location.

RESULTS

230 pts had SGD, 42 had MGD (28 pts with 2 lesions, 11 pts with 3 lesions and 3 pts with 4 lesions). Lesion weight decreased progressively with increasing numbers of lesions (888±491 mg for 1 lesion, 436±570 mg for 2 lesions, 395±686 mg for 3 lesions, 89±120 mg for 4 lesions, p = -0.43, p < 0.0001). It was possible to match equal numbers of SGD and MGD lesions by weight for 132 lesions, with similar mass (526±678 versus 525±686 mg, p = 0.99), and similar location distributions (p = 0.47). Despite being matched by weight and location, reading confidence was significantly lower for MGD than SGD lesions (2.0±1.4 versus 3.4±0.8, p < 0.0001); confidence decreased progressively with increasing lesion numbers (2.2±1.3 for 2 lesions, 1.8±1.5 for 3 lesions, 1.0±0.9 for 4 lesions, p = -0.51, p < 0.0001). Sensitivity was significantly lower for MGD than SGD lesions (64% versus 98%, p < 0.0001); sensitivity decreased progressively with increasing lesion numbers (67% for 2 lesions, 65% for 3 lesions, 25% for 4 lesions, p = -0.45, p < 0.0001).

CONCLUSION

As with planar and SPECT MIBI, in PHP, Tc-99m-MIBI SPECT/CT reading confidence and sensitivity are significantly lower in multigland disease than in single gland disease.

CLINICAL RELEVANCE/APPLICATION

MIBI SPECT/CT is less sensitive for detecting lesions in MGD than in SGD and therefore it must be used together with rapid intraoperative parathyroid hormone assay to ensure that all offending lesions are removed.

SSE16-03 Prognostic Value of FDG-PET/CT in Papillary Thyroid Cancer with the TENIS Syndrome

As with planar and SPECT MIBI, in PHP, Tc-99m-MIBI SPECT/CT reading confidence and sensitivity are significantly lower in multigland disease than in single gland disease.

RESULTS

Of 93 patients, 74 showed positive FDG uptake while the remaining 19 showed negative FDG uptake. In the FDG positive group, 21 (28%) showed Tg-DT of < 1 yr. Progressive disease (PD) was observed in 32 pts. (42%). SUVmax was significantly higher in patients with PD than others (6.7 vs 4.1, p < 0.01). PD was seen in only 1(5%). Cancer-associated death was not observed in any of the patients. There was an inverse correlation between SUVmax and Tg-DT in the positive FDG uptake group (r = -0.56).

CONCLUSION

As with planar and SPECT MIBI, in PHP, Tc-99m-MIBI SPECT/CT reading confidence and sensitivity are significantly lower in multigland disease than in single gland disease.

CLINICAL RELEVANCE/APPLICATION

MIBI SPECT/CT is less sensitive for detecting lesions in MGD than in SGD and therefore it must be used together with rapid intraoperative parathyroid hormone assay to ensure that all offending lesions are removed.

SSE16-04 Effectiveness of Semi-quantitative Analysis in I-123 Metaiodobenzylguanidine Scintigraphy for Diagnosing Pheochromocytoma

Positive FDG uptake in the TENIS syndrome indicates shorter Tg-DT and higher risk of PD. In contrast, negative FDG uptake is associated with longer Tg-DT and gentle behavior of the tumor. FDG-PET/CT is helpful in characterizing prognosis of postsurgical PCA with the TENIS syndrome.

CLINICAL RELEVANCE/APPLICATION

In patients with TENIS who have high FDG uptake, early start of additional therapies such as RFA or PEI, or chemotherapy using sorafenib or lenvaniatb may improve their prognosis. In contrast, the majority of patients with negative FDG uptake do not require aggressive additional treatments.
SSE16-06

In low risk patients with thyroid cancer, our findings may support low dose consideration prior to radioiodine ablation.

CLINICAL RELEVANCE/APPLICATION

exclusively within the thyroid bed and thyroglossal duct remnant.

The anatomic CT correlation with planar and SPECT images demonstrated the majority of the focal radioiodine uptake to be located within both, thyroid bed region and thyroglossal duct remnants. Therefore, majority of the patients with central neck uptake (28/40 (70%) had visualization of the thyroglossal duct remnant activity. Of the patients with radioiodine uptake in the neck, 12 (27%) had uptake within the thyroid bed region only, 13 (30%) had focal uptake corresponding just to the thyroglossal duct remnant, and 15 (34%) had uptake within both, thyroid bed region and thyroglossal duct remnants. Therefore, majority of the patients with central neck uptake 28/40 (70%) had visualization of the thyroglossal duct remnant activity.

CONCLUSION

Were compared using receiver operating characteristic (ROC) analyses.

RESULTS

In ROC analysis, AUC of SPECT, planar and SPECT/CT were 0.98, 0.67 and 0.76 with cut-off value of 2.26, 3 and 3, respectively. There were significant difference between SPECT and planar (p < 0.01), SPECT and SPECT/CT (p < 0.01). No significant difference between planar and SPECT/CT (p = 0.50).

SSE16-05  Postablation Radioiodine Scintigraphy SPECT/CT: Functional and Anatomic Correlation

METHOD AND MATERIALS

Twenty six patients (Male/Female=17/9, Age=57.5±14.4) with suspected pheochromocytoma were incorporated in this study. I-123 scintigraphy and adenral SPECT/CT was performed in all patients. Twelve pheochromocytomas and 14 cortical adennoma were diagnosed histopathologically or based on the clinical course including MRI. For semi-quantitative analysis, tumor-to-liver ratio (T/L) was defined as ratio of maximum count of adrenal mass divided by maximum count of normal liver of right lobe. For visual evaluation of planar scintigraphy and SPECT/CT fusion image, adenral uptake was classified as visual score (1 = lower than liver, 2 = equal to liver and 3 = higher than liver). Diagnostic performances of the three methods (T/L: SPECT, visual: planar and visual: SPECT/CT) were compared using receiver operating characteristic (ROC) analyses.

CONCLUSION

Semi-quantitative method using SPECT/CT was more sensitive and specific than visual evaluation in the diagnosis of pheochromocytoma in patients with adrenal tumor.

SSE16-06  Evaluate Correlation of Duodenogastric Reflux Detected on Tc-99m Mebrofenin Hepatobiliary Scintigraphy with Symptomatic Gastroesophageal Reflux Disease: A Retrospective Study
PURPOSE

GERD is thought to result primarily from gastric acid reflux. Recent literature suggests that symptomatic GERD also occurs from duodenogastric reflux of bile acids. This has been termed alkaline variant GERD and appears to be more damaging to the esophagus and has a more symptomatic clinical course. We aim to evaluate whether the presence of duodenogastric reflux (DGR) seen on Tc-99m mebrofenin hepatobiliary scintigraphy (MHBS) correlates with presence of clinical GERD and whether degree of DGR seen correlates with clinical severity of GERD.

METHOD AND MATERIALS

300 Tc-99m MHBS exams conducted from January 2011-December 2014 were included in this study and were evaluated for presence of DGR. Patients’ chart were reviewed to identify for clinical diagnosis of GERD and the severity of GERD that was determined using clinical data points including endoscopic evaluation of GERD, oral medications for treatment of GERD and presence/absence Barrett’s esophagus, etc.

RESULTS

83 patients (45 females and 38 males) with mean age 47.9 (range: 13 - 93 years old) were identified to have evidence of DGR. Of these patients, 31.3% patients were diagnosed with cholecystitis and 7.2% patients were diagnosed with biliary colic. 25.3% patients had only clinical history of GERD and no additional significant history. Of the patients with clinical evidence of GERD, 42.9% patients had evidence of severe DGR, 38.1% had moderate DGR and 19% had mild DGR noted. 4.7% patients with GERD and severe DGR had histopathologic evidence of Barrett’s esophagus.

CONCLUSION

DGR is easily detected and frequently identified on Tc-99m MHBS. Our study shows 25% of patients with otherwise unremarkable Tc-99mHBS scintigraphy have evidence of DGR and majority of these have moderate to severe GERD. As emerging literature is demonstrating stronger correlation between bile acid reflux and symptomatic GERD, DGR is an important diagnostic consideration as the cause of patients presenting symptoms in an otherwise normal HIDA study.

CLINICAL RELEVANCE/APPLICATION

DGR is easily detected and frequently identified on Tc-99m MHBS and a significant proportion patients with scintigraphic evidence of DGR have GERD. Reporting severity of reflux in report can facilitate patient management by alerting clinician to DGR as an important diagnostic consideration as the cause of patients presenting symptoms in an otherwise normal HIDA study.
**Neuroradiology (Parkinson Disease)**

**Monday, Nov. 30 3:00PM - 4:00PM Location: N228**

**SSE17-01**  
**A Voxel-based Evaluation of Parkinson's Disease Using Quantitative Susceptibility Mapping and Neuromelanin Imaging**

Participants
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Jay J. Pillai, MD, Baltimore, MD (Moderator)  
Medical Advisory Board, Prism Clinical Imaging, Inc; Author with royalties, Springer Science+Business Media Deutschland GmbH; Author with royalties, Reed Elsevier

Sub-Events

**PURPOSE**
To assess dopaminergic neurodegeneration with iron deposition of the substantia nigra pars compacta (SNpc) in patients with Parkinson's disease (PD) in a quantitative and reproducible fashion.

**METHOD AND MATERIALS**
This study included 14 patients with PD (Group A) and 14 normal controls (Group B) who underwent quantitative susceptibility mapping (QSM), neuromelanin (NM) imaging and three-dimensional (3D) T1W imaging on a 3T magnetic resonance imager. Both QSM and NM values of the SNpc were calculated using a region of interest (ROI) based automated segmentation system with the voxel-based morphometric technique. Images were preprocessed as follows (Figure): All QSM and NM images were coregistered with 3D T1-weighted structural images and were spatially normalized using Statistical Parametric Mapping, thus allowing voxel-based measurement with automatic setting of the ROI encompassing the SNpc. The spatially normalized images of all subjects were smoothed. Finally, the SNpc ROI was set on the QSM-NM fused image. Signal to noise ratio (SNR) of the SNpc in the NM images was calculated on the basis of mean value of the automatically segmented background region (tegmentum in the midbrain). The significance of intergroup differences in each QSM value and NM area of higher SNR than that of the background region was tested using Mann-Whitney’s U test.

**RESULTS**
For mean QSM value of the SNpc, no significant difference was shown between both groups [Group A/B: mean value (ppb) = 75.72/64.62, SD = 21.24/27.75]. But when comparing the highest 5% of QSM values in each group, the mean in Group A was significantly larger than that in Group B [Group A/B: mean value (ppb) = 175.21/133.33, SD = 45.44/41.75] (P < 0.05). The NM area of higher SNR in Group A was significantly less than that in Group B [Group A/B: mean value (pixel) = 85.79/104.07, SD = 13.66/13.56] (P < 0.05).

**CONCLUSION**
An automatic measurement system for structural and functional changes in the SNpc with voxel-based analysis can provide clinically useful information in the diagnosis of PD.

**CLINICAL RELEVANCE/APPLICATION**
SNpc is a small region, but can be assessed quantitatively and reproducibly with voxel-based analysis in the diagnosis of Parkinson’s disease.

**SSE17-02**  
**Drug-induced Parkinsonism versus Idiopathic Parkinson’s Disease: Diagnostic Utility of Nigrosome 1 MRI at 3T**

Participants
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Purpose

Discrimination between drug-induced parkinsonism (DIP) and idiopathic Parkinson's disease (IPD) is challenging because they may be clinically indistinguishable. Dopamine transporter imaging can help differentiate them, but it is expensive and imposes radiation on patients. We hypothesized that the nigrosome 1 is not affected in patients with DIP unlike in those with PD. The aim of this study was to investigate whether nigrosome 1 imaging at 3T can help differentiate PD from DIP.

Method and Materials

We enrolled 20 patients with DIP (16 female; mean age, 74) who showed normal activity on 18F-FP-CIT PET (CIT PET), 29 patients with IPD (10 female; mean age, 71; HandY stage ≤ 2) who showed abnormality on CIT PET, and 18 healthy subjects (10 female; mean age, 66). All participants underwent 3D multi-echo gradient-recalled echo imaging (number of echoes, 6) covering the midbrain parallel to the plane from the posterior commissure and top of the pons (spatial resolution, 0.5 × 0.5 × 1 mm). Two independent reviewers assessed nigrosome 1 on three slices: an upper slice at the lower tip of red nucleus, and two successive lower slices by comparing the signal intensity of the central portion of the nigrosome 1 with that of the white matter lateral to decussation of the superior cerebellar peduncles. Relative hypointensity in either side of nigrosome 1 was considered abnormal. Interobserver agreement, diagnostic sensitivity, specificity, and accuracy were analyzed.

Results

Inter-rater agreement was excellent (κ = 0.821). All 29 patients with IPD and three of 18 healthy subjects were rated as abnormal on nigrosome 1 MRI (sensitivity, 100%; specificity, 83.3%; accuracy, 93.6%; positive predictive value [PPV], 90.6%; negative predictive value [NPV], 100% between the patients with IPD and healthy subjects). Three of 20 patients with DIP were considered abnormal on nigrosome 1 MRI (sensitivity, 100%; specificity, 85%; accuracy, 93.9%; PPV, 90.6%; NPV, 100% between the patients with IPD and DIP). Abnormality on MRI was significantly more frequent in patients with IPD (P < 0.0001).

Conclusion

Nigrosome 1 imaging at 3T can differentiate IPD from DIP with accuracy of 93.9%.

Clinical Relevance/Application

High diagnostic accuracy and perfect NPV of nigrosome imaging at 3T between patients with IPD and DIP can help manage them properly and may reduce dependence on dopamine transporter imaging.

SSE17-03  The Pattern of Iron Deposition in the Progression of Parkinson’s Disease by Quantitative Susceptibility Mapping

Monday, Nov. 30 3:20PM - 3:30PM Location: N228

Participants

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Purpose

The influence of iron on the pathophysiological progression of Parkinson's disease (PD) and the pattern of iron accumulation in the subregions of substantia nigra (SN) were unclear. In the present cross-section study, we aimed to clarify the potential pattern of iron deposition in the subcortical nuclei, especially in the SN, among the controls and PD subgroups, thus the possible underlying iron-related pathogenesis of PD.

Method and Materials

Forty-eight PD patients (H-Y stage <= 2.5, n=16, belonged to mild subgroup; H-Y stage >= 3, n=32, belonged to severe subgroup), and 47 gender-, age-, duration- matched healthy controls were included in our study. All subjects participated in the 3D-enhanced T2 star weighted angiography (ESWAN) scanning. The phase images of ESWAN data were processed to generate quantitative susceptibility mapping (QSM). Then, we measured the iron content within the ROIs and the relevant clinical assessments of these patients.

Results

After controlling for age as a covariant (Bonferroni corrected), QSM values within the medSNc and latSNc increased significantly in both PD subgroups compared with controls respectively (both p<0.01), while QSM values within medSNr (p<0.01) and latSNr (p<0.05) only increased in the severe subgroup of PD. More interestingly, medSNc had higher iron content in the severe group of PD than the mild one (p<0.05), while that could not observe in the latSNc. Further, in the severe subgroup iron content within medSNr (p<0.01) and latSNr (p<0.05) elevated greatly compared with the mild subgroup.

Conclusion

Due to the limitation of present study, which recruited symptomatic patients, we didn't observe the presymptomatic or early changes in the latSNc between 2 PD subgroups. After all, we had investigated the dynamic pattern of iron deposition in the SN during the progression of PD, which was perfectly consistent with the work of Fearnley JM (Brain 1991). As the disease proceeding, the iron deposition accumulated first in the latSNc (Martin W.R. et al., 2008), and then involved the medSNc, finally reached the medSNr and latSNr.

Clinical Relevance/Application

Firstly, present work would help understand the possible pathogenesis of PD indirectly; secondly, the pattern of iron deposition would indicate the imaging biomarker of early diagnosis of PD.

SSE17-04  Participants
Chemical Exchange Saturation Transfer Signal of the Substantia Nigra as Imaging Biomarker for Assessing Progression of Parkinson’s Disease

Monday, Nov. 30 3:40PM - 3:50PM Location: N228

Participants
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PURPOSE
To evaluate chemical-exchange-saturation-transfer (CEST) signal of the substantia nigra (SN) in Parkinson’s disease (PD) patients, as well as their relationship to clinical progression.

METHOD AND MATERIALS
CEST MR imaging of 26 normal controls and 61 PD patients (18 early stage (disease duration ≤ 1 year), 19 mid stage (disease duration 2~5 years) and 24 late stage (disease duration ≥ 6 years)) were acquired on a Philips 3 Tesla MRI system. Magnetization transfer spectra with 31 different frequency offsets (-6 to 6 ppm) were acquired at the slice of the SN. The FLAIR image was used as the anatomical reference to draw regions of interest. MTRasym(3.5ppm) and MTRtotal (the integral of the MTRasym spectrum in the range of 0 to 4 ppm) of the total SN were measured. Clinical measures were obtained for PD patients, such as the Hoehn and Yahr (HandY) scale and the unified Parkinson’s disease rating scale (UPDRS), etc. One-way ANOVA was used to compare the CEST signal differences between normal controls and PD patients of all stages. Correlation analysis was made for the CEST signal of SN as well as their relationship to clinical progression.

RESULTS
Compared to normal controls, the MTRasym(3.5ppm) and MTRtotal values of the SN were significantly lower in PD patients of all stages. Both the MTRasym(3.5ppm) and MTRtotal values of the SN strongly associated with HandY scale, UPDRS, UPDRS-3 and disease duration.

CONCLUSION
CEST signal of the SN has the potential to serve as imaging biomarker for assessing progression of PD.
CEST signal of the SN has the potential to serve as imaging biomarker for assessing progression of PD.

**Clinical Relevance/Application**

CEST signal could provide information additional to conventional MR imaging and potentially serve as imaging biomarker in the progression assessment of PD.

**SSE17-06 Multivariate Pattern Analysis of Paroxysmal Kinesigenic Dyskinesia Using Diffusion Tensor Imaging**

Monday, Nov. 30 3:50PM - 4:00PM Location: N228

Participants
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**Purpose**

Paroxysmal kinesigenic dyskinesia (PKD) is a rare movement disorder. Available researches using diffusion tensor imaging (DTI) have shown that PKD is accompanied by abnormalities in white matter (WM). However, results of those publications were based on average differences between groups, which permitted little use in clinical practice. Multivariate pattern analysis (MVPA) approach is a promising analytical technique which allows the classification of individual observations into distinct classes. Thus, in current study, we aimed to (i) apply MVPA approach known as Support Vector Machine (SVM) for investigating whether fractional anisotropy (FA) of WM can be used to discriminate between patients with PKD and healthy control subjects (HCS) at the level of the individual; (ii) explore which WM regions contributed to such discrimination.

**Method and Materials**

DTI data were acquired from 48 PKD patients and 48 demographically matched HCS using a 3T MRI system. Differences in FA values of WM were used to discriminate between PKD patients and HCS using leave-one-out cross-validation with SVM based on Probid software (http://www.brainmap.co.uk/probid.htm), and to find a spatially distributed pattern of regions with maximal classification weights. We also drew a receiver operating characteristic (ROC) curve to help evaluate the performance of the classifier.

**Results**

SVM applied to FA images correctly identified PKD patients with a sensitivity of 91.67% and a specificity of 87.50% resulting in a statistically significant accuracy of 89.58% (P <0.001). This discrimination was based on a distributed network including anterior thalamic radiation temporoparietal junction, inferior fronto-occipital fasciculus, inferior longitudinal fasciculus, corpus callosum, and cingulum.

**Conclusion**

The present study demonstrates subtle and spatially distributed WM abnormalities in individuals with PKD, indicating neuroanatomical basis for the involvement of the basal ganglia-thalamocortical pathway in PKD, and provides preliminary support for the suggestion that SVM approach could be used to aid the identification of individuals with PKD in clinical practice.

**Clinical Relevance/Application**

The current study illustrated that the application of SVM to FA images could allow accurate discrimination between PKD patients and HCS, which indicated its potential diagnostic value in helping detecting this disease.
PURPOSE

Emerging treatment strategies in acute ischemic stroke (AIS) propose CTP-derived therapy selection paradigms; however, speed and availability of non-contrast CT may compel fast, qualitative approaches to risk stratification using ASPECTS. The superiority of rigorous automated approaches has been recently reported, although the magnitude of potential error in estimating core and putatively at-risk volumes using qualitative approaches remains unknown. We proposed the analysis of prediction error towards core and penumbral volumes using qualitative approaches, hypothesizing broad ranges across potential values, with greatest vulnerability to error using NCCT ASPECTS.

METHOD AND MATERIALS

54 patients (36 female, 71 years+/-16) with anterior circulation AIS imaged with NCCT and CTP were evaluated. Perfusion analysis (time ~2.5 min) was performed in an operator independent environment (RAPID). Estimated core infarct volume was calculated by relative CBF. At-risk volume was calculated at Tmax>6s. NCCT and CTP ASPECTS were determined by two independent evaluators. Linear regression models were fitted with each of the volume variables as outcome and qualitative scores as covariates. F-statistics of ANOVA were performed.

RESULTS

Demographics included median NIHSS=16 (IQR 15), mean time to imaging=233 min (IQR 252). Mean (sd) volumes for rCBF core for NCCT-ASPECTS scores 8-10 were 27(31.6), 11.2(17.8), 4.7(7.8), respectively (p<0.001), while at-risk volumes at Tmax>6s were 68.3(30.9), 56.4(55.4), 44.2(42.1) (p=0.36). For CBV-ASPECTS scores 7-10, rCBF volumes were 12.2(23), 5.1(9.4), 0(0), 0(0) (p=0.004), while at-risk volumes, Tmax>6s were 42.2(28.7), 44.3(34.6), 17.1(26.7), 47.1(56.1) (p=0.04). For CBF-ASPECTS scores 7-10, rCBF volumes were 17.6(30.5), 5(10), 0(0), 3.2(4.5) (p=0.05), while at-risk volumes, Tmax>6s were 40.4(20.8), 44.5(40), 17.1(26.7), 15.7(12.7) (p=0.07).

CONCLUSION

ASPECTS is widely reported as a quick approach to risk stratification and treatment selection in AIS, but tissue changes may lag hypoperfusion and irreversible injury. While not practical as an estimation of at risk tissue, the present study further challenges the feasibility of such approaches as predictors of irreversible core at presentation.

CLINICAL RELEVANCE/APPLICATION

Qualitative methods are prone to wide ranges of core and at-risk tissue volume for any one appearance in AIS; fast, comprehensive image triage may be advisable for therapy choice, risk stratification.

SSE18-02 Detection of Small Vessel Occlusions Using a Wavelet-based CT Angiography Reconstructed from CT Perfusion Data in Acute Ischemic Stroke

Participants

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Birgit B. Ertl-Wagner, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
**PURPOSE**

To evaluate a newly developed wavelet-based CTA (waveCTA) reconstructed from whole-brain CT perfusion (WB-CTP) data in stroke patients in which conventional single-phase CTA (spCTA) failed to demonstrate a vessel occlusion.

**METHOD AND MATERIALS**

Out of a retrospective cohort of 658 consecutive patients who had undergone multiparametric CT due to suspected stroke, we included all patients with the following inclusion criteria: (1) CT perfusion deficit as assessed by CBF, (2) no evidence of occlusion in spCTA, and (3) acute ischemic non-watershed infarction as confirmed by follow-up MRI or CT within 72hrs. waveCTA images were calculated from whole-brain CT perfusion data after initial rigid-body motion correction using the wavelet transform (Paul wavelet, order 1) of each pixel attenuation time course, from which the angiographic signal intensity was extracted as the maximum of the wavelet power spectrum. waveCTA was analyzed by two blinded and experienced readers with respect to presence and location of vessel occlusions and detail visibility of vessels in comparison to spCTA.

**RESULTS**

Sixty-three patients (9.6%, mean age 74.8 yrs, range 34-89) fulfilled the inclusion criteria. waveCTA reconstruction was successful in all patients. Overall, in 31 (49.2%) of these patients with negative spCTA, an occlusion could be identified using waveCTA. In the subgroup of 48 MCA infarctions, 24 occlusions (50.0%) were detected by waveCTA, mainly located on the M2- (12) and M3-level (10). A subgroup of ACA and PCA infarctions with 6 patients each demonstrated occlusions using waveCTA in 3 cases each. Detail visibility of small vessels (M2-4 level) was rated significantly higher for waveCTA vs. spCTA (4.5 vs. 2.8; p < 0.001).

**CONCLUSION**

Wavelet-based CT angiography reconstructed from CT perfusion data allows the detection of small vessel occlusions that are missed by spCTA in around 50% of the cases.

**CLINICAL RELEVANCE/APPLICATION**

waveCTA is a promising new angiographic reconstruction technique of WB-CTP data that improves the sensitivity in the detection of small-vessel occlusions. Further studies on the prognostic value of these occlusions may contribute to clinical decision making in acute ischemic stroke.

**SSE18-03**  **Effects of Radiation Dose Reduction in Volume Perfusion CT Imaging of Acute Ischemic Stroke**

**METHOD AND MATERIALS**

VPCT data of 20 patients with suspected ischemic stroke acquired at 80 kV and 180 mAs were included. Using realistic reduced-dose simulation, low-dose VPCT datasets with 144 mAs, 108 mAs, 72 mAs and 36 mAs (80%, 60%, 40% and 20% of the original levels) were generated, resulting in a total of 100 datasets. Perfusion maps were created and signal-to-noise-ratio (SNR) measurements were performed. Qualitative analyses were conducted by two blinded readers, who also assessed the presence/absence of ischemic lesions and scored CBV and CBF maps using a modified ASPECTS-score.

**RESULTS**

SNR of all low-dose datasets were significantly lower than those of the original datasets (p<.05). All datasets down to 72 mAs (40%) yielded sufficient image quality and high sensitivity with excellent inter-observer-agreements, whereas 36 mAs datasets (20%) yielded poor image quality in 15% of the cases with lower sensitivity and inter-observer-agreements (Figure)).

**CONCLUSION**

Low-dose VPCT using decreased tube currents down to 72 mAs (40% of original radiation dose) produces sufficient perfusion maps for the detection of ischemic brain lesions.

**CLINICAL RELEVANCE/APPLICATION**

The application of LD-CTP is associated with lower patient radiation exposure while maintaining high diagnostic accuracy for the detection of ischemic brain lesions.

**SSE18-04**  **Comparing Different Imaging Strategies in Acute Ischemic Stroke**

**METHOD AND MATERIALS**

VPCT data of 20 patients with suspected ischemic stroke acquired at 80 kV and 180 mAs were included. Using realistic reduced-dose simulation, low-dose VPCT datasets with 144 mAs, 108 mAs, 72 mAs and 36 mAs (80%, 60%, 40% and 20% of the original levels) were generated, resulting in a total of 100 datasets. Perfusion maps were created and signal-to-noise-ratio (SNR) measurements were performed. Qualitative analyses were conducted by two blinded readers, who also assessed the presence/absence of ischemic lesions and scored CBV and CBF maps using a modified ASPECTS-score.

**RESULTS**

SNR of all low-dose datasets were significantly lower than those of the original datasets (p<.05). All datasets down to 72 mAs (40%) yielded sufficient image quality and high sensitivity with excellent inter-observer-agreements, whereas 36 mAs datasets (20%) yielded poor image quality in 15% of the cases with lower sensitivity and inter-observer-agreements (Figure)).

**CONCLUSION**

Low-dose VPCT using decreased tube currents down to 72 mAs (40% of original radiation dose) produces sufficient perfusion maps for the detection of ischemic brain lesions.

**CLINICAL RELEVANCE/APPLICATION**

The application of LD-CTP is associated with lower patient radiation exposure while maintaining high diagnostic accuracy for the detection of ischemic brain lesions.
The purpose of our study was to compare two different imaging strategies in acute ischemic stroke: using Noncontrast CT (NCCT) versus CT Angiography and Perfusion (CTAP) as the first imaging modality after patient presentation. Our hypothesis is that using CTAP as the first imaging modality may correlate with better outcomes compared to NCCT depending on patient characteristics of age, NIHSS and time from symptom onset to presentation.

METHOD AND MATERIALS

In this institutional review board-approved retrospective study, 373 patients with acute ischemic stroke who presented within a one year period at two large institutions were enrolled in this study. Inclusion criteria included presentation within 8 hours of stroke symptom onset, and no evidence of hemorrhage on initial imaging study. Patients were divided into two groups: those who received NCCT and those who received CTAP as their first imaging study. Patients were subsequently stratified based on treatment strategy (no treatment, Intravenous tPA (IVTPA) treatment, and endovascular therapy), and sub-stratified based on age, NIHSS, and time from symptom onset to presentation. Outcomes of mRS scores were compared between groups to determine the best imaging strategy based on patient characteristics.

RESULTS

Among the patients who were eventually treated with IVTPA, patients who received CTAP as their first imaging study had significantly lower mRS scores compared to those who received NCCT first (p < 0.001). This difference in mRS scores was seen in the subgroup of patients greater than 70 years old, with NIHSS greater than 5, and who presented within 4.5 hours of symptom onset. There was no significant difference in outcomes between the two imaging strategies in patients who did not receive treatment at all, and those who only received endovascular therapy.

CONCLUSION

In those patients who were eventually treated with IVTPA, significantly better outcomes were observed in patients who underwent CTAP as their first imaging study compared to those who received NCCT first (the current imaging standard). In patients greater than 70 years of age, with NIHSS greater than 5, and presenting within 4.5 hours of symptoms onset, CTAP may better inform physicians as to subsequent treatment strategy.

CLINICAL RELEVANCE/APPLICATION

Imaging strategies for ischemic stroke patients should be individualized based on patient characteristics of age, NIHSS and time from symptom onset to presentation.

SSE18-05 Dynamic Grey Matter Changes during Motor Recovery after Pontine Infarction: A Voxel-based Morphometry Study

Monday, Nov. 30 3:40PM - 3:50PM Location: N229

Participants
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Kuncheng Li, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate the neural mechanisms of motor recovery after pontine infarct, we explored changes of grey matter within motor cortex by voxel-based morphometry(VBM) analysis method and calculated the correlations between the thickness of grey matter of each voxel and clinical scores.

METHOD AND MATERIALS

Fifteen stroke patients with unilateral infarction of pontine area were scanned and neurologically assessed 5 times after the stroke (within 3~7 days, at 2 weeks, 1 month, 3 months, and 6 months after stroke onset). All patients underwent MPRAGE scans on a Siemens Magnetom Trio 3.0T scanner. Fifteen age-sex with left and right handed matched healthy participants were also examined with the same protocol. The gray matter volume changes after infarction were assessed using VBM and motor deficits were evaluated with Fugl-Meyer Motor Scale (FMMS) score at the same time. The correlation between gray matter changes, infarction volumes and FMMS scores were respectively analyzed.

RESULTS

The FMMS significantly increased progressively from the seventh day to the sixth month after infarction (P<0.05). In pontine group, GMV were increased in putamen, pallidus, frontal gyrus, temporal gyrus, inferior parietal lobe, and occipital gyrus, which mostly located in the contralateral. And GMV were decreased in frontal gyrus, postcentral gyrus, precuneus, cuneate sulcus, and uvula. The results of group analysis showed that there was no significant change in normal control group between different time point. While, in stroke group the GMV showed increase in ipsilateral thalamus within 7 days compared to 3 month and 6 month. Comparison between two groups at each time point, we found that the volume of contralateral inferior parietal lobe increased continually, however, ipsilateral precuneous showed decrease of GMV during the study period. The changes of GMV in the contralateral putamen and pallidus were positive correlated with the changes in the FMMS of stroke patients(r=0.287, p=0.012); Changes in ipsilateral postcentral was negative correlated with changes in FMMS(r=-4.20, p=0.000).
The existence of gray matter volume increased, and spontaneous with motor recovery in patients with pontine infarction is closely related to brain plasticity.

**CLINICAL RELEVANCE/APPLICATION**

Our findings provide imaging evidences that reveal the motor function recovery mechanisms after cerebral infarction.

**SSE18-06 A Correlation Study between Diffusivity of Ischemic White Matter Fiber Tract and Neuro-functional Recovery in Patients with Acute Stroke by Using DTI Technique**

Monday, Nov. 30 3:50PM - 4:00PM Location: N229

Participants
Shuohui Yang, MD, Shanghai, China (Presenter) Nothing to Disclose
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Songhua Zhan, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate the correlation between diffusivity of ischemic white matter fiber tract and neuro-functional recovery in acute stroke patients by using DTI, and try to predict motor outcome of these patients.

**METHOD AND MATERIALS**

Forty unilateral cerebral ischemic patients with motor dysfunction underwent MRI and DTI study within 3 days after the onset of illness. MRI scans were done 1, 2 and 3 month after treatment. Fractional anisotropy (FA) and apparent diffusion coefficient (ADC) maps were obtained. With the reference of DW images, regions of interest (ROIs) were selected on the ischemic white matter fiber tract, and the control ROIs were selected on the contra-lateral homonymous tract. The ratios of FA and ADC (rFA and rADC) within these ROIs and infarction volume (IV) were calculated. The relationship between DTI parameters with IV and national institute of health stroke scale (NIHSS) scores were assessed. According to motricity index (MI), a total of 32 stroke follow-up patients after one year were divided into no motor deficit group and motor deficit group; DTI parameters were used to predict the motor outcome.

**RESULTS**

Significant differences were found regarding rFA, rADC and IV of ischemic white matter fiber tract among the onset, 1, 2 and 3 month of acute stroke patients (F = 13.84, P = 0.00, F = 64.57, P = 0.00 and F = 37.41, P = 0.00). There was significantly negative correlation between rFA and NIHSS scores at the onset and 1 month (r = -0.59, t = -4.59, P = 0.00, r = -0.34, t = -2.27, P = 0.02) and between rADC and NIHSS at the onset (r = -0.44, t = -3.04, P = 0.00). There was significantly positive correlation between rADC and NIHSS scores (r = 0.28, t = 1.83, P = 0.04, r = 0.39, t = 2.69, P = 0.00, r = 0.63, t = 4.99, P = 0.00) and between IV and NIHSS (r = 0.4, t = 2.73, P = 0.01, r = 0.44, t = 3.05, P = 0.00, r = 0.32, t = 2.13, P = 0.04) at 1, 2, and 3 month from the onset. There was significant correlation between the rADC of 3 month and MI of 32 stroke patients after one year (t = 2.75, P = 0.01) with AUC of ROC being 0.905.

**CONCLUSION**

There could be a significant correlation between the change of diffusivity of the ischemic white matter and the neuro-functional recovery in acute stroke patients by analyzing DTI metrics. rADC at 3 month after onset may be used to predict the motor outcome.

**CLINICAL RELEVANCE/APPLICATION**

ADC values of DTI at 3 month after onset of stroke patients may be used to predict the motor outcome.
Neuroradiology (Epilepsy)

Monday, Nov. 30 3:00PM - 4:00PM Location: N230

NR  CT  MR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

SSE19-01 A Novel Electrocorticography Grid Using Conductive Nanoparticles in a Polymer Thick Film on an Organic Substrate Improves CT and MR Imaging

Participants
Steven M. Stufflebeam, MD, Charlestown, MA (Moderator) Nothing to Disclose
Roland R. Lee, MD, San Diego, CA (Moderator) Nothing to Disclose

Purpose
Conventional electrocorticography (ECoG) grids produce extensive metal artifacts at CT and MR imaging. This study compares CT and MR artifacts from conventional ECoG grids with those from a grid developed by deposition of conductive nanoparticles in polymer thick film on an organic substrate (PTFOS).

Method and Materials
We compared the induced artifacts between the newly developed PTFOS grid and the conventional ECoG grids at CT and MR imaging. All imaging was performed on a cadaveric human head specimen. We then asked two neuroradiologists to score the quality of CT and MR images in the cases of the head sample with no grid, with conventional grids, and with PTFOS grids. The functioning of the PTFOS for cortical recording and stimulation was tested in mice. We used electron microscopy to study the microstructural changes of PTFOS after long-term implantation in mice. We also studied changes in electrical properties of the PTFOS after long-term submersion in a saline bath.

Results
The PTFOS grid produced no appreciable artifacts in CT and MR images, and the image quality reported by neuroradiologists was significantly higher for the PTFOS compared to conventional grids (P<0.05). Cortical recording and stimulation was successfully done in mice using PTFOS. PTFOS pieces showed no appreciable microstructural changes after long-term implantation in mice. After long-term submersion in the saline bath, the impedance of the PTFOS traces did not change (P>0.05) and remained within the range of 150-300Ω which is favorable for cortical recording and stimulation.

Conclusion
PTFOS grids are an attractive alternative to conventional grids as they show no appreciable artifacts at CT and MR imaging, and remain stable after long-term in-vivo implantation.

Clinical Relevance/Application
Diagnosis of surgical complications of electrocorticography grids implantation is largely dependent on CT and MR imaging. The newly developed PTFOS grid demonstrated excellent image quality both at CT and MR imaging, which can facilitate diagnosis of postoperative complications.

SSE19-02 A Novel Electrocorticography Grid Using Conductive Nanoparticles in a Polymer Thick Film on an Organic Substrate Causesless MRI Heating Compared to Conventional Grids

Participants
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Reza Atefi, PhD, Charlestown, MA (Abstract Co-Author) Nothing to Disclose
Martina Y. Villeneuve, PhD, Charlestown, MA (Abstract Co-Author) Nothing to Disclose
Michael H. Lev, MD, Boston, MA (Abstract Co-Author) Research support, General Electric Company Stockholder, General Electric Company
Alexandra J. Golby, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Rajiv Gupta, PhD, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Giorgio Bonmassar, PhD, Charlestown, MA (Abstract Co-Author) Nothing to Disclose

Purpose
Conventional electrocorticography (ECoG) grids produce extensive metal artifacts at CT and MR imaging. This study compares CT and MR artifacts from conventional ECoG grids with those from a grid developed by deposition of conductive nanoparticles in polymer thick film on an organic substrate (PTFOS).

Method and Materials
We compared the induced artifacts between the newly developed PTFOS grid and the conventional ECoG grids at CT and MR imaging. All imaging was performed on a cadaveric human head specimen. We then asked two neuroradiologists to score the quality of CT and MR images in the cases of the head sample with no grid, with conventional grids, and with PTFOS grids. The functioning of the PTFOS for cortical recording and stimulation was tested in mice. We used electron microscopy to study the microstructural changes of PTFOS after long-term implantation in mice. We also studied changes in electrical properties of the PTFOS after long-term submersion in a saline bath.

Results
The PTFOS grid produced no appreciable artifacts in CT and MR images, and the image quality reported by neuroradiologists was significantly higher for the PTFOS compared to conventional grids (P<0.05). Cortical recording and stimulation was successfully done in mice using PTFOS. PTFOS pieces showed no appreciable microstructural changes after long-term implantation in mice. After long-term submersion in the saline bath, the impedance of the PTFOS traces did not change (P>0.05) and remained within the range of 150-300Ω which is favorable for cortical recording and stimulation.

Conclusion
PTFOS grids are an attractive alternative to conventional grids as they show no appreciable artifacts at CT and MR imaging, and remain stable after long-term in-vivo implantation.

Clinical Relevance/Application
Diagnosis of surgical complications of electrocorticography grids implantation is largely dependent on CT and MR imaging. The newly developed PTFOS grid demonstrated excellent image quality both at CT and MR imaging, which can facilitate diagnosis of postoperative complications.
SSE19-03  Language Reorganization in Temporal Lobe Epilepsy - A Task Based fMRI Connectome Study

Participants
Gregor Kasprian, MD, Vienna, Austria (Presenter) Nothing to Disclose
Christian Widmann, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Ekaterina Pataraia, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Georg Langs, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Christoph Baumgartner, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Daniela Prayer, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose

PURPOSE
Atypical language representations are frequently seen in left hemispheric temporal lobe epilepsy (ITLE) patients. fMRI based language connectome analysis allows to study neuronal networks, linked to language function. The aim of this study was to visualize the (re-)organization of the language connectome (LC) in a cohort of ITLE patients.

METHOD AND MATERIALS
The functional LC was calculated on the basis of functional MRI data (3 Tesla, TE=35ms, TR=3000ms, slice thickness: 4mm, 32 slices, 96x96 matrix, 2.4x2.4x4mm, 100 dynamics, verb generation task, FreeSurfer, FSL). The LC of 8 patients with non lesional ITLE (median age 35) and 12 ITLE patients with hippocampal sclerosis (HS) (median age 42) were compared to a reference LC based on 13 healthy controls (median age 38). Variations in the functional connectome analysis were quantified using the network-based statistics (NBS) approach.

RESULTS
The language connectome of non lesional ITLE patients and HS patients showed a significantly increased interhemispheric connectivity (p<0.001), compared to healthy controls (Figure). A stronger ipsilateral connectivity of the default mode network was found in controls. Non lesional ITLE and HS patients showed an increased node degree in the Broca region.

CONCLUSION
The task-based language connectome of ITLE patients shows widespread alterations (Figure). Recruitment of interhemispheric connections may be related to functional language network reorganization due to structural alterations of the left temporal lobe and/or seizure activity.

CLINICAL RELEVANCE/APPLICATION
Task-based NBS analysis offers a new perspective in understanding the lesion induced reorganization of language function in the human brain. These results will impact the preoperative evaluation of individual ITLE patients and may reduce the incidence of postoperative language deficits.
To evaluate ultra high field MR-microscopy for the discrimination of sclerotic and non-sclerotic hippocampi (HC) in patients with mesial temporal lobe epilepsy (mTLE).

METHOD AND MATERIALS
Resected HC of 11 patients diagnosed with mTLE were scanned on a preclinical 7T MRI (ClinScan, Bruker). Morphologic images (T2w, resolution: 42x42x300 µm) were acquired. Diffusion tensor imaging was performed and voxel based maps of T1-, T2- and T2*-times were calculated for each HC. On morphologic images, the pyramid cell layer (PCL) was segmented on 10 consecutive slices. The segmentation mask was transferred to the respective parameter maps. Depending on the neuropathologic diagnosis, HC were classified sclerotic (n=9) or non-sclerotic (n=2). The parameters PCL volume, T1-, T2- and T2*-times, apparent diffusion coefficient (ADC), fractional anisotropy (FA) and trace of the diffusion tensor (TW) were inserted into a multiparametric analysis and parameter-probability curves were adjusted using GNU R's logistic response model.

RESULTS
On morphologic images, a narrowing of the PCL for the sclerotic as compared to the non-sclerotic HC is discernible (Fig. 1a). The median parameter values were determined in the PCL for sclerotic/non-sclerotic HC including PCL volume (8/11 mm3), T1 time (736/1094 ms), T2 time (85/129 ms), T2* time (42/41 ms), ADC (593/228 µm2/s), FA (0.495/0.476 a.u.), TW (495/384 mm2/s). As a result of the multiparametric analysis, T1 time is the most significant predictor of sclerosis (p=0.026), followed by T2 time (p=0.072) and PCL volume (p=0.097). The respective parameter-probability curves are shown in Fig. 1b. HC with T1 times below 750 ms have a probability higher than 90% of being sclerotic.

CONCLUSION
Ultra high field MR-microscopy revealed distinct characteristics in morphology and significantly different T1 times in the PCL of sclerotic and non-sclerotic HC. Time-adapted imaging protocols might be translated for clinical application on ultra high field systems.

CLINICAL RELEVANCE/APPLICATION
Non-invasive diagnosis of hippocampal sclerosis to preoperatively evaluate the patients' benefit of hippocampus resection using ultra high field MR-microscopy.

SSE19-05 Clinical Comparison of Three Methods for Analysis of SPECT Imaging of Epilepsy

Participants
Zaiyang Long, PhD, Rochester, MN (Presenter) Nothing to Disclose
Benjamin H. Brinkmann, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Michael K. O'Connor, PhD, Rochester, MN (Abstract Co-Author) Royalties, Gamma Medica, Inc

PURPOSE
Ictal-interictal SPECT with co-registration to MRI provides a valuable non-invasive method to localize the seizure onset zone in focal epilepsy. Currently both statistical parametric mapping (SPM)-based methods and conventional subtraction methods (e.g. SISCOM) are employed, with SPM methods providing the context of normal physiological variation. However, SPM-based methods require specialized tools and are more complex to use. Commercial software packages that are more easily integrated into the clinical practice are becoming available. The current study compares SISCOM, an SPM-based method, and a commercial package MIMneuro (MIM Software), which uses both cluster analysis and statistical differences in co-registered images.

METHOD AND MATERIALS
We retrospectively reviewed the records of 366 patients who underwent ictal/interictal Tc99m-ECD SPECT scans. We identified 25 with surgical resection and postoperative follow up for at least one year. Surgical outcomes were scored by ILAE criteria (Range 1-5: 1=seizure freedom and 5=seizures continue or increase). Hyperperfusion and hypoperfusion SPECT images co-registered with MRI were analyzed using SISCOM, SPM and MIMneuro. Correlation between SPECT localization and resected tissue was scored on a 1-5 scale (1=localization closely matches resection, 5=no match to resection location) and correlated with the patient's ILAE score.

RESULTS
Using optimized parameters, the resection overlap of images analyzed by MIMneuro showed a significant correlation with ILAE score (R2=0.76, p<0.001). SPM also showed a significant correlation with ILAE score (R2=0.51, p<0.05), whereas SISCOM did not show a significant correlation with ILAE score (R2=0.19). Summed ILAE score for all patients were 57, while summed MIMneuro, SPM and SISCOM scores were 57, 66 and 69, respectively. On a standard Windows 7 workstation (Intel Core i5-4300U CPU and 8GB of RAM), processing time per patient took less than 2 min with MIM Neuro, and took 10-15 min with SPM.

CONCLUSION
MIMneuro and SPM SPECT localizations showed better predictive value for surgical outcome compared to SISCOM. MIMneuro took less computation time than SPM, potentially providing further benefit to the clinical workflow.

CLINICAL RELEVANCE/APPLICATION
SPM and commercial MIMneuro package provide powerful tools for analyzing SPECT images for epilepsy evaluation. MIMneuro with optimized parameters can further reduce analysis time and improve localization.

SSE19-06 Stereotactic Laser Ablation for Temporal Lobe Epilepsy: MRI Findings Predictive of Seizure Freedom Outcome
Participants
Bruno P. Soares, MD, Atlanta, GA (Presenter) Nothing to Disclose
Amit M. Saindane, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Jon Willie, MD,PhD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Daniel Drane, PhD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Deqiang Qiu, PhD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Robert E. Gross, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

PURPOSE
MRI-guided stereotactic laser ablation is currently being used for amygdalohippocampotomy in mesial temporal lobe epilepsy (MTLE). The technique aims to eliminate seizures while minimizing adverse cognitive effects of open resection procedures. The purpose of this study is to establish pre- and postprocedural MRI findings that predict seizure freedom outcome with laser amygdalohippocampotomy.

METHOD AND MATERIALS
This retrospective study included 24 patients with diagnosis of MTLE who were treated with amygdalohippocampotomy and for which 12-month seizure freedom outcome data was available. Two neuroradiologists experienced in epilepsy imaging evaluated the MRI exams. On baseline exams, T2 signal intensity and volume of mesial temporal lobe regions were rated utilizing coronal oblique images. On periprocedural exams, extent of ablation of each region was rated utilizing postcontrast coronal oblique 3D T1 MPRAGE images. The patients were followed-up at 12 months after ablation and classified according to the Engel scale as seizure free / almost free or not improved. MRI findings were correlated with seizure freedom outcome by employing Fisher's exact test and Chi-square test.

RESULTS
16 patients fulfilled imaging criteria for mesial temporal sclerosis (MTS). Among these patients, 10/16 (62.5%) were seizure free 12 months after ablation. Three out of 8 patients without MRI diagnosis of MTS were free of seizures arising from the side of ablation at follow-up, while 5 of them were not improved. Among patients with MTS diagnosis, there was a significant correlation between the extent of amygdala ablation - in addition to the hippocampus - and favorable seizure freedom outcome (p= 0.032). 9/11 patients with 50% or greater ablation of the amygdala were seizure free after 12 months, compared to 1/5 patients in which the amygdala was less than 50% ablated.

CONCLUSION
MRI diagnosis of MTS predicts improved seizure freedom outcomes in patients treated with laser amygdalohippocampotomy. In these patients, our data suggests that seizure freedom outcome is improved by greater extent of ablation of the amygdala, in addition of the hippocampus. Larger sample sizes are required to better predict outcome in non-MTS patients.

CLINICAL RELEVANCE/APPLICATION
Precise knowledge of the extent and location of the ablation zone is crucial to predict seizure freedom and cognitive effects of stereotactic laser amygdalohippocampotomy in MTLE.
### SSE20 | Pediatrics Keynote Speaker: Studying the Pediatric Connectome

**Participants**
- Ashok Panigrahy, MD, Pittsburgh, PA (Moderator) Nothing to Disclose
- Susan Palasis, MD, Atlanta, GA (Moderator) Nothing to Disclose

### SSE20-02 | Post-treatment Diffusion Tensor Imaging to Evaluate Response to Total Body Hypothermia in Neonates with Hypoxic-ischemic Encephalopathy

**Participants**
- Laura Scarciolla, MD, Massafra, Italy (Presenter) Nothing to Disclose
- Carlo Cosimo Quattrociocchi, MD, PhD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
- Thomas Joseph Re, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Lorenzo Figa Talamanca, Rome, Italy (Abstract Co-Author) Nothing to Disclose
- Giuseppe Calbi, Rome, Italy (Abstract Co-Author) Nothing to Disclose
- Bruno Bernardi, MD, Bologna, Italy (Abstract Co-Author) Nothing to Disclose
- Bruno Beomonte Zobel, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
- Daniela Longo, Rome, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To test the efficacy of ADC and FA for the evaluation of treatment response in newborns with moderate and severe hypoxic-ischemic encephalopathy (HIE) treated with total-body hypothermia.

**METHOD AND MATERIALS**
27 newborns with clinical criteria of moderate-severe HIE (17 treated with total body therapeutic hypothermia, 10 nontreated) and 10 healthy neonates were studied with MR imaging and DTI. Ten treated neonates and healthy neonates underwent a follow-up brain MRI and DTI at 6 months of life. All data were acquired on a 3-T Skyra (Siemens, Erlagen, Germany). Conventional MRI imaging included: axial T1 TSE (slice thickness = 2 mm, TR=550 ms, TE 6,7 ms, matrix size = 416x512), sagittal T1 TIRM (slice thickness = 3 mm, TR=2690 ms, TE 8,5 ms, matrix size = 256x256), axial and coronal T2 TSE (slice thickness = 2 mm, TR=10320 ms, TE 122 ms, matrix size= 348x384). DTI acquisition was performed by a single-shot echo-planar sequence, one volume not diffusion-weighted (b0), and bipolar diffusion gradients (b = 800 s/mm2) applied in 30 directions. On ADC and FA maps, basal ganglia and thalamus ROIs were designed. Preprocessing of the raw DTI data was performed using FSL software. Diffusion toolkit along with TrackVis (trackvis.org) were used to reconstruct and visualize tractography pathways respectively.

**RESULTS**
Conventional MR imaging was normal in 11 (65%) treated neonates and in 3 (30%) nontreated neonates. All treated neonates presented lower FA values in all tracks, in BG and in Thalamus ROI (p<0.01) comparing to healthy newborns but higher FA values (p<10^-5) comparing to nontreated neonates. ADC values were higher in BG and in all white matter fibers (p<10^-4) comparing to nontreated neonates. At 6 months follow-up MR, the treated neonates FA and ADC values were closer to normal.

**CONCLUSION**
FA and ADC may more accurately reflect true microstructure characteristics of brain immediately after therapeutic hypothermia and at 6-months follow-up than does conventional MRI. DTI data for nontreated neonates at 6 months would be required to confirm our results.

**CLINICAL RELEVANCE/APPLICATION**
As DTI metrics reflect a different aspect of brain microstructure than conventional MRI, they may provide a more accurate tool for diagnosing and following neonates with poor neurodevelopment due to HIE.

### SSE20-03 | Increased Gray Matter Volume of Emotional Circuits in Children without Direct Parental Care

**Participants**
- Yuan Xiao, Chengdu, China (Presenter) Nothing to Disclose
- Lili Yang, Wenzhou, China (Abstract Co-Author) Nothing to Disclose
- Zhihan Yan, Wenzhou, China (Abstract Co-Author) Nothing to Disclose
- Yuchuan Fu, Wenzhou, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To test the efficacy of ADC and FA for the evaluation of treatment response in newborns with moderate and severe hypoxic-ischemic encephalopathy (HIE) treated with total-body hypothermia.

**METHOD AND MATERIALS**
27 newborns with clinical criteria of moderate-severe HIE (17 treated with total body therapeutic hypothermia, 10 nontreated) and 10 healthy neonates were studied with MR imaging and DTI. Ten treated neonates and healthy neonates underwent a follow-up brain MRI and DTI at 6 months of life. All data were acquired on a 3-T Skyra (Siemens, Erlagen, Germany). Conventional MRI imaging included: axial T1 TSE (slice thickness = 2 mm, TR=550 ms, TE 6,7 ms, matrix size = 416x512), sagittal T1 TIRM (slice thickness = 3 mm, TR=2690 ms, TE 8,5 ms, matrix size = 256x256), axial and coronal T2 TSE (slice thickness = 2 mm, TR=10320 ms, TE 122 ms, matrix size= 348x384). DTI acquisition was performed by a single-shot echo-planar sequence, one volume not diffusion-weighted (b0), and bipolar diffusion gradients (b = 800 s/mm2) applied in 30 directions. On ADC and FA maps, basal ganglia and thalamus ROIs were designed. Preprocessing of the raw DTI data was performed using FSL software. Diffusion toolkit along with TrackVis (trackvis.org) were used to reconstruct and visualize tractography pathways respectively.

**RESULTS**
Conventional MR imaging was normal in 11 (65%) treated neonates and in 3 (30%) nontreated neonates. All treated neonates presented lower FA values in all tracks, in BG and in Thalamus ROI (p<0.01) comparing to healthy newborns but higher FA values (p<10^-5) comparing to nontreated neonates. ADC values were higher in BG and in all white matter fibers (p<10^-4) comparing to nontreated neonates. At 6 months follow-up MR, the treated neonates FA and ADC values were closer to normal.

**CONCLUSION**
FA and ADC may more accurately reflect true microstructure characteristics of brain immediately after therapeutic hypothermia and at 6-months follow-up than does conventional MRI. DTI data for nontreated neonates at 6 months would be required to confirm our results.

**CLINICAL RELEVANCE/APPLICATION**
As DTI metrics reflect a different aspect of brain microstructure than conventional MRI, they may provide a more accurate tool for diagnosing and following neonates with poor neurodevelopment due to HIE.
PURPOSE

With the economic boom, hundreds of millions of laborers are migrating away from their children to pursue a better job. This international parental migration has resulted in millions of left-behind children (LBC) and has raised widespread concern. However, it is still unclear where and how the brain is affected in these children who lack parental care. Therefore, we aimed to explore the gray matter volume alteration in LBC in relative to those with parental care.

METHOD AND MATERIALS

This study was IRB approved and written informed consent was obtained from guardians. Thirty-eight LBC (age=9.6±1.8yrs, 21boys) and 30 comparison children (age=10.0±1.95yrs, 19boys) were included and performed a 3.0T MR scan. The LBC is defined as children who living with the absence of both of their biological parents for a period over six months. Image preprocessing and statistical analyses were performed with optimized voxel-based morphometry in SPM8. IQ of all participants was measured to quantify cognitive function.

RESULTS

Compared to controls, LBC showed significantly greater gray matter volume in bilateral fusiform gyri, bilateral parahippocampus, right superior parietal lobe, right thalamus, right superior occipital gyrus, left cuneus, right superior temporal gyrus, right superior medial frontal gyrus, left postcentral gyrus, left middle occipital gyrus and left putamen (p<0.05, FDR corrected). The mean value of IQ scores in LBC was not significantly different from that in controls. Furthermore, gray matter volume in bilateral parahippocampus gyr in LBC was negatively correlated with IQ score (p<0.05).

CONCLUSION

This study provided the first empirical evidence of larger gray matter volumes, especially in emotional circuits in LBC than children living with their parents, suggesting the parental care affects the brain development. Since the larger gray matter volume may reflect insufficient pruning and mature of brain, the negative correlation between the gray matter volume and IQ scores suggest that growing without parental care may delay the development of brain.

CLINICAL RELEVANCE/APPLICATION

To our knowledge, this study provides the first empirical evidence of larger gray matter volumes in emotional circuits in LBC, suggesting that parental care affects brain development. From a public health perspective, the study highlighted the importance of parental care in children and indicated early intervention and stimulation are needed to LBC.

SSE20-04 Age-dependent Signal Density of Diffusion Kurtosis Imaging (DKI) of Healthy Volunteers’ Brains at Left-right Hemispheric Level Analyses

Monday, Nov. 30 3:30PM - 3:40PM Location: S102AB

Participants

Mamiko Koshiba, PhD, Iruma-gun, Japan (Presenter) Nothing to Disclose
Takako Aoki, PhD, Iruma-Gun, Japan (Abstract Co-Author) Nothing to Disclose
Hayato Sakurai, MD, Moroyama, Japan (Abstract Co-Author) Nothing to Disclose
Tsuyoshi Sasaki, RT, Moroyama, Japan (Abstract Co-Author) Nothing to Disclose
Tomokazu Araki, RT, Moroyama, Japan (Abstract Co-Author) Nothing to Disclose
Hiroko Kakei, Moroyama, Japan (Abstract Co-Author) Nothing to Disclose
Naomi Hotta, Moroyama, Japan (Abstract Co-Author) Nothing to Disclose
Yuuki Minamikawa, Moroyama, Japan (Abstract Co-Author) Nothing to Disclose
Mamoru Nitsu, MD, Saitama, Japan (Abstract Co-Author) Nothing to Disclose
Tetsuya Kunikata, Iruma-Gun, Japan (Abstract Co-Author) Nothing to Disclose
Hideo Yamamouchi, Iruma-Gun, Japan (Abstract Co-Author) Nothing to Disclose

Background

For approaches to DKI application in neuropediatrics without any risky sedation, the lower resolution data of an infant’s smaller brain raise a question whether its significantly useful or not. As the preliminary evaluation, we are attempting to examine macroscopic DKI quantitative analyses in the data of our own medical staff volunteers if the linear regression would be visualized as previously reported age-dependency (2014).

Discussion

In the scatter diagrams with DKI signal density as a dependent variable and age as an explanatory variable, age-dependent increasing of DKI density was generally revealed repeatedly in both left and right hemispheres in the 2nd to 4th slices (e.g. square correlation coefficient (R2) = 0.52) but not in either cerebellums (R2 = 0.069) or eye balls (R2 = 0.023) imaged in the 1st slice.

Conclusion

DKI hemispheric density quantification in adult was preliminarily confirmed as a practical simple approach to diagnose neurological development. This macroscopic comprehension using DKI is expected possibly contributable to Neuropediatrics by MRI without sedation under lower resolution.

SSE20-05 Repeatability of Graph-Theoretical Metrics Derived from Resting-State fMRI in Pediatric Patients with Epilepsy

Monday, Nov. 30 3:40PM - 3:50PM Location: S102AB

Participants

Michael J. Paldino, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Wei Zhang, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Zili David Chu, PhD, Houston, TX (Presenter) Nothing to Disclose
**PURPOSE**

To measure the test-retest repeatability of metrics that quantify network architecture in the brain derived from resting-state fMRI in a cohort of pediatric epilepsy patients.

**METHOD AND MATERIALS**

This IRB approved study identified patients with: 1. epilepsy; 2. brain MRI at 3 Tesla; 3. two identical resting state fMRI acquisitions performed in the same examination. Resting-state time series were co-registered to a T1-weighted structural image. Network nodes were defined by subdivision of whole brain gray matter into 400 (coarse parcellation) or 800 (fine parcellation) volumes of interest. The strength of an edge (connection) between two nodes was defined as the absolute value of the correlation between their BOLD time series. For each weighted connection matrix, correlation coefficients were thresholded over a range of values (0.7 to 0.98). The following topological properties were calculated for each graph: clustering coefficient, transitivity, modularity, characteristic path length, smallworldness, and global efficiency. A potential difference between observations was assessed using the Wilcoxon signed-rank test. For each parameter, we calculated: 1. Mean coefficient of variation (CoV). 2. Pearson Coefficient; 3. ICC; 4. Repeatability coefficient; 5. Ninety-five percent confidence limits (95%CL) for change.

**RESULTS**

12 patients were included (4-21 yrs). There was no significant difference between observations for any metric. Maximal test-retest estimates for each metric are presented in Table 1. ICC for modularity, transitivity and clustering was consistent across thresholds (Fig 1). By contrast, ICC for characteristic path length, smallworldness and global efficiency peaked over a narrow range of threshold. Modularity, path length and smallworldness were the most repeatable measures.

**CONCLUSION**

These findings demonstrate the test-retest repeatability of network metrics in a cohort of pediatric epilepsy patients. Change in an individual patient greater than the repeatability coefficient or 95%CL for change is unlikely to be related to intrinsic variability of the method.

**CLINICAL RELEVANCE/APPLICATION**

NA

**Participants**

Qi Liu, Chengdu, China (Presenter) Nothing to Disclose  
Lizhou Chen, Chengdu, China (Abstract Co-Author) Nothing to Disclose  
Ming Zhou, Chengdu, China (Abstract Co-Author) Nothing to Disclose  
Xinyu Hu, Chengdu, China (Abstract Co-Author) Nothing to Disclose  
Ying Chen, Chengdu, China (Abstract Co-Author) Nothing to Disclose  
Lanting Guo, Chengdu, China (Abstract Co-Author) Nothing to Disclose  
Qiyong Gong, Chengdu, China (Abstract Co-Author) Nothing to Disclose  
Xiaoqi Huang, MD, Chengdu, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Despite previous studies have reported structural and functional deficits in Attention-deficit/hyperactivity disorder (ADHD) children, it's still a challenge to translate the neuroanatomic abnormalities to clinical practice. Studies focus on adults with ADHD had shown the potential clinical value of support vector machine (SVM) in distinguishing patients with ADHD from healthy controls individually, but no study has explored its usage in unmedicated children with ADHD. As ADHD has a higher prevalence in males, our study sought to use cortical thickness (CT) to distinguish the medicated-naive school-age ADHD boys from healthy controls via SVM.

**METHOD AND MATERIALS**

Forty drug-naïve ADHD boys (mean age: 10.1) and 40 healthy controls (mean age: 10.2) were recruited. The T1-weighted images were obtained by 3T MRI with SPGR sequence. The whole-brain analysis between two groups was performed via the Qdec surface-based group analysis tool in Freesurfer for CT with age as covariate (corrected by FDR p<0.05). We used PROBID software to investigate the diagnosis potential of CT of each hemisphere separately based on SVM using leave-one-out cross-validation approach. Then we examined their combined discriminative power for both hemisphere (p<0.001). We also drew Receiver Operating Characteristic (ROC) curves to assess the diagnosis accuracy power.

**RESULTS**

Compared to healthy group, ADHD boys showed significant reduction in cortical thickness of bilateral orbitofrontal, insula and lingual, right anterior and posterior cingulate, prefrontal, temporal and parietal cortex (Figure A), and left CT demonstrated obviously more significance in classification (sensitivity 80%, specificity 85%, accuracy 82.5%, P≤0.001, ROC area 0.841) (Figure B). The combined CT of both hemispheres didn't provide better result than left CT alone.

**CONCLUSION**

Our study demonstrated deficits in cortical thickness provides best solution for classification of medicated-naive ADHD boys with healthy controls. The fact that left hemisphere is more useful in classification showed the lateralization in brain neural pathology of ADHD.

**CLINICAL RELEVANCE/APPLICATION**

Classification approach based on cortical thickness may be a useful technique to distinguish the ADHD individuals from healthy controls.
**Algorithm-Enabled Reduction of Detector Crystals in Advanced PET System**

**PURPOSE**
As detector crystals constitute a large portion of a modern PET system cost, it is of significance to design a PET scanner with a reduced number of detectors without sacrificing the image quality. In this study, we investigate algorithm-enabled PET system design with a 50% reduction of detector crystals.

**METHOD AND MATERIALS**
We employ a digital PET scanner to collect IEC phantom data with initial total activity of 53 MBq. The phantom contains 6 spheres of 10, 13, 17, 22, 28, and 37 mm diameter. The activity in the smallest four spheres is 4 times the background and zero in the other two. We design a sparse PET configuration with 50% of crystals, which is to remove odd-numbered tiles in the odd-numbered rings, and even-numbered tiles in the even-numbered rings. We use an iterative algorithm based on Chambolle-Pock framework to solve a constrained-TV-minimization problem. We reconstruct images from full data by using the row-action maximum likelihood algorithm (RAMLA) as references. Scatter and random corrections are applied in the reconstruction. Images are evaluated by use of contrast of 4 hot spheres with the instruction in NEMA NU 2-2012.

**RESULTS**
Reconstructions with the new algorithm from both full and sparse data exhibit lower background noise compared to the RAMLA result. The contrast of a hot sphere of size 22 mm is 71.7%, 66.7%, and 68.5% in the full-data TV image, the sparse-data TV image, and the full-data RAMLA result, respectively. In the same order, the contrasts of the hot sphere of size 17 mm is 63.2%, 60.8%, and 59.0%; of the hot sphere of size 13 mm is 58.4%, 54.1%, and 47.3%; and of the hot sphere of size 10 mm is 32.1%, 20.6%, and 17.5%.

**CONCLUSION**
Advanced algorithms can reconstruct PET images from full data with quality improved over the RAMLA results in terms of contrast and background noise, and can yield images from data with 50% crystal reduction with potential practical utility.

**CLINICAL RELEVANCE/APPLICATION**
This work suggests that PET images of practical utility may be obtained by use of advanced algorithms from sparse-crystal data, which can be exploited for enabling crystal/cost reduction.

**Respiratory Motion Compensation for Simultaneous PET/MR Based on Measurements of Strongly Undersampled Radial MR Data**

**PURPOSE**
We propose a new method for PET/MR respiratory motion compensation (MoCo), which employs strongly undersampled measured MR
METHOD AND MATERIALS

MR data covering the thorax and abdomen of free-breathing volunteers were acquired with a Siemens Biograph mMR system. We applied a 3D encoded radial stack-of-stars sequence with a golden angle radial spacing. Two highly undersampled datasets consisting of 300 and 600 spokes were created corresponding to acquisition times of 30 s and 60 s, respectively. Respiratory motion amplitudes were derived from measured k-space centers allowing for a retrospective gating into 20 overlapping motion phase bins with a width of 10%. For all volunteers, MoCo 4D MR images and corresponding motion vector fields were generated for both highly undersampled datasets using our newly-developed method for joint motion estimation and iterative image reconstruction. Subsequently, 4D PET volumes of the volunteers with four artificial hot lesions (10 mm diameter) in the lungs and the abdomen were simulated. 3D PET and MoCo 4D PET images based on the two sets of motion vector fields derived from MR were reconstructed and compared to a reference gated 4D reconstruction with ten-fold PET acquisition time.

RESULTS

Compared to the 3D PET reconstructions, MoCo 4D PET reconstructions could reduce image blurring for both MR acquisition times. Due to its large motion amplitude, one lesion showed a double structure in the 3D reconstruction which could not be seen in the MoCo 4D reconstructions. For quantitative evaluation, SUVmean values were measured for all lesions in the end-exhale motion phases. In comparison to the reference, deviations of SUVmean were 36.7%, 24.5%, 21.5% on average for the 3D, MoCo 4D (30 s) and MoCo 4D (60 s) reconstructions, respectively.

CONCLUSION

It was demonstrated that motion compensation of PET images based on measurements of strongly undersampled radial MR data acquired during normal respiration could outperform 3D PET reconstructions in terms of image quality and quantification.

CLINICAL RELEVANCE/APPLICATION

The proposed method could be potentially integrated into clinical PET/MR to improve PET image quality and quantification, thus, increasing the diagnostic value of PET/MR.

SSE21-03 The Automated Determination of Universal Image Quality Indices for PET Scanners

Monday, Nov. 30 3:20PM - 3:30PM Location: S403A

Participants
Yaniv Rotem, BSc, MSc, Nesher, Israel (Abstract Co-Author) Employee, Koninklijke Philips NV
John A. Kennedy, PhD, Haifa, Israel (Presenter) Nothing to Disclose

Background

Evaluation of PET image quality phantom tests routinely requires deliberation and subjective decision-making. Commonly-used metrics of PET image quality do not always reflect perceptual quality differences. An automated method of measuring the structural similarity index (SSIM) reflecting known characteristics of the human visual system (HVS) has been developed to aid in the fast, objective evaluation of such tests.

Evaluation

Monthly image quality tests were performed (n=26) using an American College of Radiology (ACR) approved PET phantom (Esser flangeless) in a time-of-flight PET/CT. Scans comprised approximately 123e6 prompt counts and 19e6 random counts. An in-house MATLAB code analyzed 9.81 mm thick transaxial slices through the hot cylinders by comparing them with a digital model adjusted to known hot-to-background ratios. Registration of the digital model was performed using correlation of the outer phantom edges, and then rotating the images to maximize SSIM. In additional trials, SSIM was determined for a misregistered phantom (by 13 mm) exhibiting attenuation correction artifacts and for a list mode acquisition divided into 16 virtual acquisitions incrementing the scan time by 30 s to total of 8 minutes. SSIM was compared to a non-HVS metric, mean square error (MSE). Ideally, higher SSIM or lower MSE indicate superior image quality.

Discussion

Over approximately a two-year period, SSIM was 0.748 ± 0.007 (mean ± S.D., n=26) on ACR-approved PET phantoms. All cold and hot features were evident but highest (0.764) and lowest (0.733) SSIM were the visually better and worse images respectively. For the 16 virtual acquisitions, SSIM increased (from 0.56 to 0.74) monotonically with scan time, a known determinant of image quality. The misregistered phantom was superior to the 90 s acquisition by visual assessment, which was reflected in the SSIM (0.68 vs. 0.748 ± 0.007) Institutional research agreement, Hologic, Inc.

Conclusion

Automated PET quality control using structural similarity to model the human visual system efficiently provides an objective index to reflect small perceptual quality differences among images and can be used to ensure diagnostic accuracy.

SSE21-04 Performance Evaluation of a Prone Dedicated Breast Ring PET Scanner Designed for Improved Visualization of Posterior Breast Tissue

Monday, Nov. 30 3:30PM - 3:40PM Location: S403A

Participants
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Stam Majewski, MD, Morgantown, WV (Abstract Co-Author) Research Grant, General Electric Company; Research Grant, ONCOVISION
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Mark B. Williams, PhD, Charlottesville, VA (Abstract Co-Author) Institutional research agreement, Hologic, Inc
**PURPOSE**

To report the design and performance of a novel dedicated breast ring positron emission tomography (BRPET) system measured using a modified NEMA NU4-2008 protocol.

**METHOD AND MATERIALS**

The BRPET scanner consists of a ring of 12 detector modules. Each detector consists of a pixelated LYSO crystal connected to a position sensitive photomultiplier tube using a fiber optic light guide. The detector ring is mounted below a modified Lorad prone breast biopsy table for pendulay geometry imaging. The detector light guides extend from the photomultiplier tubes at an angle to permit closer crystal access to posterior breast tissue near the patient’s chest wall. Performance metrics evaluated include spatial resolution, sensitivity, and noise equivalent count rate. These tests were adapted from the National Electrical Manufacturers Association (NEMA) NU4-2008 protocol. Two additional phantom tests were performed to assess the amount of posterior breast tissue that cannot be imaged by the scanner due to the thickness of the table.

**RESULTS**

Spatial resolutions of 1.8, 1.6, and 1.9 mm FWHM were measured at the center of the field of view in the axial, radial, and tangential directions, respectively. The peak absolute system sensitivity was 13.2% and scatter fraction of 25.4% using an energy window of 420 - 600 keV. The peak noise equivalent counting rate and peak true rates at 3.86 MBq were 0.75 kcps and 1.23 kcps, respectively. The scanner can image to within 6.25mm of the plane defined by the top surface of the table and has the capability to scan a total of 19 cm along the central axis of a pendant breast.

**CONCLUSION**

The BRPET system can produce high-resolution PET images at clinically relevant count rates. Compared to other prone breast PET systems it has superior coverage of the posterior breast.

**CLINICAL RELEVANCE/APPLICATION**

Novel dedicated breast ring PET scanner with high spatial resolution and better visualization of posterior breast tissue compared to current breast PET systems.

### SSE21-05 A Hybrid Imaging Phantom for Quality Assurance and Research

**PURPOSE**

To construct and test a phantom that mimics the human pelvis for quality assurance, research, and performance measurements in both PET/CT and PET/MR devices.

**METHOD AND MATERIALS**

The phantom is enclosed in a PMMA box that can be filled with different liquids and radioactive tracers to simulate background signal. Refillable inserts mimic bladder, thigh bones, and prostate (including eight separate cells which can be filled with dissolved metabolites and radioactive tracers). The inserts were produced using 3D printing based on CAD models or MRI data from healthy volunteers. Activity introduced into the bladder model yields realistic PET signals while the thigh bones can be filled with fat- or bone-equivalent materials to obtain different attenuating properties. Additionally, an insert for an endorectal RF coil allows to perform MR spectroscopy (MRS). The phantom was used to check co-registration: the center of mass of the signals obtained by CT or MR within a single cell of the prostate insert was calculated and compared to the corresponding signal obtained by PET. The phantom was also used for research projects including MRS (e.g., quantification of creatine, citrate, and choline) and PET studies comparing reconstructions of data obtained with PET/MR and PET/CT scanners. Since the phantom is available as 3D voxel phantom all experiments can be cross-checked by simulations.

**RESULTS**

The misalignment of the co-registration of data from the employed PET/CT and PET/MR were 0.57 ± 0.30 pixels and 0.57 ± 0.20 pixels, respectively. The scanner can image to within 6.25mm of the plane defined by the top surface of the table and has the capability to scan a total of 19 cm along the central axis of a pendant breast.

**CONCLUSION**

The phantom is a flexible tool to study the performance of PET/CT and PET/MR systems. It can verify co-registration in a straightforward way. In addition, there is a variety of research applications, ranging from MR sequence testing to evaluations of new PET reconstruction algorithms.

**CLINICAL RELEVANCE/APPLICATION**

The phantom and its digital 3D version can help to improve quality assurance in clinical PET/CT and PET/MR scanners and offer simple approaches to test and evaluate new PET reconstruction algorithms.

### SSE21-06 Statistical Methods to Verify Lesion Detection in Low Count Environments

**PURPOSE**

To report the design and performance of a novel dedicated breast ring positron emission tomography (BRPET) system measured using a modified NEMA NU4-2008 protocol.

**METHOD AND MATERIALS**

The BRPET scanner consists of a ring of 12 detector modules. Each detector consists of a pixelated LYSO crystal connected to a position sensitive photomultiplier tube using a fiber optic light guide. The detector ring is mounted below a modified Lorad prone breast biopsy table for pendulay geometry imaging. The detector light guides extend from the photomultiplier tubes at an angle to permit closer crystal access to posterior breast tissue near the patient’s chest wall. Performance metrics evaluated include spatial resolution, sensitivity, and noise equivalent count rate. These tests were adapted from the National Electrical Manufacturers Association (NEMA) NU4-2008 protocol. Two additional phantom tests were performed to assess the amount of posterior breast tissue that cannot be imaged by the scanner due to the thickness of the table.

**RESULTS**

Spatial resolutions of 1.8, 1.6, and 1.9 mm FWHM were measured at the center of the field of view in the axial, radial, and tangential directions, respectively. The peak absolute system sensitivity was 13.2% and scatter fraction of 25.4% using an energy window of 420 - 600 keV. The peak noise equivalent counting rate and peak true rates at 3.86 MBq were 0.75 kcps and 1.23 kcps, respectively. The scanner can image to within 6.25mm of the plane defined by the top surface of the table and has the capability to scan a total of 19 cm along the central axis of a pendant breast.

**CONCLUSION**

The BRPET system can produce high-resolution PET images at clinically relevant count rates. Compared to other prone breast PET systems it has superior coverage of the posterior breast.

**CLINICAL RELEVANCE/APPLICATION**

Novel dedicated breast ring PET scanner with high spatial resolution and better visualization of posterior breast tissue compared to current breast PET systems.
PURPOSE

It can be helpful to quantify lesion-to-background contrast in resolving cases of questionable visual lesion detection. For low-count data this becomes problematic due to statistical uncertainty. This study was undertaken to determine whether curve fitting at potential lesion locations overcomes these difficulties.

METHOD AND MATERIALS

Algorithms were written in IDL to automatically identify likely locations of solid spheres and to sample neighboring uniform background volumes in multipurpose plastic and water phantoms used for routine SPECT quarterly quality assurance tests. Data were processed for 12 phantoms loaded with 370-925 MBq Tc-99m for acquisitions ranging from 11-27 seconds/projection for 64-128 projections. Each high-count acquisition was paired with low-count acquisitions for the same phantoms imaged for only 1 second/projection. Algorithms generated counts versus radii curves and counts versus angles curves, through which 3rd order polynomials were fit by minimizing $\chi^2$ variance. Similar plots were formed for 6 background volumes. Contrast was computed as $(\text{maximum}-\text{minimum})/(\text{maximum}+\text{minimum})$ for both raw counts and fitted curves. One physicist read all images and graded sphere detection confidence on a 5-point scale for each sphere. The Kolmogorov-Smirnov test determined whether continuous variables were normally distributed, based on which the t-test or Wilcoxon test determined significance of differences between means.

RESULTS

Total counts were significantly greater for high-count than low-count acquisitions (32±19 versus 3±2 Million counts, $p < 0.0001$). Fitted contrast agreed with visual scores with higher accuracy (ROC area) than raw contrast (85±3% versus 61±5%, $p<0.0001$), for both low counts (84±5% versus 67±7%, $p=0.001$) and high counts (88±4% versus 75±6%, $p=0.003$). Contrast was significantly different between high-count and low-count paired acquisitions for raw counts (41±23% versus 74±24%, $p < 0.0001$), but not for fitted contrast (37±32% versus 35±32%, $p = 0.27$). Raw contrast was correlated with total counts ($r = -0.51$, $p<0.0001$), but fitted contrast was not ($r = 0.02$, $p = 0.79$).

CONCLUSION

Compared to straightforward contrast measurement, curve fitting provided better agreement with visual assessment and more stable measurements that were independent of acquired counts.

CLINICAL RELEVANCE/APPLICATION

Our results suggest that radial count curve fitting may be useful to verify lesion detection in low count environments.
**PURPOSE**

Photon-counting CT (PCCT) is able to generate energy specific images using photons that belong to relatively narrow energy bins. The price paid is a significant increase in quantum noise due to the reduced number of photons in each bin. This work aimed to use iterative reconstruction techniques to reduce noise in bin images.

**METHOD AND MATERIALS**

The Spectral PICCS (prior image constrained compressed sensing) algorithm was used for reconstructing bin images. This algorithm is an adaptation of PICCS to spectral CT imaging; it consists of 2 steps: bin-data fidelity enforcement via SART (simultaneous algebraic reconstruction technique), and TV (total variance) minimization constrained by a prior image that is reconstructed by the classical FBP (filtered back-projection) algorithm using full-spectrum X-ray photons. The algorithm stops when a fixed iteration number is reached or the impact of the SART step is below a threshold. Different from PICCS, Spectral PICCS uses adaptive step sizes for both the SART and TV minimization. We demonstrate the impact of Spectral PICCS using data acquired from a prototype whole-body PCCT system (Siemens Healthcare, Germany) during an in vivo swine study. Three axial scans over the liver, neck, and brain regions of the swine were performed using 110 mAs and 140 kV with thresholds of 25, 45, 65, 85 keV. Each scan generated 8 sets of projection data (4 bin data sets and 4 threshold data sets), which were preprocessed on a Siemens research-only workstation. The preprocessed bin data were then reconstructed by Spectral PICCS using the full-spectrum (25-140 keV) FBP images as a prior. Image quality was assessed and compared between FBP and Spectral PICCS.

**RESULTS**

The Spectral PICCS algorithm converged monotonically. An average noise reduction of 70% was achieved in bin images by Spectral PICCS. With reduced noise, we observed enhanced low-contrast detectability in low-energy bin images, and reduction of beam hardening and Calcium blooming in high-energy bin images.

**CONCLUSION**

The Spectral PICCS algorithm can achieve significant noise reduction in energy bin images, which will benefit spectral CT imaging applications.

**CLINICAL RELEVANCE/APPLICATION**

Spectral PICCS substantially suppresses image noise at reduced usage of X-ray photons, which may translate to the realization of PCCT applications in clinical practice.
reconstruction (AIDR-3D) using qualitative and machine learning analyses in abdominal CT.

METHOD AND MATERIALS

Raw-data from 23 subsequent CTs of the abdomen were reconstructed in 9 different methods: AIDR-3D standard and strong (FC14), FPB-IR at 3 progressive regularization parameters with a 512 image matrix (mild, standard, strong) and at 4 parameters with a 1024 matrix (b=16,20,24,28). All nine datasets were displayed on one screen; 3 radiologists (19, 7 and 1 years of clinical experience, blinded to all parameters) were asked to forced rank (1-9) the datasets according to their preference along 4 axes: conspicuity; noise texture; low contrast; and overall preference. Standard deviations (SD) were measured in all patients in air. To quantify the differences between the various reconstruction methods, two categories of metrics were computed: (i) the image spectral power as a function of spatial frequency, averaged over the 23 subject scans for each reconstruction method; and (ii) the standard deviations of difference images, computed by subtracting two CATPHAN scans reconstructed using the same nine different methods. Machine learning was then used to predict the rankings based on these quantitative data.

RESULTS

SDs in air for AIDR (standard, strong), FPB-IR 512 matrix (mild, standard, strong) and 1024 matrix (b=16, 20, 24, 28) were 13.2, 11.5, 14.7, 12.1, 9.6, 9.6, 8.3, 7.4, and 6.8, respectively with a mean value of -1001 HU. Averaged over all 3 readers, FPB-IR 1024 b=20 was preferred for conspicuity (2.1) and low contrast detectability (2.7), whereas b=24 ranked best for noise texture (3.0) and overall preference (2.7). The most accurate predictions of ranking (normalized discounted cumulative gain of 0.92 out of a maximum of 1.0, p < 0.001) were achieved using the CATPHAN difference image SDs.

CONCLUSION

1024 matrix FPB-IR is preferred over 512 matrix FPB-IR and AIDR-3D. A machine learning analysis revealed that radiologist rankings could be accurately predicted based on quantitative metrics, with the standard deviations performing best.

CLINICAL RELEVANCE/APPLICATION

Image quality in abdomen imaging can be improved by 1024 matrix forward projection based iterative reconstruction. Machine learning may assist in the future with optimizing reconstruction parameters.

SSE22-03 Metal Artifact Reduction in Computed Tomography Using Computer-Aided Design Data of Metallic Implants as Prior Information

Monday, Nov. 30 3:20PM - 3:30PM Location: S403B

Participants
Daniel Kolditz, PhD, Erlangen, Germany (Presenter) Employee, CT Imaging GmbH
Veikko Ruth, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Schwab, MSc, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose
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Willi A. Kalender, PhD, Erlangen, Germany (Abstract Co-Author) Consultant, Siemens AG Consultant, Bayer AG Founder, CT Imaging GmbH Scientific Advisor, CT Imaging GmbH CEO, CT Imaging GmbH

PURPOSE

The performance of metal artifact reduction (MAR) methods in computed tomography (CT) suffers from incorrect identification of metallic implants in the artifact-affected volumetric images. The aim of this study was to investigate potential improvements of state-of-the-art MAR methods by using prior information on the implant geometry and material.

METHOD AND MATERIALS

Two MAR methods were investigated; both are based on an initial reconstruction without correction. 1. Threshold-based MAR (TH-MAR) uses adaptive threshold segmentation of the volumetric images to identify metal. 2. Computer aided design (CAD)-based MAR (CAD-MAR), which we present here, uses 3D-registration of implant CAD data and the volumetric images to determine the position and orientation of the metal implant. Subsequently, for both methods, the selected voxels are projected into the raw-data domain to mark metal areas. Attenuation values in these areas are replaced by interpolation and tissue-class modeling followed by a second reconstruction. Finally the previously selected metal voxels are replaced by the initial reconstruction (TH-MAR) or the CAD data (CAD-MAR). We evaluated if knowledge of the exact implant shape extracted from the CAD data provided by the manufacturer of the implant can improve MAR results. In addition to phantom setups with removable metallic implants, the leg of a human cadaver was scanned using a clinical CT system before and after implanting of the artificial knee joint. The results were compared regarding efficacy of artifact reduction, CT value accuracy and image noise.

RESULTS

The CAD-MAR with use of prior information was more efficient than the TH-MAR. The typical streak artifacts oriented tangentially to metal were reduced. The determination of the implant shape was more exact and not dependent on a threshold value. The visibility of structures surrounding metallic implants was markedly improved when comparing the new approach to the standard method. This was confirmed by the improved CT value accuracy and reduced image noise.

CONCLUSION

The CAD-MAR approach based on prior implant information provided image quality superior to TH-MAR correction, especially when there were further high-contrast structures.

CLINICAL RELEVANCE/APPLICATION

The use of prior information on implant geometry and material can reduce artifacts in the reconstructed volumetric images and thereby provide improved diagnostic value.

SSE22-04 Fast Implementation of the Katsevich Reconstruction Algorithm for Dedicated Breast CT

Monday, Nov. 30 3:30PM - 3:40PM Location: S403B

Participants
Zhenzhen Jiang, Erlangen, Germany (Presenter) Nothing to Disclose
Marcel Beister, Erlangen, Germany (Abstract Co-Author) Employee, CT Imaging GmbH
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Willi A. Kalender, PhD, Erlangen, Germany (Abstract Co-Author) Consultant, Siemens AG Consultant, Bayer AG Founder, CT Imaging GmbH Scientific Advisor, CT Imaging GmbH CEO, CT Imaging GmbH

PURPOSE
We designed a dedicated breast computed tomography (BCT) system with photon-counting technology with a small detector size in cone direction and use dynamic pitch spiral trajectories starting directly at the patient table in order to cover the whole breast. The Katsevich image reconstruction algorithm is suited for such trajectories, but no fast dynamic pitch implementation is available. The aim of this study was to investigate if the algorithm can be accelerated sufficiently to allow for routine clinical workflow.

METHOD AND MATERIALS
The Katsevich algorithm is an exact filtered backprojection type algorithm suitable for both constant and dynamic pitch spiral cone beam trajectories. The algorithm consists of two major parts: preprocessing of the 2D projection data and 3D backprojection. Both were adapted to support dynamic pitch datasets and to allow for fast and parallelized computation. The algorithm was accelerated by graphics processing units (GPU) using the CUDA framework. The datasets used for the measurements consisted of 6000 projections with 2816x512 pixels. We performed two reconstructions tasks: A fast preview mode with 256 images with 512² pixels and a high-resolution mode with 1024 images with 1536² pixels. Speed and image quality measurements were performed on a high-end system with an NVIDIA Quadro K5200 GPU. Image quality of the Katsevich-reconstructed images was compared to that of a standard Feldkamp-type spiral reconstruction (SFDK) algorithm.

RESULTS
2D preprocessing took 19 s and 253 s for preview and high-resolution mode, respectively. 3D backprojection took 48 s and 420 s which resulted in a total reconstruction time of 93 s and 12 min 15 s for preview and high-resolution mode, respectively. Katsevich reconstructed images were cone-beam artifact-free in contrast to SFDK images. Resolution and image noise were equivalent to the results of SFDK.

CONCLUSION
The proposed GPU implementation improved speed of reconstruction markedly and provided artifact-free high-resolution BCT images. Less than 2 minutes for the preview and less than 13 minutes for the high-resolution reconstruction appear sufficient for routine clinical workflow and can be further reduced by using multiple GPUs.

CLINICAL RELEVANCE/APPLICATION
Fast dynamic pitch spiral reconstruction is available and allows for adequate clinical workflow.

SSE22-05 Performance of a Novel Third Generation Adaptive Statistical Iterative Reconstruction-V (ASiR-V) for Dose Reduction in MDCT: Task-specific Quantitative and Qualitative Evaluation

Monday, Nov. 30 3:40PM - 3:50PM Location: S403B

Participants
Ranish Deedar Ali Khawaja, MD, Salem, MA (Presenter) Nothing to Disclose
Justin B. Solomon, MSc, Durham, NC (Abstract Co-Author) Nothing to Disclose
Yakun Zhang, MS, Durham, NC (Abstract Co-Author) Nothing to Disclose
Mannudeep K. Kalra, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Donald P. Frush, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the comparative task-specific performance of Adaptive Statistical Iterative Reconstruction-V (ASiR-V, GE Healthcare) and filtered-back-projection (FBP) reconstruction techniques across clinically relevant dose ranges and phantom sizes.

METHOD AND MATERIALS
A task-specific proprietary image quality phantom (Mercury 3.0), consisting of low contrast-detail and five variable diameter sections, was imaged on a prototype 256-row CT scanner (Revolution, GE Healthcare) at 120 kVp and incremental CTDIvol of 0.75 - 6.0 mGy using fixed and modulated tube current protocols. The images were reconstructed using FBP and ASiR-V (at three strengths: 50%, 80% and 100%) at incremental slice thicknesses of 0.625 - 5.0 mm, and characterized in terms of five task-specific metrics including detectability index \(d'\) for a 5.0 mm, 200 HU contrast lesion, and the observer task of number of visible objects [VO]. Statistical analyses were performed using Student's t test and ANOVA.

RESULTS
ASiR-V demonstrated noise reduction potential of up to 74% compared to FBP images. Both FBP and ASiR-V demonstrated a higher \(d'\) using modulated-current than fixed-current at larger body sizes (30 and 37-cm diameter), but in pediatric sizes (12 and 16-cm), \(d'\) using a fixed-current was markedly higher (\(P<.01\)). VO increased with increasing dose and slice thickness but not necessarily with increasing ASiR-V strength. At all dose levels, the VO was significantly higher with ASiR-V compared to FBP. The absolute score (difference between FBP and ASiR-V ranged from 0.51 - 0.59 (CI 95%= 0.17-1.00, P< .01).

CONCLUSION
The Mercury Phantom is an effective tool for a systematic study of performance for CT protocols and technology. ASiR-V technique has a significantly better detectability index than FBP technique at incremental CTDIvol between 0.75 - 6.0 mGy with marked reduction in image noise.

CLINICAL RELEVANCE/APPLICATION
ASiR-V iterative reconstruction technique results in higher low-contrast detection and lower objective image noise at the...
incremental CT Dose Index (CTDIvol) range of 0.75 - 6.0 mGy compared to FBP technique.

**SSE22-06 A Method for Cross-platform Comparison of Reconstruction Kernels in CT**

Monday, Nov. 30 3:50PM - 4:00PM Location: S403B

**Participants**
John M. Hoffman, BS, Los Angeles, CA (Presenter) Nothing to Disclose
Michael F. McNitt-Gray, PhD, Los Angeles, CA (Abstract Co-Author) Institutional research agreement, Siemens AG; Research support, Siemens AG; ; ; ;

**Background**
It is often necessary to standardize CT protocols across dissimilar systems. While many systems implement a version of filtered backprojection (FBP), reconstruction kernels differ between manufacturers. These differences, both in structure and name, make it difficult to identify which selection(s) will produce similar images. In this study, a method for extracting underlying kernel structure from an image was employed to describe and compare kernels within and across systems.

**Evaluation**
A scan of a QA water phantom was acquired and two sets of images were reconstructed: one using the kernel of interest (test condition), and one with a ramp filter (reference condition) using custom software. All other reconstruction parameters were fixed. The two-dimensional Fourier transform of each image was taken, and the ratio of each image in the test set to the corresponding image in the ramp set (reference condition) was calculated. A radial average was taken of each ratio image to reduce noise and recreate the relative kernel in the frequency domain for each image. The results are then multiplied by the reference kernel to isolate the test kernel. The results represent the target characteristics of the kernel for any other system that is to be matched to the reference system. This method has been applied to a range of kernels within a commercial scanner, as well as custom kernels and results have compared favorably.

**Discussion**
Our preliminary results indicate that this method will be a valuable tool in development of cross-platform protocols. The lack of dependence of the method on anything other than image data makes it extremely flexible and portable across scanners and manufacturers. Absolute representations of the kernel properties require a known kernel; if this is not available, valuable comparisons of kernels can still be made. In the future, we hope to extend the method across reconstruction algorithms.

**Conclusion**
A system-independent method to match performance characteristics of heterogeneous CT systems has been developed. This system has been tested on FBP reconstructions with different kernels and will provide an excellent basis for selecting the best matches of reconstruction kernels across scanners.
SSE23

Physics (MRI I-Image Quality, Evaluation)

METHOD AND MATERIALS

Healthy volunteers underwent multi-centric, inter- and intra-scanner (n=30 and n=12, respectively) imaging with a predefined whole-body MR protocol (including neurological, cardiovascular, thoracoabdominal and musculoskeletal sequences). A set of quantitative organ-specific measures (n=20; e.g. volume of brain's gray/white matter, SNR in TOF of basal cerebral arteries, LV endsystolic/-diastolic volume, pulmonary trunk diameter, vertebral body height, cartilage thickness, SNR of the lung, liver diameter) were obtained in a blinded fashion. Reproducibility was determined using mean weighted relative differences and interclass correlation coefficients (ICC).

RESULTS

All volunteers (44±14 years, 50% females) successfully completed imaging except for two scans due to technical issues; thus, 100 whole-body exams were finally analyzed. Mean scan time was 2:32 hrs and differed significantly across scanners (range: 1:59 to 3:12 hrs). A higher reproducibility of organ-specific MR-measurements was observed for intra- than for inter-scanner comparisons (mean ICC: 0.80±0.17 vs. 0.60±0.31, p=0.005, respectively). In the inter-scanner comparison, the mean relative differences ranged from 1.0% to 53.2%, with 45% of measurements demonstrating excellent reproducibility (ICC≥0.75). Conversely, in the intra-device comparison, the mean relative differences ranged from 0.1% to 15.6%, with 65% of measurements showing excellent reproducibility. There were no differences regarding intra- and inter-scanner reproducibility between individual organ systems (all p≥0.24).

Participants

Seth A. Smith, PhD, Nashville, TN (Moderator) Nothing to Disclose

Sub-Events

SSE23-01 Multi-Centric, Inter- and Intra-Scanner Variability of Quantitative, Organ-specific Measures in Whole-Body MR Imaging

Participants

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Ernst J. Rummenny, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Hans-Ulrich Kauczor, MD, Heidelberg, Germany (Abstract Co-Author) Research Grant, Siemens AG; Research Grant, Bayer AG;
Speakers Bureau, Boehringer Ingelheim GmbH; Speakers Bureau, Siemens AG; Speakers Bureau, Novartis AG; Speakers Bureau, GlaxoSmithKline plc.; Speakers Bureau, Almirall SA
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Not marketed for this indication. Nothing to Disclose
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Research Grant, Bayer AG; Research Grant, Siemens AG;

PURPOSE

Whole-body MR imaging is increasingly being implemented in population-based cohorts and certain clinical settings. However, to quantify the variability introduced by the different scanners is essential to make conclusions about clinical and biological data, and relevant for internal and external validity. Thus, we determined the inter- and intra-scanner variability of seven different 3 Tesla MR systems representing four major vendors.

METHOD AND MATERIALS

Healthy volunteers underwent multi-centric, inter- and intra-scanner (n=30 and n=12, respectively) imaging with a predefined whole-body MR protocol (including neurological, cardiovascular, thoracoabdominal and musculoskeletal sequences). A set of quantitative organ-specific measures (n=20; e.g. volume of brain's gray/white matter, SNR in TOF of basal cerebral arteries, LV endsystolic/-diastolic volume, pulmonary trunk diameter, vertebral body height, cartilage thickness, SNR of the lung, liver diameter) were obtained in a blinded fashion. Reproducibility was determined using mean weighted relative differences and interclass correlation coefficients (ICC).

RESULTS

All volunteers (44±14 years, 50% females) successfully completed imaging except for two scans due to technical issues; thus, 100 whole-body exams were finally analyzed. Mean scan time was 2:32 hrs and differed significantly across scanners (range: 1:59 to 3:12 hrs). A higher reproducibility of organ-specific MR-measurements was observed for intra- than for inter-scanner comparisons (mean ICC: 0.80±0.17 vs. 0.60±0.31, p=0.005, respectively). In the inter-scanner comparison, the mean relative differences ranged from 1.0% to 53.2%, with 45% of measurements demonstrating excellent reproducibility (ICC≥0.75). Conversely, in the intra-device comparison, the mean relative differences ranged from 0.1% to 15.6%, with 65% of measurements showing excellent reproducibility. There were no differences regarding intra- and inter-scanner reproducibility between individual organ systems (all p≥0.24).
CONCLUSION
In this study of seven different 3 Tesla MR systems, whole-body imaging-derived organ parameters showed good to excellent reproducibility, with less variability observed when using identical MR scanners.

CLINICAL RELEVANCE/APPLICATION
Whole-body MRI shows acceptable relative differences and high reproducibility for most organ-specific measurements, indicating internal validity and the potential for pooling data across different cohorts.

SSE23-02  Magnetic Resonance Elastography of the Brain: Assessment of Scan-rescan Reproducibility
Monday, Nov. 30 3:10PM - 3:20PM Location: S404AB

Participants
Hatim Chafi, BS, Baton Rouge, LA (Abstract Co-Author) Nothing to Disclose
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Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
Magnetic resonance elastography (MRE) has shown brain tumor to differ in stiffness in comparison to normal brain tissue. The purpose of this study was to measure the shear modulus of white and grey matter using MRE, and to assess scan-rescan reproducibility.

METHOD AND MATERIALS
MRE of the brain was performed in 10 healthy volunteers on a 3T MRI scanner using a 2D EPI MRE sequence. Shear waves were induced at frequencies of 60, 50, and 40 Hz, using an ergonomic flexible driver connected to a speaker system via a polyvinyl chloride tube. MRE phase data was acquired using a single slice and 8 temporal phases with axial T2-weighted images as reference. Motion encoding was performed in the through plane direction (Z). Elastograms were reconstructed using GE direct inversion post-processing software. Each subject was repositioned and rescanned within the hour. Wilcoxon signed-rank test was used to compare white and grey matter shear modulus measurement at each driver frequency.

RESULTS
White matter shear modulus measurements at 60, 50, and 40 Hz were 3.9 ± 0.4 kPa, 3.8 ± 0.5 kPa, and 3.4 ± 0.3 kPa, respectively. 60, 50, and 40 Hz grey matter shear modulus measurements were 3.3 ± 0.5 kPa, 2.8 ± 0.5 kPa, and 2.2 ± 0.4 kPa, respectively. White matter shear modulus measurements were significantly higher than grey matter at all frequencies (P < 0.001). The within-subject coefficient of variation of white matter and grey matter shear modulus measurements for all frequencies ranged 3.74-4.10%, and 4.68-5.95%, respectively.

CONCLUSION
Our results show that brain tissue shear modulus increases with driver frequency which highlights the importance of standardizing MRE settings in order to facilitate cross-institutional comparison. Both white matter and grey matter shear modulus measurements exhibit high reproducibility, enabling MRE as a potential clinical quantitative imaging technique.

CLINICAL RELEVANCE/APPLICATION
MRE allows for the differentiation between the shear modulus of normal brain tissue and malignancy. This technique with high reproducibility has potential for differentiating radiation necrosis from tumor recurrence in the brain.

SSE23-03  Quantification of MRI Geometric Distortion for Radiation Treatment Planning Applications
Monday, Nov. 30 3:20PM - 3:30PM Location: S404AB

Participants
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Steven Frank, Houston, TX (Abstract Co-Author) Nothing to Disclose
Joseph Weygand, Houston, TX (Abstract Co-Author) Nothing to Disclose
Jihong Wang, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
Uncertainties related to geometric distortion are a major obstacle for use of MRI in radiation treatment planning. The aim of this study is to quantify the geometric distortion in patient images by comparing their in treatment position’s MRIs with the corresponding planning CT, using CT as the non-distorted gold standard.

METHOD AND MATERIALS
Twenty-one head and neck cancer patients were imaged with MRI as part of a prospective IRB approved study. All patients had their treatment planning CT done on the same day or within one week of the MRI. MR Images were acquired with a T2 SE sequence (1x1x2.5mm voxel size) in the same immobilization position as in the CT scans. MRI to CT rigid registration was then done and geometric distortion comparison was assessed by measuring the corresponding anatomical landmarks on both the MRI and the CT images by two observers. Several skin to skin (STS; 9 landmarks), bone to bone (BtB; 8 landmarks), and soft tissue (TTT; 3 landmarks) were measured at specific levels in horizontal and vertical planes of both scans.
RESULTS
The mean distortion for all landmark measurements in all scans was 1.6±1.7 mm. For each patient 10 measurements were done in the horizontal plane and 10 were done in the vertical plane. The measured geometric distortion were significantly lower in the horizontal axis compared to the vertical axis (1.4±0.05 vs. 1.7±0.05 mm, respectively, P=0.0002*). The magnitude of distortion was lower in the BTB landmarks compared to the STS landmarks (1.2±0.06 vs. 2.0±0.07 mm, P<0.0001*). Likewise, the magnitude of distortion was lower in the TTT landmarks compared to the STS landmarks (1.5±0.09 vs. 2.0±0.07 mm, P<0.0001*). BTB distortion measurements were insignificantly different from TTT (1.2±0.06 vs. 1.5±0.09 mm, P=0.9). The mean distortion measured by observer one was not significantly different compared to observer 2 (1.6±0.07 vs 1.6±0.13 mm, P=0.16)

CONCLUSION
MRI geometric distortions were quantified in radiotherapy planning applications with clinically insignificant error of less than 2 mm compared to the gold standard CT.

CLINICAL RELEVANCE/APPLICATION
After QA against gold standard CT for quantification of errors related to goemetric distortion, MRI aquired in treatment position with customized immobilization devices and intra-oral stent is potentially usable for radiotherapy planning purposes.

SSE23-04 Multi-diffusivity and Multi-orientation Reproducibility of Apparent Diffusion Coefficient Measurement

METHOD AND MATERIALS
An RSNA QIBA ADC phantom containing 13 20ml polypropylene scintillation vials filled with aqueous solutions of polyvinylpyrrolidone (PVP) was used for measurement, as shown in Fig. 1. DWI scans were conducted with the phantom at 0°C on 8 types of Siemens scanners (3T TIM Verio, 1.5T TIM Avanto, 1.5T TIM Symphony, 1.5T TIM Espress, 3T TIM Trio, 1.5T Aera, 3T Skrya and 3T Prisma) with head coils and identical acquisition protocol. Three orthogonal imaging orientations, i.e. axial, sagittal and coronal directions were tested with b-values of 0, 500, 1000 and 2000 s/mm2; TR=5000ms; TE=136ms; parallel acceleration factor (iPAT)=2; acquisition matrix 256×256; FOV 230×230 mm2; 5 slices crossing the vials, 4mm thickness. ADC measurement for each vial was performed with ROI analysis using ADC maps from scanner.

RESULTS
Measured ADC from 8 scanners in three orientations for 13 vials are shown in Fig.2. ADC bias error of vials filled with water with respect to the reported value at 0°C was 2.1% at 3T and 1.5% at 1.5T. Overall standard deviation of ADC in water-only vials was 1.71%. Multi-platform coefficients of variance (CV) of ADC from three orientations for 5 types of vials were listed in table 1, with measured ADC ranging from 200 to 1100 mm²/s. Variability in orientation does not have a significant influence (CV≤5) on acquired ADC values.

CONCLUSION
Reproducibility of iso-center ADC measurements on eight scanners from the single vendor was verified in a wide range of diffusivity. Orientation of the image did not have a significant effect on ADC measurement; but slightly increased variance was observed with lower diffusivity. The quality assurance procedure was tested to be feasible and applicable for other vendors.

SSE23-05 Multicenter Study of Reproducibility of Wide Range of ADC at 0 °C

METHOD AND MATERIALS
MR DWI measurands are potential quantitative imaging biomarkers. However, at this juncture, there is variability in quantification of...
**METHOD AND MATERIALS**

Multiple copies of a phantom developed by NIST and RSNA QIBA, using varying concentrations of polyvinylpyrrolidone (PVP) in aqueous solution to generate physiologically relevant apparent diffusion coefficient (ADC) values, were produced and distributed. These phantoms have been scanned at isocenter to evaluate hardware across multiple institutions and platforms using a 0 °C ice-water fill solution to eliminate variability in ADC introduced by temperature differences across scanners, as well as at ambient conditions. All sites used a standardized SS-EPI pulse sequence with $b=0$, 500, 900 and 2000 mm²/s.

**RESULTS**

Initial results across 5 (out of an eventual 13) sites, 3 vendor platforms, and 2 field strengths indicate that the phantom provides a high degree of reproducibility and a wide range of ADC values. ADCs ranged from 0.12 (50% PVP by mass) up to $1.1 \times 10^{-3}$ mm²/s (water) at 0 °C, with repeatability coefficients (RCs) of 1.7% or less for water vials across sites. RCs were below 6% for all but the lowest ADC components of the phantom at 0 °C. A wider range of ADC values was seen at 37 °C, from ~0.6 to ~3.0 $\times 10^{-3}$ mm²/s, but with larger measurement error.

**CONCLUSION**

Stable, well-characterized phantoms allow for understanding sources of inter-hardware and longitudinal bias and variability and for providing a robust quality control and site qualification platform for DWI acquisitions. Slightly higher ADCs exhibited by the outermost water vial, ~70 mm from the phantom center, may indicate spatially-dependent bias, possibly due to gradient non-linearity effects. The intrinsic variability across scanners when measuring ADC is low; however, significantly larger errors can be expected when measuring slow diffusion components.

**CLINICAL RELEVANCE/APPLICATION**

This work demonstrates the utility of the phantom for quality control purposes in a multicenter, multivendor study. It allows pulse sequence testing over a relevant physiological range of ADC values.

**SSE23-06 Evaluation of Whole-body Ferrodetection Systems in Clinical MRI**

**Participants**

Felix V. Guettler, Jena, Germany (Presenter) Nothing to Disclose
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Ulf K. Teichgraeber, MD, Jena, Germany (Abstract Co-Author) Research Consultant, W. L. Gore & Associates, Inc; Research Consultant, Siemens AG; Research Consultant, CeloNova BioSciences, Inc; Research Consultant, General Electric Company;

**PURPOSE**

In the environment of a MRI, ferromagnetic objects can cause severe injuries. According to manufacturers whole-body ferrodetection ensures maximum patient safety and minimize risks for personnel and MRI equipment in clinical routine. This study aims to evaluate if a screener or an door guard system for ferromagnetic metals can increase patient safety and is reliably working in clinical practice.

**METHOD AND MATERIALS**

A highly sensitive screener for ferromagnetic objects (Ferroguard Screener, Metrasens, GB) as well as an door guard system (Ferroguard Guardian, Metrasens, GB) focusing larger ferromagnetic objects, were installed in the preparation room and at the doorway to an MRI room (Fig 1). Subsequently 400 patients were scanned with the screener as well as another 2500 patients with the door guard system. Patients examined with the screener were asked to turn around 360° in front of the system. Measurement time was documented for each first scanning process. All patients were regularly asked to remove all metal objects and inform the radiologist about any implants that might contain metal parts. In case of an alarm the patient was rescanned for a reproducible result, otherwise a false positive finding was documented. If the alarm was confirmed the patient was searched for ferrous materials and findings were documented, until no more alarm is given.

**RESULTS**

The screener system identified unknown ferrous objects in 2% of the cases. In two cases ferrous foreign bodies were found. The average measurement time for the screener was 80 sec (varying from 10 to 300 sec). The door guard system detected unknown ferrous objects in 0,3% of the cases. There were two false-positive alerts (non reproducible).

**CONCLUSION**

The number of ferrous object which are brought to the scanner room by accident, can be reduced with usage of a whole-body ferrodetection system. To avoid false alarms the door guard system requires a ferrous free environment and perfectly ferrous free clothing for the medical personnel. Ferrodetection can aid and complement, but not replace patient education and MRI safety training.

**CLINICAL RELEVANCE/APPLICATION**

The biggest risk of an MRI examination are the impact of ferromagnetic objects, that are unconsciously brought into the magnetic room. Effective mechanisms are mandatory to avoid MR-accidents.
Purpose/Objective(s): To assess outcomes of patients with anal canal cancer treated with intensity-modulated radiation therapy (IMRT) after a long time follow-up. Materials/Methods: From August 2007 to January 2011, 39 patients were treated by IMRT for anal squamous cell carcinoma. Radiation course consisted in delivering 45 Gy in 1.8 Gy daily-fractions, 5 days a week, to the primary tumor and the risk area including pelvic and inguinal nodes (PTV1). A second plan of 14.4-20 Gy was administered to the periphery of the lesion in 3 fractions. Median follow-up was 8 months (1-37 months). Actuarial 1-year local control for HCC and metastatic patients was 84% and 54% respectively. Distant progression free survival at one year was 49%. Treatment was well tolerated with CTCAE v3 grade 1 acute gastrointestinal toxicity in 3 patients, grade 3 nausea in 1 patient and grade 3 acute dermatitis in another patient. No late toxicity was seen. Conclusion: Stereotactic body radiation therapy is a safe and effective alternative option for inoperable patients with low toxicity.

Sub-Events

SSE24-03 IMRT for Locally Advanced Anal Cancer: Long Time Follow-up Experience of One Institution

Monday, Nov. 30 3:20PM - 3:30PM Location: S104A

Participants
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ABSTRACT

Purpose/Objective(s): To assess outcomes of patients with anal canal cancer treated with intensity-modulated radiation therapy (IMRT) after a long time follow-up. Materials/Methods: From August 2007 to January 2011, 39 patients were treated by IMRT for anal squamous cell carcinoma. Radiation course consisted in delivering 45 Gy in 1.8 Gy daily-fractions, 5 days a week, to the primary tumor and the risk area including pelvic and inguinal nodes (PTV1). A second plan of 14.4-20 Gy was administered to the primary tumor (PTV2) in 1.8-2 Gy-daily fractions, also 5 days a week. PTV1 and PTV2 were treated continuously without gap and without Simultaneously Integrated Boost (SIB). Concurrent chemotherapy based on 5FU and mitomycin was added for locally advanced tumors. Clinical outcome and toxicities were evaluated according to the Common Toxicity Criteria for Adverse Events 4.0 scale. Results: Thirty-one women and eight men were included in the analysis. Tumors were classified as stages I, II, III and IV in 2, 7, 27 and 2 patients, respectively. Median age was 59 years (range, 38-85). 3 patients were known to be HIV-positive or suffering from AIDS. Radiotherapy alone (RT) or with concurrent chemotherapy (RCT) was delivered in 6 (15%) and 33 (85%) patients,
respectively. Median follow-up was 66 months CI95%[62-73], 24 patients (77,4%) had at least one grade 1 toxicity among anal incontinence, intestinal, urinary or skin disorders. One patient had grade 3 vaginal toxicity. 5-year overall survival rate was 79.2% CI95%[62.6-89.0], and 5-year local disease-free survival was 68.6% CI95% [51.3-80.9], with a 5-year colostomy-free survival rate of 76.6% CI95% [58.1-87.8]. Conclusion: IMRT is effective and well tolerated in the long term.

SSE24-05  
**Implementing a Well Follow-up Care Plan for Colorectal Cancer Patients: Quality Assurance and Lessons Learned**

**Monday, Nov. 30 3:40PM - 3:50PM Location: S104A**

**Participants**
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Aamer Mahmud, MD, FRHR, Kingston, ON (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): With an increasing number of cancer survivors and limited resources, a trend of follow-up outside cancer clinics is emerging. There is little consensus on how to operationalize plan delivery. Our aims were to pilot a sustainable colorectal cancer well follow-up care plan (WFU) with embedded quality assurance measures, to ascertain satisfaction of stakeholders and identify potential barriers.

Materials/Methods: Toolkits were developed for primary care providers (PCP) i.e. standardized discharge letters, guidelines on frequency of visits and investigations, CEA form and a receipt letter. Patients received a discharge letter; a brochure on follow-up; a list of symptoms, common issues and questions; and healthy living and useful community resources. Toolkits are also available on the hospital website. Satisfaction surveys were developed for patients, PCPs and specialists.

Results: Since July 2014, 48 stable patients meeting the criteria for transfer of care were discharged to PCPs for WFU when seen at the 3-month visit following treatment completion. Completion rate of patient survey was 25%, reporting an overall satisfaction. Feedback from PCPs has been positive with an interest in additional information and timely access to specialists. Some raised concerns over additional workload. Receipt letters were received in 35% of cases and reminders are being sent for the rest. Oncology specialists supported this initiative when surveyed. Barriers to discharge included not having a PCP, concern about communication between physicians, and a lack of patient education. We continue to collect data and will update the results. Conclusion: Key features of a sustainable WFU care plan includes user-friendly toolkits for patients, PCPs and engagement of specialists. We are evaluating feasibility and safety as well as satisfaction measures. This study may also help to identify ways of knowledge translation to meet the needs of patients and PCPs.

SSE24-06  
**Use of Functional MRI Imaging to Identify Area to be Boosted in Anal Cancer Treatments**

**Monday, Nov. 30 3:50PM - 4:00PM Location: S104A**

**Participants**
Ivan Fazio, MD, Palermo, Italy (Presenter) Nothing to Disclose  
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Antonella Mazzonello, MD, Palermo, Italy (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): Evaluating if functional MRI imaging in the treatment of anal cancer, can help in identifying hypercellularity in the site of the primary tumor or in case of nodal involvement, selecting patients in which dose has to be increased to obtain remission of disease.

Materials/Methods: from January to September 2013, 10 patients affected by anal cancer in different stages of disease, had a simulation using CT and MRI imaging. In the MRI imaging we performed the DWI B 800 study which can identify in squamous cell carcinomas areas of hypercellularity which can suggest the presence of tumor tissue. All patients underwent IMRT radiation for 45 Gy in 25 fractions plus chemotherapy and a boost of 14,4 Gy using VMAT only on DWI MRI positive areas.

Results: In the short follow-up (2-8 months), we observed a clinical and radiologic complete response in 8 patients and a partial response in 2 patients (with inguinal nodes involvement). The treatment was well tolerated with only grade II skin and rectal toxicity in all 10 patients. In the follow-up functional MRI imaging we observed a progressive decreasing of the extension of DWI positivity (fig.1) up to the disappearance of it. Conclusion: Clinical use of hyperconformal treatments as IMRT or VMAT need a precise identify of areas to be treated with high doses. Functional MRI DWI study can help in squamous cell carcinomas (less in other histologies) in recognizing areas of subclinical extension of disease. Functional MRI imaging seems to be effective in differentiating inflammatory areas which seems to be positive at FDG-PET imaging.
SSE25-01  Transjugular Access for the Endovascular Management of Non-matured Autogenous Arteriovenous Fistulas

PURPOSE
The purpose of our study is to evaluate the feasibility and safety of transjugular access for the management of non-matured autogenous arteriovenous fistulas (AVF).

METHOD AND MATERIALS
We retrospectively reviewed fifty-four patients who underwent transjugular endovascular treatment for non-matured AVFs from August 2013 to February 2015. The internal jugular vein ipsilateral to the AVF was accessed under ultrasound guidance. After catheterization of the arterial limb of the fistula, fistulography was performed to identify stenotic lesions which were subsequently treated by percutaneous transluminal angioplasty (PTA). On occasions when directional guidance was necessary, venography was performed through a 23 gauge scalp needle placed distally in the outflow vein to facilitate catheterization. We assessed the types of autogenous fistulas treated, time to catheterization of the AVF from the transjugular access, and total procedure time. The technical and clinical success rates, complications rate, and primary and secondary patency rates were also evaluated. Patency following PTA was estimated using the Kaplan-Meier method.

RESULTS
Eighteen patients had brachiocephalic fistulas (33.3%) and thirty-six patients had radiocephalic fistulas (66.7%). The mean time to catheterization of the AVF was 9.8 minutes and the mean total procedure time was 36.6 minutes. Venography via a scalp needle in the distal outflow vein was required in 35.2% of the cases (19 of 54 procedures) to facilitate catheterization. Technical and clinical success were achieved in 98.1% (53 of 54 AVFs) and 92.6% of patients (50 of 54 AVFs), respectively. Minor complication (oozing at the scalp needle puncture site) occurred in one patient. There were no major complications. Primary patency rates were 78.7% at 6months and 57.5% at 1year, respectively. Secondary patency rates were 87.7% at 6 months and 82.5% at 18months, respectively.

CONCLUSION
Transjugular access for PTA of non-matured autogenous AVF is feasible and safe. This alternative route tackles potential problems of conventional techniques in PTA of non-matured fistulas such as difficult cannulation of non-matured outflow veins and hematomas following direct access into outflow veins.

CLINICAL RELEVANCE/APPLICATION
Endovascular management through transjugular access can be the first management modality in the salvage of non-matured autogenous AVF, as lowers the complication rate of conventional transvenous access.

SSE25-02  Outcomes of Fluoroscopic and Ultrasound Guided Placement versus Laparoscopic Placement of Peritoneal Dialysis Catheters

PURPOSE
A variety of Peritoneal dialysis catheter (PDC) placement techniques are available including laparoscopic placement by surgeons,
and percutaneous placement by Interventional Radiologists. The aim of this study was to compare our one-year outcomes of PDC placement using fluoroscopy and ultrasound guidance with those placed using the laparoscopic technique.

**METHOD AND MATERIALS**

We retrospectively reviewed the medical records of 201 patients who had their first PDC placed between January 2005 and October 2014. A total of 100 patients were included in the study. We compared the survival outcomes of the PDC placed using fluoroscopic and ultrasound guidance by interventional radiology (radiologic group, n=29), with the PDC placed using laparoscopic technique by surgeons (laparoscopic group, n=61). Survival analyses were performed with the primary outcome being complication-free PDC survival at 365 days. Secondary outcomes were complication-free PDC survival at 90 days, overall catheter survival, median days-to-first complication and median days-to-catheter removal.

**RESULTS**

In the radiologic group, the complication-free PDC survival at 90 and 365 days were 62% and 55% respectively, compared to 64% (p=0.99) and 38% (p=0.17) respectively, in the laparoscopic group. Catheter malfunction was the only complication that was statistically significantly higher in the laparoscopic group (41%) compared to the radiologic group (14%, p=0.05). The overall catheter survival was 83% and 72% in the radiologic and laparoscopic groups respectively (p=0.31). Further analysis of the PDC with complications and subsequent removal revealed that the median days-to-first complication and the median days-to-catheter removal were 31 and 14 respectively in the radiologic group which was significantly less, compared to 98 (p=0.0036) and 179 (p=0.0006) respectively, in the laparoscopic group.

**CONCLUSION**

The fluoroscopic and ultrasound guided placement of a PDC offers a clinically effective alternative to laparoscopic placement with similar one-year survival and complication rates. Subsequent PDC complications and removal occurred earlier in the radiologic group compared to the laparoscopic group.

**CLINICAL RELEVANCE/APPLICATION**

Peritoneal dialysis is an increasingly utilized dialysis modality due to its cost-effectiveness and patient survival equivalency compared to traditional in-center hemodialysis.

**SSE25-03**  
**Same-day versus Delayed Arteriovenous Dialysis Graft Declotting: Does Timing Affect Procedural Success and Graft Patencies?**

**Monday, Nov. 30 3:20PM - 3:30PM Location: N226**

**Participants**

Mark Winker, Durham, NC (Presenter) Nothing to Disclose  
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Gemini L. Janas, RT, Durham, NC (Abstract Co-Author) Nothing to Disclose  
Michael J. Miller JR, MD, Chapel Hill, NC (Abstract Co-Author) Speaker, Cook Group Incorporated Speaker, Boston Scientific Corporation Advisory Board, Boston Scientific Corporation Advisory Board, C. R. Bard, Inc Speaker, Kimberly-Clark Corporation  
Tony P. Smith, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose  
Charles Y. Kim, MD, Durham, NC (Abstract Co-Author) Research Grant, Galil Medical Ltd; Consultant, Kimberly-Clark Corporation; Consultant, Cryolife, Inc

**PURPOSE**

To prospectively determine whether the interval between prosthetic arteriovenous graft (AVG) thrombosis and declotting affects procedural success, postintervention primary patency, or postintervention secondary patency.

**METHOD AND MATERIALS**

From March 2012 to March 2014, 94 adult patients who were referred for AVG declotting were recruited prospectively. Patients were categorized into two groups: those whose procedure was performed the same day that AVG thrombosis was detected (same-day), or those whose procedure was performed later (delayed). Data regarding post-procedure AVG interventions and AVG failure was collected from electronic medical records, and by calling patients and their dialysis centers. Fisher’s exact test was used to compare the groups’ procedure success rates. The primary patency and secondary patency were estimated using the Kaplan-Meier technique and compared using the log rank test. Univariate and multivariate Cox regression models were used to determine factors associated with the primary and secondary patencies. Factors assessed were: age, sex, inpatient vs outpatient status, graft age, graft configuration, history of prior ipsilateral tunneled dialysis catheter, number of prior graft interventions, indwelling stent, procedure time, and patient category (same-day vs delayed).

**RESULTS**

There were 2/26 (8%) unsuccessful procedures in the same-day group, and 3/68 (4%) in the delayed group (p=0.6). The median primary patency was 125 days (95%CI 118-292) for the same-day group, and 58 days (95%CI 82-167) for the delayed group (p=0.06). The median secondary patency was 327 days (95%CI 264-481) for the same-day group, and 300 days (95%CI 292-431) for the delayed group (p=0.9). On multivariate regression only, inpatient status (HR=2.6, 95%CI 1.3-5.3, p=0.01) and delayed declotting (HR=2.3, 95%CI 1.2-4.5, p=0.01) were independently associated with an increased risk of re-intervention.

**CONCLUSION**

Declotting thrombosed AVG the same day thrombosis is detected versus on a later day does not affect procedure success, primary patency, or secondary patency.

**CLINICAL RELEVANCE/APPLICATION**

Timing of declotting thrombosed AVG (on the same-day thrombosis is detected vs later) does not affect procedure success, primary patency, or secondary patency.

**SSE25-04**  
**Five-years Clinical Experience with Paclitaxel-coated Balloon Angioplasty for Stenoses Causing Dysfunction of Dialysis Arteriovenous Fistula and Synthetic Grafts**
The evaluation of relative complications and tip-point of dialysis catheter

CLINICAL RELEVANCE/APPLICATION

Catheter scheduled into SVC, which is helpful to avoid pulmonary embolism and adjust the treatment plan.

HR-MRCP and HR-T2WI are excellent methods for visualizing catheter tip-point and related complications in patients with dialysis catheter scheduled into SVC.

CONCLUSION

Withdraw where the findings were FS (n=10), Th (n=5), ILC (n=4), and died (n=2) due to pulmonary embolism.

"Eye sign" on HR-T2WI when both lumens were obstructed (n=2). 28 subjects with relative complications had catheter’s surgical display on HR-T2WI and "single track" on HR-MRCP when one catheter lumen was filled with blood clot (n=3), and the absence of "double eyes" sign on HR-T2WI when both lumens were obstructed (n=2). 28 (70%) subjects including FS (n=17; 42.5%), Th (n=8; 20%) and ILC (n=5; 12.5%). ILC was determined using the "single eye" sign displaying catheter tip-point was 95% (38/40) in comparison with X-ray. For related complications, abnormal findings were detected in ventricle (n=2), right brachiocephalic vein (n=2), inferior vena cava (n=1), right subclavian vein (n=1). The accuracy rate of HR-MRCP was 96% (38/40) in comparison with X-ray. For related complications, abnormal findings were detected in 28 (70%) subjects including FS (n=17; 42.5%), Th (n=8; 20%) and ILC (n=5; 12.5%). ILC was determined using the "single eye" sign displayed on HR-T2WI and "single track" on HR-MRCP when one catheter lumen was filled with blood clot (n=3), and the absence of "eye sign" on HR-T2WI when both lumens were obstructed (n=2). 28 subjects with relative complications had catheter's surgical withdrawal where the findings were FS (n=10), Th (n=5), ILC (n=4), and died (n=2) due to pulmonary embolism.

CONCLUSION

HR-MRCP and HR-T2WI are excellent methods for visualizing catheter tip-point and related complications in patients with dialysis catheter scheduled into SVC, which is helpful to avoid pulmonary embolism and adjust the treatment plan.

CLINICAL RELEVANCE/APPLICATION

The evaluation of relative complications and tip-point of dialysis catheter is vital for hemodialysis patients and is helpful to adjust

METHOD AND MATERIALS

From May 2010 to August 2014, we analysed 62 patients (40 male; mean age: 60±14 years) treated with PCBs due to dysfunctional arteriovenous fistulas (AVF; n=37) or grafts (AVG; n=25). Follow up period terminated on March 2015. Eighty eight procedures were performed (28 in AVGs, 60 in AVFs) to treat 88 lesions (38 de novo, 43.18%) with 97 PCBs (mean diameter: 5.9 ± 1.1 mm, mean length: 67.2±24 mm). In 26/88 cases (29.5%) post-dilation was necessary. Primary outcome measure was target lesion primary patency (TLPP). Secondary outcome measures included the identification of factors influencing TLPP and complications rates.

RESULTS

According to Kaplan-Meier analysis, TLPP was 70.3%, 28.6%, 8.9% and 5.9% at follow up 6, 12, 18 and 24 months, respectively. Cox multivariate regression analysis identified restenotic lesions (HR: 2.54; 95% CI: 1.42-4.56, p=0.002), previous stroke (HR: 3.11; 95% CI: 1.56-6.18, p=0.001) and thrombosed vascular access at presentation (HR: 2.67; 95% CI: 1.25-5.72, p=0.01) were independent predictors of decreased TLPP. Access age <3 years was correlated with superior TLPP (HR: 0.38; 95% CI: 0.20-0.70, p=0.002). Major complication rate was 1.1% (one cephalic vein rupture managed intra-procedurally with stent graft deployment).

CONCLUSION

In this series, Paclitaxel-coated balloon angioplasty of dysfunctional dialysis access was safe and provided very satisfactory primary patency rates. Treatment of de novo lesions was correlated with significantly better patency.

CLINICAL RELEVANCE/APPLICATION

PCB angioplasty of dysfunctional dialysis access is safe and yields superior long-term patency outcomes than those reported for plain balloon angioplasty.

SSE25-06 Complications and Tip-point Location of Hemodialysis Catheter Scheduled into Superior Vena Cava: Findings on HR-MRCP and HR-T2WI

METHOD AND MATERIALS

The study protocol was approved by the local Research Ethics Committee. Informed consent was obtained from all subjects. Forty-two consecutive hemodialysis patients with suspicion of related complications were scanned by HR-MRCP and HR-T2WI using peripheral pulse wave and respiration gated technique after each catheter lumen installed with 5 ml saline. All images was assessed by two experienced radiologists in order to show the catheter tip-location and relative complications such as fibrin sheaths(FS), thrombus(Th) and intraluminal clot(ILC). All subjects would be taken chest X-ray within 1-3 days. For those patients with relative complications would be withdraw the catheter within 3-10 days. The tip location on X-ray was as the gold standard and was only in SVC and right atrium as normal.

RESULTS

40 out of 42 subjects were undergone successfully MRI. 12 subjects showed normal with "double eyes" sign on HR-T2WI and "double track" sign on HR-MRCP. For the tip-point location, 6 patients showed catheter's tip-point abnormal including inside of the right ventricle (n=2), right brachiocephalic vein (n=2), inferior vena cava (n=1), right subclavian vein (n=1). The accuracy rate of HR-MRCP displaying catheter tip-point was 95% (38/40) in comparison with X-ray. For related complications, abnormal findings were detected in 28 (70%) subjects including FS (n=17; 42.5%), Th (n=8; 20%) and ILC (n=5; 12.5%). ILC was determined using the "single eye" sign displayed on HR-T2WI and "single track" on HR-MRCP when one catheter lumen was filled with blood clot (n=3), and the absence of "eye sign" on HR-T2WI when both lumens were obstructed (n=2). 28 subjects with relative complications had catheter's surgical withdrawal where the findings were FS (n=10), Th (n=5), ILC (n=4), and died (n=2) due to pulmonary embolism.

CONCLUSION

HR-MRCP and HR-T2WI are excellent methods for visualizing catheter tip-point and related complications in patient with dialysis catheter scheduled into SVC, which is helpful to avoid pulmonary embolism and adjust the treatment plan.

CLINICAL RELEVANCE/APPLICATION

The evaluation of relative complications and tip-point of dialysis catheter is vital for hemodialysis patients and is helpful to adjust
the tip-location for further dialysis and surgical withdraw.
Intraoperative Radiation Therapy as a Boost After Neoadjuvant Chemotherapy: DFS after a Median Follow-up of 4 Years

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S103AB

Participants
Hans-Christian Kolberg, Bottrop, Germany (Presenter) Advisory Boards, Novartis AG; Advisory Boards, GlaxoSmithKline plc; Advisory Boards, Carl Zeiss AG; Advisory Boards, Genomic Health, Inc; Advisory Boards, LIV Pharma GmbH; Speaker, Novartis AG; Speaker, GlaxoSmithKline plc; Speaker, Carl Zeiss AG; Speaker, F. Hoffmann-La Roche Ltd; Speaker, Teva Pharmaceutical Industries Ltd; Speaker, Theraclion; Speaker, Genomic Health, Inc; Speaker, Amgen Inc; Gyorgy Lovey, Bottrop, Germany (Abstract Co-Author) Nothing to Disclose
Leyla Akipolat-Basci, Bottrop, Germany (Abstract Co-Author) Nothing to Disclose
Miliades Stephanou, Bottrop, Germany (Abstract Co-Author) Nothing to Disclose
Michael Untch, Berlin, Germany (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The expected local recurrence rate in 5 year follow-up after breast conserving therapy and whole breast irradiation is 7.6%. Adding a boost of the index region results in a reduced recurrence rate of 4.3%. The boost irradiation as an intraoperative procedure showed a further decrease of local recurrence rates down to 1.75%. We adapted this approach to patients after neoadjuvant chemotherapy (NACT) and are reporting the DFS after a median of 4 years of follow up. To our knowledge this is the first time that data concerning intraoperative radiotherapy with a 50 kV X-ray source after neoadjuvant chemotherapy are presented.

Materials/Methods: Between April 2010 and November 2011 we treated 61 patients after NACT (+/- chemotherapy are presented.

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Trastuzumab according to HER2-status) with an intraoperative boost of 20 Gy with a 50 kV X-ray source followed by an external radiation with 50 Gy. The patient characteristics were presented as follows and represent the high risk cohort typical for a cohort of patients treated with NACT: median age 54.9 years, 24 pts premenopausal / 37 pts postmenopausal, 31 pts G2 / 30 pts G3, 39 pts ER positive / 22 pts ER negative, 29 pts PR positive / 32 pts PR negative, 24 pts HER2 positive / 37 pts HER2 negative, 36 pts T1 / 24 pts T2 / 1 pt T3, 28 pts node negative / 33 pts node positive. 19 patients reached a pCR. 17 patients needed more than one operation. No patient was lost to follow up and at the time of data closure the median follow up was 49.56 months.

Results: At a median follow up of 49.55 months the DFS was 86.89%, the CDFS 93.44%. 18 of the 19 patients were disease free in the group of patients who reached a pCR (DFS 94.74%). In the group of 42 patients who had residual tumor after NACT, 35 were disease free (DFS 83.33%). Conclusion: A DFS of 86.89% compares favorably to the DFS expected for patients after NACT. The higher DFS in the pCR-group was expected due to the fact that a pCR after NACT +/- Trastuzumab is predictive for DFS. Still the DFS in the non-pCR-group compares favorably to the known data for patients not reaching a pCR. Our data are the first on IORT as a boost after neoadjuvant chemotherapy and show a favorable outcome of the patients in this high risk group. They strongly encourage the design of prospective trials in this indication.

MSR032-04
Preliminary Results of a Phase I Trial Evaluating Nipple Sparing Mastectomy with Immediate Reconstruction Followed by Prophylactic Nipple Areola Complex Irradiation in Early-Stage Breast Cancer: Patient Reported Satisfaction and Cosmesis Outcomes

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S103AB

Participants
Cristiane Takita, MD, Miami, FL (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Breast conserving therapy has become the standard option for patients with early stage breast cancer. Still, there are some patients in need for mastectomy due to multicentric disease or diffuse microcalcifications. If mastectomy is to be performed, keeping the nipple areola complex (NAC) is still controversial. Studies have shown that preservation of the NAC provided higher patient’s satisfaction and less psychological impact after mastectomy. Previous studies have used nipple sparing approach using intraoperative radiation (RT) to the NAC. This study is to report preliminary data of a prospective phase I trial using nipple sparing mastectomy with immediate reconstruction, followed by prophylactic NAC RT at weeks 5 to 8 postoperative.

Materials/Methods: From 2009 to 2014, 10 patients with 11 breast cancers primary (one patient had bilateral disease) were enrolled in the study. The first 6 patients were treated to the NAC using 25 Gy in 10 fractions, BID, 6 hours apart, over 5 consecutive days, using electrons (dose level II; dose escalation/de-escalation design). The next 3 patients received dose level III, 30 Gy in 10 fractions, using same regimen. Radiation was delivered 5 to 8 weeks postoperative. Patient’s cosmesis was assessed by the patient and physicians during 1, 3, 6, and 12 months after completion of protocol therapy. Patient’s satisfaction was also evaluated at same interval.

Results: Nine out of ten patients were able to complete treatment per protocol. At the last follow up, patient’s evaluation of cosmesis was excellent in 78% (7/9), good in 11% (1/9), and poor in 11% (1/9). Overall patient satisfaction with nipple sparing protocol was Good/Excellent in all patients during the time interval of evaluations. Physician’s evaluation of NAC cosmesis was excellent in 34% (3/9), good 66% (6/9). In regard toxicity, only one patient developed grade 3 infection and loss of NAC postoperative; this patient did not receive NAC RT. Of the 9 evaluable patients in the protocol, there was no NAC loss or need for treatment interruption. There was no grade 4, 5 toxicity in patients treated with NAC RT. The most common toxicity was acute radiation dermatitis and NAC pain, mostly grade 2, which completely resolved in subsequent follow up.

Conclusion: The preliminary results of this nipple sparing protocol for early stage breast cancer showed a high level of patient’s satisfaction and self-reported good/excellent cosmesis in the majority of patients treated. Toxicity appeared to be acceptable so far, mostly related to acute radiation dermatitis, grade 2. There was no NAC loss with the use of prophylactic NAC RT. Final results will be presented at completion of the trial.

MSR032-06
Dose to Organs in the Supraclavicular Region When Covering the Internal Mammary Nodes (IMN) in Breast Cancer Patients: A Comparison of VMAT Versus 3-D and VMAT

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S103AB

Participants
Vishruta A. Dumane, PhD, Chicago, IL (Presenter) Nothing to Disclose
Richard L. Bakst, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Sheryl Green, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): VMAT has been reported to offer improved dosimetric sparing of the ipsilateral lung, total lung and heart compared to 3D conformal planning while covering IMNs. However OARs in the supraclavicular region often receive higher doses compared to 3D conformal planning. We aim to compare VMAT versus a combination of 3D and VMAT to improve sparing of OARs in this region without compromising target coverage or the dosimetric advantage that is already offered on using VMAT alone.

Materials/Methods: 10 patients previously treated with VMAT at our institution were re-planned with 3D conformal planning in the supraclavicular region and VMAT inferiorly to the chestwall. VMAT planning consisted of 2 complementary arcs within a 230° arc range with 6 MV. The supraclavicular region was planned either with a single off-cord AP field or with off-cord AP/PA and field in field employing 6 MV and/or 16 MV depending on the depth of nodal coverage. Coverage criteria were PTV D95 = 50 Gy, V95 = 98% and PTV D05 = 115%. Doses to the esophagus, trachea, larynx, brachial plexus, thyroid and cord were noted in addition to the field employing 6 MV. The supraclavicular region was planned either with a single off-cord AP field or with off-cord AP/PA and field in field in the supraclavicular region and VMAT inferiorly to the chestwall. VMAT planning consisted of 2 complementary arcs within a 230° arc range with 6 MV. The supraclavicular region was planned either with a single off-cord AP field or with off-cord AP/PA and field in field employing 6 MV and/or 16 MV depending on the depth of nodal coverage. Coverage criteria were PTV D95 = 50 Gy, V95 = 98% and PTV D05 = 115%. Doses to the esophagus, trachea, larynx, brachial plexus, thyroid and cord were noted in addition to the heart, lungs and contralateral breast.

Results: Combining 3D with VMAT significantly reduced the maximum dose to the esophagus, trachea and spinal cord by 15 Gy, 11 Gy and 12 Gy and also significantly reduced mean dose to the thyroid, larynx and trachea by 14.36* (SE 3.25) Larynx Mean (Gy)14.24* (SE 2.15) Brachial Plexus Max (Gy)56.03 (SE 1.2) Trachea Mean (Gy)4.13 (SE 0.23) SE = standard error * p < 0.05
**MSRO32-07 SBRT for Secondary Lung and Liver Lesions in 35 Breast Cancer Oligometastatic Patients**

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S103AB

**Participants**

Slavisa Tubin, Empoli, Italy (Presenter) Nothing to Disclose
Franca Menichelli, Empoli, Italy (Abstract Co-Author) Nothing to Disclose
Silvia Grespi, Empoli, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Fanelli, Empoli, Italy (Abstract Co-Author) Nothing to Disclose
Gabriella Pastore, Empoli, Italy (Abstract Co-Author) Nothing to Disclose
Cecilia Amicheli, Empoli, Italy (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): This retrospective study explores the impact of SBRT as an aggressive local treatment on the disease evolution and survival of patients with oligometastatic breast cancer treated for lung and liver metastases. Materials/Methods: 24 lung lesions in 11 patients and 39 liver lesions in 24 patients (total of 63 lesions) were irradiated using SBRT between Feb. '07-Nov.'14. All 35 patients treated (KPS >70) were oligometastatic which according to our criteria implied the presence of 5 in lung- or in liver-only metastases, or 3 if present if > 1 site. 7 patients (20%) were with single metastases while 28 (80%) with multiple. 11 patients were irradiated for lung lesions while 24 for liver lesions. Histology was ductal ADK in 81% of patients, lobular in 10%, mixed in 2%, and other histologies or no data in 7%. The median diameter of the lung lesions was 1 cm (range 0.5-5) and of the liver metastases 3.5 cm (range 1-9.1). Planning Target Volume was created by adding a 3 mm margin to the Gross Tumor Volume. SBRT was delivered with VMAT by 6 MV LINAC and planned by TPS with Montecarlo algorithm. All lesions were treated in Breath-hold with different dose levels depending on tumor size and site. Almost all lung lesions (83.3%) were irradiated with 26 Gy in a single fraction prescribed to the 70% isodose (BED10 to isocenter = 175). Liver lesions were treated mainly (72%) with 37.5 Gy in 3 fractions prescribed to the 67% isodose (BED10 to isocenter = 161). Set-up and isocenter were assessed by CBCT. All patients treated for liver lesions underwent Gold fiducials insertion 1 week before CT simulation. The response was evaluated after 60 days by CT and PET, and every 3 months subsequently. Toxicity was assessed by CTCAE score. Results: Considering all treated lesions, both in lung and liver, only 5 (7.9%) "in-field" recurrences were observed, all occurred in liver during the first year from SBRT so the local control rate at 1 year was 92.1%; Dividing irradiated lesions by anatomic site 1 year local control rate for lung lesions was 100% while for liver group 87.2%. At 1 and 2 years Overall Survival (OS) rates were 86% and 69% (91% and 70% in lung-group vs. 83% and 50% in liver-group), and Progression Free Survival rates were 37% and 20%, respectively (median F.U. 19.9 months, range 2.2-60). No predictive factors of local failure were found. No toxicity > G2 (4 patients) was recorded. Conclusion: SBRT for Lung and Liver metastases in Breast oligometastatic patients is a safe and well tolerated treatment. High local control rate (only 5 recurrences in field) confirm the ablative role of SBRT using high BED doses (> 100). The low number of relapses does not allow statistical analysis on predictive factors of local failure but high local control rate in the subset of patients with primary breast cancer indicates an trend for better local control respect to other primitive tumors (92.1% at 1 year that appears stable over the time).

**MSRO32-08 Salvage Radiation Therapy for 2nd Oligo-Recurrence in Patients With Breast Cancer**

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S103AB

**Participants**

Mari Miyata, MD, Kitakyushu, Japan (Abstract Co-Author) Nothing to Disclose
Takayuki Ohguri, Kitakyushu, Japan (Presenter) Nothing to Disclose
Katsuya Yahara, Kitakyushu, Japan (Abstract Co-Author) Nothing to Disclose
Yukunori Korogi, MD, PhD, Kitakyushu, Japan (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): A new concept of "oligo-recurrence (OR)" indicates one to several distant metastases/recurrences in one or several organs which can be treated with local therapy, while the primary site of the cancer was once controlled. A previous study demonstrated that first failure detected as the state of OR (e.g. isolated loco-regional recurrence (LRR) or isolated pulmonary metastasis) could be salvaged by local therapy. However, a subset of once salvaged patients with OR could have a second failure which is also detected as the state of OR. We have often experienced this situation in patients with breast cancer and have defined that as "2nd OR." The purpose of this study was to assess the efficacy and toxicity of salvage radiotherapy (RT) for the 2nd OR of breast cancer. Materials/Methods: All the 23 patients satisfied the following requirements of our definition for 2nd OR: (i) disease-free status after initial therapy for clinically localized breast cancer had been once confirmed; (ii) first failure was detected as OR (1st OR), and disease control of the 1st OR after salvage local therapy was confirmed, while simultaneously there were no other distant metastases/recurrences; (iii) second failure was also detected as OR (2nd OR) which was treated with salvage RT. The sites of the 2nd OR were LRR in 9 patients and distant metastasis in 14 patients. The total radiation dose of the salvage RT ranged from 40–76 Gy (median, 60 Gy), the daily dose was 2.0–3.0 Gy (median, 2.0 Gy). Efficacy and toxicity of the salvage RT for the 2nd OR were retrospectively evaluated, and the predictors of a long-term survival were analyzed. Results: Twenty-one (91%) patients had an objective response. The median overall survival and progression-free survival times were 40 and 20 months after salvage RT for the 2nd OR, respectively. The three-year local (in-field) control rates were 84%. The toxicities were mild; acute toxicities = Grade 3 were seen in one patient with Grade 3 dermatitis, and no late toxicity = Grade 2 was observed, except for one patient who had a Grade 3 lymphatic edema of the arm. The first sites of disease progression after the salvage RT for the 2nd OR were out-field alone in 11 patients (48%) and both in-field and out-field in 4 patients (17%); none of the patients had first sites in local (in-field) recurrence. The univariate analysis indicated that age (Conclusion: Salvage RT for the 2nd OR was able to achieve a better local control rate and longer progression-free survival time without inducing severe toxicity, and therefore may be a potentially effective modality for inducing long-term survival in select patients.

**MSRO32-09 Cost-Effectiveness of Pertuzumab in HER2-positive Metastatic Breast Cancer**

Tuesday, Dec. 1 11:50AM - 12:00PM Location: S103AB

**Participants**

Yushen Qian, MD, Stanford, CA (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): The Clinical Evaluation of Pertuzumab and Trastuzumab (CLEOPATRA) study showed a benefit in overall
survival with the addition of pertuzumab (P) to docetaxel (T) and trastuzumab (H) (THP) compared to TH as first-line treatment for patients with HER2-positive metastatic breast cancer. With median follow-up of 50 months, median overall survival for the THP and TH groups were 56.5 and 40.8 months, respectively [Swain, NEJM 2015]. Based on these results, we performed a cost-effectiveness analysis to determine the impact of pertuzumab on the treatment of HER2-positive metastatic breast cancer.

Materials/Methods: Cost-effectiveness was evaluated from a societal perspective. A four-state Markov model was constructed to evaluate the cost-effectiveness of TH with or without P. Health states included: stable disease, progression of disease, hospice, and death. The model was run over 10 years with cycle length of 1 week. Transition probabilities were based on the results of the CLEOPATRA study. Costs were based upon 2014 Medicare reimbursement rates and manufacturers’ Average Sales Price. Interventions were evaluated with a willingness-to-pay threshold (WTP) of $100,000 per quality-adjusted life years (QALY) gained. One-way and multi-way sensitivity analyses were performed to explore the effects of specific assumptions.

Results: Our modeled overall survival and progression-free survival intervals compared well with the results of the CLEOPATRA study. Modeled median survival was 171 weeks (39.5 months) and 253 weeks (58.3 months) for TH and THP group, respectively. The addition of P resulted in an additional 0.73 QALY at an increased cost of $426,039 compared with TH, resulting in an incremental cost-effectiveness ratio (ICER) of $582,141 per QALY. Two-way sensitivity analysis showed that in the scenario where baseline costs (including cost of trastuzumab) were half of predicted, THP would not become cost-effective until discounted by 96% of the current Medicare Average Sales Price.

Conclusion: The addition of pertuzumab to docetaxel and trastuzumab in metastatic HER2(+) breast is unlikely to be cost-effective at a WTP threshold of $100,000 per QALY gained. This finding is attributed to 1) the expense of pertuzumab, and 2) that patients treated with pertuzumab have prolonged progression-free survival, and, therefore, accrue higher costs for prolonged treatment with both pertuzumab and trastuzumab. Additional results from the adjuvant trials of pertuzumab will be important to characterize the overall cost-benefit of this agent in both metastatic and early stage HER2-positive breast cancer.
Purpose/Objective(s): Radiation boost is critical for local control in MB, yet targeting the whole posterior fossa is associated with neurocognitive morbidity. The incidental hippocampal dose may account for these effects. Despite traditional tumor bed vs. posterior fossa categorization, the relative irradiated volume of posterior fossa may vary significantly. We model boost volume more rigorously as a continuous variable to investigate associations with hippocampal dose and recurrence rates.

Materials/Methods: Bilateral hippocampi and posterior fossa were contoured on T1 axial images for 25 medulloblastoma patients [3-21 years; 5 female; 15 average risk (7 18Gy, 8 23.4Gy), 10 high risk (36Gy)]. There were 9 total recurrences: 5 exoprimary (3 high risk 36Gy, 2 average risk 18Gy), 2 primary (2 average risk: 1 18Gy, 1 23.4Gy), 2 both (2 high risk 36Gy). Minimum dose received by 100% of each hippocampus (D100%) and percent volume of posterior fossa receiving 100% of boost dose (V100%) were extracted from dose-volume histograms. Analysis of covariance was used to investigate the effect of V100% as a continuous variable while controlling for total craniospinal dose categorically (Low Dose 18-23.4Gy, High Dose 36Gy). Ordinal logistic regression was used to estimate probability of overall, primary and exoprimary recurrences.

Results: Right and left total incidental hippocampal BED were both greater for the high dose group by 13.9Gy (p=0.00040) and 14.0Gy (p=0.00010) respectively. Right and left D100% significantly varied with V100% (p=0.022) and 0.15Gy (p=.032) respectively. Probability of any recurrences (p=0.079) and exoprimary recurrences (p=0.098) exhibited negative trends with V100%. Primary recurrences were not associated with V100%, and dose group was not significant. Conclusion: Incidental hippocampal doses are positively associated with boost volumes and may account for neurocognitive decline in medulloblastoma patients. Posterior fossa V100% can be a useful metric to more accurately describe boost volumes given the heterogeneity within risk groups, and new hippocampal sparing techniques may allow for greater posterior fossa coverage. Aggressive posterior fossa management may further augment metastatic compartment therapies.

ABSTRACT

Purpose/Objective(s): The medical community has suspected a correlation between Non-Small Cell Lung Cancer and brain metastasis for quite some time. Identifying reliable predicting characteristics of brain metastasis in NSCLC patients can allow for effective treatment with Prophylactic Cranial Irradiation (PCI) to minimize the risk of metastasis. We sought to identify predictive factors for patients with NSCLC to develop brain metastasis.

Materials/Methods: MOSAIQ databases were queried for patients that received radiotherapy treatment at the institution. Details of patients that received radiotherapy to the brain were collected for further data collection using the EPIC database. Pathology records of these patients were examined for presence of certain biomarkers (TTF-1, CK7, CK20, Synaptophysin, p63, and CK 5/6) and histology (adenocarcinoma or SCLC, with neuroendocrine differentiation). Radiological reports were examined for tumor site(s), tumor size information, nodal involvement, and number of nodules present. Information on age, sex, and tumor stage were also collected. Results: A total of 193 patients were identified and included in this analysis. Among these, 67 patients developed brain metastasis and 126 patients did not. A univariate analysis of
data determined that tumor stages 3 and 4 (pA multivariable logistic regression model of data determined higher stage (stages 3 or 4: p=0.004, Adjusted OR=3.612) and tumor size (Above 3 cm: pAdditionally, the presence of CK7 and Synaptophysin showed a trend and non-significant increased risk of brain metastasis (OR=2.22 and 2.90, p=0.06 and 0.40, respectively). Conclusion: Identifying the presence of predictive characteristics in NSCLC patients can help patient survival through the administration of prophylactic cranial irradiation. In this study, we showed that NSCLC of stages 3 or 4, with tumors greater than 3 cm in at least one dimension, or more than two nodes or nodules involved are predictive of brain metastasis. Presence of CK7 may also be a reliable predictor of brain metastasis. This evidence can be helpful to doctors in evaluating whether or not patients should receive PCI.

**MSRO35-04 Roles of Tumor Size and Histology in Outcomes Following Resection and Stereotactic Radiosurgery for Brain Metastases**

**Tuesday, Dec. 1 11:00AM - 11:10AM Location: S103CD**

**Awards**

**Trainee Research Prize - Medical Student**

**Participants**

Chase Escott, Lebanon, NH (**Presenter**) Nothing to Disclose

Linton T. Evans, MD, Lebanon, NH (**Abstract Co-Author**) Nothing to Disclose

Zhongze Li, Lebanon, NH (**Abstract Co-Author**) Nothing to Disclose

Nathan Simmons, MD, Lebanon, NH (**Abstract Co-Author**) Nothing to Disclose

David W. Roberts, MD, Lebanon, NH (**Abstract Co-Author**) Scientific Advisory Board, Carthera AB; Scientific Advisory Board, IMRIS Inc; Scientific Advisory Board, Medtronic, Inc; Research support, Medtronic, Inc; Equipment support, Carl Zeiss AG; Research support, Carl Zeiss AG;

Andrew Zureick, BA, Ann Arbor, MI (**Abstract Co-Author**) Nothing to Disclose

Alan C. Hartford, MD, PhD, Lebanon, NH (**Abstract Co-Author**) Nothing to Disclose

**PURPOSE**

Stereotactic radiosurgery (SRS) following resection of a brain metastasis improves disease control at the surgical site. Our prior published work demonstrated a relationship between size of the resected tumor and risk of local recurrence (LR). In this analysis we expanded our database to examine the role of tumor histology among factors that may predict recurrence and overall survival (OS).

**METHOD AND MATERIALS**

We retrospectively reviewed all patients treated through Jan 2013 who underwent SRS to the surgical bed, deferring whole brain radiation therapy (WBRT). Multiple factors - including histology, tumor size, planning target volume (PTV), dose, meningeal contact (SUP), development of leptomeningeal disease (LMD), gross total resection (GTR), number of metastases (MET#), and the RTOG's histology-specific Graded Prognostic Assessment (GPA) - were analyzed for time to local recurrence at the tumor bed (LR), to distant recurrence within the brain (DR), to intracranial recurrence (ICR), to salvage WBRT, and for OS.

**RESULTS**

122 lesions in 118 patients were treated with resection and SRS between February 2002 and January 2013. With median follow-up 18.3 months, local control rates at the resection cavity were 91.2% at 1-year, 83.4% at 2-years. Overall survival (OS) rates at 1-year and 2-years were 51.2% and 24.4%, respectively. On univariate analysis tumors > 3.0 cm, compared to smaller tumors, had a marginally significant higher risk of local recurrence (p=.057) and a significantly higher rate of WBRT (66.2% versus 35.6% at 2-years, p<.05). Multivariate Cox regressions showed pre-op size to be significant for risk of LR in patients with non-lung tumors (p<.05), but not significant for patients with NSCLC metastases. In multivariate analysis of the entire dataset, only GPA was significantly associated (p<.0001) with OS, while size, PTV, GTR, histology, SUP, dose, LMD, and MET# were not -- arguing for successful salvage of recurrences.

**CONCLUSION**

SRS without WBRT is efficacious in controlling disease recurrence following resection of brain metastases. This study supports tumor size and histology as important factors prognostic for disease control in this group of patients.

**CLINICAL RELEVANCE/APPLICATION**

Pre-operative tumor size and tumor histology are important prognostic factors for efficacy of stereotactic radiosurgery following resection for brain metastases.

**MSRO35-05 Gamma Knife Radiosurgery for Intracranial Grade 2 Meningiomas**

**Tuesday, Dec. 1 11:10AM - 11:20AM Location: S103CD**

**Participants**

Tamer Refaat Abdelrhman, MD, PhD, Chicago, IL (**Presenter**) Nothing to Disclose

Michelle S. Gentile, MD, PhD, Cambridge, MA (**Abstract Co-Author**) Nothing to Disclose

Omer Bloch I, MD, Chicago, IL (**Abstract Co-Author**) Nothing to Disclose

Maryanne Marymont, MD, Chicago, IL (**Abstract Co-Author**) Nothing to Disclose

James P. Chandler, MD, Chicago, IL (**Abstract Co-Author**) Nothing to Disclose

John A. Kalapurakal, MD, Chicago, IL (**Abstract Co-Author**) Nothing to Disclose

Irene Helenowskischi, Chicago, IL (**Abstract Co-Author**) Nothing to Disclose

**PURPOSE**

There has been few reports addressing the treatment outcomes of Gamma knife radiosurgery (GKRS) for grade 2 meningiomas. This study aims to report clinical outcomes after GKRS for intracranial grade 2 meningiomas.

**METHOD AND MATERIALS**

In this IRB approved study, we reviewed the records of all patients with histopathologically confirmed meningiomas treated with GKRS between 1998 and 2014. The median GKRS dose was 15 Gy (range 11-20) prescribed to the 50% isodose line.
RESULTS
A total of 209 meningiomas were treated consecutively and postoperatively with GKRS; of them 96 were histopathologically confirmed grade 2 meningiomas and were included in this study. Median age was 61 years, 57.3% were females and 42.7% were males. Tumor sites included anterior (11.5%), middle (11.5%), and posterior (18.7%) cranial fossae, convexity (32.3%), parasagittal (12.5%), temporal (10.4%), and others (3.1%). Mean tumor size was 3.3 cm³ (median 2.2 cm³). Among 41 (48.8%) symptomatic patients, most common symptoms were headache (21.9%), visual impairment (14.6%), hearing deficit (5.2%) and motor deficits (9.4%). After a mean follow up of 40 months (range 3 - 174), the local control rate was 70 % of all treated meningiomas. The median time to recurrence was 89 months (range 47 - 168 months). Of symptomatic patients, 54%, 39%, and 7% reported improved, stable, or worse initial symptoms, respectively. The 3, and 5-year actuarial local control rates were 69.9%, and 55.6%, respectively. The 3, and 5-years overall survival were 80.7%, and 65.6%, respectively. Multivariate analysis including tumor size, site, status (residual versus recurrent), dose, age, sex, race, previous irradiation, previous surgery, time since surgery, will be represented during the meeting in order to identify most contributing factors for local failure and provide recommendations for optimal treatment. The most common acute toxicities after GKRS were headache (1.1%), sensory loss (1.1%), visual impairment (1.1%), and dementia (3.4%). Chronic toxicities included, headache (1.1%), and visual impairment (2.2%). There were no radiation necrosis or second malignant tumors noted in our series.

CONCLUSION
This report, one of the largest GKRS series for grade 2 meningiomas, demonstrates that GKRS is a safe and effective treatment modality for grade 2 meningiomas with durable tumor control and minimal toxicity.

CLINICAL RELEVANCE/APPLICATION
GKRS is a safe and effective treatment modality for grade 2 meningiomas patients.

MSRO35-07 Stereotactic Radiosurgery for Treatment of Brain Metastases from Colorectal Cancer: A Single-Institution Experience

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S103CD

Participants
Michael A. Cummings, MD, MS, Rochester, NY (Presenter) Nothing to Disclose
Kevin Walter, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Kenneth Usuki, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Paul G. Okunieff, MD, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Alan W. Katz, MD, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Michael T. Milano, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): To review outcomes of patients with colorectal adenocarcinoma who underwent stereotactic radiosurgery for brain metastasisMaterials/Methods: A retrospective review of patients with biopsy proven colorectal adenocarcinoma treated with stereotactic radiosurgery for brain metastases from 2001-2013 was conducted under an IRB approved protocol. End points were radiologic response, neurologic symptom response, overall survival, and treatment related complications. Radiographic response to treatment was defined as stable or shrinking lesion size (accounting for expect post-radiation changes) on follow-up imaging, which was MRI in all except 1 patient. Neurologic symptom response was defined as improved or stable deficits on follow up exam with decreasing steroid dosage and no interval novel-to-patient systemic therapy. Results: Twenty-three patients received single fraction SRS using either a frame based (2002-2010) or frameless (2011-2013) technique. Mean follow up was 5.4 months (range 1 to 13) which was dictated by overall survival. A total of 46 lesions were treated. The mean lesion size on MRI was 17 mm in greatest dimension (range 2 – 35 mm) with mean PTV size of 3.4 cm³ (0.02 to 14.94 cm³). The median number of lesions treated in a single course was 2 (range 1 to 5). Median prescribed dose to isocenter was 16.5 Gy (12.5 to 20) with median minimal PTV dose of 14 Gy (10 to 19.6). Eight lesions were recurrent after previous resection. Six lesions were treated with SRS and then required retreatment with SRS. Eleven patients had previous WBRT with median dose of 30 Gy. Radiographically 72% of lesions were stable or decreasing in size using last available assessment with mean interval of 4.1 months (1 to 19.2). Mean overall survival was 6 months. Two patients died within 1 month of treatment from causes other than disease (MI, MVA). Sixteen courses of treatment coincided with presentation of neurologic symptoms, with previous WBRT in 14. Seven of these sixteen patients had improvement in their presenting deficit, first noted on assessment at median interval of 2 months after SRS (range 1.3 to 6 mos). Two patients remained steroid dependent, both on substantially decreased doses. None of the patients with neurologic response had recurrence of their presenting neurologic symptom prior to death. No patients required hospitalization for adverse effects of treatment. Two patients proceeded to resection post SRS for progressive lesion. Two patients who did not have WBRT had progression of CNS disease outside the treatment volumes.Conclusion: Stereotactic radiosurgery was well tolerated with excellent radiographic response and no major reported adverse events. In this review 44% of patients with neurologic symptoms prior to SRS had clinical improvement with length and time course not attributable to steroid therapy.

MSRO35-08 Long-term Follow-up of Intensive Chemotherapy Followed by Reduced Dose and Field Irradiation for Intracranial Germ Cell Tumors

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S103CD

Participants
Akikori Takada, MD, Tsu, Japan (Presenter) Nothing to Disclose
Noriko Ii, MD, PhD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Toshio Matsubara, MD, PhD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Yoshihiro Komada, MD, PhD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Hajime Sakuma, MD, Tsu, Japan (Abstract Co-Author) Departmental Research Grant, Siemens AG; Departmental Research Grant, Koninklijke Philips NV; Departmental Research Grant, Bayer AG; Departmental Research Grant, Guerbet SA; Departmental Research Grant, DAICHI SANKYO Group; Departmental Research Grant, FUJIFILM Holdings Corporation; Departmental Research Grant, Nihon Medi-Physics Co, Ltd
Yoshihito Nomoto, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Hidemi Toyoda, MD, PhD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Takao Deguchi, MD, PhD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Yutaka Toyomasu, MD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose

ABSTRACT
This report, one of the largest GKRS series for grade 2 meningiomas, demonstrates that GKRS is a safe and effective treatment modality for grade 2 meningiomas with durable tumor control and minimal toxicity.

CLINICAL RELEVANCE/APPLICATION
GKRS is a safe and effective treatment modality for grade 2 meningiomas patients.
Purpose/Objective(s): The purpose of this study is to report the treatment outcomes of intensive chemotherapy followed by reduced dose and field irradiation for the treatment of intracranial germ cell tumors (GCTs). Materials/Methods: 22 patients (18 males and 4 females) with intracranial GCTs were treated at our facility between 1991 and 2012. They were classified into three groups based on their characteristics: 5 patients (23%) with pure germinoma were treated with conventional-dose chemotherapy (ifosfamide-cisplatin-etoposide) followed by 24 Gy ventricular field irradiation as good prognosis group, and 14 patients (64%) with germinoma containing syncytiotrophoblastic giant cells and 3 patients (14%) with nongerminomatous GCTs were treated with high-dose chemotherapy (HDC) with stem-cell support followed by 24-50.4 Gy reduced field irradiation as intermediate and poor prognosis group, respectively. The median age was 14 years and primary sites were at pineal region for 11 (50%) patients, suprasellar region for 7 (32%) patients, and others for 4 (18%) patients and others for 7 (32%) patients. Disseminated tumors were present in 4 patients. Ten patients (45%) were treated with hydrocephalus before treatment. Four patients who relapsed after initial chemotherapy were included in this study. Results: The median follow-up duration was 113 months, 10-year overall survival rate was 78.1% and progressive-free survival rate was 69.8%, respectively. Regarding late adverse effect, pituitary dysfunction (short stature, insufficient secretion of thyroid hormone); 8 patients (36%), hearing impairment; 5 patients (23%), intelligence diminution; 6 patients (27%), convulsion; 7 patients (32%), treatment induced secondary neoplasm; 2 patients (9%), motility disorder; 2 patients (9%), azoospermia; 1 patient (4.5%) and treatment-related death (brain hemorrhage); 1 patient (4.5%) appeared. In addition, 5 (23%) patients needed intervention of a psychiatrist due to school refusal, anxiety disorder, eating disorder and self-injury behavior etc. In contrast, patients who received irradiation less than 30 Gy tended to have no late adverse effect. Conclusion: Intensive chemotherapy followed by reduced dose and field irradiation resulted in preferable outcomes. Based on our results, further study will be required from the perspective of radiation dose and field, especially for patients classified as intermediate and poor prognosis group.

PURPOSE

Purpose/Objective(s): Sacral chordomas represent approximately a third of all chordomas, a rare neoplasm of notochordal remnants. Current NCCN guidelines recommend surgical resection with or without adjuvant radiotherapy, or definitive radiation for unresectable cases. Recent advances in radiation for chordomas include conformal photon and proton beam radiation. We investigated the incidence, treatment, and survival outcomes for sacral chordomas to observe any trends in response to improvements in surgical and radiation techniques over a near 40 year time period.

METHOD AND MATERIALS

Materials/Methods: 345 microscopically confirmed cases of sacral chordoma were identified between 1974 and 2011 from the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute. Incidence and survival rates were adjusted for age. Cases were divided into three cohorts by calendar year, 1974-1989, 1990-1999, and 2000-2011, as well as into two groups by age less than or equal to 65 versus greater than 65 to investigate trends over time and by age via Chi-square analysis. Kaplan-Meier analyses were performed to determine effects of treatment on survival.

RESULTS

Results: Median age at diagnosis was 64. The age-adjusted incidence rate of sacral chordomas was .03 per 100,000. 5-year relative survival for the entire cohort was 60%. Overall survival correlated significantly with treatment modality, with 44% surviving at 5 years with no treatment, 52% with radiation alone, 82% surgery alone, and 78% surgery and radiation (p = .001). Trends of Radiation, Surgery, and Survival by Time.1974-1989(N=68)1990-1999(N=78)2000-2011(N=199)P-valuePatients Receiving Radiation53%40%33%.03Patients Receiving Surgery65%74%70%.555-year Overall Survival (%)63%59%63%.991Treatments were not mutually exclusive. Calculated from 94 cases between 2000-2006 with median follow-up 84 months.

CONCLUSION

Conclusion: Surgery remains an important component in the treatment of sacral chordomas in current practice. Fewer patients were treated with radiation more recently despite advances in photon and proton beam radiation. Overall survival remains unchanged. Additional analyses of margin status, radiation modality, and local control in current practice are warranted.

ABSTRACT

Conclusion: Surgery remains an important component in the treatment of sacral chordomas in current practice. Fewer patients were treated with radiation more recently despite advances in photon and proton beam radiation. Overall survival remains unchanged. Additional analyses of margin status, radiation modality, and local control in current practice are warranted.
SSG01

**ISP: Breast Imaging (Intervention Path Correlation)**

Tuesday, Dec. 1 10:30AM - 12:00PM Location: E451A

BR DM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Thomas J. Lawton, MD, Chapel Hill, NC *(Moderator)* Nothing to Disclose
Dianne Georgian-Smith, MD, Boston, MA *(Moderator)* Nothing to Disclose
Michael A. Cohen, MD, Atlanta, GA *(Moderator)* Nothing to Disclose

Sub-Events

**SSG01-01** Breast Imaging Keynote Speaker: Radiology-Pathology Challenges to Lobular Neoplasia and Radial Scars

Tuesday, Dec. 1 10:30AM - 10:40AM Location: E451A

Participants
Dianne Georgian-Smith, MD, Boston, MA *(Presenter)* Nothing to Disclose

**SSG01-02** Breast Imaging Keynote Speaker: Radiology-Pathology Challenges to Lobular Neoplasia and Radial Scars

Tuesday, Dec. 1 10:40AM - 10:50AM Location: E451A

Participants
Thomas J. Lawton, MD, Chapel Hill, NC *(Presenter)* Nothing to Disclose

**SSG01-03** ACR BI-RADS Assessment Category 4 Subdivisions in Diagnostic Mammography: Utilization and Outcomes in the National Mammography Database

Tuesday, Dec. 1 10:50AM - 11:00AM Location: E451A

Participants
Mai A. Elezaby, MD, Madison, WI *(Presenter)* Nothing to Disclose
Mythreiyi Bhargavan-Chatfield, PhD, Reston, VA *(Abstract Co-Author)* Nothing to Disclose
Elizabeth S. Burnside, MD, MPH, Madison, WI *(Abstract Co-Author)* Stockholder, NeuWave Medical Inc
Wendy B. Demartini, MD, Madison, WI *(Abstract Co-Author)* Nothing to Disclose

**PURPOSE**

Since 2003, the ACR Breast Imaging Reporting and Data System (BI-RADS) Atlas has suggested that mammography category 4 assessments be subdivided by likelihood of malignancy into 4A (> 2% to ≤ 10%), 4B (> 10% to ≤ 50%) and 4C (> 50% to ≤ 95%). This allows a more meaningful practice audit and aids patients, clinicians and pathologists. However, little is known about use and outcomes of category 4 subdivisions in clinical practice. We evaluated utilization of these subdivisions in the National Mammography Database (NMD), a large national registry with approximately 160 participating facilities.

**METHOD AND MATERIALS**

This study was NMD Registry Committee approved and HIPAA compliant. We included data for all diagnostic mammograms submitted to the NMD performed from January 2008 to December 2013. We calculated the utilization rate of BI-RADS assessment category 4 subdivisions overall and by year, and determined the positive predictive values of biopsy performed (PPV3) overall and by category 4 subdivision.

**RESULTS**

Data from 968,670 diagnostic mammograms were included. Overall, 90,988 (9%) were given BI-RADS assessment category 4, with subdivisions used in 30,163 (33%) and not used in 60,825 (67%) of category 4 exams. Subdivision use by year was 54% (2008), 46% (2009), 35% (2010), 31% (2011), 30% (2012) and 32% (2013). Among the 30,163 diagnostic mammograms given category 4 subdivisions, frequencies were 4A in 1,6900 (56%), 4B in 9,555 (32%) and 4C in 3,708 (12%). PPV3s were: overall category 4 20% (13,925/69,537), category 4A 8% (941/12,460), category 4B 22% (1683/7636) and category 4C 69% (1990/2892).

**CONCLUSION**

Despite the ACR BI-RADS Atlas suggestion for use of assessment category 4 subdivisions since 2003, the minority (33%) of NMD category 4 diagnostic mammograms utilized these subdivisions. When category 4 subdivisions were used, positive predictive values for biopsy performed reproduced appropriate BI-RADS specified malignancy ranges. This analysis supports the use of subdivisions in broad practice and should motivate increased utilization given benefits for patient care.

**CLINICAL RELEVANCE/APPLICATION**

In the NMD, subdivisions were used in the minority of category 4 diagnostic mammograms, but PPV3s were in BI-RADS-specified malignancy ranges. Increased utilization should be encouraged given benefits for patient care.
Biopsies of calcifications in women ≥ 70 years yielded a greater than 5% likelihood of malignancy, including triple negative and coarse heterogeneous.

35% (37/105) of fine pleomorphic, 29% (8/28) of fine linear, 20% (8/40) of amorphous, 12% (2/17) of round, and 5% (2/37) of amorphous calcifications, with no invasive disease in the coarse heterogeneous calcifications.

Invasive disease was found in 25% (7/28) of fine linear, 18% (3/17) of round, 15% (16/105) of fine pleomorphic, and 5% (2/37) of amorphous calcifications, with no invasive disease in the coarse heterogeneous calcifications.

30 (53%) low risk (low/intermediate grade) and 27 (47%) high risk (high grade) in situ cases. Of the 28 invasive cases, 24 (86%) were luminal type (ER and/or PR+), 1 (4%) HER2 (ER/PR-, HER2+), and 3 (11%) triple negative cancers; 5 (18%) were node positive.

The 236 biopsies resulted in 131 (56%) benign, 20 (9%) atypical, 57 (24%) in situ, and 28 (12%) invasive diagnoses. There were calculated in total and by morphology.

The majority opinion was recorded. Stereotactic and surgical excision pathology reports were reviewed and final tumor type, hormone receptor status, and lymph node status were recorded. Surrogate molecular subtypes based on ER, PR and HER2 data were tabulated. The proportion of benign, atypical, in situ, and invasive disease were calculated in total and by morphology.

The literature review identified 352 cases that met our inclusion criteria, with 1.1% upgrading to DCIS or invasive malignancy at excision. Our study identified 50 concordant RS/CSL without atypia, 11 discordant RS/CSL with atypia, and 2 discordant RS/CSL without atypia; all were excised. Imaging features and CNB techniques used are detailed in Figure 1. Of the 50 cases of RS/CSL without atypia that were concordant, 0% were upgraded to DCIS or invasive malignancy at excision. 16% of these cases had an excisional diagnosis of atypia that was not present on CNB. This occurred more frequently when CNB technique was automated load device (23.5%) vs vacuum assisted device (13.2%). 2/2 discordant cases upgraded to DCIS or invasive carcinoma on excision, and 3/11 cases of RS/CSL with atypia upgraded (27.2%).

Our review suggests that discordant RS/CSL without atypia do not warrant excision. The data also suggests CNB for suspected RS should be performed with larger gauge VAD for improved accuracy of risk assessment based on the presence of atypia.

Entering the era of increased detection of RS/CSL by digital breast tomosynthesis, it is relevant to have identified strict pathologic and biopsy technique criteria that may permit patients to forgo unnecessary surgery.

The literature review identified 21 published studies since 1999, reporting upgrade rates for RS from 0% to 40%. In addition to significant selection bias, each of these retrospective studies had at least one major confounding factor: 1) Administering upgrade rates of RS plus atypia with benign RS; 2) Not reporting CNB RadPath concordance and/or including discordant cases; 3) Not providing histologic review; 4) Not reporting distance from the biopsy site to upgrade lesion on excision, thereby not confirming association. With IRB approval, we identified all breast biopsies from 2004 to 2014 with RS/CSL, with and without atypia, followed by excision. All above confounding factors were addressed, and pathologic and radiologic features were catalogued for each case. Statistical significance was evaluated using the chi-square test.

The study identified 352 cases that met our inclusion criteria, with 1.1% upgrading to DCIS or invasive malignancy at excision. Our study identified 50 concordant RS/CSL without atypia, 11 discordant RS/CSL with atypia, and 2 discordant RS/CSL without atypia; all were excised. Imaging features and CNB techniques used are detailed in Figure 1. Of the 50 cases of RS/CSL without atypia that were concordant, 0% were upgraded to DCIS or invasive malignancy at excision. 16% of these cases had an excisional diagnosis of atypia that was not present on CNB. This occurred more frequently when CNB technique was automated load device (23.5%) vs vacuum assisted device (13.2%). 2/2 discordant cases upgraded to DCIS or invasive carcinoma on excision, and 3/11 cases of RS/CSL with atypia upgraded (27.2%).

Conclusion
Our review suggests that discordant RS/CSL without atypia do not warrant excision. The data also suggests CNB for suspected RS should be performed with larger gauge VAD for improved accuracy of risk assessment based on the presence of atypia.

Clinical Relevance/Application
Entering the era of increased detection of RS/CSL by digital breast tomosynthesis, it is relevant to have identified strict pathologic and biopsy technique criteria that may permit patients to forgo unnecessary surgery.

Suspicous Breast Calcifications in Women Over Age 70: Are Some Safe to Follow?

While the incidence of breast cancer increases with age, tumor prognosis in the elderly is often favorable. Our study evaluated the histologic outcomes of stereotactically biopsied breast calcifications in women ≥70 years of age to determine if specific BI-RADS morphology descriptors may be candidates for active surveillance rather than biopsy.

METHOD AND MATERIALS
In this HIPAA compliant, IRB approved study, digital mammograms from 236 consecutive patients ≥70 years who underwent stereotactic biopsy of calcifications without associated findings were independently reviewed by three breast radiologist who provided BI-RADS morphology descriptors for each case. The majority opinion was recorded. Stereotactsic and surgical excision pathology reports were reviewed and final tumor type, hormone receptor status, and lymph node status were recorded. Surrogate molecular subtypes based on ER, PR and HER2 data were tabulated. The proportion of benign, atypical, in situ, and invasive disease were calculated in total and by morphology.

RESULTS
The 236 biopsies resulted in 131 (56%) benign, 20 (9%) atypical, 57 (24%) in situ, and 28 (12%) invasive diagnoses. There were 30 (53%) low risk (low/intermediate grade) and 27 (47%) high risk (high grade) in situ cases. Of the 28 invasive cases, 24 (86%) were luminal type (ER and/or PR+), 1 (4%) HER2 (ER/PR-, HER2+), and 3 (11%) triple negative cancers; 5 (18%) were node positive. Invasive disease was found in 25% (7/28) of fine linear, 18% (3/17) of round, 15% (16/105) of fine pleomorphic, and 5% (2/40) of amorphous calcifications, with no invasive disease in the coarse heterogeneous calcifications. In situ disease was found in 35% (37/105) of fine pleomorphic, 29% (8/28) of fine linear, 20% (8/40) of amorphous, 12% (2/17) of round, and 5% (2/37) of coarse heterogeneous. There was no malignancy detected in 9 cases of calcifications described as dystrophic.

CONCLUSION
Biopsies of calcifications in women ≥ 70 years yielded a greater than 5% likelihood of malignancy, including triple negative and
lymph node positive tumors, for all suspicious calcification morphologies. Active surveillance in this age group is not appropriate.

**CLINICAL RELEVANCE/APPLICATION**

Active surveillance is not appropriate for women ≥ 70 years with suspicious calcification morphologies.

**SSG01-06 Amorphous Calcifications Rarely Represent Aggressive Malignancy**

Tuesday, Dec. 1 11:20AM - 11:30AM Location: E451A

Participants

Wendie A. Berg, MD, PhD, Pittsburgh, PA (Presenter) Consultant, SuperSonic Imagine; Departmental Research Grant, General Electric Company; Departmental Research Grant, Hologic, Inc; Equipment support, Gamma Medica, Inc; Equipment support, General Electric Company; Equipment support, Hologic Inc.;

Sue S. Chen, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose

Hayley Oligne, DO, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose

Sahand Sohrabi, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

Margaret L. Zuley, MD, Pittsburgh, PA (Abstract Co-Author) Research Grant, Hologic, Inc;

Maria L. Anello, DO, Jacksonville, FL (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To determine rate and molecular subtypes of malignancy on stereotactic biopsy of amorphous calcifications and to consider implications for overdiagnosis.

**METHOD AND MATERIALS**

From 6727 stereotactic 9-g vacuum-assisted biopsies performed from 1/1/2009 through 9/30/2013 at a single institution, consecutive cases were reviewed under an IRB-approved protocol. Calcification morphology and distribution were recorded. For cases with primarily amorphous calcifications but no more suspicious morphologies, demographic information was recorded together with imaging findings and histopathologic outcomes including excision for any high-risk result or malignancy.

**RESULTS**

Interim analysis of 804 biopsies revealed 233 (29.0%) were for amorphous calcifications in 203 women (median age 53 years, range 30-78). Of 233 biopsies, 25 (10.8%) were ultimately malignant in 24 women (median age 51, range 39-75), including nine invasive ductal carcinomas (IDC) with median size 0.3 cm (range 0.1 to 1.2 cm), all node negative, seven Nottingham grade 2 and two grade 1; seven were luminal A [ER/PR(+),HER2(-), low Ki-67] and two were luminal B [ER(+),HER2(-), Ki-67 20%; one PR(+) and one PR(-)]. Among 16 DCIS lesions, two were nuclear grade 3, 11 grade 2 (two of which were upgraded from ADH on core), and 3 grade 1; three of the DCIS were PR(-). Distribution influenced malignancy rate: 4/11(36%) linear distribution were malignant as were 3/9 (33%) segmental, 17/194 (8.8%) grouped, and 1/18 (5.6%) regional (p<0.001). Of 24 women diagnosed with cancer, 18 (75%) had risk factors other than age or breast density. Another 67/233 (28.8%) biopsies yielded a final result of atypical/high risk results: 45 ADH; 8 LCIS; 7 FEA; 6 ALH; 1 atypical apocrine adenosis.

**CONCLUSION**

Malignancy rate of 10.8% was observed on stereotactic biopsy of amorphous calcifications. All malignancies were DCIS or ER-positive IDC; 4/203 (2.0%) women were diagnosed with luminal B IDC or high nuclear grade DCIS. Among 69 lesions atypical/high risk on core biopsy only 2 (2.9%) (95%CI 0.9 to 4.9%) were upgraded at excision (grade 2 DCIS), both of whom had ipsilateral cancer (one current, one prior).

**CLINICAL RELEVANCE/APPLICATION**

Stereotactic biopsy remains necessary for amorphous calcifications, but an atypical result on vacuum biopsy of amorphous calcifications has a very low (2.9%) rate of upgrade to malignancy at excision. Further study is warranted to determine if excision is necessary in this context.

**SSG01-07 Pilot Evaluation of Minimally Invasive Needle-biopsy of Sentinel Nodes as Compared to Surgical Removal**

Tuesday, Dec. 1 11:30AM - 11:40AM Location: E451A

Participants

Stefan Paepeke, MD, Munich, Germany (Abstract Co-Author) Advisor, SurgicEye GmbH; Advisor, NeoDynamics AB

Christian H. Pfob, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

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Jens-Uwe Blommer, MD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose

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Thomas Wendler, Munich, Germany (Abstract Co-Author) Former Employee, SurgicEye GmbH

Joerg Traub, PhD, Garching bei Munchen, Germany (Presenter) Shareholder and Managing Director of SurgicEye GmbH

**PURPOSE**

Evaluate within a pilot setup feasibility and safety of minimally invasive needle-biopsy of sentinel nodes guided by SPECT/US as compared to surgical removal while defining optimal needle for follow-up trial.

**METHOD AND MATERIALS**

As pre-trial test phase of the MinimalSNB study, 38 breast cancer patients (6 centers) were taken a needle-biopsy of their sentinel lymph nodes (SLNs) under guidance of SPECT/US (SentiGuide by SurgicEye). All patients were indicated for a surgical SLN biopsy which was performed immediately after the needle-biopsy. For the test phase, 4 different biopsy systems were tested: HistoCore
14G (BIP), elite 10G and 13G (Mammotome) and CASSII 10G (Scion Medical Technologies). Histopathological examination (HandE, step-sectioning) of needle-biopsies and surgically removed SLNs were compared.

RESULTS
No single complication was reported. Occasionally, small hematomas could be found close to the SLN during surgery. The needle-biopsies showed lymphatic tissue in 29/38 cases. Within the 29 successful cases both methods matched in 26 cases (24 true negative, 2 true positive). The needle biopsy failed to detect metastases in 2 pN1 SLNs. In 1 case, the surgically resected tissue did not contain lymph nodes and the needle biopsy remained the only information on nodal status (pN0). The success of the biopsies was strongly dependent on training and experience of user making axillary needle biopsies. 5 of the failed needle biopsies were the first attempt of the user. In both false negative cases, the retrieved lymph tissue was minimal (1x 14G sample, 1x 10G sample tangential to node).

CONCLUSION
SPECT/US showed to be a valid method for percutaneous detection of SLNs and needle-guidance. Sampling SLNs with a needle seems safe and feasible. However it requires proper training and user experienced with axillary needle-biopsies. Retrieving more tissue (more cores and larger lumen needles) improves diagnostic power of needle-biopsy. These considerations will be taken within the upcoming MinimaSNB trial.

CLINICAL RELEVANCE/APPLICATION
Sentinel lymph biopsy today is a surgical diagnostic procedure with an non-zero morbidity. Moving it out of the operating theatre to a needle-based intervention has a huge impact on the burden of this procedure for the patient as well as relevant improvements in logistics, workflow and radiation burden.

PURPOSE
To investigate detection rates of ductal carcinoma in situ (DCIS), separately for different nuclear grades of the first subsequent round in relation to the initial round of a population-based digital mammography screening program.

METHOD AND MATERIALS
We included data from 516,286 subsequent round (SR) examinations (52-69 years, 2007-2010) and 720,778 initial round (IR) examinations (50-69 years, 2005-2008) from 16 screening areas provided by the population-based cancer registry. The total detection rate per 100 women screened (DetR%) for DCIS was dissected into low (SR n= 64, IR n= 181), intermediate (SR n= 220, IR n= 387) and high grades (SR n= 285, IR n= 425). Spearman rank correlations and Wilcoxon test were used. P values less than .05 were considered significant.

RESULTS
The SR-DetR% of total DCIS correlated significantly with high grade DCIS (r = 0.75; P < .001) and intermediate grade DCIS (r = 0.55; P = .028), the association with low grade DCIS was lower (r = 0.48; P = .057). SR-DetR% of DCIS low grade was lower than for intermediate (P < .001) and high grade (P < .001).The median SR-DetR% of total DCIS (0.12%) was lower than the median IR-DetR% (0.14%; P = .039). In particular, the median SR-DetR% of low grade was significantly lower than in the initial round (0.01% vs. 0.06% P = .01) while the median DetR% of intermediate grade were 0.04% and 0.05%, respectively (P = 0.19), and for high grade 0.05% and 0.06%, respectively (P = .67).

CONCLUSION
Only DCIS of low grade decreased significantly from the initial to the first subsequent screening round, it was less common than intermediate and high grade DCIS and it showed only a weak association with total DCIS detection.

CLINICAL RELEVANCE/APPLICATION
Biennial digital mammography screening of women aged 50 to 69 years showed constantly higher DCIS detection rates of the more progressive grades than of the DCIS low grade.

PURPOSE
To investigate detection rates of ductal carcinoma in situ (DCIS), separately for different nuclear grades of the first subsequent round in relation to the initial round of a population-based digital mammography screening program.

METHOD AND MATERIALS
We included data from 516,286 subsequent round (SR) examinations (52-69 years, 2007-2010) and 720,778 initial round (IR) examinations (50-69 years, 2005-2008) from 16 screening areas provided by the population-based cancer registry. The total detection rate per 100 women screened (DetR%) for DCIS was dissected into low (SR n= 64, IR n= 181), intermediate (SR n= 220, IR n= 387) and high grades (SR n= 285, IR n= 425). Spearman rank correlations and Wilcoxon test were used. P values less than .05 were considered significant.

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CONCLUSION
Only DCIS of low grade decreased significantly from the initial to the first subsequent screening round, it was less common than intermediate and high grade DCIS and it showed only a weak association with total DCIS detection.

CLINICAL RELEVANCE/APPLICATION
Biennial digital mammography screening of women aged 50 to 69 years showed constantly higher DCIS detection rates of the more progressive grades than of the DCIS low grade.
Follow up of lesions with imaging-concordant benign MRI-guided vacuum-assisted biopsy result is not currently standardized. We aim to investigate the false omission rate of benign breast MRI-guided vacuum-assisted biopsy (MVAB) to assess whether MRI follow up is needed.

**METHOD AND MATERIALS**

Medical records of patients with 9-gauge breast MRVAB from January 1, 2007 to July 1, 2012 were reviewed retrospectively. Only patients/lesions with imaging-concordant MRVAB benign result and 1) surgical histopathology or 2) minimum of 2-year imaging follow up were included in this study. The false omission rate (1-NPV= # false negative result/ # negative calls) of the MRVAB with imaging-concordant benign result was calculated.

**RESULTS**

A total of 161 patients (170 lesions) with MRVAB imaging-concordant benign result met the inclusion criteria. The majority, 127/161 (79%) patients [134/170 (79%) lesions] had only imaging follow up; 58/161 (36%) patients [61/170 (36%) lesions] had mammography and > 24 months MRI follow up; and 26/161 (16%) patients [29/170 (17%) lesions] had mammography with < 24 months follow up (MRI follow up range 2 to 20 months, median 11 months). Of the 34/161 (21%) patients [36/170 (21%) lesions] with surgical correlation, none had surgical discordance. Malignancy was later diagnosed in the same breast in 3/161 patients (1.9%): 1 invasive ductal carcinoma (IDC) (0.6%), 1 IDC with ductal carcinoma in situ (DCIS) (0.6%), and 1 DCIS (0.6%). Only 1 of these 3 patients (1/127 = 0.8%) had subsequent malignancy (IDC) near (1 cm from) the site of previous MRVAB, with malignancy discovered on follow up mammography (calcifications) >23 months after MRVAB. The other 2 patients developed cancer in a different site in the same breast: 1(DCIS) found on mammography (calcifications) >11 months post MRVAB and 1(DCIS) found on MRI (mass) >22 months post MRVAB.

**CONCLUSION**

Our study shows a false omission rate for benign MRVAB of 0.6%, with cancer near the MRVAB site detected by mammography at 24 months post MRVAB in 1/170 lesions (1 false negative result/170 negative calls).

**CLINICAL RELEVANCE/APPLICATION**

Imaging-concordant benign MRVAB has extremely low false omission rate and may not warrant MRI follow up.
PURPOSE
To evaluate the value of cardiovascular magnetic resonance (CMR)-derived myocardial strain for predicting poor outcome in patients with acute myocarditis.

METHOD AND MATERIALS
We retrospectively included 37 consecutive patients with acute myocarditis who performed CMR (23 male, mean age 41.5 yrs). Myocardial strain parameters, left ventricular (LV) end-diastolic and end-systolic volumes, LV myocardial mass, LV ejection fraction (EF) and right ventricular EF were derived from CMR. Presence of late gadolinium enhancement (LGE) was also recorded. Primary outcome was major adverse cardiovascular events (MACE). Incomplete LV functional recovery was used as secondary outcome in the group of patients who performed follow-up echocardiography after 1 year.

RESULTS
During an average follow-up of 41 ± 34 months, 11 of 37 patients (29.7%) suffered MACE, including cardiac death (n = 2), heart transplantation (n = 1), cardiac pacemaker (n = 1), rehospitalization due to cardiac events (n = 4) or embolic stroke (n = 3). Multivariable Cox proportional hazard regression analysis revealed the presence of LGE (hazard ratio 42.88, p = 0.014) and radial strain obtained from the long axis views (ErrLax, hazard ratio 0.77, p = 0.004) were significant predictors of MACE. Kaplan-Meier analysis showed worse outcome in patients with LGE or ErrLax ≤9.48. Thirty one of 37 patients (83.7%) performed follow-up echocardiography. Multivariable backward stepwise regression analysis revealed ErrLax was the sole significant predictor of LV functional recovery (hazard ratio 1.87, p = 0.042). Receiver operating characteristic curve of ErrLax was used to find optimal cut-off values for prediction of incomplete LV functional recovery, with corresponding area under the curve of 0.96. Cut-off value with the best combination of sensitivity and specificity for ErrLax was ≤14.86 (sensitivity 88.9%, specificity 95.5%).

CONCLUSION
CMR-derived ErrLax can predict poor outcome such as MACE or incomplete LV functional recovery in the patients with acute myocarditis.

CLINICAL RELEVANCE/APPLICATION
CMR-derived ErrLax can predict poor outcome in the patients with acute myocarditis. Furthermore, presence of scar indicated by LGE is also the good independent predictor of MACE. This results support the necessity for future large longitudinal follow-up studies to establish LGE and CMR-derived myocardial strain as an independent predictor of MACE in acute myocarditis.
PURPOSE
Right ventricular (RV) function is a major determinant of prognosis in pulmonary arterial hypertension. Pressure overload triggers compensatory mechanisms such as RV hypertrophy, dilatation, fibrosis and RV failure. Diffuse myocardial fibrosis and inflammation have been detected in the left ventricle non-invasively by T1 and T2-mapping using cardiac magnetic resonance (CMR) imaging. The purpose of our study was to evaluate whether T1- and T2-mapping could detect myocardial fibrosis and/or edema of the RV in patients with pulmonary arterial hypertension (PAH).

METHOD AND MATERIALS
A prospective, IRB-approved, HIPAA-compliant study identified from February of 2013 to March of 2015, 34 (6 males and 33 females with mean age of 58±15 years) subjects with PAH (24 subjects had scleroderma-induced PAH (SSc-PAH) and 10 had idiopathic PAH (IPAH). Fifteen age-matched normal controls underwent the same CMR protocol. Standard multi-sequence CMR protocol including pre-contrast (native) short-MOLLI and T2-mapping was performed. Images were processed on a dedicated workstation by drawing a region of interest on the RV inferior wall. Reproducibility was assessed by independently blinded by a second reader.

RESULTS
Right ventricular inferior wall native T1 and T2 times were significantly higher in patients compared to controls (T1: 1017 ± 96 ms vs. 930 ± 94 ms, p=0.009; T2: 55 ± 6 ms vs. 49 ± 6 ms, p<0.001). Both measures were reproducible with strong repeated measure linear regression correlations for interobserver analysis (T1: r=0.79, p<0.001; T2: r=0.72, p<0.001). There was a weak correlation between T1 values and pulse pressure (r=0.37, p<0.05). No significant correlation was found between T1 or T2 values with CMR-derived RV-ejection fraction, RV-end diastolic volume and RV wall thickness or hemodynamic measures of PAH severity from RHC such as mean pulmonary artery pressure and pulmonary vascular resistance.

CONCLUSION
T1- and T2-mapping of the right ventricle is feasible and shows high reproducibility. Future studies with a larger sample size are needed to determine its clinical utility.

CLINICAL RELEVANCE/APPLICATION
T1 and T2-mapping of the RV are potentially novel measures of fibrosis and edema for the assessment of pulmonary arterial hypertension.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Ihab R. Kamel, MD - 2015 Honored Educator
Stefan L. Zimmerman, MD - 2012 Honored Educator
Stefan L. Zimmerman, MD - 2015 Honored Educator

SSG02-03 The Prognostic Value of Coronary Computed Tomography Angiography in Asymptomatic Adults at Intermediate Risk

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S504AB

Participants
Su Jin Hong, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Yeo Koon Kim, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jae Yeon Wi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Eun Ju Chun, MD, PhD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sang Il Choi, MD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
The risk stratification methods based on conventional risk factors have limitations to predict the coronary artery disease. The purpose of this study is to evaluate the prognostic value of coronary CT angiography (CCTA) over traditional risk factors and coronary artery calcium score (CACS) in asymptomatic subjects at intermediate risk.

METHOD AND MATERIALS
From January 2006 to December 2007, 1156 asymptomatic patients at intermediate risk who underwent both CACS and CCTA for health surveillance were included. Basic demographic data, medical history, family history, laboratory data were acquired for risk factor assessment. CCTA images were analyzed by 2 cardiac radiologists in consensus. Analysis included degree of stenosis and type of plaque. The follow-up information was obtained from the hospital medical records or data on National health insurance review and assessment service by two trained researchers. Follow-up was made for cardiac events (cardiac death, nonfatal myocardial infarction, unstable angina requiring hospital stay, or revascularization later than 90 days after CCTA).

RESULTS
During a median 76 months of follow-up, the cardiac event occurred in 5.2% (n=60). For the prediction of both cardiac events and major adverse cardiac events (MACE; cardiac death, myocardial infarction and unstable angina), all of the CCTA parameters correlated significantly with outcome (all p<0.01). For the prediction of all cardiac events, the area under curves (AUCs) of Framingham risk score (FRS), FRS with CACS, and FRS with CCTA showed gradual increase (AUC 0.64 for FRS alone, 0.81 for FRS + CACS and 0.91 for FRS + CCTA; all p<0.05). However, the addition of CACS on CCTA with FRS did not add the prediction power (AUC 0.90) to the CCTA with FRS (AUC 0.91). The results for the prediction of MACE were similar. The addition of CACS or CCTA to FRS had the incremental predictive power than FRS alone (AUC 0.65 for FRS alone, 0.80 for FRS + CACS, and 0.91 for FRS + CCTA; all p<0.05). The CACS did not have the incremental value over FRS with CCTA (AUC 0.90 for FRS + CACS + CCTA and 0.91 for FRS + CCTA).

CONCLUSION
No
CCTA has incremental prognostic value over FRS and CACS in the asymptomatic subjects at intermediate risk.

CLINICAL RELEVANCE/APPLICATION
CCTA has a potential to replace the screening role of CACS in the asymptomatic subjects at intermediate risk.

SSG02-04  Assessment of Semi-automatic Quantification of Non-Calcified Plaque as a Predictor of Outcome in Acute Chest Pain Patients at Coronary CT Angiography

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S504AB

Participants
Andreas Bucher, MD, Frankfurt, Germany (Presenter) Nothing to Disclose
Rui Wang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Felix G. Meinel, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Julian L. Wichmann, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Carlo N. De Cecco, MD,PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (Abstract Co-Author) Research Grant, Bracco Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; ; ;
Aleksander Kazinski, Charleston, SC (Abstract Co-Author) Nothing to Disclose
James Spearman, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Justin R. Silverman, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Paul Apfaltrer, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the predictive value of quantified non-calcified plaque volume on clinical outcome in acute chest pain patients.

METHOD AND MATERIALS
Total plaque volume was analyzed using semi-automated segmentation software from CTA datasets of 151 acute chest pain patients (99 female; age 59.1±11.0 years). CT series were acquired on a 64 dector-row dual source CT system and reconstructed in 0.75 mm slice thickness. Non-calcified plaque volume (ncPV) was sub-categorized by density: necrotic plaque volume (nPV): <30-75 HU; fibrous fatty plaque volume (ffPV): 76-130 HU; fibrous plaque volume (fPV): 131-350 HU. As a primary endpoint, major adverse cardiac events (MACE) were recorded on follow-up. Total plaque burden (TPB) was calculated as sum of all analyzed coronary segments. Cox proportional-hazards regression, correlation coefficient and student-t tests were used for statistical evaluation.

RESULTS
Twenty-one MACE (14.4% of cases) occurred during follow-up (mean follow-up: 12.1±6.2 months). In patients who experienced MACE ncPV was significantly higher (median: 760.5 mm³; inter-quartile range: 535.7-873.2 mm³) compared to patients without MACE (median: 607.2 mm³; inter-quartile range: 448.8-760.5 mm³; P=0.024), while TPB was comparable (P=0.220). ffPV was a statistically significant predictor of MACE (P=0.001). Necrotic and fibrous plaque volume did not show significant predictive value (P>0.1).

CONCLUSION
Non-calcified fibrous fatty plaque volume was a significant predictor of subsequent MACE events in acute chest pain patients.

CLINICAL RELEVANCE/APPLICATION
Semi-automated non-calcified plaque quantification might provide reproducible predictive parameters in acute chest pain patients to predict outcome.

SSG02-05  Benefit of Four-Dimensional Computed Tomography Derived Ejection Fraction of the Left Atrial Appendage to Predict Thromboembolic Risk in the Patients with Valvular Heart Disease

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S504AB

Participants
In-Cheol Kim, MD,PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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Young-Jin Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Byoung Wook Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Namkil Chung, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Decreased left atrial appendage (LAA) emptying velocity in transesophageal echocardiography (TEE) is related with higher incidence of thrombus in LAA and increased risk of stroke. Patients with valve disease are at higher risk of thrombus formation before and after surgery. The aim of this study is to investigate the role of four-Dimensional (4D) CT performed for the evaluation of valvular heart disease to predict the risk of thrombus formation.

METHOD AND MATERIALS
Between March 2010 to March 2015, total of 62 patients who underwent 4D CT scan and TEE for cardiac valve evaluation before
surgery in Younsei Cardiovascular Hospital were retrospectively included in the current study. LAA was observed during TEE between 45 to 90 degree. Fractional area change (FAC) in TEE view (FACTEE) and emptying velocity at LAA (VeTEE) was measured. Ejection fraction (EF) of LAA (EFCT) was calculated by 4D CT with full volume analysis. The best cut-off value of EFCT to predict the presence of SEC or thrombus and correlation between the parameters were also estimated.

RESULTS

Mean age was 60 ± 15 years old and 53.2% were male. Spontaneous echo contrast (SEC) or thrombus was observed in 45.2%. Correlation between EFCT and VeTEE was noted (r=0.452, p<0.001). However, FACTEE was not significantly related to VeTEE (r=0.085, p=0.512). EFCT < 37.5% best predicted SEC or thrombus in the patients with valve disease who underwent 4D CT and TEE (AUC = 0.654, p = 0.038, sensitivity = 0.824, specificity = 0.536).

CONCLUSION

In the patients who are undergoing 4D CT before surgery, LAA EF by volume analysis might provide additional benefit to predict the risk of thromboembolic event.

CLINICAL RELEVANCE/APPLICATION

Valve CT with 4D reconstruction might provide useful information predicting SEC or thrombus.

SSG02-06  A Prospective Observational Single Blinded Study on the Role of Preoperative Computed Tomography Coronary Angiogram in Cardiac Risk Stratification in Non-Cardiac Surgery

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S504AB

Participants

Enc You-Ten, MD, PhD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Scott Beattie, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Duminda Wijeysundera, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Jo Carroll, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Deep Grewal, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Narinder S. Paul, MD, Richmond Hill, ON (Presenter) Research Grant, Toshiba Corporation; Research Grant, Carestream Health, Inc

PURPOSE

To determine the role of wide volume CT Coronary Angiography (CTCA) in assessing the cardiac risk of patients undergoing intermediate and high risk surgery.

METHOD AND MATERIALS

Prospective recruitment of 91 patients undergoing elective intermediate-major non-cardiac surgery and vascular surgery. All patients were seen and assessed in a pre-operative high risk clinic and assigned a Revised Cardiac Risk Index (RCRI). Patients with a RCRI ≥ 1 were eligible for inclusion in the trial. Patients had 12 lead ECG, cardiac stress tests and/or TTE; and all patients had preoperative CTCA using 320x0.5mm detector rows (AqONE, TMS, Japan), 0.35ms GR, 80-135kVp and 350-580mA depending on x-ray absorption profile. MACE were assessed on postoperative days: 0 - 3 and 30 using elevated blood Troponin I plus positive ECG changes, and/or cardiac symptoms, and by telephone for cardiac symptoms requiring medical attention on day 30 (if discharged at home). The results of CTCA were blinded to the clinical team unless high grade disease; severe stenosis (≥ 50%) of left main, critical stenosis (≥70%) of proximal LAD, and/or critical stenosis in ≥ 2 major coronary arteries (2VD)

RESULTS

The physical characteristics, risk factors and medications were similar between patients who were positive for MACE (n=12) and those who were not (n=79). Preoperative CTCA was unblinded in 5 patients of low-intermediate cardiac risk with high grade lesions; left main (2), LAD (2), and 2VD (1). After intervention these 5 patients had their surgery without experiencing MACE. Six blinded patients experienced MACE with an elevated troponin and ischemic ECG within 3 days post-surgery. In these patients, CTCA showed severe 2VD (1 patient) and 3VD (1 patient) and non-significant stenosis (4 patients). One patient died of a fatal MI on postoperative day 31 and CTCA showed non-significant stenosis.

CONCLUSION

CTCA can detect severe and high grade disease in patients assessed as low to intermediate cardiac risk (1-2 RCRI) with conventional methods.

CLINICAL RELEVANCE/APPLICATION

Preoperative CTCA has a promising role in cardiac risk stratification and may lead to development of optimization strategies that improve patient outcome and safety.

SSG02-07  CMR in Pulmonary Arterial Hypertension before and after Therapy in Systemic Sclerosis-Induced Pulmonary Arterial Hypertension

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S504AB

Participants

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Todd Kolb, MD, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Ihab R. Kamei, MD, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Stefan L. Zimmerman, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

PURPOSE

Pulmonary arterial hypertension (PAH) is one of the most lethal complications of systemic sclerosis (SSc) and RV function is the
Pulmonary arterial hypertension (PAH) is one of the most lethal complications of systemic sclerosis (SSc) and RV function is the major determinant of prognosis. Management of systemic sclerosis induced PAH (SSc-PAH) is challenging and despite therapeutic advances, there is still limited evidence that these therapies improve RV function. The purpose of our study was to evaluate whether CMR can identify RV functional changes in response to treatment in patients with SSc-PAH.

**METHOD AND MATERIALS**

Prospective, multicenter, IRB-approved, HIPAA-compliant study. Twenty-four treatment naïve subjects with SSc-PAH underwent right heart catheterization (RHC) and CMR assessment at baseline and after 36 weeks of treatment with tadalafil (40 mg daily) and ambrisentan (10mg daily). A standard multi-sequence CMR was acquired. All images were analyzed by a single reader on a dedicated workstation for both LV and RV quantitative volumes and function.

**RESULTS**

Treatment had a significant impact on CMR measurements such as RV end-systolic (ES) volume index, RV stroke volume (SV), RV ejection fraction (EF), RV cardiac index (CI), LV end-diastolic (ED) volume index, LV SV and LV CI. There was also a significant reduction of mean pulmonary arterial pressure (mPAP), pulmonary vascular resistance (PVR) and cardiac output by RHC. Exercise capacity improved significantly after treatment in this cohort (Table 1).

**CONCLUSION**

Patients treated for SSc-PAH demonstrated significant improvements in RV volumes and function by CMR with corresponding improved hemodynamics on RHC and improved exercise capacity.

**CLINICAL RELEVANCE/APPLICATION**

CMR can be used to non-invasively monitor improvements in RV function in patients undergoing treatment for SSc-PAH.

**Honored Educators**

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Ihab R. Kamel, MD, PhD - 2015 Honored Educator
Stefan L. Zimmerman, MD - 2012 Honored Educator
Stefan L. Zimmerman, MD - 2015 Honored Educator

**PURPOSE**

To evaluate the prevalence and clinical significance of coexistent coronary artery disease (CAD) in patients with hypertrophic cardiomyopathy (HCM) using coronary CT angiography (CCTA).

**METHOD AND MATERIALS**

Among the CCTA data registry which was composed of 41,588 consecutive patients with suspected CAD, a total of 248 patients with HCM diagnosed by clinical findings, electrocardiography, and echocardiography were retrospectively enrolled. Using CCTA, we evaluated the obstructive CAD (>50% stenosis) and plaque types (calcified, non-calcified, high-risk plaque [HP]) according to the 16-segment model. HP was defined as plaque density with <30HU and positive remodeling with >1.1, napkin ring sign and spotty calcification. Clinical risk factors and echocardiographic functional parameters were also evaluated from all the patients. The endpoint was defined as cardiac death, myocardial infarction, unstable angina requiring hospitalization, revascularization after 90 days from CCTA, or implantable cardioverter defibrillator insertion.

**RESULTS**

In patients with HCM, the prevalence of obstructive and non-obstructive CAD was 16.5% and 42.7%, respectively. During the median of 37-months observation period (range; 3-108 months), total cardiac events were occurred in 11.7% of patients with HCM. Using univariate Cox regression analysis, age, family history of previous heart disease, atrial fibrillation, lower ejection fraction (EF < 55%), Framingham risk score, calcium scoring, obstructive CAD and HP were significantly related with cardiac events (all p<0.05). After adjustment of these factors, lower EF (hazard ratio [HR], 5.7) and obstructive CAD (HR, 7.3) were independent factors (all p<0.001).

**CONCLUSION**

The prevalence of obstructive CAD was approximately one-fifth of the HCM population, and the presence of obstructive CAD was one of the independent factor for cardiac events. Therefore, the evaluation of CAD should not be overlooked.

**CLINICAL RELEVANCE/APPLICATION**

In our study, the coexistent CAD was one of the prognostic factor for cardiac events in HCM. In this regard, CCTA is helpful to provide the information not only myocardial hypertrophy but also CAD.
PURPOSE
Myocardial scarring may be related to ventricular tachyarrhythmia, one of the most serious complications associated with hypertrophic cardiomyopathy (HCM). We aimed to assess the association between late gadolinium enhancement (LGE) on MRI and 3 types of ventricular tachyarrhythmia, including ventricular fibrillation (VF), sustained ventricular tachycardia (SVT) and non-sustained ventricular tachycardia (NSVT), in patients with HCM.

METHOD AND MATERIALS
LGE MRI was performed in 167 patients with HCM. We assessed the association between the 3 types of ventricular tachyarrhythmia and the myocardial LGE, clinical risk markers (e.g., family history of sudden cardiac death [SCD], syncope) and cine MRI data (e.g., ejection fraction, myocardial mass). The myocardial LGE was defined as the region with the mean signal intensity ≥ 6 SD above the remote myocardium. Extent of LGE was estimated based on the American Heart Association (AHA) 17-segment model.

RESULTS
Of the 167 patients with HCM, 8, 4, and 23 had VF, SVT and NSVT, respectively. The remaining 132 patients had no ventricular tachyarrhythmia. Overall, 104 patients (62.3%) had myocardial segments displaying LGE. The patients with NSVT frequently showed a family history of SCD, more risk markers, and more presence and wider extent of LGE compared with patients without tachyarrhythmia (P < 0.05). The LGE extent, a family history of SCD and risk markers were significantly related to NSVT (P < 0.01), whereas there were no apparent MRI findings related to VF and SVT. The LGE extent ≥ 3 segments was related to the family history of SCD, episode of cardiac arrest and prevention ICD installation for NSVT.

CONCLUSION
There is a significant association between the extent of LGE and NSVT in patients with HCM, but we find no apparent relationship between MRI findings and VF or SVT. We should discriminate between NSVT and the other types of ventricular tachyarrhythmia and be vigilant for the LGE extent when applying LGE MRI to risk stratification for HCM with NSVT.

CLINICAL RELEVANCE/APPLICATION
Extent of late gadolinium enhancement is associated with non-sustained ventricular tachycardia among the 3 types of ventricular tachyarrhythmia in patients with hypertrophic cardiomyopathy.
To retrospectively evaluate the capability of computed-tomography (CT) radiomic features in predicting EGFR mutation status in surgically resected peripheral lung adenocarcinomas in Asian cohort patients.

METHOD AND MATERIALS
This study was approved by the institutional review board, with waiver of informed consent. 298 patients (167 for training and 131 for validation) with surgically resected peripheral lung adenocarcinomas were enrolled in this study. The EGFR mutations at exons 18 - 21 were determined by amplification refractory mutation system-PCR. We used Definiens Developer XD© (Munich, Germany) as the image analysis platform to perform tumor segmentation and feature extraction.

RESULTS
Mutant EGFR was significant associated with neversmoker status (p=0.041), lepidic predominant adenocarcinomas subtype (p=0.030), and low or intermediate pathologic grade (p=0.041) in peripheral lung adenocarcinomas. Eight radiomic features were significantly associated with the presence of EGFR mutation, including three size base features, four tumor location based features, and one runlength and cooccurrence based feature. The results of a multivariable model showed that the most important predictors of harboring EGFR mutation in Asian patients with peripheral lung adenocarcinoma were histologic subtype (OR 1.99, 95% CI 0.97-4.06), smoking status (OR 0.55, 95% CI 0.29-1.03), and one radiomic feature describing tumor location (OR 0.01, 95% CI <0.001-1.10). The AUC value calculated from the predictive logistic model was 0.650 (95% CI: 0.567 - 0.734), and the AUC value computed by cross-validation method was 0.569 (95% CI: 0.480 - 0.659). The AUC value of this predictive model on the independent validation dataset was 0.696 (95% CI: 0.605 - 0.787).

CONCLUSION
CT based radiomic features of peripheral lung adenocarcinomas can capture useful information regarding tumor phenotype, and the current model we built could be highly useful to predict the presence of EGFR mutations in peripheral lung adenocarcinoma in Asian patients when mutational profiling is not available or possible.

CLINICAL RELEVANCE/APPLICATION
The significant association between radiomic features and EGFR mutation status for patients with peripheral lung adenocarcinomas would serve as image biomarker to allow identification of patients with high incidence of harboring EGFR mutations.
To investigate the potential relationship between iodine uptake levels estimated from single source dual-energy CT (DE-CT) and perfusion parameters with dual-input perfusion CT in lung cancer.

**METHOD AND MATERIALS**

This study was an institutional review board-approved study, and written informed consent was obtained from all patients. Twenty patients with lung cancers (including 12 of adenocarcinoma, 6 of squamous carcinoma and 2 of small cell lung cancer) underwent whole volume perfusion CT and single source DE-CT with 320-row CT in one examination (30S perfusion then DE-CT). The dual-input maximum slope CT perfusion (DI-CT) analysis was employed. Then, the single source DE-CT was applied, and iodine uptake were estimated by the difference (Δλ) and the slope (ΔHU) between the CT numbers of net enhancement in 40KeV and 70KeV monochromatic images. For the perfusion CT, the pulmonary trunk and the ascending aorta were selected as the input arteries for the pulmonary circulation and the aortic circulation respectively. Pulmonary flow (PF), aortic flow (AF), and a perfusion index (PI, \(=PF/(PF+AF)\)) were calculated using the maximum slope method. The DI-CT and DE-CT parameters were analyzed by Pearson/Spearman correlation analysis, respectively.

**RESULTS**

There are significant correlations between \(\lambda, \Delta HU\) and \(\Delta HU, PF\). Correlation coefficient between \(\lambda\) and \(AF, PF\) are 0.615 (\(P<0.01\)) and 0.526 (\(P<0.05\)), respectively. Correlation coefficient between \(\Delta HU\) and \(AF, PF\) are 0.575 (\(P<0.01\)) and 0.538 (\(P<0.05\)), respectively. There is a positive correlation between the DI-CT and DE-CT parameters.

**CONCLUSION**

Both the single source DE-CT and dual-input CT perfusion analysis method can be used to estimate lung cancer perfusion. This study demonstrates that the iodine uptake of lung cancer estimated from DE-CT is significant correlated with the pulmonary flow and aortic flow supplying the tumors.

**CLINICAL RELEVANCE/APPLICATION**

The iodine uptake of lung cancer estimated from single source DE-CT may assess tumor perfusion in consistent with the whole volume perfusion CT. It has potential value to reflect tumor pathophysiology and treatment response.

**SSG03-04 Effect of Energy Level on Texture Analysis in Simultaneously Acquired Dual-Energy Chest CT**

**Tuesday, Dec. 1 11:00AM - 11:10AM Location: S404CD**

**Participants**

James Sorensen, MBCh, Houston, TX (Presenter) Nothing to Disclose
Deep Pujara, MBBS, Houston, TX (Abstract Co-Author) Nothing to Disclose
Unnati Shah, BDS, MPH, Houston, TX (Abstract Co-Author) Nothing to Disclose
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Laurence E. Court, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Jeremy J. Erasmus, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Myrna C. Godoy, MD, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Cihan Duran, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

**METHOD AND MATERIALS**

18 consecutive patients underwent chest DECT for investigation of lung nodules. All images were acquired on Siemens Somatom Definition Flash scanners. Various image acquisition and post processed data sets were evaluated, including 70keV monochromatic, 100 and 140 kVp, and a mixed 100/140 kVp (0.6 weighting factor). In each patient, a series of cylindrical ROIs were drawn in 5 different healthy tissues (bone, muscle, lung, fat, and liver), as well as an ROI delineating the lung lesion under investigation. Histogram, GreyLevel Cooccurrence Matrix, and RunLength Matrix-based texture features were then calculated in each ROI from each CT image set. The diagnostic accuracy of the features acquired from each reconstruction was then tested by using them in a machine-learning classifier to identify the tissue type present in each ROI. The diagnostic accuracy of the predictions derived from each reconstruction was then noted.

**RESULTS**

All textural features were found to vary considerably with the CT energy level. In nearly all tissues, and for all feature classes, the change in feature values with different image data sets followed a simple linear regression, with \(r^2\) values typically \(>0.9\). The exceptions to this were fat, which had a slightly weaker positive relation for most features, and skeletal muscle, in which the feature values of all tissues were found to change unpredictably with energy. In general, GLCM features were the most predictable in response to changes in kilovoltage (with \(r^2\) usually \(>0.95\)), while RLM were the least (\(r^2=0.8\)). The ability of this group of features to identify tissue types varied only slightly across the evaluated CT datasets, ranging from 77-% with mixed 100/140kVp, to 84% at 100kVp.

**CONCLUSION**

Textural features were accurately able to differentiate between tissue types on DECT, and this accuracy was independent of energy level. All textural features showed variation according to the energy level used, and for most tissue types this followed a simple linear relation.

**CLINICAL RELEVANCE/APPLICATION**

By using a simple correction factor, textural feature values in most tissues can be directly compared between CT scans acquired with different energy levels and reconstruction datasets.
SSG03-05  
Lesion Differentiation with Material Decomposition Images Acquired from Dual Energy CT of the Chest  
Tuesday, Dec. 1 11:10AM - 11:20AM Location: S404CD

**Participants**
- Alexi Otrakji, MD, Boston, MA (Presenter) Nothing to Disclose
- Azadeh Tabari, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Andrew Primak, PhD, Malver, PA (Abstract Co-Author) Employee, Siemens AG
- Jo-Anne O. Shepard, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Mannudeep K. Kalra, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Subba R. Digumarthy, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Shaunagh McDermott, FR(RCPI), Boston, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**  
To assess imaging characteristics of pulmonary abnormalities seen on material decomposition images of dual energy CT of the chest.

**METHOD AND MATERIALS**  
In an IRB approved retrospective study, 83 patients (mean age: 61±14 years, M:F 45:38, mean weight 77±18 kg) underwent dual-energy chest CT on dual source multidetector CT (Siemens Definition Flash) or a single source 64-row multidetector CT (GE 750HD Discovery). Virtual monochromatic (60 keV) images were reviewed for presence of pulmonary embolism, as well as presence, shape, size, location, and attenuation characteristics of pulmonary abnormalities. Pulmonary blood volume (PBV) images were assessed for presence and size of blood volume abnormalities in the area of pulmonary abnormalities seen on other images. Data were analyzed using Wilcoxon Signed Rank test.

**RESULTS**  
In pulmonary embolism with infarction, the size of decreased perfusion on PBV images was greater or equal to the size of pulmonary opacities on 60 keV images (size mismatch between attenuation and decomposition images in 10/83 patients). Decreased PBV ("perfusion defect") was also seen in 6/83 patients with non-occlusive pulmonary embolism without definite pulmonary infarction. The "stripe sign" described in perfusion scans was negative in all patients with infarctions and perfusion defects. In patients with atelectasis, pneumonia or emphysema the size of perfusion abnormalities on PBV was smaller or equal to the size of pulmonary opacity or lucency seen on 60 keV images (no size mismatch). Areas of heterogeneously increased perfusion on PBV with associated "Swiss cheese" appearance was seen in 17/83 patients with pneumonia. PBV abnormality in 34/83 patients with atelectasis is characterized by homogeneously increased perfusion on PBV. Perfusion abnormality in 15/83 patients with luent lesions (emphysema, air trapping, cysts) is characterized by homogeneous hypo-perfusion on PBV images.

**CONCLUSION**  
Size matching of area of abnormalities seen on attenuation and on PBV images help differentiate pulmonary opacities from pulmonary infarcts, pneumonia and atelectasis. Lessons from nuclear medicine (V:Q) can help the chest radiologists interpret DECT.

**CLINICAL RELEVANCE/APPLICATION**  
Simultaneous interpretation of virtual monochromatic and PBV images can increase the diagnostic confidence of differentiating between the lung lesions.

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Subba R. Digumarthy, MD - 2013 Honored Educator

SSG03-06  
Reproducibility and Consistency of Dual Energy Computed Tomography (DECT) Pulmonary Blood Volume (PBV) Measurements in Repeated Examinations  
Tuesday, Dec. 1 11:20AM - 11:30AM Location: S404CD

**Participants**
- Sam Dumonteil, MBBS, London, United Kingdom (Presenter) Nothing to Disclose
- Jaymin H. Patel, MBBS, BSc, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
- Charlie Sayer, MBBS, FRCR, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
- Ioannis Vlahos, MRCP, FRCR, London, United Kingdom (Abstract Co-Author) Research Consultant, Siemens AG Research Consultant, General Electric Company

**PURPOSE**  
To evaluate the reproducibility of DECT in the measurement of PBV in patients with and without pulmonary embolism (PE).

**METHOD AND MATERIALS**  
133 patients were identified from a 3yr retrospective review of all patients undergoing more than one DECT for suspected PE...
SSG03-08  Iodine-density Analysis Using Enhanced ssDECT Imaging in Differentiating Benign and Malignant Serous Cavity Effusion

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S404CD

Participants
Ye Ju, Dalian, China (Presenter) Nothing to Disclose
Alian Liu, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Yijun Liu, Dalian, China (Abstract Co-Author) Nothing to Disclose
Meiyu Sun, Dalian, China (Abstract Co-Author) Nothing to Disclose
Shifeng Tian, Dalian, China (Abstract Co-Author) Nothing to Disclose
Yingxun Kong, Dalian, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the value of quantitatively iodine concentration measurement of enhanced ssDECT imaging in the differential diagnosis of malignant and benign serous cavity effusion.

METHOD AND MATERIALS
Approval for this retrospective HIPAA-compliant study was obtained from the institutional review board, and informed consent was waived. From August 2012 to February 2015, totally 51 patients, including 17 cases of benign serous effusion and 34 cases of malignant serous effusion proven by histopathological diagnosis or laboratorial examination, underwent plain and three-phase enhanced iodine-based material density imaging (SyngoVia) were compared from the first to the second study by paired t-test. N-N paired PBV measurements were tested for reproducibility using Intraclass Correlation (ICC) before and after correction for central pulmonary arterial enhancement. The variance of the standard 6 regions was compared by paired t-test across time in both groups.

RESULTS
For N-N pairs all regional PBV measures showed no significant difference between the two scans: Both Lungs (25 v 26), Right Lung (25 v 25), Left Lung (25 v 26), 6 Regions (22 v 22, 26 v 26, 28 v 28, 24 v 23, 26 v 27, 27 v 28), all p>0.05. ICC concordance in all regions was moderate to substantial (Mean 0.66, 0.57-0.73) improving further when corrected for central pulmonary enhancement (Mean 0.75, 0.65-0.82). For the N-PE pairs all regional PBV measures showed significant reduction on the PE positive study: Both Lungs (31 v 25), Right Lung (31 v 25), Left Lung (31 v 27), 6 Regions (28 v 21, 31 v 25, 33 v 28, 28 v 23, 32 v 27, 34 v 29), all p<0.01. In the N-PE group the PE positive study demonstrated significantly increased variance of the 6 standard region PBVs compared to the normal study (554 v 1062, p=0.04), whereas comparable variance comparison in the N-N pairs was not statistically different.

CONCLUSION
In patients undergoing repeated DECT, PBV measures are reproducible with a high degree of concordance within individual patients when normal, but with significant reduction and variability in all lung regions when PE is present.

CLINICAL RELEVANCE/APPLICATION
The reproducibility of DECT PBV measures in normality and their predictable absolute value reduction and increased variance in PE raises the possibility of using such measures to assess treatment response.

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Ioannis Vlahos, MRCP, FRCR - 2015 Honored Educator
PET/CT in all patients, SUVmax was also assessed by ROI measurement placed over each nodule.

The capability of dual-point CE-DECT for nodule evaluation in each patient, ROIs were placed over all nodules for measuring values on all generated images at the two phases and difference of values between early and late phases on VNC image (ΔVNC).

All nodules were divided into two groups as follows: malignant (n=15) and benign (n=4) nodules.

To directly and prospectively compare the capability of dual-point contrast-enhanced (CE-) dual-energy CT (DECT) for distinguishing malignant from benign pulmonary nodules as compared with FDG-PET/CT.

**METHOD AND MATERIALS**

Eleven consecutive smokers (7 male and 4 female, mean age: 69 years) prospectively underwent low-dose unenhanced and xenon-enhanced CT as well as xenon-CT as Sub-CT method. To evaluate the capability of regional ventilation difference on each method, regional ventilation was assessed by consensus of board certified chest radiologists according to previously reported 3-point scoring system on a per segment basis. To determine the functional lung volume in each subject was calculated based on visual scores according to past literatures. To evaluate qualitative capability for regional ventilation assessment, the inter-method agreements were determined by kappa statistics. To determine quantitative capability for regional ventilation and pulmonary functional loss assessments among three methods, functional lung volume was correlated each other by Pearson's correlation. Finally, functional lung volume on each method was also correlated with FEV1%.

**RESULTS**

Inter-method agreements were as follows: DECT vs. Sub-CT, κ=0.90, DECT vs. SPECT/CT, κ=0.82, Sub-CT vs. SPECT/CT, κ=0.79. On correlation of functional lung volume among three methods, there were excellent correlations among three methods (DECT vs. Sub-CT: r=0.99, p<0.0001; DECT vs. SPECT/CT: r=0.96, p<0.0001; Sub-CT vs. SPECT/CT; r=0.96, p<0.0001). In addition, FEV1% had excellent correlations with all methods (DECT: r=0.93, p<0.0001; Sub-CT: r=0.93, p<0.0001; SPECT/CT; r=0.88, p<0.0001).

**CONCLUSION**

Xenon CT can be obtained by DECT and subtraction CT methods, and have similar potentials to evaluate regional ventilation and pulmonary functional loss as well as krypton ventilation SPECT/CT.

**CLINICAL RELEVANCE/APPLICATION**

Xenon CT can be obtained by DECT and subtraction CT methods, and have similar potentials to evaluate regional ventilation and pulmonary functional loss as well as krypton ventilation SPECT/CT.

**METHOD AND MATERIALS**

Fifteen consecutive patients who had 19 lung nodules totally (10 men, 5 women, mean age: 70.5 years) underwent dual-point CE-DECT and FDG-PET/CT, and pathological and/or follow-up examinations. According to the pathological and follow-up examinations, all nodules were divided into two groups as follows: malignant (n=15) and benign (n=4) nodules. From dual-point CE-DECT data obtained at 80 and 140kV, we generated virtual non-contrast (VNC) images and iodine maps at early and late phases. To determine the capability of dual-point CE-DECT for nodule evaluation in each patient, ROIs were placed over all nodules for measuring values on all generated images at the two phases and difference of values between early and late phases on VNC image (ΔVNC). On FDG-PET/CT in all patients, SUVmax was also assessed by ROI measurement placed over each nodule. To evaluate differences of all CE-
DECT indices and SUVmax between malignant and benign nodule groups, Student’s t-test was performed. For distinguishing malignant from benign nodules, ROC-based positive test was performed to determine feasible threshold values of the indices as having significant differences between the two groups. Finally, sensitivity (SE), specificity (SP) and accuracy (AC) were compared each other by means of McNemar’s test.

RESULTS
On comparison between the two groups, there were significant differences between malignant and benign groups on ΔVNC (malignant vs. benign: 0.67±4.2HU vs. 10.8±7.6HU, p=0.002) and SUVmax (malignant vs. benign: 6.7±4.6 vs. 1.5±0.58, p=0.0007). When applied feasible threshold values, diagnostic performance of ΔVNC (SE: 100 [15/15] %, SP: 50 [2/4] %, AC: 89.5 [17/19] %) was slightly better than that of SUVmax (SE: 86.7 [13/15] %, SP: 50 [2/4] %, AC: 78.9 [15/19] %), although there were no significant differences (p>0.05).

CONCLUSION
Dual-point CE-DECT is considered at least as valuable as FDG-PET/CT for distinguishing malignant from benign nodules.

CLINICAL RELEVANCE/APPLICATION
When applied dual-point CE-DECT technique, CE-DECT is considered at least as valuable as FDG-PET/CT for distinguishing malignant from benign nodules in routine clinical practice.
Gastrointestinal (Liver Masses)

Tuesday, Dec. 1 10:30AM - 12:00PM Location: E350

SSG04

Predictive Value of MRI Combined with MR Cholangiography in the Preoperative Assessment of Perihilar Cholangiocarcinoma

Tuesday, Dec. 1 10:30AM - 10:40AM Location: E350

Participants
Ernst J. Rummeny, MD, Munich, Germany (Moderator) Nothing to Disclose
Sudhakar K. Venkatesh, MD, FRER, Rochester, MN (Moderator) Nothing to Disclose

Sub-Events

SSG04-01 Predictive Value of MRI Combined with MR Cholangiography in the Preoperative Assessment of Perihilar Cholangiocarcinoma

Tuesday, Dec. 1 10:30AM - 10:40AM Location: E350

Participants
Claudio Sallei, MD, Milan, Italy (Presenter) Nothing to Disclose
Francesca Ratti, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Paolo Marra, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Luca Aldrighetti, MD, Milano, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Francesco A. De Cobelli, Milan, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the predictive value of contrast enhanced MR images with MR cholangiography (MRC) in the preoperative evaluation of perihilar cholangiocarcinoma.

METHOD AND MATERIALS
Twenty-five patients that underwent MRI/MRC and surgical treatment were included. Two radiologists evaluated the biliary MR images, including 3D-MRC and gadolinium-enhanced dynamic images, regarding the tumor resectability (including longitudinal tumor extent, vascular involvement of the bile duct cancer, and lymph node metastasis) and the surgical radicality, intended as tumor-free\(\text{tumor-involved margins (R0}\text{R1)}\) of biliary ducts and portal vein. The results of preoperative and retrospective (blinded) assessment of diagnostic data were compared with the surgical and pathology findings used as the reference standards.

RESULTS
The prospective assessment of the resection to be performed was correct in 80% of cases. For determining the assessment of tumor margins (R0\R1) of biliary ducts and portal vein, the overall accuracy was, respectively, 84% and 88% for each reviewer. The area under the receiver operating characteristic curve (Az) of the 2 reviewers for evaluation of tumor margins (R0\R1) was 0.83 and 0.78 for biliary ducts, and 0.68 and 0.97 for portal vein. In the assessment of lymph node metastasis, the overall accuracy was 0.75 for each reviewer.

CONCLUSION
MR imaging combined with MRC showed excellent diagnostic capability for assessing the tumor resectability of bile duct cancer, although it generally underestimated the tumor involvement of lymph nodes, and predicted with good diagnostic accuracy surgical radicality.

CLINICAL RELEVANCE/APPLICATION
MRI combined with MRC can predict in advance R0\R1 resection in perihilar cholangiocarcinoma. In case of R1, it can lead to a focused neo adjuvant therapy or change of the treatment strategy.

SSG04-02 Correlation between Standardized Uptake Value and Apparent Diffusion Coefficient in Focal FDG-PET Positive Hepatic Metastasis

Tuesday, Dec. 1 10:40AM - 10:50AM Location: E350

Participants
Vaseemali J. Mulla, MBBS, DMRD, Gokak, India (Presenter) Nothing to Disclose
Vishal Agrawal, Bangalore, India (Abstract Co-Author) Nothing to Disclose
Kapil K. Shirodkar, DMRD, MBBS, Mapusa, India (Abstract Co-Author) Nothing to Disclose
Govindarajan J. Mallarajaputra, MBBS, MD, Bangalore, India (Abstract Co-Author) Nothing to Disclose
Aruna R. Patil, MD, FRCR, Bangalore, India (Abstract Co-Author) Nothing to Disclose

PURPOSE
1)To evaluate a potential correlation of the maximum standard uptake value (SUVmax) and the minimum apparent diffusion coefficient (ADCmin) in FDG-PET positive hepatic metastasis 2) To study the role of Diffusion Weighted MR Imaging in patients with FDG-PET positive hepatic metastasis

METHOD AND MATERIALS
Twenty patients with a known and histopathologically proven extrahepatic primary lesion, who were referred for FDG PET and found
to have FDG avid hepatic lesion were enrolled. Regions of interest were drawn on the PET images and SUV mean was calculated. Patients with a SUVmean more than 4 were further imaged with MRI within 30-60 min of acquisition of PET images. Diffusion-weighted imaging was performed with free breathing and with b values of 0, 500, and 800. ADC map was generated using the above raw diffusion data. Regions of interest were manually drawn along the contours of neoplastic lesions, which were identified on PET and diffusion-weighted images. Maximum SUV (SUVmax) and mean SUV (SUVmean) were recorded from PET-CT fusion images using fusion viewer (Philips medical systems). Minimum ADC (ADCmin), and mean ADCmean were recorded on MRI workstation for each FDG-avid lesion. Pearson correlation coefficient was used to assess the following relations: SUVmax versus ADCmin and SUVmean versus ADCmean. A total of 33 lesions were studied.

RESULTS

Thirty three lesions were evaluated in a total of 20 patients. The mean SUVmax was 13.5 with standard deviation of 5.1; SUVmean, 8.3 with standard deviation of 3.1; mean ADCmin, 491 with standard deviation of 235; and mean ADCmean, 809 with standard deviation of 263. Pearson correlation coefficient of 0.026 was found between SUVmean and ADCmean. Pearson correlation coefficient of 0.002 was found between SUVmax and ADCmin.

CONCLUSION

There was no correlation between SUVmax and ADCmin or SUVmean and ADCmean. Focal hepatic lesions visualized on PET/CT were visualized clearly with a high contrast in the background of reduced signal from normal liver on b 0,500 and 800 maps of DWI.

CLINICAL RELEVANCE/APPLICATION

Liver metastases are the most frequently encountered malignant liver lesions. DWI is a non-contrast technique that is easy to perform, fast, has the potential to provide tissue characterization, and gives qualitative and quantitative information that can be helpful for tumor assessment. DWI gives visually comparable imaging which can be approximated to PET CT.

SSG04-03  Improving Detection of Vascular Structure and Intratumoral Hemorrhage in Primary Hepatic Carcinoma with a Multi-breath-hold Susceptibility-weighted Imaging Technique

Tuesday, Dec. 1 10:50AM - 11:00AM Location: E350

Participants
Ling Zhang, MD, Nanning, China (Presenter) Nothing to Disclose
Zhongkui Huang, Nanning, China (Abstract Co-Author) Nothing to Disclose
Yongming Dai, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Wenmei Li, Nanning, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose is to evaluate the role of abdominal susceptibility-weighted imaging (SWI) in the detection of vascular structure and intratumoral hemorrhage of primary hepatic carcinoma.

METHOD AND MATERIALS

Nineteen patients with pathologically identified primary hepatic carcinoma were imaged at 3T (MAGNETOM Verio, A Tim System, Siemens, Germany) using a standard body matrix-coil. Imaging included precontrast transverse T1-weighted GRE (flip angle 70°, TR/TE 140/2.46 msec), transverse T2-weighted fat-suppressed 2D turbo-spin-echo (TSE, flip angle 122°, TR/TE 3700/84 msec, ETL 9) and transverse abdominal 2D SWI (flip 20°, TR/TE 150/2.5 msec). For all sequences, the following parameters were used: field of view (FOV) 380×285 mm2; matrix 320-384×250, slice thickness 5 mm with a gap of 1 mm. Two to three 15-20 second breath-hold acquisitions were acquired to cover the liver. Two radiologists prospectively analyzed all magnetic resonance imaging (MRI) studies. Vascular structure and hemorrhage detected by each imaging technique were evaluated for comparison.

RESULTS

Nineteen lesions were found in nineteen patients. 2D SWI showed the evidence of hemorrhage in 12 of all 19 cases. SWI displayed vasculature of tumors in 11 cases. Only 5 cases found vasculature in conventional sequences. On 2D SWI, the hemorrhage or vasculature in the lesions manifested dot-like, streak, circular areas with hypointensity signal. In the evaluation of blood products, SWI is superior to the conventional T1WI and T2WI for visualizing the intra vascular structure and hemorrhage (X2= 4.17, P < 0.05). There was close correlation between pathological results and SWI in depicting internal architecture of lesions.

CONCLUSION

SWI surpassed conventional MRI sequences in discovering vascular structure in tumor and intratumoral hemorrhage. SWI offers a new way to show the internal structures of primary hepatic carcinoma. It is more useful than conventional MRI in showing blood products and details of tumor related veins.

CLINICAL RELEVANCE/APPLICATION

SWI offers a new way to show the internal structures of primary hepatic carcinoma. It is more useful than conventional MRI in showing blood products and details of tumor related veins.

SSG04-04  Subtraction Images of Gadoxetic Acid-enhanced MR: The Impact on Image Interpretation of Focal Hepatic Lesions in Patients at Risk for HCC

Tuesday, Dec. 1 11:00AM - 11:10AM Location: E350

Participants
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PURPOSE
To evaluate the impact of subtraction images of gadoxetic acid-enhanced on image interpretation of hepatic lesions in patients at risk for hepatocellular carcinomas (HCC)

METHOD AND MATERIALS
We retrospectively identified 228 patients (181 men, 47 women; mean age, 55.2 years) with chronic viral hepatitis or liver cirrhosis who underwent gadoxetic acid-enhanced liver MR for the evaluation of focal hepatic lesions and then hepatic resection. The patients were confirmed to have 243 focal hepatic lesions including 227 HCCs, and 16 cholangiocarcinomas. We compared the detection rate of arterial hypervascularity on subtraction images and that on visual assessment of arterial phase images. Subgroup analysis was performed according to the pathology and the size of the lesions (< 3 cm vs. > 3 cm). We assessed the impact of subtraction images in diagnosing HCC according to the American Association for the Study of Liver Diseases (AASLD) guidelines in comparison with that of visual assessment.

RESULTS
Subtraction images (92.6%, 225/243) detected arterial hypervascularity of all the focal hepatic lesions more sensitively than visual assessment (85.6%, 208/243; P = .001). On the subgroup analysis according to the pathology, the same trend was also observed in HCC (96.0% vs. 90.3%; P = .011), and in cholangiocarcinomas (43.8% vs. 18.8%; P = .125). In the 113 lesions ≤ 3 cm, subtraction images (91.2%, 103/113) depicted arterial hypervascularity significantly better than visual assessment (81.4%, 92/113; P = .013), while they did not significantly differ in detecting arterial hypervascularity in the 130 large lesions (> 3 cm, P = .109).

When we included arterial hypervascularity detected on subtraction images, it increased the sensitivity from 86.3% to 92.5% in diagnosing HCCs with the increased false positive rate from 0.8% to 2.5%.

CONCLUSION
Subtraction images can enhance the sensitivity of the non-invasive diagnosis of HCC by detecting arterial hypervascularity more sensitively especially in small focal hepatic lesions, with minimal increase in a false positive rate.

CLINICAL RELEVANCE/APPLICATION
Subtraction images may be considered as an option to enhance the diagnostic performance of the noninvasive diagnosis for HCC.

SSG04-05 Is Contrast-Enhanced Ultrasound Comparable to MRI with Liver-Specific Contrast Agent for Diagnosis of Focal Nodular Hyperplasia and Hepatocellular Adenoma?

Tuesday, Dec. 1 11:10AM - 11:20AM Location: E350

Participants
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PURPOSE
To compare the diagnostic performance of contrast-enhanced ultrasonography (CEUS) with MRI with gadobenate dimeglumine (CEMRI) for the diagnosis of focal nodular hyperplasia (FNH) and hepatocellular adenoma (HCA) in a tertiary referral center for hepatobiliary diseases.

METHOD AND MATERIALS
One hundred-nineteen patients (111 female and 8 male, mean age 39 years) referred to a tertiary center for hepatobiliary diseases were included. Patients had undergone standard diagnostic work-up with CEUS and CEMRI for the diagnosis of FNH or HCA. Final diagnosis was considered correct when outcome of CEUS and CEMRI were concordant. Histopathologic assessment (PA) followed in case of discrepancy between outcome of CEUS and CEMRI. CEMRI was considered as the reference method for final diagnosis when lesion biopsy for PA was considered undesirable or contra-indicated. Agreement between CEUS and CEMRI was calculated with Cohen's kappa and sensitivity, specificity, predictive values and likelihood ratios were calculated for CEUS and CEMRI.

RESULTS
Outcomes of CEUS and CEMRI were concordant in the majority of patients (n=80, 67%) (p<0.001) with an unweighted kappa of 0.34 (95% CI 0.20-0.49). In case of discrepancy between CEUS and CEMRI (n=39, 33%), PA followed in fourteen cases (12% of total), where CEMRI was correct in thirteen cases (93%) and CEUS in one case (7%) (p=0.002). In the remaining twenty-five cases (21% of total), CEMRI was considered as reference for final diagnosis. For HCA, sensitivity was 64% (95% CI 48% - 78%) with CEUS and 100% (95% CI 92% - 100 %) with CEMRI. For FNH, sensitivity was 67% (95% CI 55% - 77%) with CEUS, and 99% (95% CI 93% - 100%) with CEMRI.

CONCLUSION
In our study, agreement between CEUS and CEMRI was fair and the diagnostic performance of CEUS was inferior to CEMRI for diagnosis of FNH and HCA, especially with emphasis on PA proven cases.

CLINICAL RELEVANCE/APPLICATION
In case of discordance between CEUS and CEMRI, it may be justifiable to be prudent with liver biopsy and prefer CEMRI-outcome as final diagnosis, especially when the diagnosis on CEMRI is firm.
POURPOSE

Hypoenhancement on delayed phase contrast-enhanced MRI using extracellular contrast agents, such as gadobutrol, is often used as a sign to distinguish colorectal liver metastases. Some studies have suggested that MRI with intravascular contrast agent, gadoxesest, may be useful in diagnosing focal liver lesions. The goal of this study was to determine the diagnostic accuracy of this sign using gadoxesest versus gadobutrol.

METHOD AND MATERIALS

This is an interim analysis on an institutional REB-approved, prospective study. Patients with known colorectal cancer referred for a clinical gadobutrol-enhanced MRI at our institution met inclusion criteria for our study. Patients with known contraindication to MRI or MR contrast agents were excluded. Patients received both gadobutrol- and gadoxesest-enhanced liver MRI's, performed within 4 weeks of each other. Lesion-liver contrast-to-noise ratios (CNR) of all solid focal liver lesions (cysts were excluded) were measured on 10-minute delayed phase imaging for both contrast agents. Lesions with CNR<0 were considered hypoenhancing and lesions with CNR>0 were considered hyperenhancing. We calculated the sensitivity, specificity, and likelihood ratio’s of the ability of hypoenhancement to predict malignancy. Weighting was performed to account for the effects of clustering. The generalized estimating equation (GEE) was used to determine the effect of the contrast agent on the ability of the sign to predict malignancy.

RESULTS

There were a total of 265 lesions from 14 patients. The weighted sensitivity and specificity of gadoxesest was 89.2% (SD: 25.0%) and 81.3% (SD: 37.2%) respectively, which corresponds to positive and negative likelihood ratio's of 4.76 and 0.13, respectively. The weighted sensitivity and specificity of gadobutrol was 41.6% (SD: 40.9%) and 98.1% (5.6%), which corresponds to positive and negative likelihood ratio's of 22.5 and 0.59. In the GEE model, hypoenhancement on delayed phase significantly predicted malignancy (p=0.005) as did the interaction of hypoenhancement and contrast agent (p=0.006).

CONCLUSION

Hypoenhancement on delayed phase contrast-enhanced MRI with gadoxesest is a more sensitive sign of malignancy in colorectal cancer patients than with gadobutrol.

CLINICAL RELEVANCE/APPLICATION

Delayed phase gadoxesest-enhanced MRI may be a helpful problem-solving tool for excluding malignancy in colorectal cancer patients.

SSG04-07 Accuracy of the Extended Washout of Gadoxetic-Acid for Distinguishing Hypervascular Hepatic Metastases from Hemangiomas on MRI

Tuesday, Dec. 1 11:30AM - 11:40AM Location: E350

Participants

Sheela Agarwal, MD, MS, Boston, MA (Presenter) Subsequent to the conduct of this research, speaker has become an employee of Bayer HC.

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POURPOSE

The extended washout sign, slow de-enhancement of liver lesions in early hepatobiliary phase, has been proposed to help distinguish hemangiomas from conventional metastases. The intent of this study was to test this sign for hypervascular metastases.

METHOD AND MATERIALS

This IRB approved retrospective study performed quantitative and qualitative image analysis of 24 patients with proven neuroendocrine liver metastases, together with data on 45 hemangiomas and 39 with hypovascular metastases already reported. Gadoxetic-acid MR imaging was obtained during arterial and portal-venous phase, and delays of 3, 8, and 20 minutes. During each phase, signal intensities were measured for the lesion, liver, and aorta, and were normalized by paraspinal musculature. Quantitatively, extended washout was defined as a 10% change in signal intensity from 8 to 20 minutes. Statistical analysis was performed using paired Student's t-test. Qualitative analysis was performed by one reader, who assessed the appearance of all lesions on T2-weighted images alone, dynamic images alone, and combined early (8 min) and late (20 min) hepatobiliary phases. Extended washout was defined as a perceptible change in signal from 8 to 20 minutes.

RESULTS

On quantitative analysis, 84% (n=38) of hemangiomas demonstrated a positive extended washout sign while only 8% (n=2) of hypervascular metastases did, and 4% (n=7) of hypovascular metastases did. Hemangiomas demonstrated a mean change in signal intensity of 18.4% as compared to 5.5% for hypovascular metastases (p<0.05). Qualitatively, 78% of hemangiomas demonstrated a perceptible change in signal from 8 to 20 minutes, but only 4.1% of metastases did. 67% of hemangiomas demonstrated peripheral nodular enhancement during dynamic phases and 87% demonstrated classic T2 hyperintensity. Arterial enhancement of the metastases was appreciated with gadoxetic acid in 83% of the cases. When extended washout was used in combination with T2 hyperintensity, specificity increased to 98%, with a sensitivity of 96%.
CONCLUSION
The extended washout sign on gadoxetic acid-enhanced MRI can be applied to hypervascular as well as to non-hypervascular liver metastases to help in distinguishing them from hemangiomas.

CLINICAL RELEVANCE/APPLICATION
Extended washout sign, particularly when used in conjunction with T2 signal intensity, can be used to increase accuracy of differentiating hemangiomas from metastases on gadoxetate-enhanced MRI.

SSG04-09 Fully Integrated PET/MRI for the Colorectal Cancer Liver Metastases: Diagnostic Performance and Prognostic Value

Tuesday, Dec. 1 11:50AM - 12:00PM Location: E350

Participants
Dong Ho Lee, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
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PURPOSE
To evaluate the diagnostic performance and prognostic value of fully integrated PET/MRI in patients with colorectal cancer liver metastases (CRLMs)

METHOD AND MATERIALS
between January 2013 and June 2014, 55 patients with 98 CRLMs who underwent fully integrated PET/MRI and MDCT were included in this study. Among these CRLMs, 66 CRLMs in 34 patients were diagnosed by histopathology after hepatic resection, and 32 CRLMs in 21 patients were diagnosed by follow-up imaging. Among the 34 patients who underwent hepatic resection for CRLMs, 17 patients received neoadjuvant chemotherapy (NAC) and then followed by surgery. Two board-certificated radiologists independently and randomly assessed both MDCT and fully integrated PET/MRI for detection of CRLMs. In order to compare the diagnostic performance of PET/MRI for detecting CRLMs to MDCT, jackknife alternative free-response receiver-operating characteristic (JAFROC) and generalized estimating equations (GEE) were used. For the evaluation of prognostic value of PET, we analyzed recurrence-free survival in 17 patients who underwent NAC and followed by hepatic resection for CRLMs.

RESULTS
reader average figure-of-merit of PET/MRI was significantly higher than that of MDCT for detecting CRLMs (0.842 for MDCT vs. 0.932 for PET/MRI, P=0.004). Sensitivity per tumor as well as per patients of PET/MRI was also significantly higher than those of MDCT in both two readers. Especially, PET/MRI showed significantly higher sensitivities for CRLMs ≤1cm and CRLMs treated by NAC in both two readers. According to the PET imaging findings of PET/MRI, six of 17 patients who underwent NAC were classified as having iso-metabolic CRLMs on PET, while 11 patients as having hyper-metabolic CRLMs. 1-year recurrence-free survival rate was 80.0% in 6 patients with iso-metabolic CRLMs, compared to 15.2% in 11 patients with hyper-metabolic CRLMs: this difference was statistically significant (P=0.034).

CONCLUSION
fully integrated PET/MRI can provide significantly higher diagnostic performance for detecting CRLMs compared to MDCT, especially for small CRLMs and CRLMs treated by NAC. PET imaging findings of PET/MRI after NAC was a significant affecting factor for recurrence-free survival after hepatic resection.

CLINICAL RELEVANCE/APPLICATION
fully integrated PET/MRI can be helpful for patients with CRLMs.
Gastrointestinal (CT Dose Reduction)

Tuesday, Dec. 1 10:30AM - 12:00PM Location: E352

SSG05-01 Automated Tube Voltage Adaptation in Combination with Advanced Modeled Iterative Reconstruction in Thoracoabdominal Oncological Follow-up Third-generation Dual-Source Computed Tomography: Effects on Image Quality and Radiation Dose

Participants
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Kathryn J. Fowler, MD, Chesterfield, MO (Moderator) Research support, Bracco Group
Achille Mileto, MD, Durham, NC (Moderator) Nothing to Disclose

Sub-Events

PURPOSE
To evaluate image quality and radiation exposure of portal-venous-phase thoracoabdominal third-generation 192-slice dual-source computed tomography (DSCT) with automated tube voltage adaptation (TVA) in combination with advanced modeled iterative reconstruction (ADMIRE).

METHOD AND MATERIALS
Fifty-one patients underwent oncological portal-venous-phase thoracoabdominal follow-up CT twice within 7 months. The initial examination was performed on second-generation 128-slice DSCT with a fixed tube voltage of 120 kV in combination with filtered back projection reconstruction (FBP). The second examination was performed on a third-generation 192-slice DSCT using automated TVA in combination with ADMIRE. Attenuation and image noise of liver, spleen, renal cortex, aorta, vena cava inferior, portal vein, psoas muscle and perinephric fat were measured. Signal-to-noise (SNR) and contrast-to-noise ratios (CNR) were calculated. Radiation dose was assessed as size-specific dose estimates (SSDE). Subjective image quality was assessed by 2 observers using five-point Likert scales. Interobserver agreement was calculated using intraclass correlation coefficients (ICC).

RESULTS
Automated TVA set tube voltage of follow-up CT to 90 kV (n=8), 100 kV (n=31), 110 kV (n=11), or 120 kV (n=1). Average SSDE was decreased by 34.9% with 192-slice DSCT compared to 128-slice 120-kV DSCT (SSDE, 7.8±2.4 mGy vs. 12.1±3.2 mGy; p<0.001). Image noise was substantially lower, SNR and CNR were significantly increased with 192-slice DSCT compared to 128-slice DSCT (all p<0.005). Image quality was voted excellent for both acquisition techniques (5.00 vs. 4.93; p=0.083) without significant differences.

CONCLUSION
Automated TVA in combination with ADMIRE in third-generation 192-slice portal-venous-phase thoracoabdominal DSCT reduces average radiation dose by 34.9% compared to 128-slice DSCT while providing improved objective image quality.

CLINICAL RELEVANCE/APPLICATION
Automated TVA in combination with ADMIRE is feasible in routine thoracoabdominal follow-up CT on a third-generation DSCT and results in substantial dose reduction without impairment of image quality.
Low tube potential (kVp) is increasingly being applied for contrast enhanced (CE) CT exams due to availability of software solutions for automated kVp selection on new generation scanners. Therefore, we studied the impact of low kVp imaging on the radiation dose and image quality of CE abdominal CT exams obtained on new generation scanners with automated kVp selection.

METHOD AND MATERIALS

In this IRB approved retrospective study, 362 patients (age=55 years, weight=77.6 kg) underwent CE abdominal CT exams on one of our 4 scanners from same vendor (Siemens) during one month period. All of these 4 CT scanners (Star Detectors=3 (Definition Force, Flash and Edge) and conventional Solid detector=1 (Force)) have automated kvp selection (80-140) option. Radiation dose information and applied scan parameters (kVp and mA) were retrieved. For 85 randomly sampled patients, contrast-to-noise ratio (CNR) was determined and subjective IQ assessment was done by 2 radiologists. Radiologists performed independent, random, and blinded comparison for lesion detection, lesion conspicuity, and visibility abdominal structures, first for all patients on RD dose images and subsequently for SD images.

RESULTS

Mean CTDIvol were 9±3 mGy and 1.4±0.1 mGy for SD CT and RD CT, respectively. There were total 70 lesions detected on SD CT. There were five missed lesions (4 liver lesions, 2-4 mm, and a liver mass < 1.2 cm) and a pseudo liver lesion (<4 mm) on RD images regardless of Safire settings and size of patients. The lesion conspicuity was sufficient for diagnostic performance for 25/45 lesions with RD S1, 27/45 lesions with RD S3, and 24/45 lesions with RD S5 images regardless of patient size. Visibility of normal liver and renal parenchyma was sufficient on 15/20 patients with RD S1, 16/20 patients with RD S3, and 9/20 patients with RD S5. Other abdominal structures such as adrenals, pancreas, gall bladder, and bowels were sufficiently seen in most patients on RD CT.

CONCLUSION

SubmSv radiation doses for routine abdominal CT are associated with missed lesions and suboptimal image quality despite use of higher strength iterative reconstruction techniques.

CLINICAL RELEVANCE/APPLICATION

Abdominal CT acquired at CTDIvol of 1.4 mGy is not sufficient for diagnostic confidence.
Can 3rd Generation Dual-source CT Achieve 70kV-imaging for Routine Contrast-enhanced Body CT?

**Tuesday, Dec. 1 11:10AM - 11:20AM Location: E352**

**Participants**
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**Purpose**
Low-kV CT can dramatically reduce contrast media (CM) volume with maintaining sufficient contrast enhancement thanks to

**Clinical Relevance/Application**
The clinical benefits of low kVp imaging are well recognized, however, image quality concerns may limit its implementation in clinical practice. The new generation scanners with automated kVp selection, stellar detectors as well as iterative reconstructions facilitate low kVp exams without degrading image quality, especially, in large sized patients.

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Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator

**SSG05-04 Personalized Liver CT Examination Protocol Based on BMI: Combination of Optimized kVp and Optimized Iodine Injection Method**

**Tuesday, Dec. 1 11:00AM - 11:10AM Location: E352**

**Participants**
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**Purpose**
To investigate whether the personalized liver CT examination protocol based on body mass index (BMI) could obtain the diagnostic image quality.

**Method and Materials**
This prospective study was approved by IRB. Informed patient consent was obtained. From 2014 May to 2015 March, patients with known or suspected HCC were recruited consecutively, who underwent MDCT. Patients were scanned with different tube voltage (80-120 kVp) in combination with different amount of iodine contrast medium (352 to 550 mgI/kg) based on their BMI: BMI 18.0-24.0, 80-kVp, 352mgI/kg; BMI 24.1-28.0, 100-kVp, 440 mgI/kg; BMI 28.1-35.0, 120-kVp, 550 mgI/kg. All the other scanning parameters were set as the same. For each patient, the late arterial phase images were reconstructed into 6 sets of images, filter back projection (FBP) and sonogram-affirmed iterative reconstruction (SAFIRE) 1 to 5 (S1 to S5). The image noise, attenuation, contrast-to-noise ratio (CNR), and figure of merit (FOM) of the liver parenchyma and portal vein and estimated effective dose (ED) were measured and calculated. Radiologists were independently blinded to grade images quality (sharpness, image noise, beam-hardening artifacts and reconstruction artifact).

**Results**
Totally 133 patients were recruited, according to BMI, 37 in 80-kVp group, 50 in 100-kVp group, 47 in 120-kVp group. Image subjective score of S3 was significantly higher than that of the other reconstructions on the 80-kVp. Images of S2 had the highest image subjective score compared with the other reconstructions on the 100-kVp (p<0.05) and 120-kVp (p>0.05). The estimated ED was 49.6%, 56.8% lower at 80-kVp than at 100-kVp and 120-kVp. CNR of the portal vein was 16.3% higher at the 80-kVp S3 images than of 120-kVp S2 images (p>0.05). FOM of liver on the 80-kVp S3 images was higher than on 100-kVp and 120-kVp S2 images (p < 0.05). The subjective score of image quality was significantly higher for 120-kVp S2 images than for 80-kVp S3 images and 100-kVp S2 images; however, there was no significant difference among them.

**Conclusion**
High quality liver CT images could be obtained by using personalized liver CT protocol based on BMI, with combination of optimized kVp and iodine injection method.

**Clinical Relevance/Application**
This method will be of benefit to the patients with lower BMI, who will receive lower contrast dosage, significantly less radiation dose compared with the conventional uniform method.
Low-kV CT can dramatically reduce contrast media (CM) volume with maintaining sufficient contrast enhancement thanks to improved iodine absorption of lower kV. Although low-kV CT has been applied to vascular imaging, its application to parenchymal organs is limited due to high image noise or beam hardening artifact. The purpose of this investigation is to compare quantitative and qualitative data in two contrast enhanced CT protocols acquired with 3rd generation dual-source CT scanner; 70 kV CT with 60% dose of CM and 120 kV CT with a standard dose.

METHOD AND MATERIALS
We retrospectively compared 100 consecutive patients (57±12 kg) who underwent post-contrast body CT (thorax to pelvis) on 192-slice 3rd generation dual-source CT scanner at 70 kV with 60% dose of diluted 270 mgI/Kg CM (50.8±9.6 mL), with 103 historical control patients (59±13 kg) at 120 kV with a standard dose of 450 mgI/Kg CM (84.4±16.4 mL). CT values of the vessels and the visceral organs, as well as contrast to noise ratio (CNR) of hepatic and renal cysts were compared between the groups. Subjective assessment of image quality, severity of beam hardening artifact was scored on a 4-point scale. Radiation dose (CTDvol) was recorded in each case.

RESULTS
CT values of the abdominal aorta, portal vein, liver, kidney, pancreas, spleen at 70 kV with 60% CM were statistically significantly greater than those at 120 kV with a standard dose of CM (p<0.0001). There were no significant differences in CNR of hepatic or renal cysts between 70 kV and 120 kV techniques (p=0.93, p=0.11, respectively). The beam-hardening artifact at the level of thoracic inlet and the pelvis was stronger at 70 kV (120 kV, 1.1 and 1.0, 70 kV, 1.6 and 1.3, respectively), while streak artifact from intravenous CM was significantly more prominent at 120 kV technique (120 kV, 2.1, 70 kV, 1.5, respectively). Radiation dose was significantly higher in the 120 kV than 70 kV group [CTDvol; 9.1±1.7 mGy, and 8.3±2.0 mGy, respectively (p<0.01)].

CONCLUSION
70kV-CT would be sufficient for routine clinical body CT study with reduced CM and radiation dose. Although beam hardening artifact may be seen in the pelvis and the thoracic inlet, streak artifact from CM could be reduced.

CLINICAL RELEVANCE/APPLICATION
70kV imaging can provide sufficient image quality not only for the vessels but also for the organs with reduced dose of CM and radiation.

SSG05-06 Observer Performance at Varying Dose Levels and Reconstruction Methods for Detection of Hepatic Metastases

Tuesday, Dec. 1 11:20AM - 11:30AM Location: E352

Participants
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PURPOSE
To estimate the ability of abdominal radiologists to detect hepatic metastases (HM) at varying dose levels with or without iterative reconstruction (sinogram-affirmed iterative reconstruction; IR) using a two-stage study design.

METHOD AND MATERIALS
For stage I, CT projection data from 44 CT contrast-enhanced exams were collected (22 with HM). HM was defined by histopathology, progression/regression on CT/MR. Using a validated noise insertion technique, 12 datasets were reconstructed with filtered back projection (FBP) or IR for each patient at 6 dose levels (automatic exposure control settings of 60, 80, 100, 120, 160 and 200 Quality ref. mAs [QRM]; 528 cases). In each reading session, 3 abdominal imagers randomly evaluated each patient's dataset once. Using a dedicated computer workstation, readers circled all liver lesions, selecting diagnosis and confidence score (0 - 100), and then graded image quality. Automated matching of reference and reader lesions was performed using overlapping spheres. A successful reading was defined as ≥ 2 readers localizing all "essential" HM (or no non-lesion localizations in negative cases), where an essential HM was identified by the reference standard and ≥ 2 readers at 200 QRM FBP. Sample size calculations (p0=0.8, p1=0.9, alpha=0.05 (one sided)) determined ≥ 37 cases to pass through stage I. JAFROC analysis was also performed on a per-lesion basis for HM using a non-inferiority limit of -0.1

RESULTS
There were 75 HM with a median size of 1.2 +/- 0.6 cm. 7 of the 12 configurations passed through stage I screening, corresponding to dose levels of ≥120 QRM (or at 100 QRM with IR). Using non-inferiority criterion and JAFROC FOM, all but the IR 60 QRM met the a priori definition of having the lower limit of 95% CI > -0.1. At dose levels ≤ 120 QRM, IR improved diagnostic confidence (p<0.05).

CONCLUSION
Lower dose CT images reconstructed at dose levels corresponding to 120 and 160 QRM, or at 100 QRM for IR only, performed similar to 200 QRM FBP in this pilot study for detection of hepatic metastases. IR improved diagnostic image quality but not performance at lower dose levels.

CLINICAL RELEVANCE/APPLICATION
Pilot data obtained over a range of doses suggests that substantial dose reduction is possible without compromising performance.
**HONORED EDUCATORS**

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**SSG05-07  Single- and Dual-Energy Acquisition with 2nd and 3rd Generation Abdominal Dual-Source CT: Direct Comparison of Scan Modes Regarding Radiation Dose and Image Quality**

**Tuesday, Dec. 1 11:30AM - 11:40AM Location: E352**

Participants

Julian L. Wichmann, MD, Charleston, SC (Presenter) Nothing to Disclose
Lloyd Felmy, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Andrew D. Hardie, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (Abstract Co-Author) Research Grant, Bracco Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; ;
Akos Varga-Szemes, MD, PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Stefanie Mangold, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Giuseppe Muscogiuri, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Stephen R. Fuller, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Christian Canstein, Charleston, SC (Abstract Co-Author) Employee, Siemens AG

**PURPOSE**

To compare dual-energy (DE) and single-energy (SE) abdominal computed tomography (CT) in matched cohorts of routine clinical patients performed with third-generation dual-source CT (DSCT) and to assess differences in radiation dose and image quality compared to second-generation DSCT.

**METHOD AND MATERIALS**

This retrospective study was approved by the local institutional review board with a waiver of written informed consent. A total of 200 patients divided into four groups of 50 patients matched by gender and body mass index underwent portal-venous-phase abdominal DECT with standard scan protocols on second-generation DSCT (SE 120-kV, group A; DE 80/140-kV, group C) and third-generation (100-kV SE, group B; 90/150-kV DE, group D) DSCT. Radiation dose was normalized for a typical scan length of 40 cm. Dose-independent figure-of-merit (FOM) contrast-to-noise ratios (CNR) were calculated for various organs and vessels. Subjective overall image quality and image artifacts and reader confidence were assessed by three observers using five-point scales. Results were compared with two-way analysis of variance and intra-class-correlation coefficients.

**RESULTS**

Effective dose normalized for 40-cm acquisition was lowest in groups D (5.3 ± 1.9 mSv) and C (6.2 ± 2.0 mSv, P =0.103), significantly lower (both P <0.0001) compared to groups A (8.8 ± 2.3 mSv) and B (9.7 ± 2.4 mSv). Dose-independent FOM CNR peaked for liver, kidney, and portal vein measurements (all P ≤0.0025) in group D. Results for pancreas and aorta did not reach significance compared to group C (both P ≥0.0719), but did compared to groups A and B (all P ≤0.0077). Overall subjective image quality and image artifacts and reader confidence were consistently rated as excellent in all groups (all ≥1.53 out of 5).

**CONCLUSION**

Both acquisition modes with third-generation abdominal DSCT result in significantly lower radiation dose compared to second-generation DSCT while maintaining image quality. Third-generation abdominal DE DSCT can be routinely performed without any dose penalty compared to SE acquisition.

**CLINICAL RELEVANCE/APPLICATION**

Third-generation DSCT is more dose-efficient than second-generation DSCT; the spectral imaging opportunities of DE acquisition can be utilized without radiation dose penalty.

**SSG05-08  CT Enterography: Diagnostic Value Of 4th Generation Iterative Reconstructtion Algorithm with Low Dose CT-Protocol In Comparison with Standard Dose Protocol for Clinical Follow-Up of Patients with Crohn’s Disease**

**Tuesday, Dec. 1 11:40AM - 11:50AM Location: E352**

Participants

Sophie Lombardi, Vimercate, Italy (Presenter) Nothing to Disclose
Davide Ippolito, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose
Alessandra S. Casiraghi, Casatenovo, Italy (Abstract Co-Author) Nothing to Disclose
Pietro A. Bonaffini, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose
Camillo R. Talei Franzesi, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Sandro Sironi, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare radiation dose, image quality and diagnostic performance of low dose CT-enterography protocol (256 MDCT scanner) combined with iterative reconstruction algorithm (iDose4), with standard dose CT-enterography in follow-up of patients with known Crohn’s disease.
METHOD AND MATERIALS
Fifty-one patients (32 male; mean BMI 24.9), with CD underwent low-dose CTE scan in a single venous phase on 256 MDCT scanner (iCT, Philips) with following parameters: 120 kV, automated mAs dose modulation, slice thickness 2mm, with iDose4 iterative reconstruction algorithm. The same patients underwent a standard dose examination on 256-slices CT scan (120kV, 200-400mAs, depending on patient weight, slice thickness 2mm). Two radiologists, blinded to clinical and pathological findings, independently evaluated, in each scan, HU values in bowel wall and presence of CD activity features (mural thickening and enhancement pattern, mesenteric fat stranding, comb sign, lymphadenomegaly and disease's complications). Image noise and diagnostic quality were evaluated using a 4-point scale. Dose-length product (DLP) was calculated and data from both examinations were compared and statistically analyzed.

RESULTS
Low-dose CTE protocol showed high diagnostic quality in assessment of Crohn's disease features (i.e. mural thickening and enhancement, halo sign, mesenteric fat stranding, lymphadenopathy), which were detected in 43/51 (82%) of our series. Total DLP and CTDI were significantly (p<0.001) lower for CTE studies with iDose (607 mGy*cm and 12 mGy) as compared to standard dose examinations (891 mGy*cm and 19.13 mGy), allowing an overall dose reduction of 35%. The objective noise measurements were slightly higher in iDose images (DS 12.9) than in standard dose studies (DS 10.37) but not statistically significant difference was achieved (p=0.06).

CONCLUSION
Low dose CTE protocol combined with iDose4 reconstruction algorithm offers high quality images with lower radiation dose, being a useful tool in CD patients management, in regard of their young age and the frequent imaging follow-up required.

CLINICAL RELEVANCE/APPLICATION
Low-dose CTE protocol combined with iDose4 algorithm allows a significant reduction of radiation dose, while providing an appropriate diagnostic image quality for the evaluation of CD manifestations.

SSG05-09  Comparison of Model-based Iterative Reconstruction, Adaptive Statistical Iterative Reconstruction and Filtered Back Projection for Detecting Hepatic Metastases on Submillisievert Low-Dose CT
Tuesday, Dec. 1 11:50AM - 12:00PM Location: E352
Participants
Jung Hee Son, MD, Busan, Korea, Republic Of (Presenter) Nothing to Disclose
Seung Ho Kim, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jung Hee Yoon, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yedaun Lee, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yun-Jung Lim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Seon Jeong Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the image quality and diagnostic performance of model-based iterative reconstruction (MBIR), adaptive statistical iterative reconstruction (ASIR) and filtered back projection (FBP) on submillisievert low-dose CT (LDCT) for detecting hepatic metastases in patients with gastrointestinal cancer.

METHOD AND MATERIALS
From February 2014 to September 2014, 38 consecutive patients (mean age 63 years; range 33-87 years) having clinically suspected hepatic metastases underwent abdomen CT. CT protocol consisted of routine standard-dose portal venous phase scan (120 kVp), and investigational 90 second delayed low-dose scan (80 kVp) with an automatic tube current modulation. The LDCT images were reconstructed with FBP, ASIR 70% and MBIR. Two blinded readers independently scored overall image quality of each image set based on a five-point scale and recorded number of hepatic metastases on a per lesion basis (FBP, ASIR, and MBIR in order). The subjective image quality was compared by Wilcoxon signed rank test. The CT image noise was measured for each image data set. The image noise and number of detected hepatic metastases were compared among the three image data sets using the repeated measures analysis of variance.

RESULTS
105 metastatic lesions (42 lesions ≥ 1 cm, 63 lesions < 1 cm) were analyzed. The mean values of CTDIvol and DLP of LDCT were 1.66 mGy and 47.8 mGycm, respectively. The subjective image quality was improved in reading order for both readers (P<0.0001). The measured image noise was also decreased in reading order (40.5, 24.6, 14.8; P<0.0001). The pooled sensitivity was unchanged after applying ASIR from 49% (51/105) to 52% (55/105) (P=0.0697), however, significantly increased to 66% (69/105) after applying MBIR for reader 1 (P=0.0035). MBIR applied images showed a higher pooled sensitivity than ASIR applied ones (P=0.0311). For reader 2, it was not increased after applying either ASIR from 65% (67/105) to 68% (70/105), or MBIR to 67% (69/105) (P=0.4571).

CONCLUSION
Although MBIR and ASIR might improve the subjective image quality and decrease measured image noise, the reconstructed images showed a limited sensitivity in detecting hepatic metastases on submillisievert LDCT.

CLINICAL RELEVANCE/APPLICATION
The MBIR or ASIR applied images show a limited sensitivity in detecting hepatic metastases on submillisievert LDCT.
**SSG06**

**ISP: Genitourinary (Imaging Gynecological Malignancy)**

Tuesday, Dec. 1 10:30AM - 12:00PM Location: N229

**GU**  **MR**  **OI**  **BQ**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

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**Participants**

Susanna I. Lee, MD, PhD, Boston, MA (*Moderator*) Nothing to Disclose

Andrea G. Rockall, MRCP, FRCR, London, United Kingdom (*Moderator*) Nothing to Disclose

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**Sub-Events**

**SSG06-01  Genitourinary Keynote Speaker: Gynecologic Cancer Imaging-Present and Future**

Tuesday, Dec. 1 10:30AM - 10:40AM Location: N229

**Participants**

Susanna I. Lee, MD, PhD, Boston, MA (*Presenter*) Nothing to Disclose

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**ABSTRACT**

The past decade has seen the development of MRI and FDG PET-CT, both of which now play central and complementary roles in treatment planning and followup of women with uterine, ovarian and vulvar cancer. Ongoing investigations of novel techniques such as diffusion and perfusion imaging, and of PET tracers capable of targeting hypoxia and hormone receptors, will push cancer radiology firmly into the realm of the molecular, quantitative and predictive in the coming decade. PET-MRI, capable of concurrent multi-modality functional imaging, will likely prove to be a mainstay in personalized gynecologic cancer care.

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Susanna I. Lee, MD, PhD - 2013 Honored Educator

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**SSG06-02  High Grade Serous Ovarian Cancer: BRCA Mutation Status and CT Imaging Phenotypes**

Tuesday, Dec. 1 10:40AM - 10:50AM Location: N229

**Participants**

Stephanie Nougaret, MD, New York, NY (*Presenter*) Nothing to Disclose

Yuliya Lakhman, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Hebert Alberto Vargas, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Maura Micco, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

Melvin D'Anastasi, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Sarah A. Johnson, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

Ramon E. Sosa, BA, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Krishna Juluru, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Melvin D'Anastasi, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

Evis Sala, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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**PURPOSE**

To investigate the associations between BRCA mutation status and preoperative CT imaging phenotypes in women with high-grade serous ovarian cancer (HGSOC).

**METHOD AND MATERIALS**

115 patients with HGSOC (76 BRCA mutation-positive and 39 BRCA mutation-negative) and CT scans prior to the primary cytoreductive surgery were included in this retrospective HIPAA-compliant study. Two radiologists (R1 and R2) independently reviewed all CT scans and R1 determined total measurable peritoneal tumor volume (TPTV) for each patient. Associations between BRCA mutation status, CT imaging features, and TPTV were analyzed using Fisher exact test and Mann Whitney test. Inter-reader agreement was assessed with the Cohen's kappa. Kaplan-Meier and Cox proportional hazards regression survival analyses were performed.

**RESULTS**

BRCA mutation-positive HGSOC had less frequent peritoneal disease, mesenteric infiltration, and lymphadenopathy at CT (p = 0.0002, < 0.0001-0.03, 0.03 for both readers, respectively). Furthermore, the pattern of peritoneal implants was correlated with the BRCA mutation status: nodular pattern was more common in BRCA-associated tumors whereas infiltrative pattern was more frequent in sporadic tumors (p = 0.0009 and p = 0.0005 for R1 and R2, respectively). BRCA mutation-positive HGSOC had higher mean TPTV (126 cm³ ± 171) than sporadic tumors (56 cm³ ± 95) (p < 0.001). Irrespective of BRCA mutation status, mesenteric involvement by tumor was associated with shorter progression-free survival (p < 0.0001 for both readers) and overall survival (p < 0.0002 and p < 0.0001 for R1 and R2, respectively).

**CONCLUSION**

BRCA mutation status in HGSOC was linked to the distinct CT imaging phenotypes. Mesenteric disease at CT was an independent
predictor of reduced survival in both BRCA mutation-positive and sporadic tumors.

**CLINICAL RELEVANCE/APPLICATION**

BRCA-associated HGSOC have characteristic prognostically significant morphology on CT.

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Stephanie Nougaret, MD - 2013 Honored Educator
Evis Sala, MD, PhD - 2013 Honored Educator

**SSG06-03  Advanced Cervical Cancer: Quantitative Assessment of Early Response to Neoadjuvant Chemotherapy with Intravoxel Incoherent Motion Diffusion-weighted Magnetic Resonance Imaging**

Tuesday, Dec. 1 10:50AM - 11:00AM Location: N229

Participants
Yanchun Wang, Wuhan, China (Presenter) Nothing to Disclose
Dao Y. Hu, MD, PhD, Wuhan, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the utility of intravoxel incoherent motion (IVIM) diffusion-weighted magnetic resonance imaging (MRI) for predicting and monitoring the response of cervical cancer to neoadjuvant chemotherapy (NACT).

**METHOD AND MATERIALS**

This prospective study was approved by an institutional review board, and informed consent was obtained from all patients. A total of 42 patients with primary cervical cancer were recruited into this study. IVIM diffusion-weighted MRI was performed on all patients at three time points (prior to NACT, 3 weeks after the first NACT, and 3 weeks after the second NACT). The response to treatment was determined according to the Responded Evaluation Criteria in Solid Tumors (RECIST) three weeks after the second NACT treatment, and the subjects were categorized into responders and non-responders. The standard ADC, true diffusion coefficient (D), perfusion-related pseudo-diffusion coefficient (D*), and perfusion fraction (f) values were determined.

**RESULTS**

Patients were divided into responders (n=24) and non-responders (n=18) according to the RECIST guidelines. Before treatment, the D and standard ADC values were significantly higher in responders than in non-responders (both p<0.01). No significant differences were observed in D* and f. Analysis of the receiver operating characteristic (ROC) curve indicated that the threshold of D<0.93×10^-3mm^2/s and the standard ADC<1.11×10^-3mm^2/s could be used to differentiate responders from non-responders, yielding area under curve (AUC) values of 0.804 and 0.768, respectively. Three weeks after both the first and second NACT treatments, the D and standard ADC values in the responders were still significantly higher than those in the non-responders. D* and f values still showed no significant differences. The ROC curve analysis indicated that the AUC values for D and standard ADC were 0.823 and 0.763 for the second time point and 0.787 and 0.794 for the last time point.

**CONCLUSION**

IVIM may be useful for predicting and monitoring the efficacy of NACT in cervical cancer. D and standard ADC values could represent reliable early predictors of the NACT response prior to treatment. Furthermore, these parameters can be used to monitor NACT responses during and after therapy.

**CLINICAL RELEVANCE/APPLICATION**

These results should be useful for both patients and clinical doctors. Patients who are unsuitable for NACT could be given radiation or surgical treatment in a more timely manner.

**SSG06-04  Prognostic Value of Diffusion-weighted MRI and PET/CT During Concurrent Chemoradiotherapy in Uterine Cervical Cancer**

Tuesday, Dec. 1 11:00AM - 11:10AM Location: N229

Participants
Jung Jae Park, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Chan Kyoo Kim, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Byung Kwan Park, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate the prognostic value of diffusion-weighted MRI (DWI) and PET/CT during concurrent chemoradiotherapy (CCRT) of cervical cancer for predicting disease progression.

**METHOD AND MATERIALS**

This retrospective study included 67 consecutive patients (median age, 55 years; range, 28-78 years) who received CCRT for locally advanced cervical cancer. All patients underwent both 3T-DWI and PET/CT before and during (at 4 weeks) treatment. The mean apparent diffusion coefficient (ADC) and maximum standardized uptake value (SUVmax) were measured on the tumors and the percentage changes of each parameter between the two time points (ΔADC and ΔSUVmax) were calculated. In the prediction of disease progression, the diagnostic performance of tumor ΔADC and ΔSUVmax was evaluated using the time-dependent receiver operating characteristics (ROC) curve analysis. The relationship between disease progression and clinical and imaging parameters was investigated using univariate and multivariate Cox regression analyses.

**RESULTS**
During a mean follow-up of 2.7 years, disease progression was identified in 16 patients (23.9%): local recurrence (n=7), distant metastasis (n=8) and both local recurrence and distance metastasis (n=1). During treatment, the mean ADC and SUVmax significantly increased and decreased, respectively (both P < 0.001). The mean ΔADC and ΔSUVmax were 42.6 ± 17% and 67.6 ± 16.5%, respectively. In the prediction of disease progression, the integrated area under the curve of ΔADC (0.791) and ΔSUVmax (0.781) were not significantly different (P = 0.88) and the optimal cut-offs of ΔADC and ΔSUVmax were 35.1% and 60.7%, respectively. On multivariate Cox regression analysis, the ΔADC (< 35.1%) and ΔSUVmax (< 60.7%) were the only independent predictors of disease progression after treatment (hazard ratio, 4.1 and 4.5; P, 0.04 and 0.03, respectively).

CONCLUSION
The percentage changes of DWI and PET/CT parameters during CCRT offer similar prognostic value for the prediction of post-treatment disease progression in patients with cervical cancer.

CLINICAL RELEVANCE/APPLICATION
DWI, as a noninvasive tool, can be used in the prediction of therapeutic outcomes following concurrent chemoradiotherapy in patients with cervical cancer, instead of PET/CT with the risk of ionizing radiation exposure.

SSG06-05 Application of Non-Gaussian Water Diffusional Kurtosis Imaging in the Assessment of Uterine Tumors: A Preliminary Study

Tuesday, Dec. 1 11:10AM - 11:20AM Location: N229

Participants
Aliou A. Dia, MD, Suita, Japan (Presenter) Nothing to Disclose
Masatoshi Kori, MD, Suita, Japan (Abstract Co-Author) Nothing to Disclose
Hiromitsu Onishi, MD, Suita, Japan (Abstract Co-Author) Nothing to Disclose
Makoto Sakane, MD, Suita, Japan (Abstract Co-Author) Nothing to Disclose
Takahiro Tsuboyama, MD, Suita, Japan (Abstract Co-Author) Nothing to Disclose
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Mitsuaki Tatsuru, MD, PhD, Suita, Japan (Abstract Co-Author) Nothing to Disclose
Tomoyuki Okuaki, RT, Chuo-Ku, Japan (Abstract Co-Author) Employee, Koninklijke Philips NV

PURPOSE
To retrospectively evaluate the feasibility and the value of diffusional kurtosis imaging (DKI) in the assessment of uterine tumors compared with that of conventional diffusion weighted imaging (DWI) and with pathological findings as gold-standard.

METHOD AND MATERIALS
Sixty-one women (mean age: 54.85 years ±14.09, range 26-89 years) with histopathologically proven uterine cancers (51 cervical cancers and 10 corpus cancers) underwent 3-T MR imaging using DKI with high b values (b=700, 1000, 1700 and 2500 s/mm2) and DWI (b=0 s/mm2, b=700 s/mm2). Thirteen of the 61 patients (21.3%) had coexisting leiomyomas. ROI-based measurements of diffusivity (D), kurtosis (K) and ADC of the uterine cancers, leiomyomas, healthy myometrium and endometrium were performed. The areas under the ROC curve (AUC) in differentiating malignant from benign lesions were also compared.

RESULTS
Mean D of uterine cancers (0.879 mm/s² ± 0.30) was significantly lower than that of the leiomyomas (1.174 mm/s²±0.43) (P=0.008), the healthy myometrium (1.178 mm/s²±0.27) (P=0.000) and the healthy endometrium (1.308 mm/s²±0.5) (P=0.013). Mean K of uterine cancers (0.754 mm/s²±0.22) was moderately higher than that of leiomyomas (0.686 mm/s²±0.24), the healthy myometrium (0.708 mm/s²±0.19) and the healthy endometrium (0.568 mm/s²±0.25). No significant difference was found between the mean K of the uterine cancers, the leiomyomas, the healthy myometrium and endometrium (P=0.33, 0.27 and 0.23). There was no significant difference in AUC between D and ADC.

CONCLUSION
D is not superior or inferior to the conventional ADC in the differentiation between benign and malignant uterine lesions. The K that is related to the microstructural complexity was higher in uterine cancers than that of leiomyomas but without any significant difference, opposite to K values in white matter tissue of the brain, in breast or prostate cancers where the mean K of malignant lesions was significantly higher than of the benign lesions.

CLINICAL RELEVANCE/APPLICATION
The D, in non-Gaussian DKI, is equal to the conventional ADC in differentiating benign from malignant uterine lesions. The K of uterine malignant tumors was not significantly higher than that of the benign lesions, unlike in breast or prostate cancers.

SSG06-06 Clinical Value of Proton (1H-) Magnetic Resonance Spectroscopy (MRS) Using Body-phased Array Coil at 3.0 T in Pretreatment Assessment for Cervical Cancer Patients

Tuesday, Dec. 1 11:20AM - 11:30AM Location: N229

Participants
Gigin Lin, MD, Guishan, Taiwan (Presenter) Nothing to Disclose
Yu-Ting Huang, Guishan, Taiwan (Abstract Co-Author) Nothing to Disclose
Koon-Kwan Ng, Guishan, Taiwan (Abstract Co-Author) Nothing to Disclose
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Angel Chao, MD, Taoyuan, Taiwan (Abstract Co-Author) Nothing to Disclose
Chiu-Chieh Wang, Guishan, Taiwan (Abstract Co-Author) Nothing to Disclose
Chyong-Huey Lai, Guishan, Taiwan (Abstract Co-Author) Nothing to Disclose
Pen-An Liao, MD, Taipei City, Taiwan (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the clinical value of proton (1H-) magnetic resonance spectroscopy (MRS) using body-phased array coil at 3.0 T, in the assessment of cervical cancer patients.
To determine the clinical value of proton ($^{1}$H-) magnetic resonance spectroscopy (MRS) using body-phased array coil at 3.0 T, in pretreatment assessment for cervical cancer patients.

**METHOD AND MATERIALS**

We prospectively enrolled 52 histology proven cervical cancer patients (age 27-80 years) and 30 age-matched surgical candidates for benign uterine myoma without evidence of cervical cancer. Pretreatment MR study plus MRS and diffusion weighted imaging (DWI) sequences were carried out at a 3.0 T system using body-phased array coil for the pelvis. PRESS localized $^{1}$H-MRS was applied to cervical tumor or normal tissue, with resonances analyzed by using the LC-Model algorithm. Cramer-Rao lower bound (CRLB) threshold of 20% was used as quality control. We compared resonances based on: (1) tumor vs normal cervical tissue, (2) histopathology type (squamous vs adenocarcinoma) (3) T stage = IIb (4) nodal metastasis (5) distant metastasis using Mann-Whitney test.

**RESULTS**

Cervical tumor showed a lower 1.3-ppm lipid level (0.30 vs 1.01μM, P < .05), as compared with normal cervical tissue. Squamous cell carcinoma demonstrated lower levels in 1.3-ppm lipid (0.17μM vs 0.59μM, P < .05) and 0.9-ppm lipid (0.04μM vs 0.16μM, P < .05), as compared with adenocarcinoma. Tumor with T stage >= IIb had lower levels in 1.3-ppm lipid (0.15μM vs 0.53μM, P < .05), 0.9-ppm lipid (0.04μM vs 0.15μM, P < .05) and total choline (0.04μM vs 0.16μM, P < .05). Tumors with nodal metastasis contained lower levels of 1.3-ppm lipid (0.16μM vs 0.44μM, P < .05) and glutamine (0.01μM vs 0.02μM, P < .005), whereas tumors with distant metastasis contained a lower level of 1.3-ppm lipid (0.12μM vs 0.50μM, P < .05). However, resonances from cervical tumor were independent to maximal tumor size or ADC value on MRI.

**CONCLUSION**

$^{1}$H-MRS using body-phased array coil at 3.0 T in cervical cancer patients is useful in differentiating tumor, histopathology type, T stage >= IIb, nodal or distant metastasis, and is independent to maximal tumor size or ADC value on MRI.

**CLINICAL RELEVANCE/APPLICATION**

$^{1}$H-MRS using body-phased array coil at 3.0 T added additional dimensions for pretreatment assessment in cervical cancer patients.

**SSG06-07 Impact of Multparametric MRI (mMRI) on the Therapeutic Management of Suspicious Adnexal Masses Detected by Transvaginal Ultrasound (TVUS)**

**Tuesday, Dec. 1 11:30AM - 11:40AM Location: N229**

**Participants**
Simone Schrading, MD, Aachen, Germany (Presenter) Nothing to Disclose
Sabine M. Detering, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Dirk Bauerschlag, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Incidental adnexal masses at TVUS are common and diagnostically challenging. The primary goal of imaging is accurate tissue characterization to guide further management, i.e. the choice between plain follow-up vs laparoscopic surgery vs. open surgery. Aim of this study was to evaluate the diagnostic utility of mMRI for further management stratification in patients with such adnexal masses.

**METHOD AND MATERIALS**

Prospective IRB-approved trial on 126 women (mean age 54.6 years) with inconclusive adnexal masses at TVUS. All women underwent conventional work up, including pelvic examination, TVUS, and CA-125 levels. In addition, all women underwent mMRI at 3T with high resolution T2-TSE in three planes, DWI (max. b-800) and DCE. Likelihood of malignancy and appropriate management (i.e. follow-up vs appropriate surgery) was first determined based on results of conventional methods, and then, independently, based on mMRI. Then, all methods were reviewed in synopsis. Final surgical pathology served as standard-of-reference or clinical and imaging follow-up of at least 24 months.

**RESULTS**

In 65% (82/126) of patients the adnexal mass finally classified as benign, in 29% (36/126) as malignant and in 6% (8/126) as borderline. The diagnostic indices for TVUS+CA-125 alone vs. MRI alone vs. all methods combined were as follows: Sensitivity: 86% (31/36) vs. 97% (35/36) vs. 100% (36/36); Specificity: 32% (29/90) vs. 83% (75/90) vs. 80% (68/90); PPV: 34% (31/91) vs. 70% (35/50) vs. 74% (40/54), NPV: 65% (29/44) vs. 98% (75/76) vs. 100% (72/72). After mMRI, the therapeutic management was changed in 41/126 (34%) of patients. In 30 patients in whom surgery had been recommended based on conventional assessment, mMRI correctly diagnosed typical benign findings; these patients underwent follow-up instead of surgery. None of these women developed malignancy during follow-up. In another 11 patients, mMRI results correctly suggested malignancy such that open surgery was performed instead of laparoscopic surgery.

**CONCLUSION**

Compared with conventional assessment (pelvic exam, TVUS, CA-125), mMRI correctly changed the management in one-third of women with incidental adnexal masses. It helps avoid unnecessary surgery, or unnecessary surgical steps (conversion from laparoscopic to open surgery).

**CLINICAL RELEVANCE/APPLICATION**

Pelvic mMRI helps to significantly improve clinical management of asymptomatic women with incidental adnexal masses identified on TVUS.

**SSG06-08 Preoperative Tumor Texture Analysis from MRI Predicts Deep Myometrial Invasion and High Risk Histology in Endometrial Carcinomas**

**Tuesday, Dec. 1 11:40AM - 11:50AM Location: N229**

**Participants**
Tumor heterogeneity is a key feature of malignant disease. Heterogeneity in MR images can be quantified by texture analysis. We aimed to explore whether high risk histological features are reflected in texture parameters derived from preoperative MRI in endometrial carcinomas.

**METHOD AND MATERIALS**

Preoperative pelvic contrast-enhanced MRI (1.5T) including diffusion-weighted imaging (DWI) was prospectively performed in 99 patients with histologically confirmed endometrial carcinomas. Tumor region of interest (ROI) was manually drawn encircling the uterine tumor on axial T1-weighted contrast-enhanced (CE) series on the slice displaying the largest cross-section tumor area. Histogram based texture features (standard deviation, skewness and kurtosis) were calculated from these tumor ROIs. Texture parameters were analyzed in relation to established histological subtype and grade, surgicopathological staging parameters (deep myometrial and cervical stroma invasion and lymph node metastases) and MRI based tumor volume and tumor apparent diffusion coefficient (ADC) value using Mann-Whitney U test, Jonckheere-Terpstra trend test and Pearson's bivariate correlation test.

**RESULTS**

Large standard deviation (SD) in the tumor ROIs was significantly associated with presence of deep myometrial invasion (p=0.009). Lower values for skewness were observed in the tumor ROIs from endometrioid high grade tumors (p=0.012) and from non-endometrioid tumors (by definition always high grade lesions, p=0.020). Kurtosis was positively correlated to tumor volume (r= 0.27; p=0.006) and negatively correlated to tumor ADC value (r=−0.28; p=0.006).

**CONCLUSION**

MRI derived tumor texture features reflecting tumor heterogeneity are significantly related to high risk histology and predict deep myometrial invasion in endometrial carcinomas. Thus, tumor texture features based on MRI represent promising biomarkers to aid preoperative tumor characterization for risk stratified surgical treatment.

**CLINICAL RELEVANCE/APPLICATION**

Tumor texture features derived from MRI reflect high risk endometrial carcinoma and may aid preoperative risk classification for stratified surgery.
Accuracy of MR staging of endometrial cancer in a multi-site cancer network over three years does not reach single centre study results. The causes for staging inaccuracies need to be understood.
**Participants**

David C. Levin, MD, Philadelphia, PA (Moderator) Consultant, HealthHelp, LLC; Board of Directors, Outpatient Imaging Affiliates, LLC

Kimberly E. Applegate, MD, MS, Zionsville, IN (Moderator) Nothing to Disclose

**Sub-Events**

**SSG07-01 Health Service, Policy and Research Keynote Speaker: Will Use of Imaging Expand in the Near Future - Or Contract?**

Tuesday, Dec. 1 10:30AM - 10:40AM Location: S102D

Participants

David C. Levin, MD, Philadelphia, PA (Presenter) Consultant, HealthHelp, LLC; Board of Directors, Outpatient Imaging Affiliates, LLC

**SSG07-02 Access to Clinical Imaging Reports in Patient Portals and the Role of the Radiologist: The Patient Perspective**

Tuesday, Dec. 1 10:40AM - 10:50AM Location: S102D

Participants

Eduardo Hernandez-Rangel, MD, Orange, CA (Presenter) Nothing to Disclose

Wanda Marfori, MD, Orange, CA (Abstract Co-Author) Nothing to Disclose

Alessandra Miranda, MD, Orange, CA (Abstract Co-Author) Nothing to Disclose

Mayil S. Krishnam, MBBS, MRCP, Orange, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To determine patient perspective in regard to 1) access to imaging reports in patient portals 2) how imaging results are received and communicated to them.

**METHOD AND MATERIALS**

Combined electronic/paper survey was administered to adult outpatients at UCIMC. Survey questions focused on: 1) accessibility and satisfaction with patient portal (PP) 2) information about imaging procedures and concerns 3) access to imaging reports 4) patient preference as to who would explain imaging test procedures and from whom they receive imaging results: PCP, ordering/referring physician, radiologist, NP, PA or nurse 5) and potential role of radiologists in communicating results. Results were tabulated and analyzed.

**RESULTS**

Total of 66 participants completed the survey, mean age: 54 ± 18 S.D.; 60% female, 40% male. 70% had college level education and insured (97%). 53% percent had access to PP, 85% were satisfied; 47% with no access would like to have one. 89.4% had recent and multiple (56%) imaging tests; individual tests mostly CT (10%). Procedures and risks explained by technicians (53%). Radiation exposure not a major concern (61%) and most (75%) were unaware of radiation reduction strategies. 17% were concerned with side effects, contrast allergy, cost, cancer, quality and diagnosis. Access to imaging report in PP was important (92%) and timely reporting (85%); having access will not create anxiety, stress or confusion. Patients prefer to discuss results with referring physician 48%, PCP 26%, radiologist 21%, other 5%. Question re: discussing results with Radiologist showed 57.6% preference, due to the following: first person who knows the findings, is the expert and will have more complete, better and accurate information. 34% prefer a discussion with radiologist immediately post-procedure, and access to results within 24 hours 34%.

**CONCLUSION**

Overall participants preferred and are satisfied with PP and want more control of their health information. There is preference for direct discussion with radiologist but timely access to imaging results via a PP, from referring physician, PCP, or radiologist is much more important rather than from whom they receive or discuss results with.

**CLINICAL RELEVANCE/APPLICATION**

Our project is in line with RSNA and ACR campaign for patient centered practice with goal of promoting awareness of radiologist role in patient care and benefits of direct interaction with patients

**SSG07-03 Image-Rich Radiology Reports: A Value-Based Model to Improve Clinical Workflow**

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S102D

Participants

Bhavik N. Patel, MD, MBA, Durham, NC (Presenter) Nothing to Disclose

Jose Lopez, BS, Raleigh, NC (Abstract Co-Author) Nothing to Disclose

Christopher J. Roth, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the clinical value of an image-rich radiology report (IRRR) by evaluating unmet needs, interest, and preferences of referring physicians and the willingness of radiologists to create them.

METHOD AND MATERIALS
Referring physicians and radiologists of various experience and from different specialties were interviewed in this prospective, HIPAA-compliant study. Willingness to voluntarily participate for interview was solicited via email. A single investigator conducted all interviews using standard questionnaires, one for clinicians and one for radiologists. All subjects were walked through a PowerPoint mockup demonstration of an IRRR and its potential use in clinical workflow. Three methods for viewing images were presented: 1) clicking hyperlinks to access a stacked image series popup, 2) embedded clickable image thumbnails, 3) scrollable but not enlargeable medium-sized image series within the report. Questionnaire answers, free comments, and general impressions were captured and analyzed.

RESULTS
A total of 44 physicians (33M, 11F, 36 clinicians, 8 radiologists) were interviewed. Number of years in practice was < 5 (27%), 5-9 (30%), 10-14 (9%), 15-19 (11%), and > 19 (23%). 31 (70%) clinicians expressed interest in using IRRR. Of these, 81% believed IRRR would improve communication, 29 and 26 subjects stated they would very frequently use IRRR for CT and MR images, respectively, while 10 would use it for ultrasound. With regards to how images are embedded, 10 (28%) preferred method 1, 18 (50%) preferred method 2, and 8 (22%) preferred method 3. 30 subjects (83%) stated IRRR would somewhat or substantially improve efficiency. 100% of radiologists believed IRRR was a valuable concept. 5 (63%) preferred right clicking an image whereas 3 (38%) preferred pressing a function key to embed images. On the average, radiologists would be willing to spend 83 seconds per case to embed the images.

CONCLUSION
Referring physicians believe IRRR would add value by improving communication between them and radiologists as well as have some improvement on their time efficiency. Radiologists are open to providing IRRR so as long as the process of embedding images is expeditious.

CLINICAL RELEVANCE/APPLICATION
In the current era of transforming health care, novel solutions that increase value of radiology must be employed. IRRR may improve clinical workflow and communication between referring physicians and radiologists, ultimately translating into improved patient outcomes.

SSG07-04 Investigating Occult Malignancy in Patients with Unprovoked Venous Thromboembolism - A Single-centre Retrospective Study

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S102D

Participants
Tarryn Carlsson, MBChB, Bristol, United Kingdom (Presenter) Nothing to Disclose
Babu Pusuluri, Bristol, United Kingdom (Abstract Co-Author) Nothing to Disclose
John Ho, Bristol, United Kingdom (Abstract Co-Author) Speaker, Boehringer Ingelheim GmbH;
Ladli Chandratreya, MBBS, FRCR, Bristol, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE
In June 2012 the National Institute for Health and Care Excellence (NICE) published guidelines for investigating occult malignancy (CG144: section 1.5) in patients diagnosed with unprovoked venous thromboembolism (VTE). Screening for cancer in these patients remains controversial and its survival benefit is yet to be proven. Our objectives are to determine the frequency of unprovoked VTE in our institution, assess the way we investigate these patients for occult malignancy and to determine the frequency of occult malignancies in this group of patients.

RESULTS
740 investigations were undertaken to investigate a possible diagnosis of VTE of which only 108 were positive (15%). Further analysis showed that 60.2% (n = 65) were provoked, 37% (n = 40) were unprovoked and 3% (n = 3) could not be categorised. The age range of patients diagnosed with an unprovoked VTE was between 27-94 years old with a mean age of 65 years. The majority were male (n= 24). In the unprovoked VTE category 69.2% (n = 27) had a physical examination; 97.4% (n = 38) had a FBC; 84.6% (n = 33) had LFTs; 48.7% (n = 19) had a serum calcium and only 33.3% (n = 13) had a urinalysis performed within one month of the initial VTE investigation. In those patients who had a lower limb deep vein thrombosis (DVT), only 47.1% (n = 8/17) had a chest radiograph performed within one month of the VTE diagnosis. Computed Tomography (CT) of the abdomen and pelvis was performed in 57.9% (n = 22) of patients with an unprovoked VTE and 17.9% (n = 7) underwent ultrasound of the abdomen/pelvis. No further imaging was performed in 31.2% (n = 12). Of note, no mammograms were performed. In patients that went on to have cross-sectional imaging, all of them had a FBC, 86.4% had LFTs, 54.5% had a serum calcium and only 36.4% had a urinalysis performed. An occult malignancy was only identified in 2.9% (n = 1). This patient was shown to have an enlarged prostate on cross-sectional imaging was performed in 57.9% (n = 22) of patients with an unprovoked VTE and 17.9% (n = 7) underwent ultrasound of the abdomen/pelvis. No further imaging was performed in 31.2% (n = 12). Of note, no mammograms were performed. In patients that went on to have cross-sectional imaging, all of them had a FBC, 86.4% had LFTs, 54.5% had a serum calcium and only 36.4% had a urinalysis performed. An occult malignancy was only identified in 2.9% (n = 1). This patient was shown to have an enlarged prostate on cross-sectional imaging and a raised serum prostate specific antigen (PSA). Subsequent biopsy proved positive for prostate malignancy. Ultrasound did not detect any occult malignancies.

CONCLUSION
Invasive radiological investigations are not without significant morbidity. A normal physical examination, basic blood work up (FBC, LFTs, serum calcium), CXR and urinalysis may reasonably obviate the need for unnecessary invasive radiological investigations for unprovoked VTE. Patients in our study did not have satisfactory baseline investigations before being subjected to more invasive investigations such as cross sectional CT imaging, V/Q scan or mammography as recommended by NICE. Interestingly, the rate of occult malignancies in our study is very low (2.9%), which begs the question whether cross-sectional imaging/mammography is warranted at all in these patients. A further study evaluating the final outcome of the subgroup that did not undergo invasive investigation may throw additional light on this question. Based on our observations, we recommend that patients with unprovoked VTE should have a physical examination and baseline investigations (as per NICE guideline) before being considered for invasive radiological investigations.

METHODS

radiological investigations.
VTE should have a physical examination and baseline investigations (as per NICE guideline) before being considered for invasive investigation may throw additional light on this question. Based on our observations, we recommend that patients with unprovoked occult malignancies in our study is very low (2.9%), which begs the question whether cross-sectional imaging/mammography is warranted at all in these patients. A further study evaluating the final outcome of the subgroup that did not undergo invasive investigation may throw additional light on this question. Based on our observations, we recommend that patients with unprovoked VTE should have a physical examination and baseline investigations (as per NICE guideline) before being considered for invasive radiological investigations.

METHODS

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VTE should have a physical examination and baseline investigations (as per NICE guideline) before being considered for invasive investigation may throw additional light on this question. Based on our observations, we recommend that patients with unprovoked occult malignancies in our study is very low (2.9%), which begs the question whether cross-sectional imaging/mammography is warranted at all in these patients. A further study evaluating the final outcome of the subgroup that did not undergo invasive investigation may throw additional light on this question. Based on our observations, we recommend that patients with unprovoked VTE should have a physical examination and baseline investigations (as per NICE guideline) before being considered for invasive radiological investigations.
In this retrospective, observational study, patients who underwent a Computed Tomography Pulmonary Angiogram (CTPA), ventilation/perfusion (V/Q) scan or unilateral lower limb Doppler over a period of just over two months or bilateral lower limb Dopplers over a period of just over four months were assessed and categorised into ‘provoked’, ‘unprovoked’ and ‘uncertain’ using the clinical history provided in the imaging request form. Provoking factors included but were not limited to: surgery within 3 months of investigation, immobility, recent hospital admission, recent long haul flight and known malignancy. Using clinical notes, laboratory results and the institution’s picture archiving and communicating system (PACS), the patients labelled ‘unprovoked’ or ‘uncertain’ were analysed to determine whether the following investigations had been performed: physical examination at time of admission, full blood count (FBC), liver function tests (LFT), serum calcium, urinalysis and a chest radiograph (CXR) in those with lower limb VTE within one month of the initial investigation for a VTE. In addition, any imaging of the abdomen/pelvis (and mammograms in women) within 6 months of the initial investigation for a VTE was analysed by the primary investigator and a consultant radiologist. The frequency of occult malignancies was subsequently identified.

SSG07-06 Legal Issues of Vertebroplasty and the Standard of Care: A Survey of Musculoskeletal Radiologists

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S102D

Participants
Jonathan Mezrich, MD, New Haven, CT (Presenter) Nothing to Disclose
Charles S. Resnik, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

PURPOSE
Percutaneous vertebroplasty is a procedure intended to address severe pain caused by vertebral compression fractures refractory to conventional pain regimens. In 2010, the American Academy of Orthopedic Surgeons (AAOS), relying on two controversial 2009 studies, issued a guideline recommending against vertebroplasty for neurologically intact patients presenting with symptomatic osteoporotic spinal compression fractures. Clinical guidelines in radiology, however, do not oppose vertebroplasty for appropriately selected patients. A survey was circulated to determine the extent musculoskeletal radiologists perform vertebroplasty, their experiences, and whether there is an apparent standard of care in the subspecialty.

METHOD AND MATERIALS
An online survey of the approximately 1140 members of the Society of Skeletal Radiology (SSR) was conducted through SurveyMonkey.com. There were 253 responses, representing a 22.2 % response rate.

RESULTS
40 respondents (16%) indicated they perform vertebroplasty. Of those who perform vertebroplasty, 23% indicated that they
We conducted a systematic literature review via PubMed (prior to January 1, 2015), using search terms related to emergency radiology studies. Throughput, cost, and/or productivity.

**CONCLUSION**

Based on the survey results, a small minority of members of SSR perform vertebroplasty, with the majority of patients doing well with the procedure. A standard of care is the degree of care a reasonably prudent clinician in the community should exercise under similar circumstances. If a minority of clinicians in a subspecialty perform a procedure, does that reflect on the standard of care? To what extent does the AAOS guideline impact the standard of care for radiologists? Might this guideline be admitted in litigation? Might an orthopedic surgeon be called as an expert witness in a case involving a radiologist? Although not prohibited under radiology guidelines, radiologists need to consider whether the controversy creates an unfavorable legal footing.

**CLINICAL RELEVANCE/APPLICATION**

This study is relevant to all radiologists who perform vertebroplasty or care for patients with vertebral compression fractures.

**SSG07-07 Rounding Radiologists: Does Clinical Collaboration Strengthen the Relationship between Radiology Residents and Internal Medicine Teams?**

**Participants**
- Allison Aripoli, MD, Kansas City, KS (Presenter) Nothing to Disclose
- Rustain L. Morgan, MD, MS, Kansas City, KS (Abstract Co-Author) Nothing to Disclose
- Jacqueline Hill, MPH, Kansas City, KS (Abstract Co-Author) Nothing to Disclose
- Amie Robinson, BS, RT, Kansas City, KS (Abstract Co-Author) Nothing to Disclose
- Shelby J. Fishback, MD, Kansas City, MO (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To determine if incorporating radiology residents into clinical rounds as consultants strengthens the relationship between referring clinicians and radiologists.

**METHOD AND MATERIALS**

In this prospective pilot study, senior radiology residents attended daily sit-down rounds with oncology, hematology, and pulmonary inpatient teams for four-week rotations during the 2014-2015 academic year. Radiology residents reviewed and discussed imaging studies and were available by dedicated mobile phone throughout the day for questions. Pre- and post-pilot surveys were distributed to clinicians and consulting radiology residents. Survey results were analyzed to measure the pilot's effect on clinician/radiologist relationships and overall patient care.

**RESULTS**

Analysis of 60 pre- and 47 post-pilot surveys revealed that referring clinicians find having dedicated time to review imaging during rounds is beneficial and useful for clinical knowledge. While only 38% of clinicians originally believed patients would benefit from incorporating a radiologist into rounds, this increased to 62% post-pilot (p=0.02). Further, 8 of 10 scaled responses measuring aspects of clinician/radiologist relationships increased, including clinician trust in radiology resident interpretation expertise (p=0.03) and clinicians' inclination to work directly with radiologists more often (p=0.004). Radiology residents (n=4) also reported a benefit, with 75% strongly agreeing that clinical team interaction improves exam interpretation (vs. 20% pre-pilot).

**CONCLUSION**

Clinicians, radiologists, and patients benefit from incorporating radiologists into daily clinical rounds, as evidenced by improved clinical relationships and perceived benefit to patient care. Our results suggest implementation of daily consultation between specialists is possible and can result in measurable patient care advantages.

**CLINICAL RELEVANCE/APPLICATION**

Developing methods to increase collaboration between radiologists and referring clinicians is crucial to improving diagnostic and patient management decisions in the digital technology era.

**SSG07-08 Emergency Radiology Evaluation: A Systematic Literature Review of Emergency Radiology Studies Assessing Efficiency, Workflow, Time, Throughput, Cost, and/or Productivity**

**Participants**
- Brian W. Bresnahan, PhD, Seattle, WA (Presenter) Stockholder, Johnson & Johnson;
- Daniel S. Hippe, MS, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company
- Claire K. Sandstrom, MD, Seattle, WA (Abstract Co-Author) Speaker, Siemens AG
- Michael McNeeley, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
- Bruce E. Lehnert, MD, Seattle, WA (Abstract Co-Author) Research support, Koninklijke Philips NV
- Daniel Wilmers, Seattle, WA (Abstract Co-Author) Nothing to Disclose
- Steven H. Mitchell, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
- Ken F. Linnau, MD, MS, Seattle, WA (Abstract Co-Author) Speaker, Siemens AG; Royalties, Cambridge University Press;

**PURPOSE**

To describe and characterize the emergency radiology published literature for studies reporting on efficiency, workflow, time, throughput, cost, and/or productivity.

**METHOD AND MATERIALS**

We conducted a systematic literature review via PubMed (prior to January 1, 2015), using search terms related to emergency radiology evaluation. Throughput, cost, and/or productivity.
department (ED), radiology, and efficiency-related topics. We used pre-specified criteria to screen abstracts and identify manuscripts for full text review. Manuscripts selected for analysis were assessed for study time period, countries, age of participants, modalities, comparators (if any), study design, and outcomes. We characterized studies and assessed trends in the frequency of manuscripts over time using a chi-squared test.

RESULTS
Our initial search identified 208 abstracts for screening with 124 meeting full text review criteria and 80 included in final analysis. The United States was included in 73% of studies, European countries (19%), with few studies in other countries (Table 1). Most studies were in adults (78%). Multiple imaging modalities were assessed, with CT-related questions being predominant (75%). The vast majority of articles (93%) were research related rather than specifying quality improvement or education. However, 54% of publications did not include a comparator intervention. Cohort and database studies were most prevalent, whereas there were few randomized trials. Fewer than 15% included either modeling or cost assessments. Outcome measures included time estimates of varying types, including time to imaging, time to diagnosis or decision, and time of ED length of stay. Time to event and ED length of stay were included in more than 50% of reported studies. We found an increased frequency of more recent studies when assessing trends in five-year, time-period groupings (p<0.001).

CONCLUSION
A systematic literature review identified limited publications assessing emergency radiology efficiency-related metrics. More high-quality studies, including randomized controlled trials and modeling evaluations are needed to better assess ED radiology throughput, workflow, productivity, and financial implications.

CLINICAL RELEVANCE/APPLICATION
Emergency Department throughput is a mandated reporting metric, however, the evidence base is limited for comparative, high-quality research studies assessing efficiency-related radiology processes.

SSG07-09  Health Service, Policy and Research Keynote Speaker: Preventing Errors in Radiology: Implementing Safety Culture and Systems Thinking

Participants
Kimberly E. Applegate, MD, MS, Zionsville, IN (Presenter) Nothing to Disclose
Informatics (Results and Reporting)
Tuesday, Dec. 1 10:30AM - 12:00PM Location: S402AB

SSG08-01  Follow that Patient! Follow-up of Patients with Abdominal Imaging Findings of Possible Cancer
Tuesday, Dec. 1 10:30AM - 10:40AM Location: S402AB

Participants
David S. Hirschorn, MD, Staten Island, NY (Moderator) Nothing to Disclose
Arnon Makori, MD, Chicago, IL (Moderator) Medical Advisory Board, Carestream Health, Inc

Background
Focal masses potentially representing cancer are commonly discovered in patients referred for abdominal imaging. Failure to properly follow-up patients with imaging findings of possible cancer can result in missed or delayed cancer diagnoses. Yet the proportion of patients in whom follow-up is not completed, but clinically appropriate, is poorly understood.

Evaluation
In July 2013 our radiology department implemented a mandatory coding scheme for reporting the malignant likelihood of focal masses in the adrenals, kidneys, pancreas and liver on all CT, MRI and ultrasound examinations. Focal masses with codes correlating to imaging findings of possible cancer were detected in 675 unique patients between 7/1/13 and 9/31/13 of whom 24% (164/675) expired within 30 days. Chart review within 15 months revealed that 40% of patients (268/675) received imaging follow-up, 7% (50/675) pathology follow-up, 5% (35/675) other methods of follow-up (e.g. specialist referral, change in therapy), 5% (37/675) had documented reasons for the lack of follow-up, and 17% (118/675) had no reason for lack of follow-up documented in the chart.

Discussion
Over half of patients with abdominal imaging findings possibly representing cancer receive imaging, pathology or clinical follow-up within 15 months of initial detection; most commonly through imaging (40%). Yet, nearly one fifth of patients receive no follow-up and have no reason for the lack of follow-up documented in the medical record. These patients are at risk for missed or delayed cancer diagnoses.

Conclusion
Reliable methods of monitoring patients with abdominal imaging findings of possible cancer are needed to identify the nearly one fifth of patients with no documented reason for lack of follow-up in the clinical chart. Providers caring for these patients should be contacted to determine the reason for no follow-up in order to improve the quality and safety of patient care.

SSG08-03  Lexical Disparities between Reports Authored by Residents and Reports Authored by Attending Radiologists Using Natural Language Processing
Tuesday, Dec. 1 10:50AM - 11:00AM Location: S402AB

Participants
Brian E. Chapman, PhD, Salt Lake City, UT (Presenter) Nothing to Disclose
Amilcare Gentili, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Stuart L. Schulthies, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose
Marta E. Heilbrun, MD, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose

Background
We explored using simple natural language processing tools to characterize radiology reports and identify lexical features that differed between reports generated by residents and reports generated by attending radiologists. In this initial exploration, we limited ourselves to the Impression section (IS) of the reports. Reports generated from October through December 2013 were analyzed. From the IS we extracted the following features: 1) the number of words in the IS, 2) the number of RadLex concepts in the IS divided by the number of words, 3) the number of uncertainty phrases in the IS divided by the number of words in the IS, 4) the polarity of the IS (whether the concepts were expressed in a negative, neutral, or positive manner), and 5) the subjectivity of the IS. RadLex concepts consisted of all preferred names and synonyms defined in the RadLex ontology. Uncertainty terms were identified using pyConTextNLP using a lexical knowledge base defined previously. Polarity and subjectivity were measured using the textblob Python package. A logistic regression model determined the statistical relationships between lexical features and report authorship.

Evaluation
61705 impression sections were analyzed, of these 35352 were generated by an attending without a resident and 26353 were
Discussion
Our results indicate that there are measurable lexical differences between resident and attending reports. Attending reports are shorter, use more standard terms, express more positive sentiment, as well as use more uncertain expressions. It is somewhat surprising that the residents expressed less uncertainty and warrants further investigation.

Conclusion
Our study has several limitations. We have not analyzed the results by service or experience level of the residents. Also, the distribution of authorship was not uniform across services. Mammography and nuclear medicine had significantly fewer resident reports than other services.

SSG08-04  Structured Reporting vs. Free Text Reporting of MRI Examinations of the Shoulder: Potential Impact on Surgical Planning

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S402AB

Participants
Marco Armbruster, Munich, Germany (Presenter) Co-Founder of medical software company.
Sebastian Gassenmair, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Florian Haasters, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Tobias Helfen, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Henler, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Maximilian F. Reiser, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Wieland H. Sommer, MD, Munich, Germany (Abstract Co-Author) Founder, QMedify GmbH
Nora N. Kammer, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare structured reports vs. standard free text reports of MRI examinations of the shoulder and to evaluate quality of reports, satisfaction of referring physicians and potential effects for surgical planning.

METHOD AND MATERIALS
We included 30 patients who underwent MRI of the shoulder for one of the following reasons: trauma, luxation or a possible tendon tear. Exclusion criteria were known tumors, previous shoulder operations or inflammatory diseases. We acquired both standard free text reports and structured reports, which were performed with an online software with dedicated templates and clickable decision trees with concomitant generation of semantic structured reports. The template was specific for MRI of the shoulder after trauma and/or degenerative lesions and included specific information relevant for surgical planning. All reports were evaluated with regard to their impact on clinical decision making, sufficiency for surgical planning, convenience of information extraction, linguistic quality, and referring physicians’ satisfaction.

RESULTS
Overall 30 structured and 30 free-text reports were reviewed by two orthopedic surgeons with long lasting experience in surgery of the shoulder (9 yrs, 6 yrs respectively). Decision making regarding surgery vs. conservative therapy was possible without further consultations in 87% of structured and 73% of free text reports. In case of surgery the provided information was considered to be sufficient for surgical planning in 87% of structured and 60% of non-structured reports. Overall, 17% of structured and 47% of free text reports were considered to be incomplete. The effort of information extraction from the reports was considered to be time-consuming in 17% of structured and 54% of free text reports (p<0.001). The linguistic quality was not rated different between structured and non-structured reports (p=0.1745).

CONCLUSION
Structured reporting of MRI of the shoulder facilitates clinical decision making and surgical planning and potentially leads to a higher satisfaction of referring physicians.

CLINICAL RELEVANCE/APPLICATION
Structured reporting of musculoskeletal MRI examinations with dedicated and specific templates is a valuable tool to provide standardized information to referring physicians.

SSG08-05  Pilot Study of a Global Radiology Report Categorization (RADCAT) System in the Emergency Department

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S402AB

Participants
David W. Swenson, MD, Brooklyn, CT (Presenter) Nothing to Disclose
Martha B. Mainiero, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose
Grayson L. Baird, MS, Providence, RI (Abstract Co-Author) Nothing to Disclose
David C. Portelli, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose
Jonathan S. Movson, MBChB, Providence, RI (Abstract Co-Author) Nothing to Disclose

PURPOSE
To develop a global categorization system for radiology reports in the emergency department, and to evaluate the inter-observer variation of the system as a first step in establishing its clinical utility.

METHOD AND MATERIALS
In collaboration, members from the departments of diagnostic imaging and emergency medicine developed a report categorization
system with 5 grades for characterizing the urgency of findings: RADCAT 1=Normal, 2=Routine, 3=Non-Urgent imaging follow-up recommended, 4=Priority (likely to affect treatment during the ongoing care episode), and 5=Critical (requiring immediate direct physician-to-physician communication). Four radiologists interpreted a minimum of 400 studies in the ED setting, assigning each report a RADCAT designation. 58 of these 1600 reports (without images) were selected as a representative sample, and re-categorized by 6 radiologists and 6 emergency medicine physicians, all blinded to the original RADCAT designation. Inter-observer agreement was assessed using Cohen’s Kappa statistic.

RESULTS

Inter-observer agreement was interpreted according to the guidelines of Landis and Koch. Among radiologists, agreement was excellent for RADCAT 1 (κ=0.83), substantial for RADCATs 2, 3, and 5 (κ=0.73, κ=0.68, and κ=0.71, respectively), and moderate for RADCAT 4 (κ=0.54). Among emergency physicians, agreement was excellent for RADCAT 1 (κ=0.85), substantial for RADCATs 2 and 5 (κ=0.70, κ=0.77, respectively), and moderate for RADCATs 3 and 4 (κ=0.51, κ=0.52, respectively). Among both groups combined, agreement was excellent for RADCAT 1 (κ=0.85), substantial for RADCATs 2, 3, and 5 (κ=0.74, κ=0.61, and κ=0.74, respectively), and moderate for RADCAT 4 (κ=0.54). Overall agreement for RADCAT designations of all physicians was substantial (κ=0.65).

CONCLUSION

The RADCAT system for globally characterizing radiology reports may provide a valuable shorthand for communication between radiologists and emergency medicine physicians interacting through the electronic medical record, with substantial interobserver agreement demonstrated on this initial pilot study.

CLINICAL RELEVANCE/APPLICATION

We demonstrate a system for improving efficiency and fidelity of communicating information through radiology reports.

SSG08-06 Use of Conditional Statements in Radiology Follow–Recommendation Sentences: Relationship to Follow Up Compliance

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S402AB

Participants

Martin L. Gunn, MBChB, Seattle, WA (Presenter) Research support, Koninklijke Philips NV; Spouse, Consultant, Wolters Kluwer NV; Medical Advisor, TransformativeMed, Inc;
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PURPOSE

A significant proportion of patients do not receive timely follow-up (F/U) investigations that are recommended in radiology reports. Automated tools to detect, flag, and communicate F/U recommendations may increase the rate of follow-up, but risk alert-fatigue or over-reliance. The purpose of this study is to determine the correlation between conditional statements (CS) (hedge statements) in follow-up recommendation sentences (FURS) of radiology reports and the rate of F/U.

METHOD AND MATERIALS

A regular expression automated natural language processing (NLP) technique was developed to detect FURS in all radiology reports (1.6m) from 2010 to 2014 at a large multi-hospital academic radiology department. The NLP algorithm was validated using a sample of radiology reports. A representative cohort (n=355) of records containing FURS was extracted and a single expert reader (blinded to whether F/U occurred) evaluated full reports for the presence of CS; F/U timeframe, modality, and expectation of whether F/U was necessary/probable based on the entire text of the report (E=0,1,2 where 0=little, 1=moderate, and 2=high/definite). In a second phase, the expert reader determined whether the F/U occurred. A Chi-squared test was used with p < 0.05 considered statistically significant.

RESULTS

In the sample, CS’s occurred in 125/355 reports with FURS (35.2%). Appropriate F/U rate was 55.5%. CS’s occurred more in ED patients (46.3%) vs inpatient (43.1%, p<0.02) and outpatient settings (26.2%, p<0.001). FURS containing CS had lower follow-up compliance than FURS without CS (36% vs. 66%, p<0.001). The rate of CS dropped with expectation of follow up (59.4, 36.7, 16.7% with E=0, 1,2; p<0.001). However, in cases with high/definite expectation of follow-up (E=2), the rate dropped from 78.8% for no CS to 43.8% where CS’s were present (p<0.001).

CONCLUSION

This study confirms low follow-up compliance. Conditional statements in FURS are associated with a significantly lower rate of follow-up than FURS without CS.

CLINICAL RELEVANCE/APPLICATION

Radiologists may use conditional statements in recommendation sentences for less clinically important F/U recommendations. However, these CS are associated with a lower overall rate of F/U. When developing automated tools for to detect F/U compliance, the presence of CS could be incorporated into an NLP algorithm, potentially improving specificity of the system for the detection of important failures to F/U.

SSG08-07 Enabling Real-time Epidemiological Statistics Through Structured Reporting: Single-center Experience for the Incidence of Pulmonary Embolism

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S402AB

Participants

Daniel Pinto dos Santos, MD, Mainz, Germany (Presenter) Nothing to Disclose
Gordon Klos, Mainz, Germany (Abstract Co-Author) Nothing to Disclose
**SSG08-08** Support-Vector Machine Classification of Indexed Keyword Search Results: Providing Context to Keywords

**Tuesday, Dec. 1 11:40AM - 11:50AM Location: S402AB**

Participants
Jaron Chong, MD, Montreal, QC (Presenter) Nothing to Disclose
Benoit P. Gallix, MD, PhD, Montpellier, France (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Keyword-indexed based retrospective searches of full-text radiology reports provide a powerful tool for the interactive identification of case series and population cohorts from large databases. While keyword searches are effective for rare terms, diseases, or keywords, keywords alone prove particularly limited in circumstances where a condition is used very frequently with heterogeneous meanings and contexts. We propose a support-vector machine learning workflow to improve the specificity of full-text keyword searches.

**METHOD AND MATERIALS**

This proposal outlines and explores an approach drawn from natural-language processing research used in informatics and linguistics by utilizing a statistically-based machine learning technique to infer associations in words frequencies from labeled examples. In our specific, we attempt to classify sentences containing the word 'appendicitis' into multiple contexts of meaning, specifically: 1-Positive, 2-Negative, 3-Clinical History, 4-Atypical and report upon both the classification performance characteristics of such a system, potential pitfalls and limitations to the technique, as well as the relationship between performance and a progressively expanded training set.

**RESULTS**

1000 CT Abdomen/Pelvis full-text reports narrative reports were parsed and analyzed. Classification performance began 86.5% and steadily rose to 95.3% after 500 examples of tagged reports were provided at which point classification performance ranged between 93.8 - 96.8% successful classification. Classifications of both 1-Positive or 2-Negative appendicitis were generally highly reliable as were classification of 3-Clinical History. Classifications of 4-Atypical sentences had the greatest relative unreliability with only 13 re-classifications out of 1000 reports. Performance and generation of the SVM models were instantaneous on standard commodity computer hardware.

**CONCLUSION**

The application of support-vector machines is a reliable and successful method for narrative text classification and paired with a full-text indexed search engine allows for powerful contextual language analysis.

**CLINICAL RELEVANCE/APPLICATION**

Support-vector machines provide a novel and practical method of labeling and inferring context of keywords which can be used to increase the specificity of full-text indexed searches.

**SSG08-09** Initial Experience with Multi-Media and Quantitative Tumor Reporting Appears to Improve Oncologist Efficiency in Assessing Tumor Burden

**Tuesday, Dec. 1 11:50AM - 12:00PM Location: S402AB**

Participants
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Alireza Asary Yazdi, MD, MPH, Bethesda, MD (Abstract Co-Author) Research agreement, Carestream Health, Inc
Melinda Merchant, Bethesda, MD (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To explore the possibilities for real-time epidemiological metrics using data from a database of structured reports created using IHE MRRT-compliant templates.

**METHOD AND MATERIALS**

After the implementation of a browser-based tool for structured reporting we analyzed all patients from 2013 to 2015 referred from the emergency department to our department for CT because of clinically suspected pulmonary embolism. Radiological reports were read and reformatted using a dedicated MRRT-compliant template for structured reporting. All structured reports were stored in a dedicated MySQL database and various epidemiological metrics were calculated.

**RESULTS**

All relevant data was easily accessible from the MySQL database and was automatically recalculated when more patients were added to the database. After evaluating 521 cases, the calculated incidence of pulmonary embolism was 0.24 for this collective. Mean age for patients with pulmonary embolism was 61.6 and for those without 62.4. Patients with pulmonary embolism had a mean D-Dimer of 13.25 mg/l FEU whereas those without had 2.5 mg/l FEU.

**CONCLUSION**

This proof-of-concept demonstrates that when using structured reporting with meaningful templates and storing results in an accessible database any desired metric can be easily calculated in real time.

**CLINICAL RELEVANCE/APPLICATION**

We demonstrate the benefits of structured reporting. If radiologists adopt structured reporting, analyses can be easily performed in real-time for any desired metric that is included in a respective reporting template.
PurPOSE

Tumor assessment by Computed Tomography (CT) has become essential to oncologists in determining the therapeutic response of the metastatic tumor burden in cancer patients on therapeutic trials. This is done by measurement of a subset of "target" metastatic lesions on baseline and follow-up CTs. From these measurements, a quantitative assessment of the change in tumor burden over time is calculated. Traditionally, radiologists' CT reports do not consistently include these measurements. One major reason is the time and effort needed to identify target tumors on follow-up scans and making measurements. Instead, the measurements are commonly obtained from images by the oncologists themselves or with the radiologist in a tumor measurement session/consultation. A recent survey we performed at our institution demonstrated that 1) oncologists spend an excessive amount of time making measurements or searching for measurements buried in our reports and matching them to the images in PACS, and 2) oncologists and radiologists prefer measurements in reports be hyperlinked to annotated images. In an effort to improve the content and utility of CT reports for oncologists, we embarked on a collaboration with our PACS vendor (Carestream Health, Rochester, NY) to explore the addition of capacities to PACS that would facilitate the generation of tumor measurement data by the radiologist and presentation in a Multi-media (MM) report with hyperlinks to images that would enable efficient use by oncologists. The recent PACS upgrade we helped develop (v 12.0 Vue PACS) includes the hyperlink capacity and tables and graphs as part of the report, and tools that facilitate lesion identification and quantification (temporal image registration, lesion segmentation and serial 3D localization of measurements; measurement on current exam is automatically related to measurements on prior exams). In this pilot study, we assessed the impact of the PACS upgrade on the timing of radiologists in generating and of oncologists in using MM reports on cancer patients.

RESULTS

Radiologists' average dictation times were 11.9 (±5.6) and 12.6 (±4) minutes, before and after PACS upgrade, respectively. Although the reporting time has increased after PACS upgrade, the observed difference was not statistically significant in our study (P value = 0.53). This timing is on par with an average day on CT service in that it takes about 6 hours to dictate and measure 25 complex cancer follow-up cases at our institution. Average time for an oncologist to assess tumor burden initially (text-only reports) was 15.4 (±5.9) minutes. Average time for oncologist to assess tumor burden using the multimedia reports was 6.2 (±2.9) minutes for a mean time savings of 8.9 minutes (Range 5-14 minutes per study) when used the MM report to enter data into study forms (P<0.001).

CONCLUSION

Our pilot study results demonstrate that multimedia reports with data tables and hyperlinks to measurements on key images of target lesions facilitate analysis of tumor response by oncologists resulting in a significant time savings. These MM reports may be generated by radiologists without significant increase in reporting times. We anticipate in our facility alone up to 6-10 hours work by each team of oncologists and research staff could be saved using MM presentation. Although we measured time to complete the work by radiologists and oncologists, time is not the only domain that will be impacted by this innovation. With time saved and more straightforward presentation of data through quantitative MM reports, further studies in larger, more controlled settings can further test if MM reports are a more effective provision of care by improving oncologist's decisions and patient outcomes. Leveraging technology that provides professional-appearing content and media-rich reporting including links to images, reports, and the images may also become increasingly important to patients with the more widespread use of patient portals.

METHODS

Two radiologists recorded the times it took them to dictate CT exams (of the Chest, Abdomen and Pelvis) in which they measured target lesions on 20 consecutive cancer patients on therapeutic trials before and after the PACS upgrade. The difference between the average times was tested using permutation test. Additionally, an oncologist recorded the times to extract and tabulate target lesion measurements on 10 CT studies of five synovial sarcoma patients that had been reported prior to the PACS upgrade. The timing was also recorded for the same process on the MM reports of the same patients after these reports became available. The permutation test of paired samples was used to compare the mean time differences between extracting the needed data from traditional text only and MM reports by the oncologist.
**First Clinical Trial on Ultrasound Molecular Imaging Using KDR-Targeted Microbubbles in Patients with Breast and Ovarian Lesions**

**Participants**
Kathryn A. Morton, MD, Salt Lake City, UT (Moderator) Nothing to Disclose
Zaver M. Bhujwalla, PhD, Baltimore, MD (Moderator) Nothing to Disclose

**Method and Materials**
21 women (34-66 yrs) with focal breast lesions and 24 women (48-79 yrs) with focal ovarian lesions were injected IV with BR55 (0.03-0.08 mL/kg bw) and 2D USMI of the target lesions was performed dynamically every 2 min starting 5 min after injection up to 29 min, using the linear 15L8 probe (Siemens) or the endocavitary 1123 probe (Esaote). Normal breast tissues surrounding the lesion or the contralateral presumed normal ovary served as intra-patient controls. Blood pressure, EKG, oxygen levels, heart rate, CBC, and metabolic panel were obtained before, and 30 min, 1h, 24h after BR55 administration. Persistent focal BR55 binding on USMI was visually assessed in consensus by 2 blinded offsite radiologists as none, possibly or definitely. Patients underwent surgical resection of the target lesions and tissues were stained for CD31 and KDR. A pathologist assessed vascular KDR expression using a 4-point scale (none, weak, intermediate, high). Adjudication was performed in consensus (offsite radiologists and pathologist) to match clinically.

**Results**
USMI with BR55 was well tolerated by all patients at all doses, without safety concerns. Among the 40 patients included in the analysis, KDR expression was higher in malignant breast and ovarian lesions (score 2.40±0.63 and 2.08±0.64, respectively) compared to benign breast and ovarian lesions (2.08±0.64 and 1.33±0.50). KDR expression matched well with presence of focal BR55 binding on USMI in malignant breast (13/15; 86.7%) and ovarian (11/13; 84.6%) lesions, as well as benign breast (2/3; 66.7%) and ovarian (8/9; 88.9%) lesions. Focal USMI signal could be detected up to 29 min after injection.

**Conclusion**
Use of BR55 in USMI of breast and ovarian lesions is safe and effective and preliminary data indicate that KDR-targeted USMI signal matches well with vascular KDR expression on IHC.

**Clinical Relevance/Application**
This study provides proof of principle on feasibility and safety of KDR-targeted USMI in patients with breast and ovarian lesions and lays the foundation for further clinical trials.
Further work on FACBC as a radiotracer in locally advanced breast cancer is warranted.

**METHOD AND MATERIALS**

64Cu-DOTA-cetuximab (ab’)2 was prepared from cetuximab monoclonal antibody and probe affinity for EGFR assessed. A panel of TNBC cell lines (MDMBA468, MDMBA231, HCC70) was treated with the AKT inhibitor GDC-0068 or the PI3K inhibitor GDC-0941 for one day at a range of concentrations. Following treatment, we assessed in vitro EGFR probe uptake. In vitro uptake study results were compared to protein quantification as assessed by Western blot. After treatment of HCC70 mouse xenografts with control, GDC-0068, or GDC-0941 for two days, PET-CT imaging of HCC-70 tumors with 64Cu-DOTA-EGFR F(ab´)2 was performed.

**RESULTS**

In vitro treatment with GDC-0068 resulted in increased EGFR Probe uptake of 25%, 139%, and 16% for MDAMB468, MDMBA231, and HCC70, respectively. In vitro treatment with GDC-0941 resulted in increased EGFR uptake of 6%, 87%, and 88%, for the same panel of cell lines. In vitro uptake studies demonstrate close correlation with changes in EGFR expression as assessed by Western blot. In vivo imaging of HCC70 mouse xenografts with EGFR PET Probe after treatment with control, GDC-0068, or GDC-0941 demonstrate SUVmean of 0.32 (±0.03), 0.50 (±0.01), 0.62 (±0.01), with all comparisons significant (p<0.01).

**CONCLUSION**

We demonstrate in a murine model of triple-negative breast cancer that changes in EGFR expression induced by targeted therapeutics can be non-invasively assessed using a 64Cu-DOTA-EGFR F(ab´)2 PET imaging probe. We demonstrate that changes in the level of EGFR expression, potentially indicative of therapeutic response, differ depending on the growth-pathway inhibited.

**CLINICAL RELEVANCE/APPLICATION**

Noninvasive assessment of changes in EGFR expression could be a valuable clinical tool for rapid assessment of therapeutic efficacy of targeted growth pathway inhibitors in TNBC, allowing for dynamic clinical decision making in response to imaged resistance profiles.

**SSG09-03 FACBC PET/CT Before and After Neoadjuvant Therapy in Locally Advanced Breast Cancer: A Prospective Pilot Clinical Trial**

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S504CD

Participants
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Jason S. Lewis, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Genes for amino acid transport proteins are highly upregulated in both invasive ductal carcinoma (IDC) and ILC, as compared to normal breast epithelium. This molecular phenotype may allow for the development of imaging agents based on amino acid metabolism. We evaluated whether Fluorine-18 labeled 1-amino-3-fluorocyclobutane-1-carboxylic acid (FACBC), an amino acid analog labelled with fluorine-18, could be used as an imaging agent for local staging of locally advanced breast cancer before and after neoadjuvant therapy.

**METHOD AND MATERIALS**

This prospective clinical trial is being performed under IRB approval. In this trial, newly diagnosed breast cancer patients that are planned for neoadjuvant systemic therapy followed by surgical resection undergo FACBC PET/CT prior to systemic therapy and then again following completion of systemic therapy. Maximum Standardized Uptake Values (SUVmax) and other quantitative measures of FACBC-avidity are measured for the primary breast tumor and nodal metastases before and after systemic therapy. Following surgery, FACBC results are correlated with postoperative histopathologic results.

**RESULTS**

Of 28 planned patients, we have currently accrued 23. All 23 accrued patients have undergone the pre-neoadjuvant therapy FACBC PET/CT. All 23 primary breast lesions were FACBC avid with SUVmax values of 2.3 to 17.5. 18 of 23 patients (78%) had FACBC avid axillary nodes with SUVmax values of 1.2 to 14.6. In 2 of 23 patients (9%), an unsuspected extra-axillary local nodal metastasis was detected on the pre neoadjuvant therapy FACBC PET/CT. SUVmax of these nodes was 2.1 and 2.2, and both were pathologically proven to be metastases. 15 of 23 patients (65%) have completed both pre- and post-neoadjuvant PET/CT scans and histological analysis following surgical resection. In 13 of these 15 patients (87%), a reduction of SUVmax in the primary breast cancer of greater than 90% could accurately identify the presence or absence of complete response/near complete response as defined by post surgical histologic analysis.

**CONCLUSION**

This pilot trial of FACBC PET/CT in locally advanced breast cancer demonstrates potential uses of FACBC PET/CT before and after neoadjuvant therapy.

**CLINICAL RELEVANCE/APPLICATION**

Further work on FACBC as a radiotracer in locally advanced breast cancer is warranted.

**SSG09-04 Operation-naïve Invasive Ductal Carcinoma of the Breast. Comparison of Staging Performed with**
Whole Body DWI, PET, PET-CT, and PET-MR

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S504CD

Participants
Onofrio A. Catalano, MD, Napoli, Italy (Presenter) Nothing to Disclose
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Mark Vangel, PhD, Charlestown, MA (Abstract Co-Author) Nothing to Disclose
Marco Catalano, Napoli, Italy (Abstract Co-Author) Nothing to Disclose
Umar Mahmood, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;
Emanuel Nicolai, Napoli, Italy (Abstract Co-Author) Nothing to Disclose
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PURPOSE
To compare the performance of whole body (WB) DWI, WB-PET, WB-PETCT, and WB-PETMR in patients with newly diagnosed invasive ductal breast cancer, before undergoing treatment.

METHOD AND MATERIALS
49 consecutive women with newly diagnosed invasive ductal carcinoma of the breast underwent WB-DWI, WB-PET, WB-contrast enhanced (CE) PETCT and WB-CE-PETMR before treatment. A radiologist and a nuclear medicine physician evaluated in consensus the studies and searched for occurrence, number, and location of metastases. Final staging and number of lesions, according to each technique, were compared. Pathology and imaging follow up were used as the ground truth reference.

RESULTS
All the techniques correctly staged 32/49 patients: stage2b in 8, 2c in 7, 3c in 4, 4 in 13. They provided discordant stages in 17/49 patients: 1 (stage 2a): staged-4 by WB-PET; 4 (stage 2b): 3/4 staged-2a by WB-PET and WB-PETCT, 1/4 staged-4 by WB-DWI;3 (stage 3a): 2/3 staged-2b by WB-PET and WB-PETCT, 1/3 staged-4 by WB-DWI;3 (stage 3c): 2/3 staged-2a by WB-PET and WB-PETCT, 1/3 staged-4 by WB-PET and WB-PETCT;6 (stage 4): 1/6 staged-3a by WB-PET, WB-DWI, and WB-PETCT, 1/6 staged-2b by WB-PET and WB-PETCT, 1/6 staged-2b by WB-DWI, and WB-PET, 1/6 staged-2a by WB-DWI, 1/6 staged-3c by WB-DWI, and 1/6 staged-3a by WB-PET, WB-PETCT and 3c by WB-DWI. Staging performance of WB-PETMR (49 correctly staged) was significantly better than WB-PETCT (38 correctly staged) (P<0.001, chi square-test). The best performing modality for malignant lymph-node detection was WB-PETMR (47 of 49 patients), followed by WB-DWI (37/49), followed by WB-PET and WB-PETCT (15 patients each). Significantly more malignant nodes were detected by WB-PETMR (P<0.0001, paired t-tests). At least as many true-positive lesions were detected by WB-PETMR than by any of the other three modalities for 46 patients. The corresponding number of patients for WB-PET, WB-PETCT, and WB-DWI were 40, 39 and 34, respectively.

CONCLUSION
PETMR allows a better accuracy in initial staging of surgical-naive ductal invasive breast cancer. The higher performance is likely related to the additive information of PET, DWI, as well as of the other sequences (STIR, T1-weighted Dixon, HASTE, ADC maps, and CE-T1 weighted images) of WB-PETMR.

CLINICAL RELEVANCE/APPLICATION
When available WB-PETMR should be considered for proper staging of naive ductal invasive breast cancer.

SSG09-05 Multiparametric 18F-FMISO PET/MRI for Assessment of Treatment Response to Chemo-radiation and Hypoxia Monitoring in Cervix Cancer Patients: A Feasibility Study

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S504CD

Participants
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Katja Pinker, MD, New York, NY (Presenter) Nothing to Disclose

PURPOSE
To demonstrate feasibility of combined multiparametric positron emission tomography/magnetic resonance imaging at 3T (3T MP PET/MRI) and to assess treatment response and hypoxia monitoring in cervix cancer patients undergoing chemo-radiation therapy.

METHOD AND MATERIALS
In this IRB-approved prospective study 7 patients underwent sequential 3T MP 18F-FMISO PET/MRI at baseline; 2 and 5 weeks (w) after start and 3 months (FU) after treatment. MRI protocol consisted of a high-resolution isotropic T2-w SPACE, a DWI EPI (b=50/850 sec/mm²) and a high-resolution contrast-enhanced (CE) T1-w VIBE sequence. Patients were injected with 330 MBq 18F-FMISO and scanning was started 240 min after injection. CT data was used for attenuation correction. PET and MR image registrations were performed using Mirada RTx (Mirada Medical, Oxford, UK, ver. 1.4.0.23) software. Gross tumour volume (GTV)
was contoured by an experienced radiation oncologist on PET/MRI data sets. The volume of GTV was assessed for tumor size, CE-kinetics, restricted diffusivity and 18F-FMISO-avidity using SUVmax and SUV (SUVnorm) normalized to gluteal muscle uptake. At follow up, cervix was contoured, since all patients showed clinically complete remission.

RESULTS

3T MP 18F-FMISO PET/MRI was successfully performed in all patients at every time-point. Median GTV volume was 43.9 cc at baseline, 22.4 cc after 2w (20-25 Gy) and 7.7 cc after 5w (40-45 Gy). Mean ADC values were 1.02 ± 10^(-3) mm^2/sec increasing to 1.18 ± 10^(-3) mm^2/sec after 2w and to 1.27 ± 10^(-3) mm^2/sec after 5w and to 1.37 ± 10^(-3) mm^2/sec at FU. All GTVs showed mean initial-enhancement (IE) followed by a plateau with an increasing IE at 2w and 5w and wash-out at 5w. At FU, there was a persistent enhancement. The mean 18F-FMISO SUVnorm was 3.1 at baseline and decreased to 2.3 at 2w and 2.0 at 5w and follow-up. In all patients there was never the whole tumor 18F-FMISO-avid, but 18F-FMISO-avid spots within the tumor indicative of hypoxia could be identified before and during the course of therapy.

CONCLUSION

MP 18F-FMISO PET/MRI in cervix cancer patients at 3T is feasible and enables non-invasive monitoring of morphological and functional changes during treatment.

CLINICAL RELEVANCE/APPLICATION

3T MP 18F-FMISO PET/MRI can depict areas of tumor hypoxia during therapy and thus identify patients at risk who need an aggressive treatment approach.

SSG09-06 Correlation of PET-MR Biomarkers with Breast Cancer Molecular Subtypes, Grading and Presence of Distant Metastases at Time of Presentation

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S504CD

Participants
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Umar Mahmood, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;
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Andrea Sorcelli, MD, Napoli, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate if PET-MR biomarkers correlate with molecular genetic subtypes, grading, and presence of distant metastases at time of presentation in naïve ductal invasive breast cancers.

METHOD AND MATERIALS

21 consecutive patients with naïve ductal invasive breast cancer and genetic molecular subtype profiling underwent whole-body contrast enhanced FDG-PET-MR (Biograph mMR, Siemens). Two readers, using commercially available software, measured the following PET-MR biomarkers: ADC, Ktrans, Ve, Kep, IAUC, SUVmax, SUVmean, and MTV. They were correlated with genetic molecular subtypes, grading and occurrence of distant metastases.

RESULTS

Genetic molecular subtypes were as follows: ER-7, ER+14; PR- 8, PR+ 13; HER2-11, HER2+10; Ki67-low (<=35%), Ki67 medium/high (>35%). Grading was G2 in 14 and G3 in 7. Six patients had distant metastases. The following biomarkers were higher in the ER- and PR- compared to ER+ and PR+ patients: Kep (923±1320 versus 6492±2358, p=0.01), SUVmax (14.19±7.17 versus 6.17±4.24, p=0.04), and SUVmean (8.44±4.01, p=0.004). ADC directly correlated with the degree of Ki67 expression (1019±256 for Ki67<=35%, 1338±105 for Ki67>35%). Grading was G2 in 14 and G3 in 7. Six patients had distant metastases. The following biomarkers were lower in HER2- patients compared to HER2+ cases: ADC, Ktrans, Ve, Kep, IAUC, SUVmax, SUVmean, and MTV. They were correlated with genetic molecular subtypes, grading and occurrence of distant metastases.

CONCLUSION

In naïve ductal invasive breast cancers, PET-MR biomarkers correlate with molecular genetic subtypes and with grading, but not with the presence of distant metastases.

CLINICAL RELEVANCE/APPLICATION

PET-MR biomarkers might have prognostic and therapeutic implications on patients’ management.

SSG09-07 Impact of Estrogen Receptor Gene Mutations on [18F]-Fluoroestradiol Uptake in Breast Cancer

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S504CD

Participants
Manoj Kumar, MS, Madison, WI (Abstract Co-Author) Nothing to Disclose
Ginny L. Powers, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Justin Jeffery, Madison, WI (Abstract Co-Author) Nothing to Disclose
Yongjun Yan, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Amy M. Fowler, MD, PhD, Saint Louis, MO (Presenter) Nothing to Disclose
PURPOSE

Accurately predicting therapeutic responsiveness in women with breast cancer remains challenging. Positron emission tomography (PET) imaging using [18F]-16alpha-17beta-fluoroestradiol (FES) provides a way to non-invasively and longitudinally examine the subset of tumors expressing estrogen receptor alpha (ERα) which comprise approximately 70% of all breast cancers. However, the effect of mutations in the gene encoding ERα, recently identified in patients with endocrine-resistant, metastatic breast cancer, on FES uptake is unknown. We developed a model system to test how mutations in ERα influence the uptake of FES.

METHOD AND MATERIALS

Stable cell lines expressing either wild-type ERα (231-ER) or a point mutation in the ligand-binding pocket, G521R (231-G521R), were created in the ERα-negative human breast cancer cell line MDA-MB-231. ERα-positive MCF7 human breast cancer cells were used as a positive control and parental MDA-MB-231 cells were used as a negative control. Cell uptake of FES was measured in vitro with microPET/CT imaging and gamma counting. In addition, in vivo FES uptake was measured in MCF7 and 231-ER tumors grown as xenografts in athymic nude mice.

RESULTS

FES uptake was observed both in vitro and in vivo in the MCF7 and 231-ER cells/tumors. However, there was no significant FES uptake in the 231-G521R cells or parental MDA-MB-231 cells. The 231-ER cells had a similar dose response curve to MCF7 in competition assays using increasing doses of cold estradiol, and as consistent with the uptake data, 231-G521R binding was not altered by cold competition.

CONCLUSION

These data support the use of stable cell lines expressing variant forms of ERα as models for demonstrating the effects of ERα gene mutations on FES uptake. Ongoing studies are focusing on the effects of recently identified clinically-relevant ERα mutations on FES uptake and on the prediction of response to ER-targeted therapies.

CLINICAL RELEVANCE/APPLICATION

FES-PET imaging provides a non-invasive way to probe ERα function and may prove useful in identifying the development of ERα gene mutations and thus predicting endocrine resistance in ERα-positive breast cancer patients.

SSG09-09 Imaging Patients with Breast and Prostate Cancers Using Combined 18F NaF/18F FDG and TOF simultaneous PET/ MRI

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S504CD

Participants

Ryogo Minamimoto, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose
Andreas M. Loening, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Valentina Taviani, PhD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Sanjiv S. Gambhir, MD, PhD, Stanford, CA (Abstract Co-Author) Board Member, Enlight Biosciences; Board Member, ImaginAb, Inc; Board Member, FUJIFILM Holdings Corporation; Board Member, ClickDiagnostics, Inc; Consultant, FUJIFILM Holdings Corporation; Consultant, Gamma Medica, Inc; Speaker, ImaginAb, Inc; Stock, Enlight Biosciences; Stock options, Enlight Biosciences; Travel support, Gamma Medica, Inc
Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (Abstract Co-Author) Research collaboration, General Electric Company; Consultant, Arisys; Research Grant, Bayer AG; Andrei Iagaru, MD, Stanford, CA (Abstract Co-Author) Research Grant, General Electric Company; Research Grant, Bayer AG

PURPOSE

We previously reported the pilot evaluation of a simultaneous PET/MRI scanner with TOF capability, as well as the use of combined 18F NaF/18F FDG PET/CT in cancer patients. Here we prospectively compared the combined 18F NaF/18F FDG PET/MRI against 99mTc-MDP in patients with breast and prostate cancers for the detection of metastatic disease.

METHOD AND MATERIALS

Fifteen patients referred for 99mTc-MDP bone scans were prospectively enrolled from Oct 14 - Mar 15. The cohort included 7 men with prostate cancer and 8 women with breast cancer, 41 - 85 year-old (average 61 ± 13). 18F NaF (0.7-2.2 mCi, mean: 1.2 mCi) and 18F FDG (3.8-5.2 mCi, mean: 4.2 mCi) were subsequently injected from separate syringes. The PET/MRI was done 6-30 days after bone scan. The whole body MRI protocol consisted of T2-weighted, DWI, and contrast-enhanced T1-weighted imaging. Lesions detected with each test were tabulated and the results were compared.

RESULTS

All patients tolerated the PET/MRI exam, and PET image quality was diagnostic despite the marked reduction in the administered dosage of radiopharmaceuticals (80% less for 18F NaF and 67% less for 18F FDG compared to standard protocols). Five patients had no bone metastases identified on either scans. Bone scintigraphy and PET/MRI showed osseous metastases in 9 patients, but more numerous bone findings were noted on PET/MRI than on bone scintigraphy in 3 patients. One patient had negative bone scan, but bone metastases were seen on PET/MRI. Lesions outside the skeleton were identified by PET/MRI in 3 patients.

CONCLUSION

The combined 18F NaF/18F FDG PET/MRI is superior to 99mTc-MDP scintigraphy for evaluation of skeletal disease extent. Further, it detected extra-skeletal disease that may change the management of these patients, while allowing a significant reduction in radiation exposure from lower doses of PET radiopharmaceuticals administered. A combination of 18F NaF/18F FDG PET/MRI may provide the most accurate staging of patients with breast and prostate cancers prior to the start of treatment.

CLINICAL RELEVANCE/APPLICATION

The combined 18F NaF/18F FDG PET/MRI is superior to 99mTc-MDP scintigraphy for evaluation of skeletal disease extent.

SSG09-09 In Vivo Assessment of Ovarian Tumor Response to Tyrosine Kinase Inhibitor Pazopanib using Hyperpolarized 13C-Pyruvate MRS and 18F-FDG PET/CT Imaging in a Mouse Model

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S504CD

Participants

Iagaru, MD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Minamimoto, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose
Sanjiv S. Gambhir, MD, PhD, Stanford, CA (Abstract Co-Author) Board Member, Enlight Biosciences; Board Member, ImaginAb, Inc; Board Member, FUJIFILM Holdings Corporation; Board Member, ClickDiagnostics, Inc; Consultant, FUJIFILM Holdings Corporation; Consultant, Gamma Medica, Inc; Speaker, ImaginAb, Inc; Stock, Enlight Biosciences; Stock options, Enlight Biosciences; Travel support, Gamma Medica, Inc

PURPOSE

FES-PET imaging provides a non-invasive way to probe ERα function and may prove useful in identifying the development of ERα gene mutations and thus predicting endocrine resistance in ERα-positive breast cancer patients.

METHOD AND MATERIALS

FES uptake is unknown. We developed a model system to test how mutations in ERα influence the uptake of FES.

RESULTS

FES uptake was observed both in vitro and in vivo in the MCF7 and 231-ER cells/tumors. However, there was no significant FES uptake in the 231-G521R cells or parental MDA-MB-231 cells. The 231-ER cells had a similar dose response curve to MCF7 in competition assays using increasing doses of cold estradiol, and as consistent with the uptake data, 231-G521R binding was not altered by cold competition.

CONCLUSION

These data support the use of stable cell lines expressing variant forms of ERα as models for demonstrating the effects of ERα gene mutations on FES uptake. Ongoing studies are focusing on the effects of recently identified clinically-relevant ERα mutations on FES uptake and on the prediction of response to ER-targeted therapies.
Purpose

Early response measures for ovarian cancer are needed for common targets such as tyrosine kinases. Via effects on signaling within tumor cells or via effects on angiogenesis, such inhibitory drugs have the potential to alter tumor metabolism. 18Fluorodeoxyglucose (18F-FDG) mimics glucose and can be used to evaluate early glycolysis. Hyperpolarization magnetic resonance spectroscopy (MRS) imaging can be used to study pyruvate, which can be produced by glycolysis and other pathways and sits at a decision point for aerobic versus anaerobic metabolism. Our purpose was to assess whether either early or late components of metabolism can serve as indicators of response of ovarian cancer to tyrosine kinase inhibitor (including angiogenesis inhibitor via VEGF receptor inhibition) Pazopanib.

Method and Materials

Seventeen days after injection of 2 x 106 human ovarian SKOV3 tumors cells into female nude mice, treatment with vehicle or Pazopanib (2.5 mg/mouse po) was initiated. Longitudinal T2-weighted MR, hyperpolarized pyruvate MRS, and 18F-FDG PET/CT imaging were performed pre-treatment as well as 2 days and 2 weeks after treatment.

Results

Pazopanib was effective in inhibiting ovarian tumor growth compared to control (p<0.05). Significantly higher pyruvate to lactate conversion (lactate/pyruvate+lactate ratio) was found 2 days after treatment with pazopanib compared to pre-therapy (p<0.005, n=8). This was not seen with control or with 18F-FDG PET/CT imaging.

Conclusion

Findings suggest that later metabolic events (pyruvate to lactate conversion) may serve as an early indicator of response of ovarian cancer to tyrosine kinase (angiogenesis) inhibitor pazopanib in mouse models, even when early glycolytic events do not.

Clinical Relevance/Application

Hyperpolarized 13C-Pyruvate MRS may serve as an early indicator of response to tyrosine kinase (angiogenesis) inhibitors such as pazopanib in ovarian cancer even when 18F-FDG PET/CT does not.
**SSG10**

**ISP: Musculoskeletal (Hand and Wrist)**

**Tuesday, Dec. 1 10:30AM - 12:00PM Location: E450B**

**Participants**
Mary G. Hochman, MD, West Roxbury, MA (Moderator) Stockholder, General Electric Company; Stock options, Nomir Medical Technologies, Inc; Author, UpToDate, Inc
Mary M. Chiavaras, MD, PhD, Ancaster, ON (Moderator) Nothing to Disclose

**Sub-Events**

**SSG10-01**  **Musculoskeletal Keynote Speaker: MR Evaluation of the Hand-Technique and Application**

**Tuesday, Dec. 1 10:30AM - 10:50AM Location: E450B**

**Participants**
Jean-Luc Drape, MD, PhD, Paris, France (Presenter) Nothing to Disclose

**ABSTRACT**

To optimize MRI of fingers nine technical points should be especially checked: (1) the choice of the surface coil according to the clinical findings, (2) the gradient strength and the bandwidth, (3) the positioning and the contention, (4) a dedicated scout view, (5) the spatial resolution, (6) the slice thickness with a special attention to 3D millimetric slices, (7) the choice of a main slice plane according to the suspected lesion, (8) the suppression of motion artifacts and (9) the use of stress images if possible (collateral ligaments, pulleys, extensor tendon).

**SSG10-03**  **MR Morphology of Triangular Fibrocartilage Complex: Correlation with Quantitative MR and Biomechanical Properties**

**Tuesday, Dec. 1 10:50AM - 11:00AM Location: E450B**

**Participants**
Thummanoon Ruangchaijatuporn, MD, Bangkoknoi, Thailand (Presenter) Nothing to Disclose
Eric Y. Chang, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Reni Biswas, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Sheronda Statum, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Betty Tran, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Won C. Bae, PhD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Christine B. Chung, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Wrist pain may involve the triangular fibrocartilage complex (TFCC; Fig.A). The purpose of this study was to evaluate MR morphology of TFCC tissues, and relate it to regional quantitative MR (qMR) and biomechanical properties.

**METHOD AND MATERIALS**

Five cadaveric wrists (22 to 70 yrs) were imaged at 3T using morphologic (PD SE, Fig.AC; 3D SPGR, Fig.B) and quantitative (ME SE T2; UTE T2*; 2D SCMP T1rho; 3D MAPSS T1rho; UTE T1rho) MR sequences. In 8 geographic regions (Fig.B), morphology of TFCC disc and the laminae were evaluated for pathology (Fig.BDE) and quantitative MR (qMR) values (Fig.F). Four of the samples were disarticulated, and biomechanical indentation testing was performed on the distal surface of the discs (Fig.C). Instantaneous (Indentation) modulus, taking into account tissue thickness, was determined.

**RESULTS**

On PD SE images, pathology of TFCC disc included degeneration (Fig.BE) and tears (Fig.E), while that of the lamina included degeneration, degeneration with superimposed tear, and mucinous transformation (Fig.E). Calcifications were highly visible on 3D SPGR images (Fig.D). Calcifications were found only among pathologic regions, and disc pathology was found more frequently in the proximal than distal regions. In the disc (Fig.G), most qMR values were the lowest in normal samples, and increased significantly with degeneration or tear. Indentation modulus (Fig.G) showed an inverse trend, being the highest in normal samples and decreasing with pathologic changes. qMR properties also correlated moderately with indentation modulus. Laminae samples (Fig.H) were mostly pathologic, and requires additional normal samples to discern qMR changes.

**CONCLUSION**

These results show potential utility of morphologic, qMR, and biomechanical techniques to characterize pathology of the TFCC.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative MR techniques provide novel and sensitive means of evaluating tissues of TFCC, which compliment conventional techniques.

**SSG10-04**  **Accessory Tendon Slips of the Extensor Carpi Ulnaris: MRI Findings and Association with Tendon Abnormalities**

**Tuesday, Dec. 1 11:00AM - 11:10AM Location: E450B**

**Participants**
Fabio Becce, MD, Lausanne, Switzerland (Presenter) Nothing to Disclose
Antoine Rochette, MD, Quebec, QC (Abstract Co-Author) Nothing to Disclose
Eric G. Pessis, MD, St Denis, France (Abstract Co-Author) Nothing to Disclose
Patrick Ormoumi, MD, Lausanne, Switzerland (Abstract Co-Author) Nothing to Disclose
Henri Guerin, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Dominique Le Viet, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Jean-Luc Drape, MD, PhD, Paris, France (Abstract Co-Author) Nothing to Disclose

PURPOSE
Anatomic variants are common in the wrist and hand, and some of them may be the triggering factor of tendon disorders. The purpose of this study was to report the MRI findings of accessory tendon slips arising from the extensor carpi ulnaris (ECU), and evaluate their association with ECU tendon abnormalities.

METHOD AND MATERIALS
All wrist MRI scans performed over a 1-year period in two university hospitals were retrospectively reviewed. Patients with prior ulnar-sided wrist surgery and MRI scans without at least axial T1-weighted and T2-weighted sequences were excluded. Two musculoskeletal radiologists independently assessed the presence of accessory tendon slips arising from the ECU, as well as ECU tendinosis, partial or complete tears, and tenosynovitis. The origin and insertion of the accessory tendon slips were noted, and their diameter and the cross-sectional area of the ECU tendons were measured.

RESULTS
A total of 254 wrist MRI scans from 257 patients (139 men, 115 women; mean age, 46 years) were included. The prevalence of accessory tendon slips arising from the ECU was 23% (58/254). Surgical correlation was available in 12% (7/58) of cases. Their mean long-axis diameter was 1.1 ± 0.2 mm. Their origin was always visible, while their insertion on the fifth metacarpal or extensor digiti minimi tendon was seen in 33% (19/58) of cases. Patients with accessory tendon slips had statistically significantly more ECU tendon abnormalities and tenosynovitis than patients without the anatomic variant (14% vs. 6%, and 46% vs. 11%, respectively; p ≤ 0.02). The prevalence of accessory tendon slips was statistically significantly higher in patients with ulnar-sided wrist pain (23% vs. 14%, p = 0.01).

CONCLUSION
Accessory tendon slips arising from the ECU are common and frequently associated with ECU tendon abnormalities. They are frequently found in patients with ulnar-sided wrist pain.

CLINICAL RELEVANCE/APPLICATION
Accessory tendon slips arising from the ECU are important to recognize because they represent a diagnostic pitfall and may also play a role in the pathogenesis of ECU tendon abnormalities.

SSG10-05 Computer-Based Temporal Subtraction Analysis of Joint Space Narrowing in Rheumatoid Patients: Validation Study in Carpal Joints

Tuesday, Dec. 1 11:10AM - 11:20AM Location: E450B

Participants
Shota Ichikawa, Sapporo, Japan (Presenter) Nothing to Disclose
Tamotsu Kamishima, MD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Kenneth Sutherland, Hokkaido, Japan (Abstract Co-Author) Nothing to Disclose
Takanobu Okubo, Asahikawa, Japan (Abstract Co-Author) Nothing to Disclose
Kou Katayama, Asahikawa, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the computer-based method using temporal subtraction in carpal joints of rheumatoid arthritis (RA) patients, which can detect the difference in joint space between two images as the joint space difference index (JSDI).

METHOD AND MATERIALS
Twenty-seven rheumatoid arthritis patients (24 females and 3 males, mean age 60 years) on Tocilizmab were enrolled. Radiographs were obtained at baseline and at 1 year. The joint space narrowing (JSN) of a total of 229 carpal (3rd carpometacarpal, 5th carpometacarpal, scaphoid-trapezium, scaphoid-capitate, and radius-scaphoid) joints on bilateral hand radiographs was assessed by our computer-based method, setting the Sharp/van der Heijde method as the gold standard. We performed three examinations to confirm that the JSDI reflects the chronological change in joint space width. We compared the JSDI of joints with JSN progression (increase in Sharp/van der Heijde score) in the follow-up period with those without JSN progression. In addition, we examined whether there is a significant difference in terms of laterality or topology of the joint.

RESULTS
The JSDI of joints with JSN progression was significantly higher than those without JSN progression (Mann-Whitney U test, p < 0.001). There was no statistically significant difference in the JSDI between left and right carpal joints, which was analyzed for 5 different joints altogether and each joint separately (Mann-Whitney U test, p > 0.05 respectively). There was no statistically significant difference in JSDI among different joints (Kruskal-Wallis test, p = 0.155). In all examinations, the results of the computer-based method were consistent with those of the Sharp/van der Heijde method as the gold standard.

CONCLUSION
These results suggest that our computer-based method may be useful to recognize the joint space narrowing progression on radiographs in carpal joints.

CLINICAL RELEVANCE/APPLICATION
The computer-based temporal subtraction method can detect the joint space narrowing progression in the wrist, which is the single most predilection site for rheumatic diseases.
**Hand MRI: Quality of Fat Signal Suppression with Dixon versus CHESS and STIR Imaging**

Tuesday, Dec. 1 11:30AM - 11:40AM Location: E450B

**Participants**
- Thomas P. Kirchgesner, MD, Brussels, Belgium (Presenter) Nothing to Disclose
- Vassiliki Perlepe, MD, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose
- Nicolas Michoux, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose
- Ahmed Larbi, MD, Nimes, France (Abstract Co-Author) Nothing to Disclose
- Frederic E. Lecouvet, MD, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose
- Bruno C. Vande Berg, MD, PhD, Brussels, Belgium (Abstract Co-Author) Consultant, Bone Therapeutics SA

**PURPOSE**

To compare the quality of fat signal suppression and signal to noise ratio (SNR) obtained by the Dixon method in comparison to the CHESS (CHEmical Shift Selective) and STIR (Short Tau Inversion Recovery) sequences at hand MRI of healthy subjects.

**METHOD AND MATERIALS**

Both hands of 14 healthy volunteers were imaged with IDEAL T1 SE (Spin Echo), IDEAL T2 SE, FS (Fat Saturated) T1 SE, FS T2 SE and STIR on a 1,5T MR scanner. A prospective, IRB-approved study was performed on healthy adult subjects with and without a history of habitual KC. Exclusion criteria were a history of pain or arthritis in the hands. Recorded clinical history included KC events per day multiplied by the number of KC years (allowing the calculation of "crack-years") and a QuickDASH questionnaire. Physical examination, including grip strength and Beighton scoring, was performed by two subspecialty orthopaedists blinded to subject KC history. US (with temporal resolution of 87 frames/sec) was conducted by a single sonographer, with static and cine images recorded before, during, and after metacarpophalangeal joint (MPJ) distraction was performed by the subjects. Two blinded musculoskeletal radiologists interpreted the images for a definite hyperechoic focus during and after MPJ distraction (not present prior to distraction); this was compared against the reference standard of an audible "crack" during joint distraction.

**RESULTS**

We studied 400 MPJs of 40 subjects (17 women, 23 men), with mean age of 33 years (range, 18-63). In comparing 10 non-KC subjects (with 0 "crack-years") versus 30 KC subjects (with "crack-years" ranging from 16 to 800), there was no significant difference in sex, age, QuickDASH score, grip strength, or Beighton score. In 62 of the 400 MPJs, there was an audible "crack" during manual distraction. Range of motion was noted to significantly increase in these 62 MPJs with respect to active and passive flexion, and passive extension between pre and post KC (p<0.05). With US, blinded readers had a good sensitivity (R1, 75%; R2, 80%) and excellent specificity (R1, 94%; R2, 95%), with a very good inter-observer reliability of 0.87 (p<0.0005). A brilliant hyperechoic flash that was simultaneous with the KC event and arose over approximately 115 msec was highly characteristic.

**CONCLUSION**

US examination during movement of the MPJs can show distinctive findings of KC with relatively high specificity and inter-observer reliability. US features corroborate the theory of cavitation as the etiology for sound generation in voluntary KC.

**CLINICAL RELEVANCE/APPLICATION**

Audible emissions may be associated with a broad array of (intraarticular and extraarticular) clinical conditions, but KC has a characteristic US appearance.
CLINICAL RELEVANCE/APPLICATION

Dixon sequences should be further investigated in patients with inflammatory hand diseases as they yield better quality for fat suppression than currently validated sequences.

SSG10-08  Value of Tomosynthesis for Lesion Evaluation in Osteoarthritic Hands Using the OARSI Score

Tuesday, Dec. 1 11:40AM - 11:50AM Location: E450B

Participants
Katharina Martini, Zurich, Switzerland (Presenter) Nothing to Disclose
Anton S. Becker, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Joerg Mueller, Dusseldorf, Germany (Abstract Co-Author) Employee, FUJIFILM Holdings Corporation
Roman Guggenberger, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Gustav Andreisek, MD, Zurich, Switzerland (Abstract Co-Author) Grant, Hoicim Ltd; Grant, Siemens AG; Speaker, Mepha Pharma AG;
Speaker, Guerbet AG; Travel support, Guerbet AG; Consultant, Otsuka Holdings Co, Ltd; Travel support, Otsuka Holdings Co, Ltd;
Institutional Research Grant, Bayer AG; Institutional Research Grant, Guerbet AG; Institutional research collaboration, Siemens AG;
Institutional research collaboration, Koninklijke Philips NV; Speaker, General Electric Company; Speaker, Koninklijke Philips NV;
Speaker, Siemens AG; ;
Thomas Frauenfelder, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate the value of Tomosynthesis in depicting osteoarthritic lesions in comparison to conv. X-ray, with use of computed tomography (CT) as standard-of-reference.

METHOD AND MATERIALS

Imaging of 12 cadaver wrists was performed with Tomosynthesis in anteroposterior (ap) projection (50 kV at 40 mA; tube angle: 40°), conventional X-ray and multi-detector CT (70kV at 16mA ref). Distal interphalangeal joint (DIP) II, DIP III, proximal interphalangeal joint (PIP) II, PIP III, first carpometacarpal (CMC) and scaphotrapezotrapezoidal joint (STT) were individually graded using the Osteoarthritis Research Society International (OARSI) score by two independent readers for the presence of osteophytes (0-3), joint space narrowing (0-3), subchondral sclerosis (0-1), lateral deformity (0-1), subchondral cysts (0-1) and erosion (0-1). Total scores range from 0-60. Inter-reader agreement (Cohen's k) was calculated. CT served as standard of reference.

RESULTS

Comparing Tomosynthesis and conventional X-ray to CT, the agreement was of 69.64% vs. 63.89% for the presence of osteophytes; 80.56% vs. 56.94% for joint space narrowing; 69.44% vs. 68.1% for subchondral sclerosis; 94.44% vs. 91.67% for lateral deformity; 97.22% vs. 80.56% for subchondral cysts; and 100% vs. 97.22% for erosion. While Tomosynthesis showed no significant difference (p=0.846) in OARSI score grading to CT (mean OARSI-score CT: 16.8, SD=10.64 vs. mean OARSI-score Tomosynthesis: 16.25, SD=9.56), conventional X-ray had significant lower mean OASIS scores (mean OARSI-score X-ray: 11, SD=8.33; p=0.037). Inter-reader agreement for OARSI scoring was excellent (k= 0.83).

CONCLUSION

Tomosynthesis depicts more lesions than conventional X-ray compared to CT.

CLINICAL RELEVANCE/APPLICATION

The mean OARSI score of Tomosynthesis is not significantly different from CT.

SSG10-09  Assessment of Pisotriquetral Instability with 3D Dual Echo Steady State (DESS): Is It Associated with Trauma or not?

Tuesday, Dec. 1 11:50AM - 12:00PM Location: E450B

Participants
Hee-Dong Chae, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Hye Jin Yoo, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ja-Young Choi, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Sung Hwan Hong, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To determine if there is an association between pisotriquetral (PT) instability and trauma history or internal derangements of the carpal joint by using three-dimensional (3D) dual echo steady state (DESS)

METHOD AND MATERIALS

We evaluated 44 patients with distal radius fracture (patient) and other 44 patients without previous trauma history (control), who underwent 3T magnetic resonance (MR) imaging including 3D DESS sequence. To analyze PT instability, three parameters were measured on axial and sagittal images by two blinded-readers, independently: PT interval, PT angle and pisiform translation relative to triquetrum. The MR appearances of PT joint and ulnar-sided structures were also evaluated. The associations between PT instability and distal radius fracture, abnormality of ulnar-sided structures or osteoarthritic features of PT joint were calculated.

RESULTS

PT instability parameters measured by two radiologists showed good or excellent agreement (ICC=0.628-0.965). Proximal translation of pisiform in relation to triquetrum was reduced in the patients with distal radius fracture (P=0.028). However, there was no difference of other instability parameters between the two groups. ECU tendinopathy was associated with larger PT interval (P=0.01) and with wider opening of sagittal PT angle (P=0.021). Triangular ligament tear was also related to reduced proximal translation of pisiform (P=0.031). Osteoarthritic features of PT joint and triangular fibrocartilage tear were not associated with PT instability.
CONCLUSION

Only pisiform translation was associated with distal radius fracture. Other instability parameters were not affected by distal radius fracture. ECU tendinopathy and triangular ligament tear were associated with PT instability.

CLINICAL RELEVANCE/APPLICATION

Knowledge of PT instability and its relation to other carpal abnormality and traumatic disorder will facilitate early diagnosis of PT instability preventing symptomatic degenerative change of PT joint.
SSG11

Nuclear Medicine (PET/MRI for Oncology)

Tuesday, Dec. 1 10:30AM - 12:00PM Location: S505AB

CT MR NM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Farrokh Dehdashti, MD, Saint Louis, MO (Moderator) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Homewood, AL (Moderator) Nothing to Disclose

Sub-Events

SSG11-01 Outcome of Missed Lung Nodules in 18F-FDG-PET/MRI Compared to 18F-FDG-PET/CT in Cancer Patients

Tuesday, Dec. 1 10:30AM - 10:40AM Location: S505AB

Participants
Lino Sawicki, MD, Dusseldorf, Germany (Presenter) Nothing to Disclose
Johannes Grueneisen, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Heusch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Bockisch, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the clinical relevance of small pulmonary nodules missed by 18F-fluorodeoxyglucose positron emission tomography/magnetic resonance (18F-FDG-PET/MR) imaging compared to 18F-FDG PET/computed tomography (18F-FDG-PET/CT).

METHOD AND MATERIALS
Fifty cancer patients (mean age: 56.4 years, range: 18-84, 29 female, 21 male) who underwent 18F-FDG-PET/CT and 18F-FDG-PET/MRI for tumor staging on the same day were retrospectively enrolled. 18F-FDG-PET/CT and 18F-FDG-PET/MRI datasets were analyzed by two independent readers in random order in separate session with a minimum of four weeks apart. Presence, location, size and presence of focal tracer uptake was noted for each lung detected on 18F-FDG-PET/CT and on 18F-FDG-PET/MRI using T1w VIBE with fat saturation as morphological dataset. Follow-up CT or 18F-FDG-PET/CT (mean time-to-follow-up 11 months, range: 3-11) was used as reference standard to define each nodule as benign or malignant based on changes in size and under consideration of administered therapies. A nodule-to-nodule comparison between 18F-FDG-PET/CT and 18F-FDG-PET/MRI was performed using descriptive statistics.

RESULTS
Forty-two lung nodules detected on 18F-FDG-PET/CT were missed on 18F-FDG-PET/MRI. Average size of missed nodules was 4 mm +/- 1.3 mm; range: 2 mm - 7 mm. None of the missed lung nodules presented with increased tracer uptake. Of the 42 lung nodules missed on 18F-FDG-PET/MRI 33 (79%) nodules were rated benign, while 9 (21%) nodules were rated malignant according to follow-up examinations.

CONCLUSION
Even though the majority of small lung nodules missed on 18F-FDG-PET/MRI was rather benign, there was a relevant number of undetected potential metastases. The impact of these small additional metastases on therapeutic decisions and prognosis still has to be evaluated.

CLINICAL RELEVANCE/APPLICATION
Lower detection rate of PET/MRI vs. PET/CT for small lung nodules must be considered in cancer staging. Our data indicate that there is a small but relevant number of undetected potential metastases.

SSG11-02 PET/MR versus PET/CT in the Initial Staging of Head and Neck Cancer

Tuesday, Dec. 1 10:40AM - 10:50AM Location: S505AB

Participants
Tetsuro Sekine, MD, PhD, Zurich, Switzerland (Presenter) Nothing to Disclose
Felipe D. Barbosa, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Irene A. Burger, New York, NY (Abstract Co-Author) Nothing to Disclose
Felix P. Kuhn, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Gustav K. Von Schulthess, MD, PhD, Zurich, Switzerland (Abstract Co-Author) Research Grant, General Electric Company; Speaker, General Electric Company; Research Grant, General Electric Company; Research Grant, General Electric Company
Patrick Veit-Haibach, MD, Zurich, Switzerland (Abstract Co-Author) Research Grant, Bayer AG; Researcgrant, F. Hoffmann-La Roche Ltd; Research Grant, General Electric Company
Martin W. Huellner, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the diagnostic accuracy of PET/MR with PET/CT for newly diagnosed head and neck cancer.

METHOD AND MATERIALS
This prospective study was approved by the institutional review board and by national government authorities. In this study,
SSG11-03  Added Value of PET/MRI to MDCT for the Assessment of Preoperative Staging and Resectability in Gastric Cancer

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S505AB

Participants
Dong Ho Lee, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Se Hyung Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Research Grant, Mallinckrodt plc; Research Grant, Samsung Electronics Co Ltd
Bo Yun Hur, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Joon Koo Han, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate whether PET/MRI can improve the diagnostic performance of TNM staging and can help making accurate decision for resectability in patients with gastric cancer compared to MDCT alone.

METHOD AND MATERIALS
The institutional review board of our hospital approved this retrospective study. Twenty-nine patients with histologically confirmed gastric cancers underwent preoperative MDCT and PET/MRI for staging and decision of resectability. Two abdominal radiologists independently assessed MDCT without and with PET/MRI and determined preoperative TNM staging as well as resectability of gastric cancer. The diagnostic performance using MDCT without and with PET/MRI was compared by using McNemar test and receiver operating characteristic analysis.

RESULTS
Diagnostic accuracies for assessing T and N staging were not significantly improved by adding PET/MRI in both readers. However, PET/MRI showed significantly improved diagnostic accuracy for M staging in one reader (P=0.031) and marginal improvement in the other reader (P=0.063) compared to MDCT alone. Regarding resectability of gastric cancer, the diagnostic accuracy of MDCT with PET/MRI was significantly higher than that of MDCT alone in both readers (P=0.016 for reader 1 and P=0.004 for reader 2). Additional seven patients (7/23, 30.4%) in reader 1 and nine patients (9/23, 39.1%) in reader 2 were correctly classified according to the resectability of gastric cancer by adding PET/MRI.

CONCLUSION
PET/MRI could significantly improve the diagnostic accuracy for preoperative M staging as well as resectability of gastric cancer compared to those of MDCT alone, and additional one-third of patients were correctly classified according to the resectability by using PET/MRI.

CLINICAL RELEVANCE/APPLICATION
PET/MRI could significantly improve the diagnostic accuracy for preoperative M staging as well as resectability of gastric cancer compared to those of MDCT alone, and additional one-third of patients were correctly classified according to the resectability by using PET/MRI.

SSG11-04  Combined Reading of PET and MR Datasets in Integrated PET/MR: A Comparison of Different MR Sequences in Whole-body Oncological Imaging

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S505AB

Participants
Benedikt M. Schaarschmidt, MD, Dusseldorf, Germany (Presenter) Nothing to Disclose
Johannes Grueneisen, Essen, Germany (Abstract Co-Author) Nothing to Disclose
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Verena Ruhlmann, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Christian Buchbender, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the performance of different magnetic resonance (MR) sequences in tracer uptake allocation and visual detectability in integrated [18]F-fluorodeoxyglucose ([18]F-FDG) positron emission tomography (PET)/MR examinations intraindividually and with
computed tomography (CT) from PET/CT.

**METHOD AND MATERIALS**

Whole-body, contrast-enhanced PET/CT and subsequent PET/MR was performed in 61 patients for an oncological tumor staging. In PET/MR, the protocol comprised the following sequences: T2, turbo inversion recovery magnitude (TIRM), non-enhanced T1, contrast-enhanced T1, and diffusion-weighted imaging (DWI). Per patient, visual lesion detectability and anatomical allocation of the PET finding were assessed using a four-point ordinal scale (scored from 0 to 3) in a maximum of ten [18]F-FDG-avid lesions in the different MR sequences and in CT from PET/CT. Malignancy of each lesion was confirmed using radiological follow-up and histopathology as standard of reference. Differences in each category were analyzed using Wilcoxon rank sum tests. To prevent α-error accumulation, Bonferroni-Holm correction was performed.

**RESULTS**

A total of 225 PET positive lesions were analyzed. 156 lesions were confirmed as malignant by radiological follow up and 69 by histopathology. T2 (mean 2.4±0.9), TIRM (mean 2.5±0.9), DWI (mean 2.5±1.0), and CT (mean 2.5±0.9) had a comparable visual detectability and were superior to non-enhanced T1 (mean 2.2±1.0). Anatomic allocation of the PET finding was similar in T2 (mean 2.6±0.7), TIRM (mean 2.8±0.7), and CT (mean 2.6±0.7) but was significantly higher compared to non-enhanced T1 (mean 2.4±0.8) and DWI (mean 2.1±1.0).

**CONCLUSION**

In whole-body imaging, T2, TIRM and contrast-enhanced T1 provide a lesion detectability and an anatomical allocation of a PET finding that is comparable to PET/CT. While non-enhanced T1 may be omitted, the necessity of DWI has to be investigated further in specific diagnostic problems.

**CLINICAL RELEVANCE/APPLICATION**

The results of this study help to optimize PET/MR protocols, leading to reduced examination times, improved workflow and increased patient comfort in every day clinical practice.

**Evaluation of a FAST-protocol for Simultaneous 18F-FDG PET/MR Imaging for the Evaluation of Patients with Lymphoma**

**Participants**

Johannes Grüneisen, Essen, Germany (Presenter) Nothing to Disclose
Lino Sawicki, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
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Michael Forsting, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Thomas C. Lauenstein, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Lale Umutlu, MD, Essen, Germany (Abstract Co-Author) Consultant, Bayer AG

**PURPOSE**

PET/CT with 18F-FDG is widely accepted as the diagnostic standard of care for patients with lymphoma. The purpose of this study was to evaluate the diagnostic performance of a FAST-protocol for integrated PET/MR imaging, used for pretreatment staging, therapy monitoring and surveillance of patients with lymphoma in comparison to PET/CT.

**METHOD AND MATERIALS**

44 consecutive lymphoma patients were prospectively enrolled for a clinically indicated PET/CT and a subsequent PET/MR examination. For PET/MRI readings, a whole-body FAST-protocol was implemented, comprising (1) a transversal DWI (EPI) sequence, (2) a transversal T2w HASTE sequence and (3) a transversal post-contrast T1w VIBE sequence. Two readers separately evaluated both examinations and were instructed to identify all tumor lesions. Furthermore, the standardized uptake value (SUV) for all 18F-FDG-avid lesions was determined in PET/CT and PET/MRI, using volume of interest (VOI) analysis. Agreement between PET/CT and PET/MRI regarding SUVmax and SUVmean was tested using Pearson’s product-moment correlation.

**RESULTS**

Malignant lesions were present in 24 of the 44 patients. Both, PET/CT and PET/MRI correctly identified disease presence in all 24 patients. Furthermore, all PET-positive lesions that were visible on PET/CT were also detectable on PET/MRI. Determined SUVs were significantly higher in PET/MRI than in PET/CT (SUVmax 9.8 vs 7.2, p<0.001; SUVmean 5.3 vs 4.2, p<0.001), however, there was a strong correlation between SUVmax and SUVmean of the two imaging modalities (R =0.89, p<0.001 and R =0.90, p<0.001). Estimated scan duration of one whole-body PET/CT examination as well as for the standard and fast protocol for whole-body PET/MR imaging amounted to 18.5 ± 1.0 min and 27.5 ± 2.0 min, respectively. Furthermore, calculated mean effective-dose for a whole-body PET/CT scan was 66.5% higher than for a FAST-PET/MRI examination.

**CONCLUSION**

The FAST-protocol for PET/MR imaging offers an equivalently high diagnostic performance for staging lymphoma patients in comparison to PET/CT with only a slightly prolonged examination time.

**CLINICAL RELEVANCE/APPLICATION**

With regard to patient comfort related to scan duration and a markedly reduced radiation exposure, FAST-PET/MRI may serve as a powerful alternative to PET/CT for a diagnostic work-up of patients with lymphoma.

**Diagnostic Accuracy of Whole-body 18F-FDG PET/MRI and Whole-body DWI/MRI for the Evaluation of Patients with Lymphoma**

**Participants**
Johannes Grueneisen, Essen, Germany (Presenter) Nothing to Disclose
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Benedikt M. Schaarschmidt, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
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Lale Umutlu, MD, Essen, Germany (Abstract Co-Author) Consultant, Bayer AG

PURPOSE
To prospectively evaluate the diagnostic performance of integrated 18F-FDG PET/MRI for whole-body staging of patients with lymphoma in comparison to DWI/MRI.

METHOD AND MATERIALS
42 consecutive patients underwent a whole-body 18F-FDG PET/MRI (Biograph mMR, Siemens) including diffusion-weighted imaging (DWI) for pretreatment staging as well as for therapy monitoring and surveillance of lymphoma disease. Two radiologists separately evaluated the DWI/MRI datasets, followed by a second reading of 18F-FDG PET/MRI datasets. Both readers were instructed to identify the total number of tumor lesions. Apparent diffusion coefficients (ADC) and standardized uptake values (SUV) were determined and served as an orientation for a differentiation between malignant and benign lesions. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy in the detection of malignant lesions were calculated for DWI/MRI and 18F-FDG PET/MRI.

RESULTS
Malignant lesions were present in 23 of 42 patients. 18F-FDG PET/MRI enabled correct identification of all 23 (100%) patients and was true negative in 18/19 (95%) cases. DWI/MRI detected disease presence in 20/23 (87%) patients and was true negative in 17/19 (89%) patients. Furthermore, the calculated sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 18F-FDG PET/MRI for the detection of malignant lesions were 97%, 91%, 97%, 91% and 95%, respectively. The respective values for DWI/MRI were 80%, 74%, 89%, 59% and 79%.

CONCLUSION
The results demonstrate the superiority of 18F-FDG PET/MRI in detecting malignant and benign lesions in lymphoma patients in comparison to DWI/MRI alone.

CLINICAL RELEVANCE/APPLICATION
The present study underlines the usefulness of 18F-FDG PET data as a valuable additive to MR imaging for a more accurate evaluation of patients with lymphomas, enabling a reduction of false-positive findings.

PURPOSE
To assess and compare the diagnostic performances of [18F]-FDG-PET/CT and [18F]-FDG-PET/MR in patients with Hodgkin (HL) and Non-Hodgkin lymphoma (NHL).

RESULTS
Thirty patients were included: MALT lymphoma, n=14 patients; mantle cell lymphoma, n=4; nodal marginal zone lymphoma, n=3; Burkitt, follicular lymphoma, and HL, n=2 respectively; and DLBCL, T-cell, and post-transplant NHL, n=2, respectively. Five patients were scanned twice: 3 for staging and restaging and 2 twice for restaging. Overall 35 examinations were available for this study. PET/MR showed 100% Se and Sp (95%CI, 86.7-100%; and 72.2-100%; respectively). PET/CT showed 80% Se and Sp (95%CI, 60.9-91.1%; and 49-94.3%; respectively). The region-based agreement between PET/MR and PET/CT was 98.9%. Three patients were upstaged by PET/MR (stage I instead of 0; all MALT lymphomas).

CONCLUSION
[18F]-FDG-PET/MR showed a higher diagnostic value for the detection of lymphoma than PET/CT, particularly for MALT lymphoma.

CLINICAL RELEVANCE/APPLICATION
[18F]-FDG-PET/MR showed a higher diagnostic value for lymphoma than PET/CT. Since PET/MR also offers a lower radiation exposure, it may possibly become the preferred imaging technique for lymphoma.

PURPOSE
To compare the diagnostic performances of PET/MR and PET/CT in patients with Hodgkin (HL) and Non-Hodgkin lymphoma (NHL).

RESULTS
Thirty patients were included: MALT lymphoma, n=14 patients; mantle cell lymphoma, n=4; nodal marginal zone lymphoma, n=3; Burkitt, follicular lymphoma, and HL, n=2 respectively; and DLBCL, T-cell, and post-transplant NHL, n=1, respectively. Five patients were scanned twice: 3 for staging and restaging and 2 twice for restaging. Overall 35 examinations were available for this study. PET/MR showed 100% Se and Sp (95%CI, 86.7-100%; and 72.2-100%; respectively). PET/CT showed 80% Se and Sp (95%CI, 60.9-91.1%; and 49-94.3%; respectively). The region-based agreement between PET/MR and PET/CT was 98.9%. Three patients were upstaged by PET/MR (stage I instead of 0; all MALT lymphomas).

CONCLUSION
[18F]-FDG-PET/MR showed a higher diagnostic value for the detection of lymphoma than PET/CT, particularly for MALT lymphoma.

CLINICAL RELEVANCE/APPLICATION
[18F]-FDG-PET/MR showed a higher diagnostic value for lymphoma than PET/CT. Since PET/MR also offers a lower radiation exposure, it may possibly become the preferred imaging technique for lymphoma.
Simulation of Tracer Dose Reduction in PET by Retrospective Undersampling of PET Listmode Data

Tuesday, Dec. 1 11:50AM - 12:00PM Location: S505AB

Participants
Sergios Gatidis, MD, Tubingen, Germany (Presenter) Nothing to Disclose
Christian Wehrsln, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose
Juergen F. Schaefer, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolaou, MD, Tubingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG
Nina Schwenzer, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Holger Schmidt, PhD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose

Purpose
To implement and validate a method for simulation of low-dose PET images.

Method and Materials
In order to simulate a reduction of PET tracer dose, PET images acquired in list mode data were retrospectively undersampled by random deletion of pre-defined proportions of PET events. The resulting undersampled PET data were then reconstructed resulting in PET images simulating PET images acquired at lower tracer doses. In order to validate this proposed approach, phantom experiments were performed using a dedicated PET phantom according to the National Electrical Manufacturers Association (NEMA). Phantom compartments were filled with different activity concentrations of 18F-Fluoride. PET data were acquired at different times points corresponding to decreasing tracer dose concentrations (according to the radioactive decay of 18F) on a combined PET/MR scanner (Biograph mMR, Siemens). Reduced-dose PET images were additionally derived from the measured data set with the highest activity concentration (first measurement) using the proposed method. Measured and corresponding simulated PET images were compared by visual inspection and by quantification of image quality metrics signal-to-noise ratio (SNR), background variability (BV) and contrast recovery coefficients (CRC).

Results
PET images acquired by measurement at different activity concentrations were visually equivalent to the corresponding simulated PET images. Quantitative analysis of the measured image quality metrics also revealed a high similarity between measured and simulated low-dose PET images. Deviations of SNR, BV and CRCs were lower than 20% for all activity concentrations.

Conclusion
Simulation of low-dose PET images is possible by retrospective undersampling of PET list mode data and enables the generation of PET images with similar characteristics as PET images actually measured at low activity concentrations.

Clinical Relevance/Application
The proposed approach will enable the simulation and comparison of different tracer dose regimes in a clinical setting. Thus, it will be possible to derive optimal dose regimes with minimal diagnostic radiation exposure and sufficient diagnostic image quality.
PURPOSE
Organization of white matter microstructure has been related to cognition. Yet, it remains unclear whether it is a brain-wide loss or localized loss of microstructure that leads to worse cognition. We investigated the role of tract-specific white matter microstructural organization in global cognitive function and specific cognitive domains.

METHOD AND MATERIALS
In 4516 non-demented middle-aged and elderly (mean age 63.8 ±11.1 years, 55.4% female) we obtained diffusion magnetic resonance imaging parameters (fractional anisotropy (FA) and mean diffusivity (MD)) in 25 white matter tracts using probabilistic tractography. In general, lower values of FA and higher values of MD are reflecting loss of white matter microstructural organization. With a cognitive test battery we assessed memory, information processing speed, executive function, and motor speed. We studied the association of tract-specific white matter microstructural organization and cognition using multivariable linear regression models, adjusting for macrostructural pathology, cardiovascular risk factors and APOE-ε4 allele carriership.

RESULTS
Loss of tract-specific white matter microstructure in all tracts, except for the brain stem tracts, was associated with worse global cognition. Lower FA in the association and callosal tracts and higher MD in the projection and association tracts most strongly related to poorer cognition. Loss of white matter microstructure associated with worse information processing speed, executive functioning, and motor speed, but not with memory.

CONCLUSION
Loss of white matter microstructure mainly in projection, association and callosal tracts is related to worse cognition, especially to worse information processing speed, executive function and motor speed, but not to memory.

CLINICAL RELEVANCE/APPLICATION
Tract-specific microstructural changes may aid in identifying early biomarkers to predict which persons will suffer from neurodegenerative diseases.

PURPOSE
Recently, we have developed new phase-weighted MR imaging, "Phase Difference Enhanced Imaging (PADRE)", in which phase difference between objective and surrounding tissue is selected in order to enhance the contrast of objective tissue. We compared the precentral gyr (PG) of patients with amyotrophic lateral sclerosis (ALS) and healthy subjects on PADRE images to determine whether the visualization of changes makes it possible to discriminate between ALS patients and healthy subjects on an individual
METHOD AND MATERIALS

At first, with a nonblinded manner, two radiologists reviewed the normal and ALS appearances of the PG on PADRE images, and deviations from the normal PG appearance were recorded. Next, the observer performance study based on the PG abnormalities on PADRE image was performed by two reviewers, and both diagnostic accuracy and inter-observer agreement for the diagnosis of ALS on PADRE images were calculated.

RESULTS

At the nonblinded evaluations, the two radiologists consensually defined the PG as abnormal when the following finding was present; a low signal intensity layer was seen in the middle gray matter in the PG. By the low signal intensity layer, we found that the four-layer organization could be characterized in the PG (Figure). The observer performance study demonstrated that the sensitivity, specificity, and accuracy of PG abnormalities on PADRE images for discriminating ALS patients from healthy subjects were 100% for reviewer 1 and 90%, 100%, and 96% for reviewer 2. The k values for inter-observer agreement were excellent (k = 0.932).

CONCLUSION

We propose the term 'stripe sign' to describe the characteristically abnormal appearance (four-layer organization) of the PG in the ALS patients. Based on novel PADRE finding on the PG it was possible to discriminate between ALS patients and healthy subjects. The PADRE finding in ALS patients may reflect pathologic changes due to the degeneration of upper motor neurons.

CLINICAL RELEVANCE/APPLICATION

PADRE in ALS patients showed a stripe sign on precentral gyr, which may be the useful finding for diagnosis of ALS on an individual basis.

SSG12-03 Systolic Cerebrospinal Fluid Flow Distinguishes Patients with Normal Pressure Hydrocephalus from Age-Matched Controls

Participants

Sophia Mueller, MD, Munich, Germany (Presenter) Nothing to Disclose
Sarah Lause, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Porembchar, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Roman Schniepp, Munich, Germany (Abstract Co-Author) Nothing to Disclose
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Birgit Ertl-Wagner, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

Patients with idiopathic normal pressure hydrocephalus (iNPH) suffer from a potentially treatable cause of dementia, and therefore benefit from fast and precise diagnosis. However, MR-based imaging signs are often ambiguous, and obscured by concomitant age-related changes such as generalized atrophy and microangiopathy. The aim of this study was to find an MR-based flow measure that can help discriminate iNPH patients from age-matched controls.

METHOD AND MATERIALS

10 patients with NPH (mean age=74.4, STD=6.2, 8 female), 18 age-matched healthy control subjects (mean age=71.1, STD=5.2, 11 female), and 14 young control subjects (mean age=21.6, STD=1.7, 8 female) were studied using a 3.0 T MR scanner (Siemens Healthcare, Erlangen, Germany). Cine phase-contrast images of blood and CSF flow to and from the cranium were used to quantify systolic CSF flow rate and arterial blood flow rates.

RESULTS

Maximal systolic CSF flow rate was significantly decreased in iNPH patients as compared to age-matched healthy controls (p<0.01). Maximal systolic arterial blood flow, however, did not differ significantly between patients and their age-matched controls (p>0.05). Both maximal arterial blood flow and CSF flow were reduced in healthy adult subjects and iNPH patients as compared to the young control group (p<0.0001 respectively).

CONCLUSION

While both vascular and CSF flow rates showed age-related decline, only reduction of CSF flow exceeded age-related changes in iNPH patients.

CLINICAL RELEVANCE/APPLICATION

Reduced systolic CSF flow rates are a robust and easily obtainable MR-based measure that may support the diagnosis of iNPH.

SSG12-04 Enlarged Perivascular Spaces on MRI - Pathological or Normal Finding in Cognitive Impairment?

Participants

Sara Shams, Stockholm, Sweden (Presenter) Nothing to Disclose
Juha Martola, Espoo, Finland (Abstract Co-Author) Nothing to Disclose
Andreas Charidimou, Boston, MA (Abstract Co-Author) Nothing to Disclose
Mykol Larvie, MD, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Tobias Granberg, Stockholm, Sweden (Abstract Co-Author) Nothing to Disclose
Maja Shams, Stockholm, Sweden (Abstract Co-Author) Nothing to Disclose
Yngve Forslin, Stockholm, Sweden (Abstract Co-Author) Nothing to Disclose
Enlarged perivascular spaces (EPVS) are seen as a normal finding in the brain. However, increased amounts of EPVS have shown associations with high age and impaired cognitive function, and are thought to be a marker of cerebral small vessel disease. In this study we sought to investigate EPVS in a continuum of cognitive impairment, and the associations with clinical and radiological parameters.

METHOD AND MATERIALS
989 patients undergoing memory investigation (mean age 63 ±10) were recruited and scanned on 1.5T MRI scanners. Routine clinical cerebrospinal fluid (CSF) biomarkers, amyloid B42 (AB42), total-tau (T-tau), tau phosphorylated at threonine 18 (P-tau), and CSF/ serum albumin ratios were analyzed in 761 patients. Rating of EPVS was made on T2-weighted sequences according to the EPVS rating scale. Associations between EPVS and clinical and radiological parameters were analyzed with multivariate linear and logistic regression models, controlling for appropriate variables.

RESULTS
Increasing number of EPVS had increased odds ratio for white matter hyperintensities (WMH) (OR: 3.7, 95CI: 2.5-5.4), cerebral microbleeds (OR: 2.3, 95CI: 1.6-3.3) and lacunar infarctions (OR: 3.2, 95CI: 2.2-4.8). Odds ratios for EPVS further increased with high age (OR: 2.5, 95CI:1.8-3.5), mild cognitive impairment (OR:1.1, 95CI: 1.0-1.1), and vascular dementia (OR:2.5, 95CI: 1.1-5.8), but not in Alzheimer's disease. No association between low cognition, measured by the MMSE test, and increased EPVS was seen. AB42 levels decreased with increasing EPVS (Beta: -0.131, P<0.01). T-tau (Beta: 0.10, P<0.01) and P-tau (Beta: 0.08, P<0.05) levels increased with increasing EPVS. No difference was seen in CSF/serum albumin ratios.

CONCLUSION
Our results suggest that increased EPVS may be a marker of cerebral small vessel disease, and associated with cognitive impairment. Increased EPVS with vascular dementia, but not with Alzheimer's disease suggests that EPVS may be more associated with vessel damage caused by hypertensive arteriopathy.

Enlarged perivascular spaces may be a marker of cerebral small vessel disease, and associated with cognitive impairment.

SSG12-05 Diffusion Tensor Imaging of the Corticospinal Tract in Patients with Amyotrophic Lateral Sclerosis, Primary Lateral Sclerosis, and Mimic Syndromes

Tuesday, Dec. 1 11:10AM - 11:20AM Location: N226

Participants
Elizabeth K. Weidman, MD, New York, NY (Presenter) Nothing to Disclose
Sumit N. Niogi, MD, PhD, New York, NY (Abstract Co-Author) Institutional license agreement, Athlemetrics ; Potential royalties, Athlemetrics
Andrew D. Schweitzer, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
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Mona Shahbazi, New York, NY (Abstract Co-Author) Nothing to Disclose
Dale Lange, New York, NY (Abstract Co-Author) Nothing to Disclose
Apostolos J. Tsioris, MD, New York, NY (Abstract Co-Author) Research Consultant, BioClinica, Inc

PURPOSE
Diffusion tensor imaging (DTI) of the corticospinal tract (CST) has been proposed as an objective method to aid in diagnosis of amyotrophic lateral sclerosis (ALS) and primary lateral sclerosis (PLS). Clinical diagnosis of ALS and PLS is difficult as early symptoms are indistinguishable from those of other neurologic disorders. We test whether CST changes measured by DTI are different in patients with ALS and PLS compared with other motor symptom-predominant neurologic disorders.

METHOD AND MATERIALS
3 Tesla 33-direction DTI data were retrospectively reviewed in patients with suspected ALS. 6 regions of interest (ROI) were selected along each CST bilaterally using a semi-automated technique operating on native space. Subjects were categorized by diagnosis (definite ALS, probable ALS, PLS, and disease mimics ultimately diagnosed with a non-upper motor neuron condition). Fractional anisotropy (FA) and mean diffusivity (MD) values from the ROIs were analyzed by diagnostic group using Mann-Whitney U-tests and non-parametric ANOVA.

RESULTS
DTI sequences for 27 patients including 13 patients with definite ALS, 3 probable ALS, 3 definite PLS, and 8 other suspected upper motor neuron diseases ultimately not diagnosed as ALS or PLS were analyzed. Average CST FA was lower in patients with definite or probable ALS and PLS vs other diagnosis (0.56 vs 0.61, p<0.009). MD was higher in definite or probable ALS and PLS vs other diagnosis (0.00076 vs 0.00071, p= 0.03). By ROI, FA in definite ALS and PLS groups was significantly lower than other diagnosis group at the level of the left pons, left cerebral peduncle, and left pyramid (p<0.05). MD was higher in the ALS and PLS groups than other diagnosis group in the left cerebral peduncle (p=0.01)

CONCLUSION
We have demonstrated significant differences in FA and MD in patients with ALS and PLS compared to mimic syndromes, which may be of clinical utility in differentiating these disorders. This is the first study to our knowledge to compare DTI measures in patients with known ALS, PLS, and other motor symptom-predominant neurologic disease. Further evaluation with additional patients and comparison with controls is warranted.

CLINICAL RELEVANCE/APPLICATION
SSG12-06  Fluid Dynamics Study of CSF in Idiopathic Normal Pressure Hydrocephalus

Tuesday, Dec. 1 11:20AM - 11:30AM Location: N226

Participants
Lekang Yin, Shanghai, China (Presenter) Nothing to Disclose
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Jiajun Zheng, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Xiaozhu Hao, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Xiaoxue Zhang, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To study the difference of CSF fluid dynamics at the aqueduct between idiopathic normal pressure hydrocephalus (iNPH) patients and normal elderly.

METHOD AND MATERIALS
A total of 15 iNPH patients (iNPH group) and 20 healthy volunteers as normal control (NC group) were included in this study. The flow data of CSF through the aqueduct were collected with phase-contrast cine method in 3T MR unit (MR PC-cine). The CSF fluid dynamics parameters including peak cranio-caudal velocity, peak caudo-cranial velocity, net flow volume, stroke volume, minute flow volume, as well as the direction of net flow were measured and compared statistically between the two groups.

RESULTS
The flow curve of iNPH group was similar to the NC, both presented a sinusoidal flow pattern and caused a net flow per cardiac cycle. All fluid dynamics parameters except for peak cranio-caudal velocity (iNPH vs NC: 6.50±1.63 vs 5.76±1.32, P=0.20) were significantly increased in patients with iNPH. The net flow of 13 iNPH patients (13/15) were in the caudo-cranial direction, while 15 volunteers (15/20) were in the opposite direction, which was statistically significant differences (P =0.002).

CONCLUSION
iNPH patients present a hyperdynamic flow with increased velocity and volume during a cardiac cycle. The degree of rising in caudo-cranial direction exceeds that in cranio-caudal direction. The resulting reversal of net flow direction may play a key role in the occurrence of hydrocephalus in iNPH patients.

CLINICAL RELEVANCE/APPLICATION
This finding about the reversal of net flow direction in iNPH patients helps to understanding the development of the disease.

SSG12-07  Quantitative Susceptibility Mapping of the Motor Cortex in ALS and PLS Patients: A Biomarker for Upper Motor Neuron Dysfunction

Tuesday, Dec. 1 11:30AM - 11:40AM Location: N226

Participants
Santanu Chakraborty, FRCR, DMRD, Ottawa, ON (Presenter) Grant, Bayer AG; Grant, General Electric Company
Gerd Melkus, PhD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Pierre Bourque, Ottawa, ON (Abstract Co-Author) Nothing to Disclose

PURPOSE
Motor Neuron Disease is a progressive neurodegenerative disease characterized by lower- (LMN) and upper motor neuron (UMN) dysfunction in ALS (Amyotrophic Lateral Sclerosis) and mostly UMN dysfunction in PLS (Primary Lateral Sclerosis). The diagnosis is currently based on clinical assessment, electrodiagnostic studies and exclusion of other diseases. Electromyography effectively detects LMN degeneration but there is no definite technique for demonstrating UMN involvement and UMN findings on clinical examination may not occur until late in the disease course. A method that detects early UMN involvement and accurately monitors disease progression is highly desirable especially for future clinical trials and strategies for early intervention.

METHOD AND MATERIALS
Ten ALS and three PLS patients were included in the study. The QSM processing was performed with a software package developed in-house using Matlab. To evaluate the susceptibility changes, ROIs were drawn into the right (RMC) and the left motor cortex (LMC). For control, susceptibility values were calculated from ROIs in the anterior border of precentral gyrus on the right (RCT) and left (LCT). We correlated the susceptibility values between the primary motor cortex (in the hand knob area) and the anterior border of precentral gyrus with presence of UMN signs (spasticity and hyperreflexia) and also most affected side of symptoms.

RESULTS
Patients with spasticity symptoms have significant higher susceptibility values in the motor cortex area than those who do not (p<0.043). In the patient group showing symptoms of spasticity the susceptibility in the control cortex area is significant lower than in the motor cortex area (p<0.001).

CONCLUSION
Our results suggest QSM could be a quantitative tool to detect changes in the UMN changes in ALS and PLS. Larger prospective studies will be needed to find the incidence, sensitivity and specificity of this sign in ALS patients and to establish its prognostic value.

CLINICAL RELEVANCE/APPLICATION
QSM could be a quantitative tool to detect changes in the motor cortex in ALS and PLS patients as an objective marker of UMN involvement. However, larger prospective studies will be needed to find the incidence, sensitivity and specificity of this sign and its
prognostic value.

**SSG12-08 A Preliminary Study of the Relationship between the Volume of Hippocampal Subfields and Memory Deficits in Patients with Thalamus Infarction**

*Tuesday, Dec. 1 11:40AM - 11:50AM Location: N226*

**Participants**
Tianyou Luo, Chongqing, China (Abstract Co-Author) Nothing to Disclose
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**PURPOSE**
Although clinical and animal studies show the memory function is affected in thalamus infarction (TI), and thalamic nucleus have prominent direct and indirect connections with the hippocampal system, there is no study on the effects of the diagnosis of memory dysfunction of TI on hippocampal subfields volume with in vivo magnetic resonance (MR) imaging. To investigate the influence of thalamic infarction on the memory and hippocampal subfields volume, we measured the volume of each hippocampal subfield of patients with TI using structural MR imaging and tested their association with the performance of the memory.

**METHOD AND MATERIALS**
A total of thirty-seven TI patients and thirty-eight age-matched healthy controls were enrolled in the present study. MR imaging were performed at a 3.0T MR scanner. Volumes of hippocampal subfields on MR images were automatically estimated using FreeSurfer software. Clinical examinations (verbal recall, recall of the complex graphics and digit span backward task) were performed for all subjects. Two sample t-test was conducted to explore differences in hippocampal subfield volumes, with intracranial volume and age as covariate variables. Partial correlation analyses were used to examine the relationship between volumes of hippocampal subfields and the memory function in patients, when controlling age, gender and years of education.

**RESULTS**
TI group had smaller volume in presubiculum (left, p<0.001; right, p<0.001) and subiculum (left, p=0.029; right, p=0.006) when compared with healthy control. In addition, smaller presubiculum volumes were related with poorer long delayed recall (r=0.403, p=0.020) and complex graphics recall (r=0.410, p=0.018) in TI patients. Moreover, smaller subiculum volumes were associated with poorer short delayed recall (r=0.397, p=0.022).

**CONCLUSION**
Our findings indicated that thalamic infarction lead to hippocampal abnormality and memory deficits. These preliminary results suggested that information might not be passed between hippocampal subfield regions and thalamus, and aberrant hippocampus could not be responsible for memory function in patients with thalamus infarction.

**CLINICAL RELEVANCE/APPLICATION**
As far as we know, this is the first study exploring the pattern of volume reductions in specific hippocampal subfields in TI patients and investigating association between hippocampal subfield volume and memory function.

**SSG12-09 Alzheimer’s Disease: Diagnostic Potential of Phase Difference Enhanced MR Imaging at 3T**

*Tuesday, Dec. 1 11:50AM - 12:00PM Location: N226*

**Participants**
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**PURPOSE**
Phase difference enhanced imaging (PADRE) technique can selectively enhanced the phase difference between the target and surrounding tissue and might visualize amyloid-related brain changes in Alzheimer’s disease (AD). We aimed to determine whether it is possible to diagnose patients with AD on an individual basis using 3T MR images with PADRE.

**METHOD AND MATERIALS**
All MRI studies were performed with a 2-mm 2D fast-field echo sequence on a 3-T Philips scanner. We studied 10 AD patients (7 females, 3 males; age range 53-82 years, mean age 64 years) and 10 age-matched healthy controls. Two radiologists independently graded the signal of the cerebral cortices in the superior frontal gyrus (SFG), superior temporal gyrus (STG), precuneus (PrCn) and cuneus (Cun) on MR images with PADRE using a 4-point scale: grade 0, no delineation of low signal area (LSA); grade 1, subtle delineation of LSA; grade 2, partial delineation of LSA; and grade 3, diffuse delineation of LSA. Contrast ratio (CR) between the cortices and adjacent white matter was measured. Mann-Whitney U test was used for qualitative and quantitative assessments.

**RESULTS**
For the cortices other than the SFG, the mean grade of the cerebral cortex was significantly higher for AD patients than control subjects (STG, p=0.027; PrCn, p=0.0002; Cun, p=0.013). Mean CR of the cerebral cortices other than the SFG was significantly higher for AD patients than control subjects (STG, p=0.0052; PrCn, p=0.023; Cun, p=0.002).

**CONCLUSION**
Our MR study using PADRE suggests that the signal in the specific cerebral cortices in AD patients is different from that in healthy subjects.
CLINICAL RELEVANCE/APPLICATION

3T MR images with PADRE may provide useful information for the diagnosis of AD.
SSG13

Neuroradiology (Imaging of White Matter and Demyelinating Disease)

Tuesday, Dec. 1 10:30AM - 12:00PM Location: N227

NR  MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSG13-01 Subcortical White Matter Hyperintensity Burden in Astronauts

Tuesday, Dec. 1 10:30AM - 10:40AM Location: N227

Participants
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PURPOSE
We postulated that subcortical white matter hyperintensities (WMH) without clinical symptoms might be occurring in astronauts exposed to hypobaric conditions. We previously demonstrated the presence of increased WMH burden in high altitude U-2 pilots (U2P) and altitude chamber aerospace physiology personnel (AOP) occurring in the absence of clinical symptoms.

METHOD AND MATERIALS
In our prior study evaluating WMH burden in high altitude U-2 pilots (U2P) and aerospace physiology personnel (AOP) we obtained 2-dimensional 5mm clinical MRI sequences, both T2 FSE and FLAIR. Brain exams were conducted on the two Siemens 3T magnets with either a 12-channel or 32-channel phased array head coil. The National Aeronautics and Space Administration (NASA) has previously obtained similar 3T brain MRI scans on 42 astronauts after international space station (ISS) mission completion. These scans were conducted on 3 different 3T magnets, two Siemens scanners and one Philips scanner, with 12-channel head coils. WMH burden was evaluated by 1 neuroradiologist and 1 neurologist for lesion count. Assessment of lesion volume is in progress. Nonparametric Wilcox statistics were used to compare the astronauts to our normative, advanced degree (DOC) population (n=162) data as well as our AOP group (n=83) and U2P group (n=105). Age range of our prior study populations was 26-50; average DOC 34.6; average AOP 36.5; and average U2P 37.7. NASA age range 35-55, average 45.

RESULTS
The average number of WMHs for U2P was 8.1; AOP 6.3; DOC 2.8; and for the NASA astronauts 9.4. Wilcoxon rank sum test with continuity correction data demonstrates a significant difference for WMH burden between the NASA group and DOC (p value = 0.0211). There was no significant difference between the NASA group and AOP (p = 0.4762) or U2P (p = 0.725) groups.

CONCLUSION
Astronauts demonstrate a similar WMH burden to our high altitude U2 pilots and aerospace physiology personnel, significantly higher than the normal population.

CLINICAL RELEVANCE/APPLICATION
This study suggests the potential for similar pathophysiology in astronauts as seen in personnel exposed to the hypobaric environment in military operations, which has direct relevance to future deep space operations. Understanding the association between WMHs and hypobaric exposure may provide insight into the pathophysiology of other white matter disease processes.

PURPOSE
To improve the spatial resolution and contrast-to-noise ratio (CNR) of fluid attenuated inversion recovery (FLAIR) MRI.
METHOD AND MATERIALS

Data from 5 healthy controls and 29 patients with relapsing-remitting and progressive multiple sclerosis (MS) were acquired on a Philips 3T using sagittal 3D sequences. Signal-to-noise ratio and CNR were estimated by assessing the noise between repeated acquisitions of the same scan. Various spatial resolutions ranging from 0.2 mm³ to 1 mm³ were tested.

RESULTS

Gray matter (GM)- white matter (WM) CNR was by 55% and 74.5% higher in FLAIR² than in FLAIR and double inversion recovery (DIR) and improved between lesions and WM by 59% and 29.6%, respectively. The figure shows a 3D T2 (A), a conventional 3D FLAIR (B), 3D FLAIR² (C) and 3D DIR of a person with relapsing-remitting MS. In agreement with the quantitative CNR measurements, lesion conspicuity and contrast between GM and WM appear improved on FLAIR². Here, FLAIR² was acquired at 0.6x0.75x1.35 mm³ and reconstructed to 0.3 mm³ voxels, while DIR was acquired and reconstructed to 1 mm³. The 3D-nature of FLAIR² allowed the visualization of callosal and infratentorial MS lesions. Cortical and juxtaocular MS lesions were more conspicuous in FLAIR² than in the other scans.

CONCLUSION

We present a simple approach for obtaining CSF suppression with improved CNR compared to conventional FLAIR and DIR. Lesions in the entire brain are captured, including infratentorial regions, the corpus callosum and most of the cervical cord as well as cortical lesions, at high spatial resolution. With its DIR-like contrast, FLAIR² may elegantly resolve the debate whether or not to include DIR into the standard imaging protocol of MS.

CLINICAL RELEVANCE/APPLICATION

FLAIR² is very easy to acquire on most MR scanners. Apart from MS, the improved detection of WM hyperintensities will benefit research and diagnosis in Alzheimer's disease, neurotrauma, stroke and other applications. The isotropic 3D-acquisition allows for excellent image registration in serial studies, which may improve automated detection of lesions. Dedicated head-neck coils will allow to assess abnormalities in the entire cervical cord and parts of the thoracic cord.

SSG13-03 Clinical Feasibility of Synthetic MRI in Multiple Sclerosis: A Diagnostic and Volumetric Validation Study

Tuesday, Dec. 1 10:50AM - 11:00AM Location: N227

Participants
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Sten Fredriksson, MD, PhD, Stockholm, Sweden (Abstract Co-Author) Speaker, Actavis, Inc; Speaker, Bayer AG; Speaker, Bogen Idec Inc; Speaker, Merck KGaA; Speaker, Novartis AG; Speaker, sanofi-aventis Group; Speaker, Teva Pharmaceutical Industries Ltd
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PURPOSE

To implement synthetic magnetic resonance imaging (syMRI) on a new scanner type and to compare its diagnostic accuracy with conventional MRI in multiple sclerosis (MS). Secondary aims were to study the repeatability of syMRI volumetry and compare its feasibility with commonly used volumetric methods.

METHOD AND MATERIALS

This prospective study was approved by the ethical review board and written informed consent was obtained. In October 2014, 20 MS patients were consecutively recruited along with 20 healthy controls. SyMRI was implemented on a Siemens 3T scanner. Comparable conventional (11:00 minutes) and synthetic (6:50 minutes) T1, PD, T2 and FLAIR images were acquired. Diagnostic accuracy, lesion detection and artifacts were assessed by blinded neuroradiological evaluation and contrast-to-noise ratios by manual tracing. Volumetry was performed with SyMRI, Freesurfer, FSL and SPM. Ordinal data was analyzed using Wilcoxon signed ranks test and categorical data using McNemar test. Repeatability was quantified using the inter-measurement coefficient of variance (CoV).

RESULTS

Synthetic images were of good to sufficient quality, except FLAIR images that were degraded by artifacts. All participants were correctly classified as patients/controls and incidental findings were identical with both MRI techniques. There were no differences in lesion number (P = 0.78) or location (P = 0.50-0.77). SyMRI provided the fastest segmentations with the lowest CoV for brain volume (0.14%) and brain parenchymal fraction (0.14%).

CONCLUSION

SyMRI provides diagnostic T1-, PD- and T2-weighted images in MS patients and controls. Synthetic brain tissue segmentations are fast and precise quantitative biomarkers suitable for longitudinal MS studies.

CLINICAL RELEVANCE/APPLICATION

Synthetic MRI can lower the threshold of implementing radiological quantitative biomarkers into clinical practice in MS by providing fast and precise brain tissue segmentations Conventional T1, PD and T2 sequences could possibly be replaced by synthetic images with the additional benefits of being able to arbitrarily adjust the weightings post-hoc and a slight reduction in acquisition times, meanwhile providing abovementioned quantitative biomarkers.

SSG13-04 Grey/white Matter Ratio at Diagnosis, and the Risk of 10-year Multiple Sclerosis Progression

Tuesday, Dec. 1 11:00AM - 11:10AM Location: N227
Participants
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PURPOSE
Grey and white matters are both affected in multiple sclerosis (MS), but poorly correlate among each other. This is possibly due to the heterogeneous pathological substrates of the disease, with preponderance of white matter demyelinating inflammation in relapsing-remitting (RR), and of grey matter neurodegeneration in secondary progressive (SP). Aim of the study is to investigate the relationship between grey and white matter in a population of newly diagnosed RRMS subjects, with long-term MS-related outcomes.

METHOD AND MATERIALS
The present 10-year retrospective longitudinal study included 134 RRMS subjects that performed MRI at the time of diagnosis with acquisition of T1-weighted volumes for segmentation purposes. In particular, the ratio between grey and white matter was subsequently calculated. The occurrence of clinical relapses, the reaching of Expanded Disability Status Scale (EDSS) 4.0, and the SP conversion were recorded during a mean follow-up period of 10.1±1.8 years (from 7.1 to 13.2).

RESULTS
During the study period, 54 subjects (40.3%) reached EDSS 4.0, and presented reduced grey/white matter ratio, as compared to subjects not reaching EDSS 4.0 (1.270±0.156 and 1.343±0.185, respectively) (p=0.017). At the same time, 29 subjects (21.6%) converted to SP, and presented reduced grey/white matter ratio, as compared to subjects not converting to SP (1.241±0.149 and 1.334±0.179, respectively) (p=0.012). In particular, subjects with higher grey/white matter ratio at diagnosis had a 80% reduced rate of reaching EDSS 4.0 (p=0.040; hazard ratio=0.195; 95% confidence interval=0.041-0.829), and a 90% reduced rate of SP conversion, as compared to subjects with lower grey/white matter ratio (p=0.043; hazard ratio=0.105; 95% confidence interval=0.011-0.831).

CONCLUSION
The ratio of grey/white matter is a predictor of disability progression and of SP conversion in newly diagnosed RRMS subjects, suggesting that different pathological substrates are present from the early phases of MS, and highlighting the importance of appropriate MRI techniques at MS diagnosis.

CLINICAL RELEVANCE/APPLICATION
The present study evaluated for the first time the ratio between grey and white matter in MS, suggesting a novel MRI method to predict MS progression from the diagnosis.

SSG13-05 Substages of Acute Multiple Sclerosis Lesions Demonstrated on Quantitative Susceptibility Mapping and R2* from Gradient Echo MRI
Tuesday, Dec. 1 11:10AM - 11:20AM Location: N227

Participants
Yan Zhang, Wuhan, China (Presenter) Nothing to Disclose
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Yi Wang, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
Multiple sclerosis (MS) lesions at early stages are highly dynamic and pathologically heterogeneous, and therefore not well delineated in standard MRI. Quantitative susceptibility mapping (QSM) and R2* may offer new insight into the rapid changes in myelin and iron content within new lesions. The goal of this study was to characterize changes in QSM and R2* at various stages of lesions gadolinium enhancement.

METHOD AND MATERIALS
This retrospective study included 43 MS patients with newly identified T2w white matter lesions that first appeared on the current T2w image compared to the former scans. All patients underwent a 3D gradient multiple echoes sequence to generate QSM and R2* maps. These new lesions were substaged according to enhancing patterns: nodular, shell and non-enhancing. Lesions susceptibilities and R2* values were quantified and compared using analysis of variance (ANOVA) among three patterns. A paired t test was used to analyze susceptibility and R2* between the enhancing rim and the non-enhancing core of shell lesions.

RESULTS
Of the total 116 new T2w WM lesions, 65 were nodular with 62 (95.4%) isointense on QSM, 17 were shell with 15 (88.23%)
hyperintense on QSM and 34 were non-enhancing hyperintense on QSM lesions. The susceptibilities relative to contralateral mirror side normal appearing WM (NAWM) were 0.66 ppb ± 4.64 for nodular, 10.21 ppb ± 6.92 for shell, and 19.94 ppb ± 7.39 for non-enhancing (P<.01). R2* values relative to NAWM were -5.60 Hz ± 7.39, -7.80 Hz ± 2.40 and -3.10 Hz ± 2.48 (P<0.001) respectively. Of the 17 shell enhancing lesions, the differences of susceptibilities and R2* between the enhancing rim and non-enhancing core were significant (7.65 ppb ± 6.92 vs 15.51 ppb ± 7.30, P < .05; -6.13 Hz ± 2.31 vs -9.13 Hz ± 2.95, P <.05).

CONCLUSION

Gadolinium enhancement of acute MS lesions only reflects breakdown of blood–brain barrier. New T2 MS lesions may be substaged into acute, sub-acute, and early chronic according to GRE data: no change in QSM but rapid decrease in R2* during acute stage, rapid increase in QSM and further decrease in R2* during sub-acute, and increase in both QSM and R2* during early chronic.

CLINICAL RELEVANCE/APPLICATION

QSM and R2* can be used to capture different stages of early multiple sclerosis (MS) lesions.

SSG13-06 Decreased GABA Concentrations in Patients with Relapsing-remitting Multiple Sclerosis Demonstrated by Edited Magnetic Resonance Spectroscopy

Tuesday, Dec. 1 11:20AM - 11:30AM Location: N227

Participants
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Fuxin Ren, Jinan, China (Abstract Co-Author) Nothing to Disclose
Qianmei Cao, Jinan, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

Gamma-aminobutyric acid (GABA) is the main inhibitory neurotransmitter in the central nervous system. Previous studies have demonstrated that there is a dysfunctional GABAergic neurotransmission in animal models of multiple sclerosis (MS). Edited magnetic resonance spectroscopy (MRS), using the MEGA-PRESS sequence, is the most widely used technique for detecting GABA in the human brain. However, to date there has been a paucity of studies exploring changes in GABA concentration in patients with MS. In this study, therefore, J-difference edited MRS was used to investigate GABA concentrations in patients with relapsing-remitting MS (RRMS) and healthy controls.

METHOD AND MATERIALS

Fifteen patients with RRMS (7 males/8 females, mean age 41.7±3.6 years) and fifteen healthy controls (6 males/9 females, mean age 43.3±4.7 years) were examined on a 3T scanner and T1-weighted three-dimensional TFE images were used as a localizer. The MEGA-PRESS sequence (TR 2000 ms; TE 68 ms; 256 averages) was used to measure GABA concentrations in the posterior cingulate cortex (PCC), left dorsolateral prefrontal cortex (DLPFC) and left hippocampus (LHC). For quantification, a shorter measurement (8 averages) of the unsuppressed water signal was obtained. The MRS data were analyzed using 'Gannet' (GABA-MRS Analysis Tool) in Matlab with Gaussian curve fitting to the GABA peaks. 3 Hz exponential line broadening was applied. The ratios of the integrals of the GABA and water signals, making corrections for T1 and T2 relaxation times and partial volume effects, were used to calculate water-scaled GABA concentration in mmol/L (mM) using a formula.

RESULTS

GABA concentrations in the PCC and LHC regions were significantly lower in RRMS patients compared to healthy controls (PCC region: 0.95±0.09 mM vs. 1.06±0.13 mM, p = 0.01; LHC region: 1.04±0.20 mM vs. 1.23±0.22 mM, p = 0.02). No statistical difference in GABA concentrations in the DLPFC region was seen between groups (0.91±0.10 mM vs. 0.95±0.13 mM, p = 0.32).

CONCLUSION

These results are consistent with a hypothesis of dysfunctional GABAergic neurotransmission in the central nervous system in patients with MS, and suggest a potential treatment target for MS.

CLINICAL RELEVANCE/APPLICATION

MRS study suggests dysfunctional GABAergic neurotransmission in the central nervous system in patients with MS, as well as a potential treatment target for MS.

SSG13-07 Temporal Assessment of Injury and Repair in Multiple Sclerosis Lesions Using Structure Tensor Analysis

Tuesday, Dec. 1 11:30AM - 11:40AM Location: N227

Participants
Laura Chin, Edmonton, AB (Abstract Co-Author) Nothing to Disclose
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Yunyan Zhang, MD, PhD, Calgary, AB (Abstract Co-Author) Nothing to Disclose

PURPOSE

Multi-focal plaques remain to be the hallmark of multiple sclerosis (MS). Subtle changes in lesion structure are ongoing but not detectable with standard measures. Here we aimed to determine how lesions evolve in brain MRI of MS patients using a new measure of tissue alignment, structure tensor analysis.

METHOD AND MATERIALS

19 untreated MS patients were scanned bimonthly for 14 months at 1.5T. All images were non-uniformity corrected and sequential images were co-registered to baseline MRI (month 0). T2 lesions were segmented with reference to other MRI contrasts and followed over time. For lesions appeared during study, we mapped their onset time to baseline for consistency. Structure tensor analysis was applied to the corrected T2 images that resulted in 2 index maps: coherency and energy, which represent tissue...
anisotropy and total strength of directions respectively. Lesion outcomes were then extracted from corresponding index maps and averaged per MRI slice, timepoint, and patient. Lesion size was also computed for comparison. Outcome significance was assessed using multi-effect modeling (p<=0.05).

RESULTS
We identified 156 white matter lesions; 145 visible throughout the study; 15 lesions appeared post baseline and were adjusted. Overall, there is a trend to increase for lesion coherency, prominently from month 10. Lesion energy appeared stable except a remarkable decrease at month 8, as also seen in lesion coherency. These results are not affected by lesion adjustment. Lesion size tended to decrease over 14 months.

CONCLUSION
Abrupt increase in lesion coherency from month 10 suggests tissue repair including remyelination in these patients. While being a similar measure to diffusion anisotropy, structure tensor coherency has the advantage of using standard MRI, no extra scan time needed. Stable energy and lesion size may indicate lack of sensitivity of these measures. Further confirmation is warranted.

CLINICAL RELEVANCE/APPLICATION
Structure tensor coherency may become a new measure of nerve repair in MS lesions after demyelination. As it is embeddable to clinical MRI, this measure may improve routine patient care.

SSG13-08  Lack of Correlation between Neck Venous Drainage and Multiple Sclerosis

Tuesday, Dec. 1 11:40AM - 11:50AM Location: N227

Participants
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PURPOSE
Presence of flow abnormalities in neck veins of Multiple Sclerosis (MS) patients is still controversial, and the best imaging technique to evaluate them is not well defined yet. Aim of this study is to evaluate, using a quantitative MRI analysis, blood flow and venous stenosis in neck vessels, and investigate if there are differences between MS patients and healthy controls (HC), along with possible correlation with clinical scores.

METHOD AND MATERIALS
A group of 61 Relapsing-Remitting MS patients (mean age 38±11 years; F/M=27/34) and 18 HC (mean age 38±13.6 years; F/M=8/10) underwent MR scan of the neck. Acquisition included a 2D dynamic Phase-Contrast sequence (TR=66.8ms; TE=5.3ms; slice thickness=3mm; 30 time points), with peripheral retrospective triggering, acquired as a single slice at two different levels (C2 and C6). Quantitative measures, obtained with a semi-automated method through a dedicated software (Signal Processing In NMR - SPIN, Detroit, USA), were: left and right internal jugular vein (IJV) flow rates, and their cross-sectional areas, total IJV flow rate, total arterial and venous blood flow rates and the corresponding arteriovenous mismatch. Clinical variables included: number of relapses, disease duration, Expanded Disability Status Scale, Annualized Relapsing Rate and Multiple Sclerosis Severity Score. All statistical analyses were performed using SPSS (SPSS Inc, 2008, V.17.0. Chicago, SPSS Inc.).

RESULTS
Only 13/61 (21.3%) MS patients, with 7/18 HC (38.9%), showed a reduction in IJV cross sectional area. An independent samples t-test between MS patients and HC showed no significant differences for any flow measure. Furthermore, no correlations were found between any MR measure and clinical variables.

CONCLUSION
Quantitative MR evaluation of blood flow in neck vessels found no difference between MS patients and HC in any of the tested flow measures, confirming that the neurovascular hypothesis of MS is, in our sample, not suitable. Also, MS patients and HC showed no difference in terms of IJV area, suggesting that IJV stenosis is not related to the disease. Further studies, with a larger HC group, need to be performed to confirm our results.

CLINICAL RELEVANCE/APPLICATION
Neck venous drainage abnormalities have been claimed to be associated with Multiple Sclerosis. Conversely, our quantitative MR analysis seems to exclude that venous patterns are related to the disease.

SSG13-09  fMRI and Multiple Sclerosis: Cognitive Function Assessment Using Verbal Fluency Paradigm

Tuesday, Dec. 1 11:50AM - 12:00PM Location: N227

Participants
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Tania M. Netto, PhD, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Lucas Ramos, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Lucas Faria, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
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PURPOSE

Multiple Sclerosis (MS) is an autoimmune disease of Central Nervous System, characterized by chronic inflammatory demyelination of both white and grey matter pathology. Individuals with MS suffer from a range of physical, psychiatric, and cognitive symptoms. Cognitive impairments have been reported in 40-60% of these patients and verbal fluency tests such as semantic and phonemic have consistently been reported as more sensitive to executive functions impairments in MS than other measures. The aim of this study was to evaluate MS patients by functional magnetic resonance imaging (fMRI) with a verbal fluency paradigm and cognitive neuropsychological scores.

METHOD AND MATERIALS

Nineteen patients with MS (14 women; mean age 35.47 years, SD +/- 9.01) underwent a neuropsychological assessment including: Mini Mental State Examination for exclusion criteria; Semantic and Phonemic Verbal Fluency to measure verbal initiation and inhibition, memory, phonological and semantic language; and Hayling test to evaluate verbal initiation and inhibition, search strategies, syntactic-semantic and processing speed. This was followed by one fMRI session within a period of no more than one month and no less than 1 week. All MRI studies were performed on a 3T Siemens Trio, using fMRI EPI sequences while the patients responded to a verbal fluency task. Image processing and analysis were done using BrainVoyager software using GLM.

RESULTS

During Whole brain analysis (qFDR<0.05) we found an increased BOLD response to verbal fluency task of Wernicke and Brocas areas and Inferior Frontal Gyrus (Broadman Area 9) in left hemisphere. In a ROI analysis, this activation had an inverse correlation (r = -0.61, p<0.01) between Hayling test scores and Wernicke area fMRI responses during Verbal Fluency task. In this situation, subjects that scored higher in Hayling test exhibited lower Wernicke responses to verbal fluency task.

CONCLUSION

This results revealed that those patients that had reduced processing speed to evoke words had higher scores in Hayling test and lower brain responses in Wernicke area, reflecting on executive functions difficulties in initiation and inhibition of phonological and semantic language.

CLINICAL RELEVANCE/APPLICATION

Cognitive impairments are important causes to functional disability on ME patients, and knowing its functional relationships in the brain can affect treatment decisions and improve patients life quality.
**PURPOSE**
We developed a method for improving the image quality of U-LDCT by means of a supervised patch/pixel-based machine-learning technique called an MTANN. The MTANN can create the virtual higher-dose CT (v-HDCT) from U-LDCT by learning the relationship between U-LDCT and higher-dose CT. The purpose of this study was to investigate the clinical feasibility of U-LDCT with the MTANN technology for LCS.

**METHOD AND MATERIALS**
Thirty subjects (median age: 66 y.o.; range: 55-74) underwent CT LCS with both low-dose CT (LDCT) and U-LDCT using a 320-detector-row CT scanner (Aquilion One, Toshiba, Japan). LDCT were performed under our LCS protocol (120 kVp, automatic tube-current control with 22 noise index, 0.5 mm x 80 detector row, 1.39 pitch factor, 2 mm reconstruction slice thickness and interval), while U-LDCT were done with the same parameters except a tube-current-time-product of 5 mAs. Effective radiation doses for LDCT and U-LDCT were approximately 2.0 and 0.2 mSv, respectively. Both LDCT and U-LDCT were reconstructed with the filtered-back-projection algorithm. Our MTANN converted U-LDCT images to v-HDCT images. Two radiologists reviewed LDCT images, and "gold-standard" pulmonary nodules 4 mm or larger in diameter were determined in consensus. We evaluated v-HDCT in comparison to the "gold-standard" by using a 3-point subjective scale, i.e., Grade 3: a nodule and its type (solid nodule [SN] or ground-glass nodule [GGN]) were accurately identified on v-HDCT; Grade 2: a nodule but not its type was identified confidently; Grade 1: a nodule could not be identified.

**RESULTS**
We identified 18 nodules (16 SN; 2 GGN) on LDCT images in the 30 subjects. All 16 SNs on v-HDCT were classified as Grade 3, whereas the 2 GGNs were Grade 2.

**CONCLUSION**
All SNs and GGNs could be identified on MTANN v-HDCT, but a nodule type for 2 GGNs was difficult to be determined confidently.

**CLINICAL RELEVANCE/APPLICATION**
MTANN may be useful for further reduction of radiation dose in LDCT for lung cancer screening.

**PURPOSE**
To reduce motion artifacts of the coronary arteries (CAs) and to increase the temporal resolution (TR) while utilizing only the minimal amount of rawdata needed for a short-scan reconstruction.

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**Sub-Events**
SSG14-01 Lung Cancer Screening (LCS) in Ultra-low-dose CT (U-LDCT) by Means of Massive-Training Artificial Neural Network (MTANN) Image-Quality Improvement: An Initial Clinical Trial

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**Sub-Events**
SSG14-02 Motion Compensation from Short-Scan Data in Cardiac CT

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**Sub-Events**
SSG14-01 Lung Cancer Screening (LCS) in Ultra-low-dose CT (U-LDCT) by Means of Massive-Training Artificial Neural Network (MTANN) Image-Quality Improvement: An Initial Clinical Trial

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**Sub-Events**
SSG14-02 Motion Compensation from Short-Scan Data in Cardiac CT

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METHOD AND MATERIALS

The TR in diagnostic single source cardiac CT lies in the order of 0.15 s. In cases with higher heart rates, however, motion artifacts remain in the region of the CAs. Motion compensation (MoCo) algorithms estimate and apply motion vector fields (MVF) and can, potentially, reduce such artifacts by effectively improving the TR. Most of the MoCo algorithms described so far require scan data significantly larger than the short scan interval to estimate the motion parameters. We propose a new approach to increase the TR in the region of the CAs. It consists of three steps: a) performing an initial reconstruction and segmenting the CAs, b) estimating the motion from the short scan interval (180° + fan angle) and c) performing the MoCo. The last two steps are based on the decomposition of the initial volume into N overlapping limited angle reconstructions. As an initial MVF guess the barycenters of the CAs are determined slice-wise in the limited angle image volumes. The MVFs are iteratively refined using a cost function maximizing the image sharpness. To validate the algorithm a dynamic CA simulation study is employed. Furthermore the algorithm is applied to clinical patient data with heart rates between 60 bpm and 90 bpm. Motion-compensated reconstruction is performed in several heart phases.

RESULTS

In the simulated and measured cases the value N = 30, yielding limited angle images covering a 12° projection range each, turned out to be sufficient. The TR could be increased which was found by comparison with simulations at faster rotation speeds. Regarding the patient data we found that 10 coronary segments showed motion artifacts and with our MoCo method we were able to remove the artifacts in all but two cases.

CONCLUSION

We presented a cardiac MoCo algorithm providing an improved delineation of the coronary arteries. The findings have been evaluated based on a simulation study and on patient data, where the visibility of the coronary arteries increased due to an increased temporal resolution.

CLINICAL RELEVANCE/APPLICATION

Increasing the temporal resolution in cardiac CT imaging and thereby reducing motion artifacts improves the accuracy in the diagnosis of coronary artery disease.

SSG14-03  XACT: A New Imaging Modality Based on Ultrasonic Detection of X-ray Absorption

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S403B

Awards
Trainee Research Prize - Fellow

Participants
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Liangzhong Xiang, PhD, Norman, OK (Abstract Co-Author) Nothing to Disclose

PURPOSE

Absorption based X-ray imaging including CT is an invaluable tool in medical diagnostics. However, the use of conventional CT is limited by two factors; one is the limited spatial resolution, and the other is the relatively high radiation dose. The purpose of this study is to explore X-ray induced acoustic computed tomography (XACT), a new imaging modality, which take advantages of the X-ray absorption contrast at low radiation dose and high ultrasonic resolution in a single modality.

METHOD AND MATERIALS

First, a theoretical model was built to analyze the sensitivity to X-ray absorption by comparing with XACT and conventional X-ray imaging. Second, an XACT imaging system was developed to evaluate the X-ray induced acoustic signal generation. 60-nanosecond X-ray pulses were generated from an X-ray source operated at the energy of 150 kVp with a 25-Hz repetition rate. The X-ray induced acoustic signals were captured by a commercial ultrasonic transducer (2.25 MHz in central frequency).

RESULTS

Theoretical analysis shows that X-ray induced acoustic signal has 100% relative sensitivity to the X-ray absorption. It naturally filters out the X-ray scattering. Less background from the ultrasonic detection of X-ray absorption will increase the imaging sensitivity. In the experiment, a lead wire and a piece of bone were irradiated to demonstrating the X-ray induced acoustic signals generation, respectively. A major peak is readily observed in the signals. We found that the pulse width of the acoustic signal was about 0.66 us; which correspond with the target size of 1 mm. The radiation dose of a single pulse is 0.03 mGy. It is only 1/100 less radiation dose of the normal X-ray CT.

CONCLUSION

In XACT imaging, we detect the acoustic signal generated by X-rays instead of detecting X-rays themselves. The acoustic signal is sensitive only to the X-ray absorption, and not to X-ray scattering. Using this principle, we improve the imaging sensitivity of X-ray absorption. Taking advantage of the high ultrasonic resolution, we can also perform 3-D imaging with a single X-ray pulse and without any mechanical motion of the imaging system. We can thus reduce the radiation dose by a factor of 100, and image 100 times faster when compared to the conventional X-ray CT. This new modality has the potential to revolutionize X-ray imaging applications in medicine and biology.

CLINICAL RELEVANCE/APPLICATION

Dedicated breast XACT for breast cancer screening.

SSG14-04  Assessment of Dose Performance of a New Technique for Single Source Dual Energy Acquisition

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S403B

Participants
Christian Hofmann, Erlangen, Germany (Abstract Co-Author) Employee, Siemens AG
Dual Energy (DE) scanning has skyrocketed in scientific relevance and diagnostic importance. The goal of this research is to determine if a novel, yet simple technique for DE utilizing a single x-ray tube by applying a split filtration to the x-ray beam in scan direction enabling simultaneous acquisition of different spectra, allows for dose efficient CT acquisitions compared to other single source DE approaches and standard single energy scanning.

METHOD AND MATERIALS

Two water equivalent phantoms, an anthropomorphic phantom (20cmx30cm) and a circular phantom (30cm), both equipped with an iodine insert (150mg I/cm³) in the center, were used for measurements. Four different scan acquisitions at matched dose (CTDInvol) were utilized for comparison; split filter DE (SFDE) utilizing 120kV, Dual Scan DE (optimized mA between kVs, DSDEopt.), Dual Scan DE (fixed mA between kVs, DSDEfixed), and 120kV single energy (SE). Each phantom was scanned 5 times for each acquisition to gather statistical meaningful. All measurements were performed on systems with highly integrated circuit detectors (Stellar, Siemens, Forchheim, Germany). Image noise and iodine contrast-to-noise ratio (CNR) were measured in mixed images generated by linear combination of the high and low kV images resulting in minimal image noise.

RESULTS

At equal CTDInvol the image noise in SFDE approach tends to be lower than in the other approaches. For the anthropomorphic phantom: $\sigma_{SFDE} = 11.6 < \sigma_{SE} = 13.9 < \sigma_{DSDEfix} = 14.4 < \sigma_{DSDEopt} = 14.5$ HU. For the circular phantom: $\sigma_{SFDE} = 21.5 < \sigma_{DSDEfix} = 22.4 < \sigma_{DSDEopt} = 23.1$ HU. At equal CTDInvol the iodine CNR tends to be highest for DSDEopt followed by SFDE. For the anthropomorphic phantom: $CNR_{DSDEopt} = 27.9 > CNR_{SFDE} = 24.9 > CNR_{SE} = 24.2 > CNR_{DSDEfix} = 22.4$. For the circular phantom: $CNR_{DSDEopt} = 15.4 > CNR_{SFDE} = 14.9 > CNR_{SE} = 14.0 > CNR_{DSDEfix} = 12.7$.

CONCLUSION

SFDE provides an effective solution to simultaneously acquire high and low energy data without dose penalties compared to standard single scanning, thus enabling routine Dual Energy scanning.

CLINICAL RELEVANCE/APPLICATION

Dose efficient dual energy scanning has been limited to dual source systems. SFDE allows for dose efficient scans on a single source systems, further enabling routine Dual Energy in clinical practice.

SSG14-05 Value of Scout-View Based Personalized Scan Protocol Selection of Spectral CT Imaging Individual Contrast Medium Protocol

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S403B

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PURPOSE

To investigate the value of scout-view based personalized scan protocol selection of gemstone spectral imaging and personalized contrast medium protocol (400mgI/kg) in enhanced abdomen CT, comparison the image quality with routine 120 kV and contrast medium protocol.

METHOD AND MATERIALS

83 patients suggested with abdomen enhanced CT scan were enrolled and all were divided into two groups randomly. Group A (n=49) used tube voltage of 120kV and automatic exposure control (AEC), according to the body mass index (BMI), the noise index (NI) of AEC were setted as 10 (BMI<23), 12(23≤BMI≤26) and 14(BMI>26) respectively. The maximum mA corresponded CTDIvol approximate GSI protocol was used for arterial phase and vein phase. The average mA corresponded CTDIvol approximate GSI protocol was used for parenchyma phase. Monochromatic images at 60keV blending with 40% adaptive statistical iterative reconstruction (ASIR) were reconstructed. The CT value and SD value of abdomen aorta and erector spinae were measured and the contrast-noise-ratio was calculated. Data was compared with student T-test.

RESULTS

The image noise and the CT value of aorta and erector spinae showed no significant difference between two groups (both P>0.05). The CNR of two groups have no significant difference (43.89±19.08 vs 38.29±49.44, P>0.05). The DLP of group B was lower than that of group A (460.91±225.18 vs 390.69±129.03, P<0.05). The total contrast volume of group B had an average 25.29% decrease than that of group A (74.71±11.04 vs 100ml±0.00, P<0.05).

CONCLUSION

Personalized scan and contrast medium protocol in spectral CT imaging significant reduce radiation dose and contrast medium dose without compromising image quality.

CLINICAL RELEVANCE/APPLICATION

Spectral CT imaging provides a high-quality angiographic technique, which allows use of a lower contrast agent compared with conventional 120-kVp SECT.
SSG14-06 Fluence Field Modulation for Low-dose X-ray Computed Tomography using Compact Multiple Aperture Devices

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S403B

Participants
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PURPOSE
CT scanning at low doses is limited by the scanner’s ability to adapt to specific patients and imaging tasks. Current clinical CT permit exposure reductions via x-ray technique selection and current modulation. While dynamic fluence field modulation (FFM) has been proposed to greatly expand the capability of CT systems to customize acquisitions and minimize dose, design constraints including actuation speed, g-forces, and available space make practical solutions difficult. In this work, we propose a novel, compact FFM system based on multiple aperture devices (MADs) that can meet these practical requirements to provide patient-specific low-dose acquisitions.

METHOD AND MATERIALS
We develop a theoretical framework for design and simulation of MADs and construct prototype devices for initial characterization. MADs are essentially binary filters (entirely blocking or transmitting the x-ray beam on a fine scale). Spatial modulation is established through appropriately sized, space-variant aperture design. Dynamic FFM is possible when two devices are placed in series, and translated relative to one another. Various design options are explored – especially those that minimize undesirable high-frequency field modulations while enforcing the desired low-frequency modulations. Prototype devices were constructed using tungsten sintering and characterized on a CT test bench.

RESULTS
Various multiple apertures devices were studied including designs meant to yield flat fluence patterns for circular and elliptical objects of various sizes. In test bench studies using prototype devices, flattened fields are demonstrated in physical phantoms, minimized high-frequency aperture patterns are observed, and artifact-free tomographic reconstructions are produced and shown to have similar image quality as compared to traditional (static) bow-tie filters.

CONCLUSION
With relative motion requirements of less than a millimeter/quarter rotation, minimum thicknesses of several millimeters, and a rigid filter material, practical device placement within a clinical CT gantry is achievable. Combined with good image quality in initial reconstruction results, multiple aperture devices are a potential solution to practical FFM in CT.

CLINICAL RELEVANCE/APPLICATION
The proposed dynamic FFM system is practical for clinical CT scanners and will facilitate customized patient scans, maximizing diagnostic imaging performance at minimum radiation exposures.

SSG14-07 Quantitative Assessment of Coronary Artery CT Images with Full Iterative Reconstruction Performed on a 320 Detector-row Scanner

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S403B

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Akira Taniguchi, RT, Otawara, Japan (Abstract Co-Author) Employee, Toshiba Corporation
So Tsushima, Otawara, Japan (Abstract Co-Author) Employee, Toshiba Corporation

PURPOSE
To compare the spatial resolution, image noise, and image quality of volume scans performed on a 320 detector-row CT scanner with filtered back projection (FBP), hybrid iterative reconstruction (IR), and a new full IR algorithm.

METHOD AND MATERIALS
Using a 320-detector scanner (Aquilion One Vision, Toshiba) we scanned Catphan- and pulsating coronary artery (CA) phantoms (diameter 4 mm) with plaque-, calcium plaque-, and Cypher stent stenosis. The phantoms contained an iodine solution (CT number 350 HU at 120 kV) and were scanned in the volume scan mode, non-gated. Scanning was at 50-, 100-, and 150 mAs. Reconstruction was with filtered back projection (FBP) and quantum denoising filters, hybrid IR (Adaptive Iterative Dose Reduction-3D: AIDR 3D), and full IR (FIRST). We recorded the image noise (standard deviation [SD] of the CT number and the noise power spectrum), image resolution (contrast of the ladder pattern and the modulation transfer factor [MTF]), and the full width at half maximum (FWHM) of the inner diameter of the simulated CAs and performed Tukey's multiple comparisons among the different scan parameters.
RESULTS
The image noise on images acquired at 150 mAs was 7.9 (FBP), 10.0 (AIDR 3D), and 8.1 (FIRST) and the [WU1] 50% MTF was 0.45, 0.49, and 0.78. The mean absolute percentage error of the FWHM was 4.2, 4.7, and 6.6% (50% plaque stenosis model), 4.4, 3.7, and 2.1% (50% CA stenosis model), and 26.2, 25.8, and 14.4% (stent model). The FWHM [k2] of the stent model [WU3] on images reconstructed with FIRST was significantly larger than with FBP or AIDR 3D (p<0.01). On images reconstructed with FIRST, the image quality was improved by 15-20% compared with FBP or AIDR 3D.

CONCLUSION
On scans of the simulated pulsating CA, FIRST yielded better image noise and spatial resolution than FBP or AIDR 3D.

CLINICAL RELEVANCE/APPLICATION
Full iterative reconstruction (FIRST) yields better image noise and spatial resolution than FBP or AIDR 3D and facilitates the accurate quantitative analysis of CT images of the coronary artery.

SSG14-08 Phase Retrieval and De-wrapping in Grating-based X-ray Differential Phase Contrast CT with Twin-peaks in Phase-stepping Curves
Tuesday, Dec. 1 11:40AM - 11:50AM Location: S403B

Participants
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Xiangyang Tang, PhD, Atlanta, GA (Abstract Co-Author) Research Grant, Sinovision Technologies Co Ltd

PURPOSE
In x-ray differential phase contrast (DPC) CT implemented with Talbot interferometry, phase-stepping procedure is widely employed to extract the phase signal for imaging. Since the fabrication process may cause defects in analyzer grating G2, the actual period of G2 may double the nominal period of G2, and the experimental determined phase-stepping curve (PSC) exhibits two distinct peaks within an actual period 2g2. For such a DPC-CT system with twin-peak PSCs, we develop an approach to retrieve and unwrap the phase signal.

METHOD AND MATERIALS
Based on the paraxial Fresnel-Kirchhoff theory, we derive an analytical formula to characterize the PSCs of an x-ray Talbot interferometry with flawed analyzer grating. We also conduct an experimental investigation into the phase retrieval and de-wrapping in x-ray DPC-CT with twin-peak PSCs. An x-ray Talbot interferometry with 4.6 micron of g2 is utilized to scan a mouse and a phantom that consists of tubes filled with water, cotton, sugar and air.

RESULTS
Fourier analysis of the PSC demonstrates that its first-order Fourier component with spatial frequency 1/2g2 is non-negligible, although it is smaller in magnitude than the second-order Fourier component with spatial frequency 1/g2. Consequently, experimental results show that in comparison with scanning G2 over its nominal period g2, stepping G2 over its actual period 2g2 can provide data to enable a significantly improved reconstruction of the phase-contrast CT images. Furthermore, with the use of the phase signal retrieved from the first-order Fourier component, the possible phase wraps in the phase signal retrieved from the second-order Fourier component can be removed.

CONCLUSION
Our theoretical analysis and experimental investigation show that for an x-ray DPC-CT imaging system with twin-peak PSCs, the PSCs should be determined by scanning G2 over the double of its nominal period g2; and then the PSCs can be utilized to retrieve and unwrap the phase signal for imaging.

CLINICAL RELEVANCE/APPLICATION
The preliminary results reported in this study may be of relevance to the preclinical and eventually clinical applications of grating-based x-ray phase contrast CT.

SSG14-09 Third-generation Dual-source CT of the Neck Using Automated Tube Voltage Adaptation in Combination with Advanced Modeled Iterative Reconstruction: Evaluation of Image Quality and Radiation Dose
Tuesday, Dec. 1 11:50AM - 12:00PM Location: S403B

Participants
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Boris Bodelle, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate image quality and radiation dose in third-generation 192-slice dual-source computed tomography (DSCT) of the neck using automated tube voltage adaptation (TVA) with an advanced modeled iterative reconstruction (ADMIRE) algorithm.

METHOD AND MATERIALS
CT studies of the neck in 116 patients were retrospectively evaluated. Group A (n=59) was examined on a second-generation DSCT with automated TVA and standard filtered back projection (FBP). Group B (n=57) was examined on a third-generation DSCT with automated TVA and ADMIRE. Age, neck diameter, and attenuation and noise of sternocleidomastoid muscle, internal jugular vein (IJV), submandibular gland, tongue, subscapularis muscle, and cervical fat were measured. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated. Size-specific dose estimates (SSDE) were assessed. Diagnostic acceptability was rated by three readers on a five-point scale.

RESULTS
Age (Group A, 57.9±18.1 years; Group B, 57.4±17.7 years; p=0.87) and effective body diameter (Group A, 15.1±1.6 cm; Group B, 15.8±1.9; p=0.075) did not differ significantly. Tube voltage in Group A was automatically set by TVA to 100 kV for all patients in group A (n=59), and to 70 kV (n=2), 80kV (n=5), and 90kV (n=50) in Group B. Average image noise was reduced and CNR was increased significantly (both p<0.001) in group B compared to group A. Diagnostic acceptability was rated consistently high in both groups with significantly better ratings for Group B than for Group A (4.83 vs. 4.56; p<0.001). Average SSDE was reduced by 34% in Group B compared to Group A (20.38±1.63 mGy vs. 13.04±1.50 mGy, p<0.001).

CONCLUSION
Combination of automated TVA and ADMIRE reconstruction in neck CT using third-generation DSCT results in a 34% radiation dose reduction compared to second-generation DSCT with automated TVA and FBP reconstruction with substantially lower image noise and significantly increased CNR and subjective image quality.

CLINICAL RELEVANCE/APPLICATION
Automated TVA in combination with ADMIRE should be routinely applied to neck DSCT in clinical routine to reduce radiation exposure and image noise, and to increase image quality.
**PURPOSE**

In the design of diagnostic and therapeutic treatment rooms for Nuclear Medicine, an important consideration is the shielding required for blocking the ionizing radiation from the radioactive isotopes. The primary radiation, possibly with build-up correction, can be calculated analytically. However, little data is available to estimate the radiation dose contribution of ionizing radiation that travels over the (typically lead) shielding in the wall and scatters of the ceiling; so-called skyshine. We aim to determine the contribution of this skyshine to the radiation dose received by people outside Nuclear Medicine rooms.

**METHOD AND MATERIALS**

Monte-Carlo simulations were performed with Gate/Géant for different heights of lead shielding in the wall, and different ceiling heights. A point source of Tc-99m (141keV), I-131 (365keV) or F-18 (511keV) was placed free in air, 1m above the floor, 3m from the wall. We used lead shielding of 2mm (Tc-99m) and 8mm (I-131, F-18). In total 165 simulations were run; for each isotope we varied the shielding height (between 1.8m and 5.0m) and ceiling height (3.0-5.0m). These simulations allow us to compare the contribution of the direct radiation (through the shielding), and skyshine (over the shielding).

**RESULTS**

We find that the skyshine contribution to the total radiation dose varies greatly (from <2% to ~100%), and strongly depends on photon energy. For low photon energies (e.g. Tc-99m) skyshine is often a dominant factor. For higher photon energies (e.g. F-18), shielding the primary radiation is typically the most important concern.

**CONCLUSION**

We have performed simulations that allow an estimation of the contribution of skyshine to the radiation dose outside a room, based on room use (occupancy, total radioactivity used), ceiling- and shielding height and the isotope used. For lower photon energies (e.g. Tc-99m) this can be a major contribution, which, if neglected, can result in insufficiently shielded rooms. These results will allow for safer and better optimized shielding designs in Nuclear Medicine departments.

**CLINICAL RELEVANCE/APPLICATION**

Our research will aid safer and better optimized shielding designs in Nuclear Medicine departments as the contribution of scattered radiation from the ceiling (skyshine) can be properly accounted for.
dose levels. The CTDIvol at each kV was matched to that in the 100Sn scan with quality reference mAs (QRM) values of 300, 150, 100, 50, and 25. Images were reconstructed using an iterative reconstruction method (ADMIRE, Siemens) with a kernel of Bv49-2. A 0.6 cc point ion chamber was used to measure radiation dose at 6 locations of each phantom. For each phantom size, dose level, and kV setting, image noise at uniform areas of the central region was measured and averaged across 10 slices. The average dose from the point-chamber measurement, instead of CTDIvol, was used to evaluate the dose efficiency. Radiation dose was calculated for each kV and each phantom size such that the noise was matched to that in the 120 kV images acquired at a dose level specified by 100Sn and 100 QRM, which was deemed clinically acceptable for lung cancer screening. The percent dose reduction of 100Sn relative to 120 kV for each phantom size was estimated.

RESULTS

100Sn generated images with the lowest noise among all tube voltages for all three phantom sizes at the same radiation dose. At a dose level that is considered clinically acceptable (100Sn, 100 QRM), the noise was reduced by 31%, 30%, and 28% for small, medium, and large phantom sizes compared with 120 kV. The corresponding dose reduction was 52%, 51%, and 49%.

CONCLUSION

The 100 kV with an added beam filtration can reduce radiation dose by 49-52% compared with the 120 kV in lung cancer screening CT.

CLINICAL RELEVANCE/APPLICATION

Added beam filtration such as tin filter has the potential to improve dose efficiency in lung cancer screening CT.

SSG15-03 Radiation Dose Reduction Using Mini-Mobile Digital Imaging System in a Neonatal Intensive Care Unit

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S404AB

Participants
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PURPOSE

The aim of this work was to determine the radiation dose received by infants from radiographic exposure and compare to mini-mobile digital imaging system (mini-DI) and conventional mobile digital radiography (DR) for entrance surface dose (ESD) and image quality for neonatal chest imaging

METHOD AND MATERIALS

The sample consisted of 20 neonatal chest x-rays of 12 neonates admitted and treated in a neonatal intensive care unit (NICU). All the neonates were preterm in the range of 25-35 weeks, with a mean of 31.5 weeks. We used a mini-DI system (Meteor, Nanofocusray Co. Ltd, Korea), which was adapted a flat-panel detector and monoblock X-ray source and conventional mobile DR (EFX vision, Shimadzu medical system, Japan) for comparison. The protocols of neonatal chest imaging were 60kV and 0.15 mAs for mini-DI, and 60kV and 1.2 mAs for mobile DR, respectively. With each protocol and system, ESD was measured using a dosimeter (Piranha, RTI electronics, Sweden). Signal to noise ratio (SNR), contrast to noise ratio (CNR) and modulation transferring function (MTF,10%) were calculated for image quality using bar phantom (x-ray test pattern type 18, FUNK, Germany).

RESULTS

The mean ESD for the mini-DI and mobile DR were 28.3±0.09 μGy and 254.6±1.04 μGy, respectively (p< 0.001). Regarding image quality, the mean SNR values for the mini-DI and mobile DR were 626.8 vs 18.4, the CNR value were 30.2 vs 26.8, and 10% MTF were 131μm vs 162μm, respectively. The diagnostic performance of mini-DI was better than those of conventional DR.

CONCLUSION

The results of our study show that neonates received ten-times lower dose from mini-mobile digital imaging system compare to conventional mobile DR. The mini-DI would be useful with dose reduction and good image quality in a NICU considering the sensitivity of the neonates to radiation

CLINICAL RELEVANCE/APPLICATION

The mini-mobile digital imaging system would be useful in a NICU for dose reduction considering the sensitivity of the neonates to radiation.

SSG15-04 A Method for Dose Reduction in Dedicated Breast CT Using a Wedge Filter: Theory and Preliminary Validation

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S404AB

Participants
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John M. Boone, PhD, Sacramento, CA (Abstract Co-Author) Research Grant, Siemens AG Research Grant, Hologic, Inc Consultant, Varian Medical Systems, Inc

PURPOSE

To improve image quality and reduce patient dose in dedicated breast CT (bCT) by means of a wedge filter design that modulates
the x-ray beam in the cone angle direction.

METHOD AND MATERIALS

Using a large cohort of breast CT images and the known geometry of our prototype bCT scanner, the x-ray path length profile through each breast as a function of position along the z-axis was obtained by ray tracing from the x-ray tube focal spot through the breast CT data and onto the detector panel, with some assumptions. A complete description of the air kerma at scanner isocenter and resulting arbitrary detector units (ADUs) on the projection images were then measured on our system by sweeping through all possible tube current values (up to detector saturation). Our bCT system's modeled x-ray spectra were then mathematically filtered with increasing thicknesses of 20% glandular breast tissue to provide a relationship between changes in air kerma and hence ADU values with varying x-ray path lengths through breast tissue. For several different filter materials (Cu, Ti, and Al) a nonlinear regression algorithm was developed to estimate the wedge filter thickness profiles needed to equalize the ADU values (behind the breast) along the z-axis of the detector.

RESULTS

Using a 60 kv x-ray spectrum with 0.3 mm Cu pre-filtration, the wedge filter thickness profiles resulting from the proposed algorithm were fit using linear regression and resulted in R² values > 0.9110 for all materials analyzed (Cu, Ti, and Al). The resulting wedge-shaped filters increased linearly from 0 mm (posterior edge of detector) to 1.1, 4.3, and 25.1 mm thick (anterior edge of detector) for the Cu, Ti, and Al filter materials, respectively.

CONCLUSION

A proposed design of a wedge-shaped filter for dedicated bCT has the potential of reducing patient dose by reducing incident air kerma along the thinner anterior regions of the breast where the dose is the highest; and improving image quality by reducing beam attenuation along the thicker posterior regions of the breast where image noise dominates. Furthermore, the proposed design is robust because it makes use of a large number of patient bCT datasets and it would be relatively straightforward to implement on our prototype bCT systems.

CLINICAL RELEVANCE/APPLICATION

This study is directly related to the improvement of clinical breast imaging because it has the potential of reducing patient dose and improving image quality.

SSG15-05 Five Year Review of Size and Age Specific CT Radiation Exposures in a Research Hospital During Advanced Dose Reduction Inititives

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S404AB

Participants
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David A. Bluemke, MD, PhD, Bethesda, MD (Abstract Co-Author) Research support, Siemens AG

PURPOSE

To review size and age specific CT exposures during various dose reduction initiatives over five years at a major research center. Our aim was to extract all CT exam exposure, size, age and other data from PACS dating back to 2010. Detailed data extractions allow us to compare across research protocols and ordering physicians demonstrating successful targeted radiation exposure reductions relative to prior and new benchmark exposures. Principal Investigators establishing new research protocols use this data to select optimal scanner settings and dose reductions for their studies.

METHOD AND MATERIALS

Using an in house extraction tool (Radiation Exposure Extraction Engine), we extracted CT exposure data from DICOM headers over three (as of submission) years (Feb 2012 to March 2015). Parameters included age, anatomic region(s), phases, scan protocol settings, research protocol number and ordering provider. We were also able to obtain body volume segmentation of scanned regions automatically with our extraction tool for accurate size estimation. Dose reduction initiatives included BMI based kVp reduction in 2010, model based iterative reconstruction starting in 2011, kVp modulation and application of Virtual non-contrast in 2013. We compared dose reductions in our most common exams, including chest, abdomen and pelvis routine and triple phase exams and chest CT.

RESULTS

As of submission, we have successfully extracted exposure data of 38,200 CT exams from eight scanners. We compared age and size specific similar research protocols throughout the last three years with aggressive dose reduction initiatives on 554 research protocols and 87 CT scan protocols. Example CT exams presented showed significant dose reductions over each year (p < 0.001).

CONCLUSION

Collecting size specific CT exposure and other data over several years has allowed us to confirm and compare many types of dose reduction initiatives across several hundred research and scan protocols. We demonstrated significant dose reductions over each year of continued dose reductions on our most common exams.

CLINICAL RELEVANCE/APPLICATION

Our results demonstrated and compared several successful exposure reduction initiatives during a dynamic time of advanced exposure reduction innovation. This is the largest review of CT exposures available to our knowledge that include parameters such as age, body size, ordering doctor, research protocol number, etc.
### SSG15-06 Virtual Non-enhanced Images Acquired by Material Suppression Iodine (MSI) in Enhanced Spectral CT Imaging on Chest: In Comparison with Plain Scan

**Tuesday, Dec. 1 11:20AM - 11:30AM Location: S404AB**

**Participants**
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**PURPOSE**
To evaluate the feasibility of virtual non-enhanced images post-processed by MSI in enhanced spectral CT imaging in comparison with the images of plain scan on chest.

**METHOD AND MATERIALS**
The chest plain and iodine-enhanced standardized CT scanning was performed sequentially on 11 patients using a 64-row CT scanner (GE healthcare, Discovery CT750 HD). The enhanced images were post-processed into virtual non-enhanced images following the function of material suppression iodine (MSI) on AW4.6 workstation (GE healthcare). The virtual non-enhanced images were compared with the images of plain scan by analyzing the CT values in selected vessels. The statistical analysis was carried on.

**RESULTS**
The CT values of the region of interest (ROI) in thoracic aorta, ascending aorta, pulmonary artery trunk, and dorsal muscle in enhanced images of chest were 258.38±29.21HU, 266.37±36.02HU, 239.91±57.63HU, and 45.64±48.64HU. All CT values on MSI images for the vessels mentioned above dropped to 44.00±6.23HU, 43.71±9.41HU, 47.03±11.93HU, 43.47±11.01HU, and 40.41±9.96HU, respectively. The MSI images demonstrated similar CT values as plain scan (40.25±6.19HU, 39.14±9.27HU, 40.11±11.01HU, and 40.41±9.96HU, respectively) (P>0.05). There were no significantly different values of CTDIvol between plain scan and enhanced CT scan (8.38±2.77 mGy vs. 8.85±1.83 mGy) (p>0.05) meanwhile.

**CONCLUSION**
Virtual non-enhanced images acquired by MSI effectively suppressed iodinate contrast, which was comparable to plain CT images on chest. Successful substitution scans lead to nearly 50% radiation dose reduction and got equal image quality.

### SSG15-07 Quantifying Uncertainties in Absorbed Organ Dose Calculations in Monte Carlo Simulations of Dental Cone Beam CT Applications

**Tuesday, Dec. 1 11:30AM - 11:40AM Location: S404AB**

**Participants**
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Reinhilde Jacobs, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
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Hilde Bosmans, PhD, Leuven, Belgium (Abstract Co-Author) Co-founder, Qaelum NV Research Grant, Siemens AG

**PURPOSE**
To estimate the uncertainty of calculated absorbed organ doses in dental Cone Beam CT (CBCT) Monte Carlo (MC) simulations due to uncertainties in the measurement of Half Value Layer (HVL) and in the positioning of the Field of View (FOV).

**METHOD AND MATERIALS**
X-ray tubes are applied to our EGSnrc MC framework via equivalent source models which consist of an energy spectrum derived from HVL measurements and a filter description specified from air kerma measurements across the radiation field. The HVL of the Promax 3D Max scanner (Planmeca, Finland) was measured at 96 kV with a farmer ion chamber. Source models were generated for the measured HVL and for HVL values corresponding to theoretical deviations of ±2.5% and ±5%. In a first study, each spectrum was directed towards the Zubal head phantom to simulate a jaw examination protocol (130 x 90 mm²). The centre of the FOV was initially placed between the upper and the lower jaw and axially positioned such that the entire denture is imaged. In a second study, a fixed source model was directed ten times to the phantom, each time shifting the centre of the FOV by ±1 cm and ±2 cm in the front-back direction, 1cm diagonally, 1 cm back and 1 cm down.

**RESULTS**
The HVL at 96kV was 9.05mmAl. A 5% lower HVL value results in an average 34.4% overestimation in absorbed organ doses, whereas a 5% overestimation results in an average 33.02 % underestimation in calculated organ doses. The more the FOV is shifted frontwards (either on the midline or diagonally) the lower the doses get. Shifting the FOV down, there is a noticeable 35% dose increase in the esophagus, a 28% dose increase in thyroid, a 29% decrease in brain and 29.62 % decrease in eye lens dose.

**CONCLUSION**
Underestimating HVL in the generation of equivalent source models procedure results in a thinner filter present on the beam path and hence in higher doses. In cases of highly filtered beams, such as CT or CBCT, uncertainties of 5% in HVL and its implementation to source models intended for MC dose calculations lead to 34% over or under estimation of calculated organ doses. Similar uncertainties are obtained for misplacements of the FOV on the model.

### CLINICAL RELEVANCE/APPLICATION
Accurate dental CBCT dose calculations in head voxel models via Monte Carlo simulations require accurate HVL measurements and careful FOV positioning.

**SSG15-08 A Monte Carlo Dosimetry Comparison Study of Two Different Paediatric Protocols for Teeth Auto Transplantation Planning and Follow-up**

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S404AB

**Participants**
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**PURPOSE**
To investigate via Monte Carlo (MC) simulations whether or not, a newly proposed autotransplantation tooth protocol in a new scanner, yielding images of similar quality with the existing protocol performed in an old scanner, is capable of reducing the dose to paediatric patients (justification).

**METHOD AND MATERIALS**
The clinical protocol requires one high resolution treatment planning CBCT scan to guide the segmentation of the tooth to be transplanted and two follow-up scans, one and two years later. The current protocol in Accuitomo 170 (Morita, Japan) employs a 60x60 mm2 'High Resolution' planning scan and two follow up 'Standard Resolution' 40x40 mm2 scans. The newly proposed one is to be carried out in Promax 3D Max (Planmeca, Finland) using a planning scan (90x100 mm2), followed by two (50x55 mm2) scans (all of them 'Ultra low dose, normal reconstruction'). To compare organ doses, MC simulations in voxel phantoms were implemented. CT scans of three paediatric patients (5 and 8 years old male, 12 years old female) were used to segment internal anatomy and create paediatric head voxel models. Three clinical dental applications (canine, incisor and premolar tooth) were investigated. An EGSnrc based MC framework was calibrated and employed to calculate absorbed organ doses and effective dose (ED) for each paediatric voxel phantom.

**RESULTS**
The total EDs of the currently used protocol for the 3 dental applications range from 356 µSv to 390 µSv for the 5 years old, 390 to 402 µSv for the 8 years old and 270 to 288 µSv for the 12 years old children. The new suggested protocol results in ED ranges of 267 to 275 µSv, 242 to 246 µSv and 207 to 208 µSv for 5, 8 and 12 years old respectively. The contribution of the planning scan on the total ED is 70% on average with the current protocol in Accuitomo 170 and 50% with the newly proposed one in Promax 3D Max.

**CONCLUSION**
Effective doses for the new protocol are lower and it is therefore dosewise justified. The contribution of the follow up scans to the total ED suggests that the next step towards dose optimisation should investigate the dose reduction of the follow up scans even further.

**CLINICAL RELEVANCE/APPLICATION**
The newly proposed tooth auto transplantation protocol delivers lower doses to children compared to the currently used protocol.

**SSG15-09 Is Simulation of 3D Tube Current Modulation Needed for Organ Dose Assessment with MC Frameworks?**

Tuesday, Dec. 1 11:50AM - 12:00PM Location: S404AB

**Participants**
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**PURPOSE**
To estimate the error associated with breast and lung dose calculation when using longitudinal tube current modulation (TCM) only versus the full 3D TCM information for three chest CT protocols.

**METHOD AND MATERIALS**
Four cadavers (3 female, 1 male) with different BMI (underweight, normal, overweight and obese) were scanned with a Siemens Definition Flash CT scanner using Standard-, XCare- and Flash-protocols (120 kVp, TCM). CTDIvol was matched to the patient specific CTDIvol of the Standard protocol for comparison purposes. The doses to the lungs and breasts were calculated with a MC simulation framework (EGSnrc) by using the full 3D TCM information obtained from raw data versus the use of longitudinal modulation only, obtained from DICOM headers. For each cadaver a voxel model was generated to be used for the dose calculation.

**RESULTS**
Results were analyzed per protocol and BMI. For the Standard protocol, independently of patient habitus, lung and breast dose differences between the two TCM methods were negligible (3.6% at maximum). For the XCare protocol, not accounting for the angular modulation caused a maximum underestimation of the lung dose for the underweight BMI of 1.6%. However, for the breast we found an overestimation for the smaller BMI (7.0%) whereas the tendency reverted to an underestimation which increased with BMI (up to 14.4%). For the Flash protocol we found that the lung dose is underestimated for all BMI, with a maximum of 4.6% for
the underweight, decreasing to 0.7% for overweight, when considering only longitudinal TCM. For the breast, we found an overestimation for the underweight BMI (3.3%), and a tendency to switch to underestimating values of 1.4% and 0.9% for the normal and overweight BMI, respectively.

CONCLUSION

Lung and breast dose estimations with MC frameworks or commercial tools that implement only z-modulation are within 5% of the respective doses when simulating 3D TCM for chest CT scans using a Standard or a Flash CT protocol. For the XCare protocol, the use of 3D TCM is recommended. This can be explained by the larger impact of the patient’s anatomy and the particular tube current modulation scheme used for that protocol.

CLINICAL RELEVANCE/APPLICATION

The implementation of longitudinal modulation only is sufficiently accurate for Standard and Flash CT protocols. This facilitates organ dosimetry estimation as 3D TCM is not accessible without the help of the manufacturer.
**SSG16**

**Physics (Image Processing/Analysis II)**

Tuesday, Dec. 1 10:30AM - 12:00PM Location: S502AB

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**SSG16-01** Multi-material Electronic Cleansing for Non-cathartic Ultra-Low-Dose Dual-Energy CT Colonography

**Participants**
Yulei Jiang, PhD, Chicago, IL (Moderator) Consultant, Quantitative Insights, Inc; Research Agreement, QView Medical, Inc

**Sub-Events**

**METHOD AND MATERIALS**

Twenty-seven patients were prepared for a non-cathartic colorectal examination by oral ingestion of 50 ml of iodinated contrast on the day before and two hours prior to DE-CT scans. DE-CTC images were acquired at a current/voltage of 15 mAs/140 kVp and 40 mAs/80 kVp with sinogram-affirmed iterative image reconstruction. Our novel MUMA-EC performed a water-iodine material decomposition of the DE-CTC images and calculated virtual-monochromatic (VM) images at multiple energies, after which a random forest classifier was used to label the images into the regions of lumen air, soft tissue, fecal tagging, and two types of partial-volume boundaries based on the features of these images. EC was performed by removing materials other than soft tissues from the original CTC image. For pilot evaluation, 280 volumes of interest (VOIs) representing typical EC artifacts (Type I: air-tagging boundary; Type II: three-material layer; Type III: three-material mixture) in current EC schemes were extracted and labeled into a reference standard. The metric of EC accuracy was the mean overlap ratio (OR) between the reference standard labels and the labels generated by the MUMA-EC, a dual-energy EC (DE-EC), and a single-energy EC (SE-EC) schemes. The effective radiation dose of the CTC examination was also assessed.

**RESULTS**

In MUMA-EC, the mean±std of ORs for Types I, II, and III artifacts were 0.981±0.035, 0.919±0.040, and 0.941±0.052, respectively, which were higher than those of SE-EC (0.972±0.040 [p<.01], 0.890±0.046 [p<.01], and 0.915±0.057 [p<.01], respectively), and DE-EC (0.980±0.038 [p=.48], 0.911±0.043 [p<.01], and 0.937±0.048 [p<.05], respectively). Visual assessment confirmed that the MUMA-EC generates less EC artifacts than do DE-EC and SE-EC. The average CTDIvol was 0.95 mGy and the effective dose was 0.75 mSv per CTC scan.

**CONCLUSION**

Our MUMA-EC scheme yielded superior performance over conventional DE-EC and SE-EC schemes in identifying and minimizing subtraction artifacts on non-cathartic ultra-low-dose DE-CTC images.

**CLINICAL RELEVANCE/APPLICATION**

Current electronic cleansing methods for visualization of the colonic surface in CTC produce subtraction artifacts. The proposed method shows potential to minimize these artifacts and to facilitate non-cathartic examination.

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**SSG16-02** Deep-Learning-based Bladder Segmentation in CT Urography

**Participants**

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Elaine M. Caoili, MD, MS, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

**METHOD AND MATERIALS**

To develop a computerized method for bladder segmentation in CT Urography (CTU) scans for computer-aided diagnosis of bladder cancer and treatment planning.
METHOD AND MATERIALS

A challenge for computerized bladder segmentation in CTU is that the bladder often contains regions filled with IV contrast and without contrast. We previously developed a Joint level Set Analysis and Segmentation System (CLASS) that segments the non-contrast (NC) and the contrast (C) filled regions separately and automatically conjoins the two contours. However, the similar gray levels between the NC region and the adjacent organs often caused errors in the NC contour. We trained a Deep-Learning Convolutional Neural Network (DL-CNN) to distinguish between inside and outside of the bladder NC region using 1.18 million ROIs. The trained DL-CNN was used to generate probability maps for slices of a CTU case. Thresholding and hole-filling were applied to the map to generate the initial contour for the NC region. 3D and 2D level set was used to refine the contours. The refined NC contours were conjoined with the cascade-level-set segmented C contour to obtain the full bladder contour. Segmentation performance was evaluated using 159 cases (78 training, 81 testing). Computerized segmentation accuracy compared against 3D hand-segmented contours was evaluated using average volume intersection % (AVI), average % volume error (AVE), and average minimum distance (AMD).

RESULTS

The AVI, AVE, and AMD for segmentation with DL-CNN were 87.8±8.9%, 3.5±16.3%, 3.0±1.5 mm, respectively, for the training set and 84.1±11.7%, 6.6±15.0%, 3.1±16.6 mm, respectively, for the test set. With CLASS, these values were 84.2±11.6%, 9.0±16.6%, 3.4±1.8 mm, respectively, for the training set and 79.4±13.4%, 14.6±15.3%, 3.5±1.5 mm, respectively, for the test set. Differences in all measures were statistically significant (training: p<0.03, testing: p<0.002) except AMD for the training set (p=0.08).

CONCLUSION

Using the DL-CNN for the NC region performed better than using CLASS alone, demonstrating the feasibility of using DL-CNN with level-set for the segmentation of the NC region of the bladder. Further work is underway to apply the DL-CNN to the entire bladder.

CLINICAL RELEVANCE/APPLICATION

Bladder segmentation is a crucial step for detection of bladder cancer and wall thickening in CAD and for treatment planning. This study demonstrates a useful method for automatic bladder segmentation.
We propose a fast, semi-automatic and accurate framework for 3D assessment of carotid vessel wall based on a 3D segmentation technique for quantification of the Vessel Wall Volume (VWW) with low observer variability.

**METHOD AND MATERIALS**

This HIPAA compliment study received IRB approval. Patients with non-surgical carotid artery disease (30-95% stenosis) underwent 3T carotid MRI (Philips). Two image sets were acquired using: 1) a rapid 3D Time of Flight sequence in the axial orientation, and 2) MRIPH sequence (a T1 weighted inversion recovery fat suppressed 3D Fast Field Echo technique in the coronal orientation) In this study, we considered a 3.2cm segment of the carotid centered at the bifurcation. User input was required to identify the lumen contour in a single image to be used as initial contour for segmentation. Fast marching level-set technique was used to move the control points in 3D space to minimize an energy function. Next, the 3D lumen segmentation was transfered and registered to the corresponding MRIPH images. Lumen boundary adjustment was applied on the MRIPH images if necessary. Outer wall boundary was delineated using a similar technique.

**RESULTS**

We estimated the correlation coefficient, $R$, to evaluate the conformity between the manually and automatically computed volumes. The proposed method yielded correlation coefficients of 0.97, 0.95 and 0.85 for the lumen, outer and vessel wall volume respectively, indicating a high conformity between manual and automatic estimations. We used a two-tailed t-test to estimate the conformity between manual and automatic measurements, which yielded a non-significant P-values of 0.98, 0.81 and 0.37 indicating that automatic estimations of volumes are not significantly different from those obtained from manual segmentation.

**CONCLUSION**

We developed a framework for vessel wall volume assessment based on the intensity and shape features in MR images estimated from user-provided segmentation of the vessel wall in a single image. The algorithm was tested on 40 carotids and a close correlation was demonstrated between the results and manual segmentation by two expert radiologists.

**CLINICAL RELEVANCE/APPLICATION**

The proposed technique can be used for 3D assessment of the carotid MR images to assist radiologists to diagnose abnormality in carotid artery as well as atherosclerosis disease faster and with lower user variability.

**SSG16-05 Automatic Colon Segmentation using Statistical Approach and Global Convexification in CT**

Tina Binesh Marvasti, Toronto, ON (Abstract Co-Author) Nothing to Disclose

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Salwa Elshazly, BS, Louisville, KY (Abstract Co-Author) Nothing to Disclose

Ahly A. Farag, MS, PhD, Louisville, KY (Abstract Co-Author) Nothing to Disclose

Tishan Navneet Singh, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose

Alan R. Moody, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Accurate segmentation of the colon is an essential part for any computer aided diagnosis colonography system. Colon segmentation is a challenging problem for numerous reasons such as the variability in the topology of the colon and its asymmetrical and twisted shape (i.e. Haustral folds); regions consistent in intensity to that of air, soft tissue and oral contrast agents being similar to high-attenuation structures similar to bones. The presence of residual stool and lesions as well as disconnected colon segments further add to the difficulties of the problem. In this work, we describe a new statistical and variational method for automatic colon segmentation in CT images.

**METHOD AND MATERIALS**

The segmentation approach is designed in a multi-tiered information propagation framework using statistical and variational methods. First, an initial segmentation using the intensity histogram volume of a typical CT. The Expectation-Maximization, is used to obtain a threshold intensity that encompasses the colon air regions and soft tissue. The global/convex continuous minimization problem of the active contour model and the active contours model without edges are generalized to the 3D space (GAC in fig.) and mathematically manipulated enhancing reconstruction of topological changes of haustral folds while maintaining polyps on colon walls. Post-processing of 3D connected component and morphological operations provided the final segmented colon volume.

**RESULTS**

A subset from the ACRIN study (30 supine oral contrast enhanced abdominal CT scans) is used to assess the accuracy and robustness measures for colon segmentation. The approach shows promise in its ability to obtain both air-filled and fluid-filled colon regions in 2-3 minutes for datasets of size 512x512x400 and slight increase in time as the dataset size increases to over 600 slices. Results of overall Dice 93.8% and Jaccard 90.2% are comparable to current state-of-the-art using less datasets.

**CONCLUSION**

We present an automatic multi-tiered statistical and variational approach in abdominal CT for colon segmentation. The proposed method shows promising results with the current state-of-the-art.

**CLINICAL RELEVANCE/APPLICATION**

The method can be used as an initialization to computer-aided detection of polyps, 3D virtual navigation of the colon and registration of prone/supine CT scans.
**RESULTS**

The mean error was 0.61 ± 0.37 cm with a range from 0.1 cm to 1.06 cm.

**METHOD AND MATERIALS**

For 9 LM's in 4 BCT volumes compressed in the cranio-caudal (CC) view, the root-mean-squared distance error between the LM location of the ray-cast projected compressed BCT volume and that in the corresponding DM view of the same breast. In this pilot study, 10 BCT volumes and the corresponding digital mammograms (DMs) were generated from BCT volumes of isotropic resolution assuming homogeneous material properties. A compressed view is simulated from a BCT volume using finite element (FE) method. The FE model uses quadratic tetrahedral elements with 5-parameter Mooney-Rivlin non-linear constitutive material. More than 97% of the elements have aspect ratio of less than 5 with a chosen loading of the BCT volume in the anterior-posterior direction is compensated before the compression model is applied. The breast is compressed until the thickness reaches the same thickness as that used for acquiring the corresponding DM view of the same breast. In this pilot study, 10 BCT volumes and the corresponding digital mammograms (DMs) were obtained by inter-institutional collaboration. Four volumes were found to have identifiable landmark (LM) locations and used for evaluation.

**PURPOSE**

Automated classification of pulmonary arteries and veins in thoracic CT scans is an unsolved problem which is important for e.g. CAD of pulmonary embolisms and treatment planning. This study presents and validates a new anatomy-based method to automatically classify arteries and veins in non-contrast chest CT scans.

**METHOD AND MATERIALS**

A set of 55 full inspiration non-contrast low dose chest CT scans (16x0.75mm, 120-140kVp, 30mAs) with variable severity of emphysema and interstitial lung diseases, were taken from a lung cancer screening trial. In all state-of-the-art vessel segmentation algorithms, arteries and veins are attached at locations where they cross, since these algorithms are not designed to distinguish between bifurcating and crossing vessels. This method starts with automatic vessel segmentation, followed by pruning the vessel segmentation to detect locations that are inconsistent with the topology of a tree structure. By disconnecting the vessels at these locations, the vessel segmentation is separated into subtrees that fulfill a tree structure and are assumed to be of an arterial or venous label. Next, subtrees are grouped using anatomical knowledge that arterial and venous capillaries meet each other at the alveoli, which implies that the corresponding peripheral arteries and veins go towards similar regions. By analyzing the peripheral vessels in each subtree, subtrees of the same artery-vein label are grouped without knowing the actual label. To extract the final artery-vein labels of the grouped subtrees, classification is performed using the fact that veins have an overall larger volume compared to arteries. For quantitative evaluation, two human observers manually labeled a total of 2750 randomly selected arteries and veins from all 55 scans. The accuracy and Cohen's kappa between the observers and between the method and observers were used for evaluation.

**RESULTS**

Inter-observer Cohen's kappa was 0.84 with 93% accuracy. The proposed method achieved a mean accuracy of 88% and a Cohen's kappa of 0.76.

**CONCLUSION**

A new concept for artery-vein separation and classification was presented that uses anatomical information from peripheral arteries and veins. The performance of the presented method closely approximated the inter-observer agreement.

**CLINICAL RELEVANCE/APPLICATION**

Automatic artery-vein classification is essential for investigating pulmonary hypertension, COPD and for improving CAD systems for pulmonary embolisms.
CONCLUSION
The uncompressed 3D BCT of isotropic resolution offers a unique opportunity to model the breast compression and deformation accurately with an error of less than 1 cm. The result for the modeling in CC view shows the potential for application to other views. The compression model will be further validated with breasts of various sizes and density categories and different compression views using appropriate material properties for fatty, glandular and skin tissues.

CLINICAL RELEVANCE/APPLICATION
The modeling of the breast compression and deformation process will be useful for automated localization and registration of lesions in multi-view or multimodality image analysis of the breast.

SSG16-08 A Novel Computational CT Image Analysis Method for Classifying Benign and Malignant Thyroid Nodules: A Preliminary Study

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S502AB

Participants
Wenxian Peng, PhD, Hangzhou, China (Presenter) Nothing to Disclose
Shunren Xia, Hangzhou, China (Abstract Co-Author) Nothing to Disclose
Yihong Chen, Hangzhou, China (Abstract Co-Author) Nothing to Disclose
Xiafeng Xu, MD, Hangzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the feasibility of utilizing texture features to classify the benign thyroid nodules from malignant ones in Computed Tomography (CT) images.

METHOD AND MATERIALS
Ninety-three thyroid nodules of 58 patients undergone thyroid surgery were enrolled in this study from January 2012 to December 2013. Final diagnoses were confirmed histopathologically after surgery. Axial non-contrast CT images in 134 (50 malignant and 84 benign) were chose and we extracted 28 texture features with the gray level co-occurrence matrix (GLCM) (13 features) and the gray level gradient co-occurrence matrix (GLGCM) (15 features). Support Vector Machine (SVM) was used in data classification. Leave one out cross validation (LOOCV) strategy was utilized to take full advantage of the samples.

RESULTS
With texture features of GLCM, 66/84 benign (66 goiters, 4 thyroiditis an14 thyroid adenoma ) and 32/50 malignant images (49 papillary thyroid cancer, 1 follicular thyroid cancer ) can be classified correctly (the accuracy-rate 0.7313), the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of classification is 0.7857, 0.7857 and 0.6400 respectively, which the AUC of ROC is 0.7874; The GLCM is 0.7612, 0.8810, 0.5600, 0.7708 and 0.7368 respectively, which the AUC is 0.7980; According to relativity (>0.999), Twelve features involved reach the accuracy-rate 0.7612, sensitivity 0.8452, specificity, positive predictive value (PPV) and negative predictive value (NPV) of classification is 0.7857, 0.6400, 0.7857 and 0.7926.

CONCLUSION
As the preliminary study in thyroid CT image analysis, texture feature may help classify the benign from the malignant thyroid nodules.

CLINICAL RELEVANCE/APPLICATION
GLCM and GLGCM texture features can be used in Thyroid nodule CT image analysis to help classify nodule property and is recommended when the diameter of nodule is more than 3 mm.

SSG16-09 Extracellular Volume Fraction (ECV): A Semi-automatic Method to Map the Myocardium

Tuesday, Dec. 1 11:50AM - 12:00PM Location: S502AB

Participants
Nicola Galea, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Luisa Altabella, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Marco Cami, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Andrea Fiorelli, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Marco Francone, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Elisabetta Di Castro, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Iacopo Carbone, MD, Montreal, QC (Presenter) Nothing to Disclose

PURPOSE
Cardiovascular magnetic resonance (CMR) is a useful tool for myocardial tissue characterization representing the only non-invasive methodology to assess fibrosis and edema in vivo. The extracellular volume fraction (ECV) estimation is emerging as accurate biomarkers in many cardiac diseases associated with diffuse myocardial fibrosis. ECV represent the percentage of tissue comprised of extracellular space, which increases in presence of fibrosis, and is reproducible, not affected by field strength. Our aim was to develop an automatic software for ECV map creation.

METHOD AND MATERIALS
30 subjects underwent to MOLLI sequence (scheme: 3[3][3][5]) before and 15-20min after injection of gadobenate dimeglumine (Gd-BOPTA) on a 1.5T MR scanner (Magnetom Avanto). Imaging parameters: matrix 218x256, voxel size 1.41x1.41x8mm³, TR/TE 1.44/1.12 ms, minimum TI 120 ms with 80ms increment,FA 35°. First, pre- and post- contrast MOLLI images underwent to non-rigid image registration for motion correction and patient position variations. Then, T1 maps were generated using MRmap. T1 time was calculated with a 3-parameter curve fitting using a Levenberg-Marquardt algorithm and additional T1* correction. ECV map was finally generated using a home-made program (developed in Matlab, Mathworks Inc.) according to the equation: ECV=[1-hematocrit]ΔR1myo/ΔR1blood. ΔR1myo=(1/T1myo-post)-(1/T1myo-pre) was obtained taking the reciprocal of the T1 maps on a
pixel-by-pixel basis. Blood relaxation rate $\Delta R_{\text{blood}} = (1/T_{1\text{blood-post}}) - (1/T_{1\text{blood-pre}})$ were calculated automatically creating a mask on the $T_1$ pre contrast map applying a threshold, then applied on $T_1$ post contrast map to calculate the mean $T_{1\text{blood-post}}$.

**RESULTS**

We compare the ECV myocardium values obtained manually drawing ROI in the myocardium and blood of $T_1$ pre- and post-contrast images with ECV values obtained from the same ROI in ECV map. The mean deviation between manual and automatic ECV values is less than 3% (t-paired Test: p=0.9).

**CONCLUSION**

Our software provide semi-automatically an informative pixel-wise ECV map, enabling the direct visualization of the extent and severity of ECV alterations respect to manual approach.

**CLINICAL RELEVANCE/APPLICATION**

Ease automatic generation of ECV map may provide further qualitative information about the distribution of fibrosis and the pattern of disease.
Breast Imaging (Quantitative)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: Arie Crown Theater

SSJ01

Participants
Fiona J. Gilbert, MD, Cambridge, United Kingdom (Moderator) Medical Advisory Board, General Electric Company; Research Grant, GlaxoSmithKline plc; Research Grant, General Electric Company
Descipa Kontos, PhD, Philadelphia, PA (Moderator) Nothing to Disclose

Sub-Events

SSJ01-01 Relationship between Computer-extracted MRI-based Phenotypes and the Risk of Breast Cancer Recurrence as Predicted by PAM50 Gene Expression Array

Tuesday, Dec. 1 3:00PM - 3:10PM Location: Arie Crown Theater

PURPOSE
Clinical teams are increasingly relying on genetic profiles for breast cancer subtyping, prognostication, and treatment decisions. We investigate the relationship between computer-extracted breast MRI phenotypes with the PAM50 gene array (which includes two methods: PAM50 Risk of Relapse Subtype [ROR-S] and PAM50 Risk of Relapse Subtype + Proliferation [ROR-P]) in order to understand MRI’s potential role in assessing risk of breast cancer recurrence.

METHOD AND MATERIALS
We analyzed a retrospective dataset of 84 de-identified, breast MRIs contributed by 5 institutions to the NCI’s "The Cancer Imaging Archive" (TCIA), along with clinical, histopathological, and genomic data from "The Cancer Genome Atlas" (TCGA). Each MRI examination imaged a biopsy proven invasive breast cancer comprised of 74 (88%) ductal; 8 (10%) lobular, and 2 (2%) mixed. Of these cancers, 73 (87%) were ER+, 67 (80%) were PR+, and 19 (23%) were HER-2+. We performed computerized analysis on each cancer yielding computer-extracted image-based tumor phenotypes (CEIPs), quantifying size, shape, morphology, enhancement texture, kinetic curve assessment, and enhancement variance kinetics. Regression and ROC analysis were conducted to assess the predictive ability of CEIPs relative to the multi-gene assays' continuous outputs.

RESULTS
Multiple linear regression analyses demonstrated statistically significant Pearson correlations (0.5-0.55) between CEIP signatures and the PAM50 recurrence scores. The most important CEIPs included tumor size and enhancement texture patterns characterizing tumor heterogeneity. Use of CEIP in the tasks of distinguishing between good and poor prognosis in terms of levels of recurrence yielded area under the ROC curve values (standard error) of 0.88 (0.05), 0.73 (0.06), 0.72 (0.08), and 0.61 (0.09) for MammaPrint, Oncotype DX, PAM50 Risk of Relapse Subtype (ROR-S), and PAM50 ROR-P (subtype+proliferation), respectively, with all but the latter showing statistical difference from chance.

CONCLUSION
Quantitative breast MRI radiomics shows promise as a method for image-based phenotyping to assess risk of breast cancer recurrence. This work helps us begin to understand which MRI features may be most powerfully correlated with genetic recurrence risk.

CLINICAL RELEVANCE/APPLICATION
Computerized MRI tumor phenotyping yield quantitative predictive features that have the potential to advance precision medicine and affect patient treatment strategy.
SSJ01-02 Dynamic Contrast Enhanced (DCE) Breast MR Features Associated with Prognostic Factors in Triple Negative Breast Cancers (TNBC)

Tuesday, Dec. 1 3:10PM - 3:20PM Location: Arie Crown Theater

Participants
Bo La Yun, MD, Seongnam, Korea, Republic Of (Presenter) Nothing to Disclose
Sun Mi Kim, MD, PhD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Mijung Jang, Seongnam, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jong Yoon Lee, MD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ja Yoon Jang, MD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the association of DCE MR features including texture and histogram analysis with pathologic prognostic factors in TNBC.

METHOD AND MATERIALS
From June 2012 to February 2015, 92 TNBC patients (mean age 53 ±13 years) based on immunohistochemical staining (IHC) enrolled our study. We excluded patient underwent primary systemic therapy. For texture (13 grey level co-occurrence matrix features) and histogram analysis using in-house program, the ROIs were drawn along the margin of the cancer in the largest diameter image at 1.5 minute after contrast injection. For dynamic enhancement pattern analysis, MR CAD system (CADstream) was used. The percentage of fast or medium initial enhancement and persistent, plateau and washout delayed enhancement were analyzed. The pathologic results of specimens were categorized according to histologic grade and axillary nodal status, and IHC result (Ki-67, cytokeratin 5/6, EGFR, p53). The correlation of texture features and enhancement pattern with each pathologic prognostic factor were assessed. Interobserver agreement was also investigated.

RESULTS
High histologic grade was associated with low angular second moment (ASM, p=0.025). Axillary nodal metastasis was associated with high maximum MR diameter (p=0.013), high entropy (p=0.024), and low ASM (p=0.026), low information measure of correlation (JMC1, p=0.046). High Ki-67 index (≥14%) tumors showed high percentage of fast initial enhancement (p=0.015), high percentage of plateau or washout delayed enhancement (p<0.001, p=0.001) on dynamic enhancement pattern, high entropy (p<0.001), low ASM (p=0.004) and low JMC1 (p=0.004) on texture analysis. The positivity of cytokeratin 5/6 or EGFR associated with high entropy (p=0.004), high inverse difference moment (IDM, p=0.029), low sum average (p=0.038), low JMC1 (p=0.005) and low JMC2 (p=0.038) on texture analysis, and low mean (p=0.042) and low median (p=0.037) on histogram analysis. Positivity of p53 was not associated with DCE MR features. The agreement of texture and histogram features was good (ICCs>0.9).

CONCLUSION
Dynamic enhancement pattern, texture and histogram features in DCE MR were associated with pathologic prognosis factors in TNBC. These image features would predict aggressiveness of TNBC on preoperative MR.

CLINICAL RELEVANCE/APPLICATION
DCE MR features would predict TNBC aggressiveness. It could be used for non-invasive evaluation of TNBC before chemotherapy or surgery.

SSJ01-03 Automatic and Accurate Breast Cancer Volumetric Segmentation on MRI with Varying Degrees of Background Parenchymal Enhancement

Tuesday, Dec. 1 3:20PM - 3:30PM Location: Arie Crown Theater

Participants
Harini Veeraraghavan, New York, NY (Presenter) Nothing to Disclose
Brittany Dashkevsky, MD, DPhi, New York, NY (Abstract Co-Author) Nothing to Disclose
Girard Gibbons, BA, New York, NY (Abstract Co-Author) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Joseph O. Deasy, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Elizabeth J. Sutton, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
Breast MRI background parenchymal enhancement (BPE) varies between women and can limit the radiologists ability to accurately define breast cancer extent of disease. Here we sought to develop a computer model that could automatically generate volumetric segmentations of breast cancers on MRI with varying degrees of BPE.

METHOD AND MATERIALS
46 patients with HER2+ invasive breast cancers were included with either mild (n=23) or marked (n=23) BPE. We developed in-house software that combines dynamic contrast enhanced (DCE) MR images acquired at multiple time points (1 pre and 3 post contrast) to generate volumetric tumor segmentation. The DCE-MR images are combined through spectral embedding from which scalar images are computed. The algorithm is initialized with a manually delineated contour of the tumor on a single slice. A model of the tumor is automatically learned using a Gaussian mixtures model (GMM) using the individual time series and the computed scalar images. The GMM classifications are used to refine a joint segmentation generated from the individual sequences using an automatically seeded grow cut method.

RESULTS
The computer-generated volumetric segmentations were compared with a radiologist-delineated segmentation by computing DICE overlap scores (1.0 -best, 0 -worst). For tumors with mild BPE, the maximum DICE score was 0.92, the lowest was 0.28 and the median was 0.79. For tumors with marked BPE, the maximum DICE score was 0.90, the lowest was 0.04 and the median was 0.71. Two sampled t-test between the scores computed for the mild and marked BPE tumors failed to reject the null hypothesis indicating that there was no difference in the segmentation performance regardless of the extent of BPE.

CONCLUSION
Our method achieves reasonably accurate volumetric tumor regardless of the extent of BPE.

**CLINICAL RELEVANCE/APPLICATION**

Automatic and accurate segmentation of breast cancers with marked BPE can aid the radiologist in accurately defining the extent of disease and minimizing inter-observer variability.

**SSJ01-04 Association between Quantitative Measures of Breast Parenchymal Complexity and False-Positive Recall from Digital Mammography: Results from a Large Prospective Screening Cohort**

*Tuesday, Dec. 1 3:30PM - 3:40PM Location: Arie Crown Theater*

**Participants**

Shonket Ray, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose  
Brad M. Keller, PhD, Philadelphia, PA (Presenter) Nothing to Disclose  
Jinbo Chen, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose  
Emily F. Conant, MD, Philadelphia, PA (Abstract Co-Author) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG  
Despina Kontos, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate associations between quantitative features of breast parenchymal complexity and false-positive (FP) recall from breast cancer screening with digital mammography.

**METHOD AND MATERIALS**

Digital mammography (DM) images from an entire one-year cohort of women screened for breast cancer at our institution (Sept. 2010 - Aug. 2011) were retrospectively analyzed. A total of 10,571 screening mammography exams were acquired using either a GE Essential or Hologic Selenia full-field digital mammography (FFDM) unit. All images sets consisted of bilateral cranio-caudal (CC) and medio-lateral oblique (MLO) views and were vendor post-processed (i.e., "For Presentation" images). To characterize breast tissue complexity, thirteen texture features were extracted using a locally adaptive computerized parenchymal texture analysis algorithm. As a comparative established risk factor for FP recall, breast percent density (PD) was estimated on a per-woman basis using previously validated automated software. Logistic regression was performed to evaluate associations between FP recall and the extracted complexity features, using a case-control design where FP-recalls (N=1064) were randomly age-matched to negative screening controls (N=3192) at a 1:1.3 ratio. Odds ratios (OR) and area under the curve (AUC) of the receiver operating characteristic (ROC) were used to assess strength of associations.

**RESULTS**

Combining PD and texture features yielded an AUC=0.62 (95%CI: 0.60-0.64), with PD (OR=1.01; 95%CI: 1.00-1.01), texture energy (OR=1.43; 95%CI: 1.27-1.61) and sum variance (OR=1.23; 95%CI: 1.07-1.52) associated to higher risk of FP recall (p<0.05), while texture difference variance (OR=0.67; 95%CI: 0.58-0.78) and information correlation (OR=0.77; 95%CI: 0.69-0.85) were inversely associated to FP recall (p<0.05). A baseline model of PD alone yielded had AUC=0.52 (95%CI: 0.50-0.54, PD OR=1.00; 95%CI: 1.00-1.01).

**CONCLUSION**

Quantitative features of mammographic parenchymal texture complexity may be indicative of the risk for false-positive recall from screening with digital mammography.

**CLINICAL RELEVANCE/APPLICATION**

Incorporating quantitative features of breast parenchymal texture may augment breast density as a parenchymal complexity descriptor to help personalize breast cancer screening recommendations.

**SSJ01-05 Prediction of False-Negative Breast Cancer Screens with Digital Mammography: Preliminary evaluation of a Quantitative Breast Complexity Index**

*Tuesday, Dec. 1 3:40PM - 3:50PM Location: Arie Crown Theater*

**Participants**

Andrew Oustimov, Philadelphia, PA (Presenter) Nothing to Disclose  
Emily F. Conant, MD, Philadelphia, PA (Abstract Co-Author) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG  
Lauren Pantalone, BS, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose  
Brad M. Keller, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose  
Meng-Kang Hsieh, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose  
Despina Kontos, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Breast density is a known confounder of mammographic sensitivity, and increasingly reported for guiding supplemental screening recommendations. We assess the predictive value of a refined quantitative index of dense tissue complexity in identifying women at high-risk of false-negative screens.

**METHOD AND MATERIALS**

We retrospectively analyzed data from an entire one-year (09/01/10 to 08/30/11) screening cohort at our institution (N = 10,728). Among women with negative screening, false negatives (FNs) were defined as cancer detected in a follow up period of 12 and up to 24 months prior to the next routine screening exam (N=11). Controls were identified as women confirmed negative also at subsequent screening, and were randomly selected and matched to FNs based on age and race, at a 1:3 ratio (N=33). To specifically determine the added value of our breast complexity index (BCI), controls were also matched to FNs based on BI-RADS density, and on the interpreting radiologist. The BCI was derived from a range of computer-extracted parenchymal texture descriptors, including Grey-level Histogram, Haralick, and Edge-enhancement features (N=29), summarized via principal component analysis (PCA). Associations between the BCI-PCA components and the odds of FN screening were determined via univariate analysis (PCA).
logistic regression and discriminatory capacity was assessed via receiver operating characteristic (ROC) curve analysis.

RESULTS
The BCI was significantly associated with the odds of FN screening (OR: 0.67, 95% CI: 0.45 - 1.00, p = 0.05), while exhibiting potential to discriminate between false negative screeners and controls confirmed as negative at subsequent screening (AUC = 0.69, 95% CI: 0.48 to 0.88). The first 3 principle components accounted for 88% of the total variance in the features.

CONCLUSION
The significant association between BCI and the odds of FN screen, in a case-control sample with identical BIRADS density distributions, suggests that refined quantitative measures of breast complexity may be more sensitive than qualitative BIRADS density in identifying women at high-risk for a false-negative screening exam.

CLINICAL RELEVANCE/APPLICATION
Quantitative measures of breast complexity may result in more sensitive markers for guiding supplemental screening recommendations, than the reporting of conventional BIRADS breast density.

SSJ01-06 Dedicated Computer Aided Detection for Automated 3D Breast Ultrasound Detects Invasive Ductal Cancers Independent of Hormonal Receptor Status

Tuesday, Dec. 1 3:50PM - 4:00PM Location: Arie Crown Theater

Participants
Jan Van Zelst, Nijmegen, Netherlands (Presenter) Nothing to Disclose
Tao Tan, Nijmegen, Netherlands (Abstract Co-Author) Research Grant, QView Medical, Inc
Nico Kanssimeijer, PhD, Nijmegen, Netherlands (Abstract Co-Author) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV; Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (Abstract Co-Author) Speakers Bureau, Bayer AG

PURPOSE
Prognostic factors such as hormonal receptor (HR) status (estrogen and progesteron) in invasive ductal cancers (IDC) are associated with ultrasonographic imaging phenotypes that may limit differentiating aggressive IDC from benign masses. Therefore, in this study we compared the relative sensitivity of a commercially developed computer aided detection (CADe) program in the detection of HR+ and HR- IDCs and biopsied benign breast lesions.

METHOD AND MATERIALS
The local IRB waived the need for informed consent for this study. ABUS exams of 101 women with 66 IDCs and 35 biopsied benign lesions were randomly selected from a large image archive. All IDCs were examined by a pathologist on the surgical specimen and benign lesions were examined on a histological core needle biopsy specimen. For all IDCs we extracted HR status from the pathology reports. All lesions were annotated by outlining the contour of the lesion based on radiology and pathology reports. After reading the cases, the CADe program (Qview Medical Inc., Los Altos, ca., USA) generated a series of suspicious region candidates that were marked in the ABUS scans. The location of these candidates were objectively compared to the location of the annotations. Thereafter, the relative sensitivity of the CADe program was computed for the HR+ IDCs, HR- IDCs and the benign lesions. Chi-square tests were used to analyze the differences between the sensitivities of these three groups. Statistical differences are considered significant when p < 0.05.

RESULTS
CADe marked 71.2% of the IDCs as suspicious versus 45.7% of the benign lesions (p=0.012). Of the HR+ IDCs, 69.2% were marked by CADe. This is significantly higher than the marked proportion of benign lesions (p=0.028). Also the detection of HR- IDC's (78.6%) was better than that of the benign lesions (p= 0.037). The detection of HR+ IDC's did not statistically differ from the HR- IDC's that were marked by CADe (p=0.48).

CONCLUSION
Computer Aided Detection software can detect and mark IDCs independent from the hormonal status. Furthermore, CADe differentiates between suspicious benign breast lesions and HR negative IDC's that are known for their benign-like ultrasonographic appearance.

CLINICAL RELEVANCE/APPLICATION
Computer Aided Detection software has the potential to aid radiologists in detecting even the more aggressive breast cancers and may aid in differentiating between aggressive subtypes of cancer and suspicious benign lesions.
Breast Imaging (Nuclear Medicine/Molecular Imaging)

Participants
Priscilla J. Slanetz, MD, MPH, Belmont, MA (Moderator) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (Moderator) Advisory Board, Hologic, Inc;

Sub-Events

SSJ02-01  Multiparametric Evaluation of Breast Lesions with 18-Fluorodeoxyglucose Positron Emission Tomography Magnetic Resonance Imaging

Tuesday, Dec. 1 3:00PM - 3:10PM Location: E450A

Participants
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PURPOSE
To assess the performance of multiparametric 18-Fluorodeoxyglucose positron emission tomography magnetic resonance imaging (MP PET-MRI) using dynamic contrast-enhanced MRI (DCE-MRI), diffusion weighted imaging (DWI) and FDG-PET in differentiating between benign and malignant abnormalities identified on DCE-MRI.

METHOD AND MATERIALS
28 newly diagnosed breast cancer patients were prospectively enrolled in this Institutional Review Board (IRB) approved study. 25 patients underwent FDG PET-MRI imaging. Breast abnormalities identified in these patients on DCE-MRI were assessed for their likelihood of malignancy for each individual parameter (DCE-MRI, DWI and PET) as well as for combinations of the parameters. Malignancy vs. benignity of each lesion was then determined by histopathology or, in some cases where final pathologic diagnosis was not available, by pre- and post-chemotherapy imaging. If an abnormality showed a response to chemotherapy, it was presumed malignant. Sensitivity, Specificity, PPV and NPV were then measured.

RESULTS
60 lesions were identified, of which 6 had no pathology or imaging follow-up, 11 were deemed benign and 43 malignant (6 presumed malignant). MP PET-MRI significantly improved specificity over DCE-MRI (100% vs 45%, p=0.012) and DCE-MRI combined with PET (100% vs 36%, p=0.004) or DWI (100% vs 44%, p=0.011). There was a trend toward increased PPV with MP PET-MRI vs DCE-MRI (100% vs 88%), but was not statistically significant. Further, there was no statistically significant differences in sensitivity or NPV (p>0.05).

CONCLUSION
Multiparameter 18FDG PET-MRI increases specificity and decreases false positives of DCE-MRI without significant loss of sensitivity.

CLINICAL RELEVANCE/APPLICATION
MP PET-MRI improves specificity of DCE-MRI which may lead to more accurate staging, decreasing false positives and unnecessary biopsies.

SSJ02-02  Visualization of Primary Breast Cancer Lesions with a Dedicated PET for Hanging Breast Imaging in Comparison to PET/CT

Tuesday, Dec. 1 3:10PM - 3:20PM Location: E450A

Participants
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Renato Valdes Olmos, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose

PURPOSE
Evaluate the performance of a dedicated PET for hanging breast imaging (MAMMI-PET) for the visualization of breast cancer lesions
in two European hospitals while comparing the results obtained with whole body PET/CT.

**METHOD AND MATERIALS**

After institutional review board approval we prospectively included 230 female patients (age: mean 52 y, range 24-82y) with >= 1 histologically confirmed primary breast cancer lesion (=index lesion) between March 2011 and March 2014. All patients that gave written informed consent were scanned with the MAMMI-PET (Oncovision, Valencia, Spain) after injection of 180-240 MBq and following standard whole body PET/CT. All index lesions on the MAMMI-PET scored 0, 1 or 2 for quantity of FDG uptake, which was tested in relation to histological (ductal, lobular) and molecular (ER/PR/Her2) breast cancer subtype, tumor grade, breast length, maximal tumor diameter and affected breast quadrants. We also compared the visibility score of the primary tumor between MAMMI-PET with standard PET/CT.

**RESULTS**

Totally 234 affected breasts were scanned with proven primary breast cancer lesions (diameter 5-170 mm). The MAMMI-PET sensitivity was 98.6% for lesions located within the device scanning range. Twenty-three lesions (9.8%) near the pectoral muscle did not reach the scanning range and where therefore not visualised by MAMMI-PET. Of 11 index lesions smaller than 1 cm 9 where visualised by MAMMI-PET. Lesion visibility was not influenced by tumor grade (p=0.21) or cancer subtype (p=0.8345). In comparison to PET/CT MAMMI missed 19 lesions of which 18 were outside its scanning range. However PET/CT was not able to detect 15 index lesions visualized by MAMMI (p=0.61). MAMMI-PET detected 41 additional lesions of which 16 where proven malignant (39%), 15 (36.6%) seen on other modalities, and 14 (34.2%) only visible on MAMMI-PET.

**CONCLUSION**

Without limitations due to tumor size, grade or histological subtype the MAMMI-PET is able to detect almost all breast cancer index lesions located within its scanning range and is for this lesion category more sensitive than PET/CT.

**CLINICAL RELEVANCE/APPLICATION**

With the dedicated MAMMI-PET it is possible to visualise primary breast cancer lesions in prone position without compression and without the limitation known for PET/CT of tumor size and histological subtype.

**SSJ02-03**

**Pretreatment Prediction of Response to Preoperative Chemotherapy by Multiparametric F-18 Fluorodeoxyglucose Positron Emission Tomography - Magnetic Resonance Imaging in Breast Cancer Patients**

Participants
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Nelly Salem, MD, Cleveland, AL (Abstract Co-Author) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (Abstract Co-Author) Advisory Board, Hologic, Inc;

**PURPOSE**

To assess whether multiparametric [F-18]fluorodeoxyglucose (FDG) positron emission tomography (PET) - magnetic resonance imaging (FDG-PET/MR) using dynamic contrast-enhanced MRI (DCE-MRI), diffusion-weighted imaging (DWI), and FDG-PET is able to predict response to preoperative chemotherapy in breast cancer patients. A pilot study.

**METHOD AND MATERIALS**

A prospective, IRB approved study including twenty seven female patients with biopsy proven primary breast cancer underwent breast-specific PET/MR using Philips Ingenuity TF, 3T system. Patients treated with preoperative chemotherapy followed by surgery or post chemotherapy imaging were enrolled. Patients who had evidence of systemic metastases were excluded. DCE-MRI, DWI, and FDG-PET were qualitatively and semiquantitatively analyzed. The response to chemotherapy was assessed by the pathologic analysis of surgical specimen, or post chemotherapy imaging in two patients awaiting definitive surgery, and then correlated with PET/MR data.

**RESULTS**

Eighteen patients met the criteria to be enrolled in the study. Response to chemotherapy was complete in 4 (22%), partial in 8 (44%), and no response in 6 (33%) patients. On MRI, the apparent diffusion coefficient (ADC) value for responders to chemotherapy (partial or complete) (mean=0.78 x 10⁻³ mm²/s) was significantly higher than for non-responders (mean=0.56 x 10⁻³ mm²/s) (p=0.45). All the responders had ADC value of greater than 0.65 x 10⁻³ mm²/s. With FDG-PET, there was no significant difference in maximum standardized uptake value (SUVmax) in responders (mean=7.38) versus non-responders (mean= 6.87) (p=0.85). The DCE-MRI kinetic curves and morphology showed no significant difference between responders and non-responders.

**CONCLUSION**

In our pilot study, DCE-MRI with DWI was found to be valuable for pretreatment prediction of response to chemotherapy in breast cancer. Higher ADC values were associated with response. With limited number of patients, there was no proven benefit of PET/MR over DCE-MRI in the prediction of response to chemotherapy. Further studies with larger cohorts and evaluating imaging characteristic changes after an early dose of chemotherapy would be helpful.

**CLINICAL RELEVANCE/APPLICATION**

DCE-MRI with DWI may improve the ability to predict response to preoperative chemotherapy in patients with breast cancer.

**SSJ02-04**

**Insights in Physiology of Breast Parenchyma: Is There a Correlation of Breast Parenchymal Uptake of 18FDG, Breast Parenchymal Enhancement on DCE-MRI, Amount of Fibroglandular Tissue and Age?**
Over the clinical range 0-6 cm, the MBI system demonstrated better spatial resolution than the BSGI system while yielding a 2.6-fold improvement. At 4mCi, spots were undetectable in 9 out of 25 patient studies, with 5 lesions identified on MBI and 3 on BSGI. The CD phantom showed that for BSGI, 9 hot spots were undetectable, while for MBI, 5 hot spots were detectable. With the dual head configuration of MBI, spatial resolution at 5 cm distance from one detector is equivalent to 1 cm from the collimator, spatial resolution was 4.1, 5.1 and 6.2 mm on BSGI, and 2.0, 4.7 and 7.3 mm on MBI, respectively. However, the clinical use of MBI employs an energy window of 110-154 keV, yielding a sensitivity of 1042 cpm/uCi. At distances of 1, 3 and 5 cm, respectively. System sensitivity was 403 cpm/uCi (BSGI) and 790 cpm/uCi (MBI) using a standard +/-10% energy window. In the 25 patient studies, 5 lesions (CNR>3) were identified on MBI whereas 3 were identified on BSGI.

RESULTS

There was no BPE in 58, mild in 54, moderate in 14 and marked in 3 patients. SUVmax for patients with no BPE was 1.57 (SD 0.6), for mild BPE 1.93 (SD 0.6), for moderate BPE 2.42 (SD 0.5), and for marked BPE 1.45 (SD 0.3). There were highly significant correlations between age, BPU, BPE and FGT. Correlation coefficients ranged between moderate and strong. While BPE, BPU and FGT were positively correlated with each other, all of these parameters were negatively correlated with age (Figure 1). The intra-class correlation coefficient for BPU measurements was excellent with 0.973. Inter-reader and intra-reader agreement for BPE was very good with a Kappa-value of 0.860 and 0.822 respectively.

CONCLUSION

BPU of normal breast parenchyma can be reproducibly assessed using SUV metrics and is positively correlated with BPE and FGT in DCE-MRI. There is a negative correlation of BPU, BPE and FGT with age.

CLINICAL RELEVANCE/APPLICATION

BPU, BPE and FGT provide insights in tumor physiology and decrease with age. In patients with dense breasts a possible masking effect of lesions by BPU/BPE must be considered.

SS302-05 Clinical Comparison of MBI and BSGI for Low Dose Breast Imaging

Tuesday, Dec. 1 3:40PM - 3:50PM Location: E450A

Participants

Zaiyang Long, PhD, Rochester, MN (Presenter) Nothing to Disclose
Carrie B. Hruska, PhD, Rochester, MN (Abstract Co-Author) Institutional license agreement, Gamma Medica, Inc
Michael K. O’Connor, PhD, Rochester, MN (Abstract Co-Author) Royalties, Gamma Medica, Inc

PURPOSE

Breast specific gamma imaging (BSGI) and molecular breast imaging (MBI) are promising techniques for supplemental imaging in women with dense breast tissue. This study compares the performance of such systems at administered doses of Tc-99m sestamibi that are acceptable for low dose imaging.

METHOD AND MATERIALS

The BSGI system comprised a single-head multi-crystal NaI system (pixel size 3.2 x 3.2 mm) equipped with a hexagonal-hole lead collimator. The MBI system comprised a dual-head cadmium zinc telluride detector system (pixel size 1.6 x 1.6 mm) equipped with registered tungsten collimators. System sensitivity, uniformity, energy and spatial resolution were measured using NEMA methods. A 6-cm thick contrast detail (CD) phantom with 48 hot spots (3-10 mm diameter) was used to assess contrast-noise-ratio (CNR) using average background count densities observed in clinical studies at 4mCi dose. 25 patients receiving 4-8mCi doses were imaged on both systems under IRB approval.

RESULTS

The BSGI and MBI systems had integral uniformities of 6.1% and 3.8%, and energy resolution (at 140 keV) of 13.1% and 4.3%, respectively. System sensitivity was 403 cpm/uCi (BSGI) and 790 cpm/uCi (MBI) using a standard +/-10% energy window. In clinical use, MBI employs an energy window of 110-154 keV, yielding a sensitivity of 1042 cpm/uCi. At distances of 1, 3 and 5 cm from the collimator, spatial resolution was 4.1, 5.1 and 6.2 mm on BSGI, and 2.0, 4.7 and 7.3 mm on MBI, respectively. However, with the dual head configuration of MBI, spatial resolution at 5 cm distance from one detector is equivalent to 1 cm from the opposing detector for the most frequently observed compressed breast thickness of 6 cm. Application of the Rose criterion for lesion detection (CNR>3) to images of the CD phantom showed that for BSGI, 9 hot spots at 4mCi were undetectable. For MBI, 5 hot spots at 4mCi were undetectable. In the 25 patient studies, 5 lesions (CNR>3) were identified on MBI whereas 3 were identified on BSGI.

CONCLUSION

Over the clinical range 0-6 cm, the MBI system demonstrated better spatial resolution than the BSGI system while yielding a 2.6-
Correlation of Semi-Quantitative Breast-Specific Gamma Imaging Findings with Dynamic Contrast-Enhanced MRI Parameters assessed by a Computer-Aided Evaluation Program and Prognostic Factors of Breast Cancers

Tuesday, Dec. 1 3:50PM - 4:00PM Location: E450A

Participants
Saemee Ahn, MD, PhD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
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Jeong Seon Park, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Soo-Yeon Kim, MD, Guri, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Purpose
To investigate whether a correlation exists between the semi-quantitative breast-specific gamma imaging (BSGI) findings and dynamic contrast-enhanced (DCE) MRI parameters assessed by a computer-aided evaluation program and prognostic factors of breast cancers

Method and Materials
Semi-quantitative index of lesion to non-lesion ratio (L/N) in BSGI and DCE-MRI parameters assessed by a computer-aided evaluation program and histopathologic prognostic factors of 47 invasive breast cancers were obtained. Correlation between L/N ratio and DCE-MRI parameters assessed by a computer-aided evaluation program, including tumor size (cm), angio-volume (cc), degree of initial peak enhancement (%), persistent enhancement proportion (%), washout enhancement proportion (%), or prognostic factors, including axillary nodal status, histologic grade, expression of estrogen receptor (ER), progesterone receptor (PR), human epidermal growth factor receptor 2 (HER2) and Ki-67 were analyzed.

Results
The mean L/N ratio of 47 tumors was 3.63 ± 2.19 (range: 1-13.1). The L/N ratio was higher in tumors with larger tumor size (P<0.001), increased angio-volume (P<0.001), higher degree of initial peak enhancement (P<0.001), increased washout enhancement proportion (P=0.003), high histologic grade (P=0.013), and higher Ki-67 (P=0.002). The calculated multiple correlation coefficient was 0.80 (P<0.001).

Conclusion
There was a strong multiple correlation between the semi-quantitative L/N ratio in BSGI with DCE-MRI parameters assessed by a computer-aided evaluation program and prognostic factors of breast cancers.

Clinical Relevance/Application
The relationship between the radiotracer uptake in molecular imaging and DCE-MRI parameters may offer an in-depth understanding into the characterization of breast cancer.
Remote 4D MR Flow Assessment of Aortic Valve Regurgitation

Participants
Leena Mammen, MD, Grand Rapids, MI (Moderator) Nothing to Disclose
Scott R. Akers, MD, PhD, Philadelphia, PA (Moderator) Nothing to Disclose
Diana Litmanovich, MD, Haifa, Israel (Moderator) Nothing to Disclose

Sub-Events
SSJ03-01  Remote 4D MR Flow Assessment of Aortic Valve Regurgitation

Purpose
4D MR Flow has shown to have advantages over standard cardiac magnetic resonance (CMR), offering both anatomical and functional information in just a single acquisition. Processing of the large amount of data requires dedicated software. We evaluated the feasibility and performance of a cloud-based application that combines pre-processing and visualization of 4D Flow data, and assessed its accuracy for the detection and grading of aortic valve regurgitation (AR) using trans-thoracic echocardiography (TTE) as reference.

Method and Materials
Between June 2014 and January 2015 patients planned for clinical CMR were consecutively approached to undergo the 4D Flow examination. The 4D Flow data was uploaded to a dedicated web-based software application for eddy-currents correction, interactive visualization of the anatomical and flow components, and detection and grading of the aortic regurgitation. The diagnostic characteristics of 4D MR Flow were evaluated against TTE.

Results
Fifty-four patients were included. The agreement between 4D Flow and TTE for the grading of AR was good (κ=0.726). For detection of any degree of AR, 4D MR Flow had a sensitivity of 94.4% (81.3-99.2), a specificity of 72.2% (46.5-90), and a positive (PPV) and negative predictive value (NPV) of 86.7% (59.5-97.9) and 87.1% (72.6-95.7) respectively. To identify clinically relevant moderate or severe AR, 4D Flow MR had a sensitivity of 100% (40.2-100), specificity of 98% (89.3-99.7), PPV of 80% (28.8-96.7) and NPV of 100% (92.7-100).

Conclusion
Aortic regurgitation can be detected and graded accurately using 4D Flow in comparison to TTE. The use of a remote application with advanced data correction, integrated with interactive imaging tools allowed for interpretation of the 4D Flow data.

Clinical Relevance/Application
The potential advantages of a 4D Flow protocol are that during a free-breathing acquisition of 7-10 minutes, flow sensitive information in all three dimensions is acquired for the entire thorax. Without a need to specify beforehand, or assistance during the examination, flow can be retrospectively measured anywhere and in any direction within the thorax. While 2D sequences measure flow in a static plane, 4D Flow allows for continuous alignment of the measurement plane to the position of moving structures (e.g. valve annulus). In case of regurgitation jets that change direction throughout the heart cycle, 4D Flow imaging can provide more complete visualization.

Mitral Annular Dimensions and Geometry in Normals and Patients with Mitral Regurgitation: Implications for CT-based Sizing in Transcatheter Mitral Valve Implantation

Participants
Nicolas J. Bilbey, MD, Vancouver, BC (Presenter) Nothing to Disclose
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Jian Ye, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
George Mak, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Adam Berger, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Mean AVA derived by 3D planimetry, 2D planimetry, and echocardiography were 0.77 ± 1.04 cm², 0.72 ± 1.16 cm², and 0.75 ± 0.32 cm², respectively.

RESULTS

Intra- and interobserver agreements were determined by using intraclass correlation coefficient (ICC). Receiver operating characteristic (ROC) curve were calculated. Sensitivity for accurate measurement and quantification of valve contours; 3 = mild blurring of valve contours, 4 = excellent and no artifact). Sensitivity for accurate measurement and determinations of effective aortic orifices (EAO) using the continuity equation (1 = severe blurring of images, 2 = moderate blurring of valve contours, 3 = mild blurring of valve contours, 4 = excellent and no artifact). Sensitivity for accurate measurement and quantification of valve contours; 3 = mild blurring of valve contours, 4 = excellent and no artifact).

METHOD AND MATERIALS

Patients with retrospectively-gated cardiac CT performed at our institution (2012-2014) and free of cardiovascular disease were included (‘normals’, n=105, 57±11yrs, 51 female). Patients with mitral regurgitation (MR) being considered for transcatheter mitral therapy were also evaluated (mitral valve prolapse, MVP, n=24, 78±12yrs, 10 female; functional MR, FMR, n=20, 69±14yrs, 6 female). Mitral annular dimensions (projected area, perimeter, trigone-trigone (TT), intercommissural (IC) and septal-lateral (SL) distance) were measured during mid-late diastole and compared between groups. Maximal left atrial (LA) and phasic left ventricular (LV) volumes were also measured.

CONCLUSION

We describe normative CT values for the D-shaped mitral annulus. Moreover, we demonstrate differences in and varied drivers of annular dimensions in patients with MVP and FMR who are being considered for transcatheter mitral therapy.

CLINICAL RELEVANCE/APPLICATION

The data presented provides useful information regarding annular sizing using cardiac CT for the purposes of TMVI.

HONORED EDUCATORS

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at:

https://www.rsna.org/Honored-Educator-Award/

Jonathon A. Leipsic, MD - 2015 Honored Educator

SSJ03-03 Aortic Valve Planimetry by High-Resolution 3-Dimensional MR Image Acquisition with a Breath-Hold: Comparison with Conventional Cine MR Imaging and Echocardiography to Assess the Severity of Aortic Valve Stenosis

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S502AB

Participants

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So Hyeon Bak, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sung-Ji Park, Seoul, Moldova, Republic Of (Abstract Co-Author) Nothing to Disclose
Yeon Hyeon Choe, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

We intended to evaluate the novel application of high-resolution 3-dimensional MR image acquisition with single-breath-hold SSFP sequence to calculate the aortic valve area (AVA).

METHOD AND MATERIALS

In 88 consecutive patients (66.9 ± 9.59 years, 63% men) with varying degrees of aortic valve stenosis, high-resolution 3D SSFP images (3D planimetry; 2.0 mm slice thickness, 20 contiguous slices; image matrix, 256 ´ 209) were acquired with single breath-hold during mid systole and mid diastole. SSFP cine MR imaging (2D planimetry) and velocity-encoded cine MRI (slice thickness, 4.5 mm) in three levels of aortic valve were also performed. AVA area was measured by two experienced observers using commercial software (iNtuition, TeraRecon). MR imaging measurements and image quality were compared with transthoracic echocardiographic measurements of effective aortic orifices (EOA) using the continuity equation (1 = severe blurring of images, 2 = moderate blurring of valve contours, 3 = mild blurring of valve contours, 4 = excellent and no artifact). Sensitivity for accurate measurement and receiver operating characteristic (ROC) curve were calculated. Intra- and intersubject agreements were determined by using intraclass correlation coefficient (ICC).

RESULTS

Mean AVA derived by 3D planimetry, 2D planimetry, and echocardiography were 0.77 ± 1.04 cm², 0.72 ± 1.16 cm², and 0.75 ± 0.32 cm², respectively.
SSJ03-04  Association between Geometric Distribution of Wall Shear Stress and Aortic Dilatation in Patients with Aortic Stenosis: Comparison between TAV and BAV

Tuesday, Dec. 1 3:30PM - 3:40PM Location: S502AB

Participants
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Dong Hyun Yang, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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Young-Hak Lim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Namkug Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Stockholder, Coreline Soft, Inc
Joon-Won Kang, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Tae-Hwan Lim, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Although abnormal wall shear stress (WSS) distribution is suspected to have a significant role on the development of the aortic dilatation, the relationship between hemodynamics characteristics and aortic dilatations is not fully understood yet. The present study investigates the association between the WSS distributions and aortic dilatations in aortic-stenosis (AS) patients with tricuspid aortic valves (TAV) and bicuspid aortic valves (BAV).

METHOD AND MATERIALS
A total of 54 moderate and severe AS-patients (TAV=32, BAV=22) who underwent cardiac computed tomography (CT) and phase contrast magnetic resonance imaging (PC-MRI) at the ascending aorta were retrospectively collected. For calculation of WSS, 2D velocity profiles were extracted from PC-MRI at the level of ascending aorta. Then, a total of 360 velocity line-profiles were extracted from the center of the vessel to the wall with 1 degree angular increments. Aortic diameter was measured at 10 levels from aortic annulus to distal descending aorta using CT. Differences of the aortic diameters and WSS distributions between TAV and BAV were statistically analyzed using student t-test. Association between aortic diameter and regional WSS at the level right pulmonary artery were evaluated using linear regression.

RESULTS
Patients with BAV showed more asymmetric systole blood flow compared to those with TAV (center of flow r/R; 0.59±0.11 vs. 0.67±0.10, p=0.018). As a result, AS patients with BAV has significantly higher systolic WSS (0.55±3.14 Pa vs. 2.91±3.20 Pa, p<0.009) at the right-posterior region and lower systolic WSS (1.12±3.58 vs. 3.12±3.36, p=0.044) at the left and left-posterior regions of the ascending aorta. In accordance with the increased WSS distribution, AS patients with BAV are found to have larger diameters of the ascending aorta compared to those with TAV (BAV vs. TAV: 43.7±7.2 mm vs. 34.1±4.8 mm, p < 0.001). Linear regression between the aortic diameter and systolic WSS shows that the increment of the WSS represents about 14% of the aortic dilatation.

CONCLUSION
Among patients with aortic stenosis, patients with BAV showed more eccentric WSS and larger aortic diameter as compared to those with TAV at the level of ascending aorta. Eccentric distribution of WSS showed significant correlation with aortic diameter.

CLINICAL RELEVANCE/APPLICATION
WSS may be used to predict future risk of aortic dilatation in patients with aortic stenosis.

SSJ03-05  Multidetector-row Computed Tomography in Patients with Suspected Prosthetic Valve Dysfunction: A Prospective Study

Tuesday, Dec. 1 3:40PM - 3:50PM Location: S502AB

Participants
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Ricardo P. Budde, MD, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
PURPOSE
To systematically assess the role of retrospectively ECG-gated multidetector-row computed tomography (MDCT) for the evaluation of patients with suspected prosthetic heart valve (PHV) dysfunction.

METHOD AND MATERIALS
We performed a prospective cross-sectional study and enrolled patients consecutively during their clinical presentation in two university hospitals. Inclusion criteria were: 1. Aortic PHVs with an increase (>20mmHg) of the max. transprosthetic pressure gradient (TPG), 2. Mitral PHVs with a high mean TPG (>10mmHg), 3. Abnormal (peri)valvular leakage, 4. Leaflet restriction on fluoroscopy (>5 degrees) or 5. Clinical abnormalities likely due to PHV-dysfunction (e.g. stroke). All patients underwent transthoracic (TTE) and transesophageal (TEE) echocardiography ± fluoroscopy (routine diagnostic work-up). Additional cardiac retrospectively ECG-gated MDCT imaging was performed on a 256-slice or 64-slice MDCT scanner in all patients.

RESULTS
Forty-two patients were included (mean age 62±13 years) with 40 mechanical and 9 biological PHVs (34 aortic, 15 mitral). Main reasons for suspected dysfunction were: aortic TPG increase (n=20, 48%), clinical abnormalities (n=14, 33%) and/or abnormal (peri)valvular leakage (n=12, 29%). Median radiation exposure was 11.6 mSv [interquartile range 10.8-14.4], 40 patients (95%) were imaged on the 256-slice scanner. MDCT detected one or more PHV-related pathologies in 32/42 (76%) patients: pannus (n=11), thrombus (n=5), pannus/thrombus (n=2), PHV angulation (n=2), left ventricular outflow tract obstruction (n=4), paravalvular leakage (n=7), pseudoaneurysms (n=2), bioprosthesis degeneration (n=1), native annulus remnant (n=1), patient prosthesis mismatch suspicion (n=2) and restricted leaflet motion of unknown cause (n=3).

CONCLUSION
In this prospective study, MDCT imaging revealed a morphological substrate in 32/42 (76%) patients with suspected PHV dysfunction and showed a valuable imaging tool for PHV evaluation.

CLINICAL RELEVANCE/APPLICATION
Additional MDCT imaging allows identification of the underlying pathology in the diagnostic work-up of suspected PHV dysfunction.

SSJ03-06 CT-Angiography Prior to Transcatheter Aortic Valve Replacement (TAVR) - Identification of Different Parameters Leading to a Post-interventional Valvular or Para-valvular Leak

PURPOSE
The purpose of this study was to identify pre-interventional factors by means of CT-Angiography, which could predict the incidence of a significant post-interventional paravalvular or valvular leakage (PVL) in TAVR patients.

METHOD AND MATERIALS
In this retrospective study 160 datasets of patients that underwent TAVR from 2007 until 2013 were analyzed. In 87 patients (36 male, 51 female, mean age 82.6 years, range 63-95 years), all necessary post-interventional echocardiographic datasets were available to evaluate the degree of aortic insufficiency up to 30 days after TAVR (mild, moderate, severe - moderate to severe aortic insufficiency was rated as clinically significant). Using the CT-Datasets following parameters were evaluated: diameter (D) and area of the annulus, distance between the annulus and the right and left coronary artery, respectively, valve calcification degree (no, mild, moderate, severe calcification), cover index \((100 \times [\text{prosthesis D} - \text{D_mean Annulus}]/\text{prosthesis D})\) and eccentricity indices (\(\text{D_meanAnnulus} - \text{D_areaAnnulus}\) and \(\text{D_maxAnnulus} - \text{D_minAnnulus}\)). Data was statistically analyzed by means of linear and multivariate regression analysis and correlated with degree of post-interventional aortic insufficiency.

RESULTS
CoreValve- and Edwards Sapien prostheses were implanted in 20 and 67 patients, respectively. In 94.3% of the patients a post-interventional PVL of any degree within 30 days was detected by echocardiography. Degree and rate of PVL was not different between the CoreValve or Edwards Sapien System. Univariate regression analysis reported a sole significant (p<0.01) reverse relationship between the cover index and severity of post-interventional PVL. All other parameters showed no significant correlation with degree of PVL. In patients with a prosthesis oversizing of at least 15% no clinical relevant PVLs were detected.

CONCLUSION
In this study the cover index is the strongest and sole predictor of post-interventional PVL in TAVR patients. A certain degree of prosthesis oversizing may be required to reduce the incidence of PVL.

CLINICAL RELEVANCE/APPLICATION
Pre-interventional identification of factors leading to a post-interventional PVL could help to develop strategies to reduce rate of post-interventional PVL.
PURPOSE
To investigate the diagnostic value of T2-mapping in patients with acute myocarditis (ACM) and to define an appropriate cut-off value for edema detection.

METHOD AND MATERIALS
CMR data of 35 patients with clinically suspected ACM and confirmation of diagnosis by CMR according to the Lake Louise criteria were retrospectively analyzed. 30 healthy volunteers (HV) served as a control. All patients and HV were examined on a clinical 1.5T scanner, where - in addition to the routine CMR protocol - a breathhold Gradient Spin Echo (GraSE) T2-mapping sequence had been acquired at a basal, midventricular and apical slice in short axis view. T2-maps were segmented according to the 16-segments AHA-model and segmental T2 values as well as the segmental pixel-SD were analyzed. Statistical analysis was conducted using independent t-test, multiple logistic regression analyses, random forests, and decision trees.

RESULTS
Means of global myocardial T2 or pixel-SD showed only small differences between HV and ACM patients (T2: 58.7 ± 0.3 ms vs. 63.1 ± 0.4, p < .001; pixel-SD: 7.7 ± 0.1 vs. 8.6 ± 0.2, p < .001), lying in the observed normal range of HV. In contrast, variation of T2 values as well as of pixel-SD was much larger in ACM patients compared to HV. In random forests and multiple logistic regression analyses, the combination of the highest segmental T2 value within each patient (maxT2) and the mean absolute deviation (MAD) of log-transformed pixel-SD (madSD) over all 16 segments within each patient proved to be the best discriminators between HV and ACM patients with an AUC of 0.85 in ROC-analysis. In decision trees, a cut-off of 0.22 for madSD and of 67.7 ms for maxT2 resulted in 83% specificity and 97% sensitivity for classification between HV and ACM, even when not taking into account Lake Louise criteria.

CONCLUSION
The proposed cut-off values for maxT2 and madSD in the setting of ACM allow edema detection with high sensitivity and specificity and in a quantitative manner. The two parameters have the potential to overcome the hurdles of T2-mapping for its integration into clinical routine and should be validated in a greater patient cohort.

CLINICAL RELEVANCE/APPLICATION
Myocardial edema is an important factor not only in ACM. T2-mapping promises to be a quantitative approach in edema imaging, overcoming some limitations of qualitative edema assessment.
The proposed 3D-Dixon based method allows accurate measurement of cardiac fat volumes, free of ionizing radiation and provides a

CLINICAL RELEVANCE/APPLICATION

The implemented Dixon method allows accurate measurement of PFV and EFV with all benefits of a 3D-approach similar to CT.

CONCLUSION

The sepal wall showed higher prT1 value and ECVF but lower poT1 value than the lateral wall of mid- and basal levels. PoT1 value and ECVF are significantly affected by hypertension and LV mass.

CLINICAL RELEVANCE/APPLICATION

Normal range of T1 values and ECVF and their segmental variation should be differentiated from myocardial pathologic conditions. Moreover the cardiovascular risk factors may affect T1 values, ECVF, and LV function in asymptomatic subjects before cardiovascular symptoms develop.

METHOD AND MATERIALS

A cardiac triggered and respiratory navigator gated 3D-gradient echo pulse sequence (TR=5.4ms, TE1/TE2 = 1.8/4.0ms, α=20°, voxel size 1.5x1.5x3.0mm3) was developed for cardiac Dixon imaging. Based on this sequence fat fraction maps were computed. After correction for relaxation effects and setting of an appropriate noise threshold, voxels with more than 50% signal from fat were added for volumetry. Validation of the measurement accuracy was performed in a phantom consisting of muscle tissue and five different known volumes of fat (50-200ml). The proposed sequence was acquired in 34 healthy volunteers (22 male, BMI range 14-42 kg/m2, age range 21-79y) at 1.5T (Ingenia, Philips). Analysis was performed independently by two readers by drawing two 3D-region of interests, one for EFV and one for PFV. Additionally, EFV and PFV were compared between overweighted and non-overweighted subjects (BMI >25kg/m2 and BMI <25kg/m2, n=17 each) with 42 kg/m2, age range 21-79y) at 1.5T (Ingenia, Philips). Analysis was performed independently by two readers by drawing two 3D-region of interests, one for EFV and one for PFV. Additionally, EFV and PFV were compared between overweighted and non-overweighted subjects (BMI >25kg/m2 and BMI <25kg/m2, n=17 each) with

RESULTS

The overall prT1 and poT1 values and ECVF were 1006 ± 291.5 ms, 454.2 ± 38.5 ms, and 0.24 ± 0.04, respectively. There was significant difference between apical segments and mid-basal segments in poT1 value and ECVF (p<0.03) and between mid-septal segments and mid-lateral segments in T1 values and ECVF (p<0.04). ECVF showed reverse correlation with LV mass (p=0.002). There was significantly lower poT1 value (449 ± 35.6 ms) and higher ECVF (0.24 ± 0.04) in subjects with hypertension compared with those (459 ± 43.3 ms and 0.23 ± 0.02) of subjects without hypertension (p<0.05). Subjects with DM showed no difference in all T1 values from subjects without DM or hypertension, except poT1 values in mid-septal segments (447 ± 23.6 ms vs 459 ± 45.6 ms, p<0.02). Subjects with both risk factors showed no difference in all T1 values from subjects without DM or hypertension, except prT1 value between apical septal and lateral segments (1007 ± 126 ms vs 999 ± 156 ms, p=0.03).

CONCLUSION

There was significantly lower poT1 value (449 ± 35.6 ms) and higher ECVF (0.24 ± 0.04) in subjects with hypertension compared with those (459 ± 43.3 ms and 0.23 ± 0.02) of subjects without hypertension (p<0.05). Subjects with DM showed no difference in all T1 values from subjects without DM or hypertension, except poT1 values in mid-septal segments (447 ± 23.6 ms vs 459 ± 45.6 ms, p<0.02). Subjects with both risk factors showed no difference in all T1 values from subjects without DM or hypertension, except prT1 value between apical septal and lateral segments (1007 ± 126 ms vs 999 ± 156 ms, p=0.03).
valuable tool for cardiovascular risk stratification.

**SSJ04-04 Reproducibility of Cine Displacement Encoding with Stimulated Echoes (DENSE) in Human Subjects**

Tuesday, Dec. 1 3:30PM - 3:40PM Location: S504AB

Participants
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James C. Carr, MD, Chicago, IL (Abstract Co-Author) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

**METHOD AND MATERIALS**

Following the approval of the institutional review board (IRB), 10 healthy volunteers without documented history of cardiovascular disease were recruited. For each participant, 2D DENSE were performed twice (at different days) and the data were obtained at basal, midventricular and apical levels of the LV with a short-axis view. The first and second principal strains (E1 and E2), radial thickening strain (Err), circumferential rotating strain (Ecc), twist and torsion were calculated. The intra-, inter-observer and inter-study variances were evaluated using coefficient of variation (CoV) and intra-class correlation coefficient (ICC).

**RESULTS**

In total, there are 160 pairs of myocardial segments (from 2 scans on 10 subjects) for quantitative analysis and comparison. Figure 1 shows an example set of DENSE images demonstrating myocardial displacement maps from a single subject for scan #1 and #2. The images demonstrated similar image quality and systolic displacement patterns for both acquisitions. These observations were confirmed by segment-by-segment comparisons which showed no significant differences in peak Ecc, E1, E2, twist and torsion between two sequential scans. A difference in radial strain was noted, Err (0.43 ± 0.22 vs 0.38 ± 0.19, p = 0.008). There was good scan-rescan reproducibility of peak Ecc (CoV = 20.59%, ICC = 0.815, p < 0.001), E2 (CoV = 14.85%, ICC = 0.757, p < 0.001), twist (CoV= 34.12%, ICC = 0.911, p < 0.001) and torsion (CoV = 11.07%, ICC = 0.818, p < 0.001). There was moderate scan-rescan reproducibility of Err (CoV = 36.36%, ICC = 0.664, p < 0.001) and E1 (CoV = 32.74%, ICC = 0.646, p < 0.001). The figure shows similar segmental patterns for all indices, significant differences only for 2 apical segments between two scans.

**CONCLUSION**

DENSE is a reproducible MRI technique for characterizing regional myocardial motion on a per-segment basis in human subjects.

**CLINICAL RELEVANCE/APPLICATION**

In the present study, we demonstrated the overall reproducibility of DENSE for the description of LV motion on a per-segment basis for human subjects.

**SSJ04-05 The Relationship between the Transluminal Attenuation Gradient (TAG) Measured from Coronary CT Angiography (CTA) and Coronary Blood Flow: Validation in Left- versus Right-Dominant Circulation**

Tuesday, Dec. 1 3:40PM - 3:50PM Location: S504AB

Participants
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**PURPOSE**

TAG characterizes the dropoff in contrast enhancement across a coronary artery in a CT angiogram. We sought to validate a theoretical relationship to coronary flow using the known relationships of physiologic flow amongst the three main coronary arteries.

**METHOD AND MATERIALS**

We hypothesized that during changing inflow contrast concentration (eg, during bolus up-/down-slope), TAG relates to volumetric flow as 

\[
\text{TAG} = \frac{\text{Lumen Area} \times \text{Inflowing Contrast Enhancement Change}}{\text{TAG}}
\]

using this equation were calculated in 25 patients with <25% diameter stenoses imaged with 320-row CTA (AquilionOne, Toshiba), and compared between those with right- (RD) vs left-/co-dominant (LD) circulation. Lumen area was determined for the arterial length used for TAG measurement. For 22 patients with bolus tracking images additionally available, inflow contrast enhancement change during the CTA was estimated in the ascending aorta. TAG-derived flow was averaged for each major coronary artery of LD and RD patients separately, and compared to invasively-measured flows reported in the PREDICTION trial (n=496 patients; Sakamoto et al, Am J Cardiol 2013;111:1420-).

**RESULTS**

20 patients were RD and 5 LD. In those with bolus tracking images, TAG-derived flow in the LAD and LCX was within 4-16% of physiologic values; RCA flow was over/underestimated by 21-40%. In terms of physiologic LD/RD ratios, TAG-derived flow in the
LAD for LD vs RD patients was 1.09 (104 vs 92.5 ml/min), which compares well to the known physiologic ratio of 1.07 (2% difference). Similarly, the ratio for the LCX was 1.47 (113 vs 76 ml/min) compared to the physiologic ratio of 1.57 (6% difference), and in the RCA it was 0.37 (56 vs 158 ml/min) compared to 0.50 (26% difference).

CONCLUSION

The TAG in coronary arteries appears inversely proportional to resting coronary flow. Knowledge of the temporal change of inflow contrast concentration further enables derivation of coronary flow from TAG.

CLINICAL RELEVANCE/APPLICATION

Knowledge of the relationship of TAG to coronary flow can enhance detection of functionally significant CAD. We have used this relationship to increase TAG accuracy for predicting a significant invasive fractional flow reserve (FFR<0.8), and to obtain more accurate hyperemic blood flow boundary conditions for FFR-CT estimation via computational fluid dynamics.

Participants

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PURPOSE

The aim of this study was to evaluate the diagnostic performance of the combined assessment of coronary computed tomography angiography (CTA) and quantitative myocardial CT perfusion (CTP) to identify obstructive coronary artery disease (CAD).

METHOD AND MATERIALS

The study group comprised consecutive 34 patients (mean age 68.7 years) who underwent combined CT protocol and cardiac magnetic resonance (CMR) prior to invasive coronary angiography (ICA). CT scan protocol consisted of pharmacological stress dynamic myocardial CTP and coronary CTA using 256-slice CT. Obstructive CAD was defined as stenosis>=50% on ICA with a corresponding myocardial ischemia on CMR. Quantitative CTP assessment was performed with myocardial blood flow (MBF), which was calculated by model-based deconvolution method using semi-automated prototype software (FUJIFILM RI Pharma Co., Ltd., Tokyo, Japan) built on MATLAB (The MathWorks Inc, Natick, MA). A cut-off value of CT-MBF was determined for detecting myocardial ischemia assessed by CMR using receiver operating characteristic (ROC) analysis at a vessel level. The presence of coronary stenosis was assessed with lesions defined as follows: 0-no luminal stenosis; 1-minimal (<25% stenosis); 2-mild (25-49% stenosis); 3-moderate (50-69% stenosis); 4-severe (70-99% stenosis); and 5-occlusion. Coronary stenosis >= 50% or unavailable vessels were defined as significant, and CT-MBF was referred consequently. A vascular territory with a significant stenosis on CTA along with CT-MBF less than the cut-off value was considered to be positive. Diagnostic performance (sensitivity, specificity, positive and negative predictive value [PPV and NPV]) of CTA, CTP and combined assessment (CTA+CTP) for detecting obstructive CAD.

RESULTS

A cut-off value of CT-MBF was 1.28 ml/g/min. In comparison with ICA and CMR, sensitivity, specificity, PPV and NPV were 97%, 47%, 52% and 97% for CTA, 84%, 76%, 67% and 89% for CTP and 84%, 89%, 82% and 90% for combined assessment. Area under the ROC curve of CTA, CTP and combined assessment were 0.79, 0.83 and 0.88.

CONCLUSION

Combined CT assessment of CTA and quantitative CTP imaging allows for evaluating obstructive CAD with high diagnostic accuracy using single modality.

CLINICAL RELEVANCE/APPLICATION

Combined CT protocol of CTA and CTP allows for anatomical and physiological assessment of coronary artery disease with high diagnostic accuracy by using a single modality.
SSJ05-01 Quantitative CT Imaging Features Improve Prediction of EGFR Mutation Status in Lung Adenocarcinomas

Participants
Jin Mo Goo, MD, PhD, Seoul, Korea, Republic Of (Moderator) Research Grant, Guerbet SA;
Mark S. Parker, MD, Mechanicsville, VA (Moderator) Nothing to Disclose

Sub-Events

PURPOSE
To retrospectively identify the relationship between epidermal growth factor receptor (EGFR) mutation status, predominant histologic subtype, and computed tomographic (CT) characteristics in surgically resected lung adenocarcinomas in an Asian cohort patients.

METHOD AND MATERIALS
This study was approved by the institutional review board, with waiver of informed consent. Findings of preoperative chest CT were retrospectively evaluated in 385 surgically resected lung adenocarcinomas. 30 CT descriptors that characterized tumor location, size, shape, margin, density, enhancement, internal, external, and associated findings were assessed. EGFR mutations at exons 18 - 21 were determined by using a polymerase chain reaction (PCR)-based assay. Univariable and multivariable analyses were performed for this study. The area under ROC curve (AUC) was computed using the leave-one-out cross-validation method.

RESULTS
EGFR mutations were found in 168/385 patients (43.6%). Mutations were found more frequently among female, never smokers, and with lepidic predominant adenocarcinomas, intermediate pathologic grade, among tumors of smaller size, with spiculation, GGO or mixed GGO, air bronchogram, cavitation, vascular convergence, thickened adjacent bronchovascular bundles, and pleural retraction, and also among tumors without pleural attachment, well-defined margin, marked heterogeneous enhancement, severe peripheral emphysema, severe peripheral fibrosis, or lymphadenopathy (P < 0.05). The most important and significantly independent predictors of harboring EGFR activating mutation for the model with both clinical variables and CT features were never smokers, tumors of smaller size, with cavitation, homogeneous enhancement, and pleural retraction when adjusting for gender, pathologic grade, and thickened adjacent bronchovascular bundles. ROC curve analysis showed that clinical predictors combined with CT features (AUC = 0.76) were superior to clinical predictors alone (AUC = 0.61).

CONCLUSION
Quantitative CT imaging features of lung adenocarcinomas in combination with clinical predictors can predict EGFR mutation status better than clinical predictors alone.

CLINICAL RELEVANCE/APPLICATION
Selecting patients with high potential for EGFR mutations by combining imaging-based predictors with known clinical variable may result in a population with a greater sensitivity to EGFR-TKI treatment.

SSJ05-02 18F-FDG Uptake as a Prognostic Factor for Tumor Recurrence in Patients with Pathologic Stage I Lung Adenocarcinomas

Participants
Ying Liu, MD, Beijing, China (Presenter) Nothing to Disclose
Ning Wu, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To analyze the 18F-FDG uptake features and the correlation between 18F-FDG uptake and tumor recurrence in patients with pathologic stage I lung adenocarcinomas.

METHOD AND MATERIALS
One hundred and seventeen patients with stage I lung adenocarcinomas proved by surgery were studied retrospectively. Eighty-
four patients had a subsequent follow-up. The tumors' SUVmax in different groups of size, density, tumor differentiation degree and T staging were analyzed by Kruskal-Wallis test. The correlations between the SUVmax and clinicopathologic factors were analyzed using Spearman rank correlation. The disease-free survival (DFS) periods in different clinicopathologic groups were estimated using the Kaplan-Meier method and Log-rank test.

**RESULTS**

The SUVmax of pathologic stage 1 lung adenocarcinomas were significantly different in different groups of size, density, tumor differentiation degree and T staging, respectively (P<0.01). The SUVmax was positively correlated with the size of the adenocarcinomas (P<0.01), and were both negatively correlated with the density and tumor differentiation degree (P<0.01). But there was no correlation with the tumor T staging (P>0.05). The patients with an SUVmax of <2.5 had a much better DFS period than those with an SUVmax of ≥2.5 (P<0.05). The DFS periods showed no statistical differences in other clinicopathologic groups (P>0.05). But tumor with a poorly differentiated degree was associated with reduced DFS period compared with those with well differentiated degree (P<0.05).

**CONCLUSION**

18F-FDG uptake is correlated with the tumor differentiation degree, and has a prognostic value for predicting the tumor recurrence in the patients with pathologic stage 1 lung cancer. The patients with an SUVmax of <2.5 have a much better DFS periods than those with an SUVmax of ≥2.5.

**CLINICAL RELEVANCE/APPLICATION**

The level of metabolic activity observed with 18F-FDG uptake correlates with the probability of tumor recurrence in the patients with pathologic stage 1 lung cancer.

**SS305-03 Evaluation of Texture Analysis Parameters in EGFR or ALK-Positive Advanced Non-Small Cell Lung Cancer (NSCLC)**

**Tuesday, Dec. 1 3:20PM - 3:30PM Location: S404CD**

Participants
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Benjamin Besse, Villejuif, France (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The quantitative assessment of heterogeneity in tumor images through Texture Analysis is an emerging tool that can potentially provide a non-invasive prognostic biomarker. We investigated if Texture Analysis parameters derived from contrast-enhanced CT (CTTA) were associated with EGFR/ALK status and have a prognostic value in NSCLC patients treated with tyrosine-kinase inhibitors.

**METHOD AND MATERIALS**

The CT images of advanced NSCLC patients with EGFR mutation or ALK translocation treated with tyrosine-kinase inhibitors were retrospectively reviewed. CTTA using the filtration-histogram method was applied to the region of interest (ROI) in the primary tumor of the enhanced-CT by two independent operators to examine the inter-individual reproducibility. A Wilcoxon test was used to correlate CTTA and EGFR / ALK status and a Cox model to evaluate the prognostic value of CTTA for overall survival. A p-value cutoff of 0.01 was used to adjust for multiple testing.

**RESULTS**

CTTA parameters were evaluated in CT scan from 68 patients recruited in 2 centers between 2008 and 2013, of them, 80.9% (n=55) were EGFR mutated and 19.1% (n=13) ALK+ NSCLC. The CTTA measures were highly reproducible between the 2 operators as indicated by Bland-Altman plots and correlation values. The skewness of the distribution was significantly different between EGFR mutated and ALK+ tumors for coarse texture with spatial filter value 3.3 (p=0.002), filter value 2.8 (p=0.001) and medium texture with spatial filter value 2.2 (p=0.004). The median follow-up time was 35 months; 39 deaths occurred. The A unit increase in skewness in coarse texture (2.8 spatial filter) was significantly associated with better survival with an univariate cox analysis (HR: 0.36 [0.2-0.69] p=0.002). A multivariate analysis adjusted by prognostic factors (PS, lymphocyte count, hepatic and adrenal metastasis) indicate a similar trend for better survival (HR: 0.40 [0.2-0.8] p=0.01).

**CONCLUSION**

CTTA parameters were reproducible between the 2 operators. The skewness was significantly different between EGFR mutated and ALK rearranged advanced NSCLC and may have a prognostic value.

**CLINICAL RELEVANCE/APPLICATION**

Texture analysis of CT images is a simple tool that has proven inter-individual reproducibility and that might have a potential to provide prognostic and molecular indicators to help clinicians in their treatment strategy.
SS305-04 Dynamic CE-Perfusion Area-Detector CT vs. FDG-PET/CT: Capability for N-Stage Assessment in Non-Small Cell Lung Cancer Patients

Participants
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Kazuo Sugimura, MD, PhD, Kobe, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

PURPOSE
To prospectively and directly compare the capability for N-stage assessment between dynamic contrast-enhanced (CE-) perfusion area-detector CT (ADCT) and FDG-PET/CT in non-small cell lung cancer (NSCLC) patients.

METHOD AND MATERIALS
44 consecutively pathologically diagnosed NSCLC patients (26 males, 18 females; mean age 67 years) who were candidates for surgical treatment underwent dynamic CE-perfusion ADCT that were performed at two or three different positions as single examination, PET/CT, surgical treatment and pathological examination. From all perfusion ADCT data in each subject, whole chest perfusion map was computationally generated based on dual- and single-input maximum slope and Patlak plot methods by means of previously reported software. For quantitative diagnosis of metastatic lymph node and N-stage, perfusion parameters and SUVmax at each lymph node were evaluated by ROI measurement. Then, Student's t-test was performed to determine the difference between metastatic and non-metastatic lymph nodes. To determine the diagnostic capability and feasible threshold value on a per node basis analysis, ROC analyses were performed among all indexes as having significant difference between two groups. Finally, sensitivity, specificity and accuracy for diagnosis of metastatic lymph node and N-stage were compared by means of McNemar's test.

RESULTS
Systemic arterial perfusion from dual-input maximum slope method and SUVmax had significant difference between metastatic and non-metastatic lymph nodes (p<0.05). Although there was no significant difference of area under the curve between systemic arterial perfusion and SUVmax on a per node basis analysis (p>0.05), specificity (SP: 92.1%) and accuracy (AC: 92.8%) of former were significantly higher than those of latter (SP: 88.3%, p=0.004; AC: 88.3%, p=0.005). In addition, when assessed N-stage in all patients, accuracy of systemic arterial perfusion (75%) was also significantly higher than that of SUVmax (55.8%, p=0.008).

CONCLUSION
Dynamic CE-perfusion ADCT has better potential for N-stage assessment than PET/CT in NSCLC patients.

CLINICAL RELEVANCE/APPLICATION
Dynamic CE-perfusion ADCT has better potential for N-stage assessment than PET/CT in NSCLC patients.

SS305-05 CT-based Quantification of 3rd Generation Bronchial Luminal Collapsibility in Patients with Chronic Obstructive Lung Disease (COLD) and Correlations with Corresponding Lung Volume Changes

Participants
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PURPOSE
To assess the degree of bronchial lumen collapsibility in 3rd generation bronchi in COPD grade IV (GOLD) patients by using quantitative chest-CT (virtual bronchoscopy) in correlation with corresponding changes of lung volumes between end-inspiration and end-expiration.

METHOD AND MATERIALS
29 patients (male=14; median age=63.36y; range 48-76y) with grade IV COPD underwent chest-CT at our institution from January 2010 to November 2014. Two thin-slice (0.6mm) non-enhanced image data sets were acquired both at end-inspiration and end-expiration using helical technique (120 kV, 100-150 mAs). The software automatically identified the bronchial tree for quantitative bronchial lumen assessment (crossectional area) both at end-inspiration and end-expiration. Each bronchial lumen was measured at 0.5 cm after the offspring of a 3rd generation bronchus. Subsequently, the edges of the bronchial lumen were corrected hand drawn with using a hand free polygonal ROI. Lung lobes were semi-automatically segmented and the volumes of segmented lobes and the percentage of their volumes below the threshold -950 HU (LAV - 950HU) were calculated. We evaluated the impact of lobar compressibility (Vexp. vs. Vinsp., or residual volume) on bronchial collapsibility.
RESULTS
Mean total lung volume decreased by 17.8% in expiration (6877 ± 1641 mL in inspiration and 5495 ± 1160 mL in expiration). Mean expiratory bronchial collapse was 15%. The degree of bronchial lumen collapsibility correlated well with the magnitude of volume reduction of the corresponding lobes (Spearman's r = 0.7, p = 0.001). Importantly, this correlation holds also true for the individual lobes. Considering also the emphysema phenotype, collapsibility and volume reduction were stronger for homogenous compared to heterogeneous emphysematous lobes (diameter reduction 13.1% vs 25.1%; volume reduction 14.2% vs 19.4%, respectively).

CONCLUSION
With about 15%, collapsibility of 3rd generation bronchi in COPD patients was significantly lower than that in the trachea and the main bronchi compared to earlier published data. Bronchial wall consistency (cartilage rings vs. cartilage + mebranous wall) seem to be the reason for these differences. The collapsibility correlated well with the reduction in lung volume.

CLINICAL RELEVANCE/APPLICATION
The degree and the sites of increased bronchial lumen collapsibility have severe clinical consequences for understanding and planning novel endobronchial therapies.

SSJ05-06  Sensitivity of Airway Wall Thickness Measurements: Influence of Small Airways
Tuesday, Dec. 1 3:50PM - 4:00PM Location: S404CD

Participants
Jean-Paul Charbonnier, Nijmegen, Netherlands (Presenter) Nothing to Disclose
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David A. Lynch, MBCh, Denver, CO (Abstract Co-Author) Research support, Siemens AG; Scientific Advisor, PAREXEL International Corporation; Consultant, Boehringer Ingelheim GmbH; Consultant, Gilead Sciences, Inc; Consultant, F. Hoffmann-La Roche Ltd; Consultant, Veracyte, Inc;
Eva M. Van Rikxoort, PhD, Nijmegen, Netherlands (Abstract Co-Author) Stock holder, Thirona BV Co-founder, Thirona BV

PURPOSE
Changes in the morphology of the airways contributes to lung function impairment in chronic obstructive pulmonary disease (COPD). Measurements of airway morphology might be influenced by the quality of the airway segmentation. In this study we investigate the stability of a commonly used airway measurement (Pi10) from CT scans for varying segmentation depths of the airways.

METHOD AND MATERIALS
Inspiratory low-dose thoracic CT scans of 267 subjects, well distributed over GOLD stages, were selected for this study. Airways were automatically extracted by a state-of-the-art segmentation method and manually corrected to ensure a leakage free segmentation. Airway wall thickness quantification was performed in orthogonal cross-sections every 1mm throughout the entire airway tree using an intensity-integration technique which accounts for partial volume effects. Using regression on all cross-sectional measurements, airway morphology was expressed as the square root of wall area at airways with a perimeter of 10mm (Pi10). To determine the sensitivity of the Pi10 measurement to the length of the segmented airway tree, sensitivity analysis was performed on Pi10 by leaving-out wall measurements of the smallest airways and recalculating the Pi10. For each subject, Pi10 regression analysis was repeated excluding airways with a lumen perimeter below 6mm, 8mm or 10mm. The recalculated Pi10 measurements were compared to the baseline Pi10.

RESULTS
The segmented airway trees consisted for 55% of airways with lumen diameters below 10mm, 19% below 8mm, and 1% below 6mm. The average baseline Pi10 of all subjects was 2.43 +/- 0.56 (range [1.40, 4.36]), which corresponds to an average airway wall thickness (for an airway with a lumen perimeter of 10mm) of 0.52mm +/- 0.21mm. By excluding airways with a lumen perimeter below 6, 8 or 10mm from the regression analysis, absolute changes in Pi10 were 0.003 +/- 0.004 (0.11%), 0.035 +/- 0.023 (1.46%), and 0.107 +/- 0.087 (4.6%), respectively, corresponding to changes in airway wall thickness (at 10mm lumen perimeter) of 0.001, 0.013, and 0.039mm.

CONCLUSION
The commonly used Pi10 measurement to express airway morphology from a CT scan is insensitive to the exclusion of smaller airways in the computation.

CLINICAL RELEVANCE/APPLICATION
When expressing airway morphology as Pi10, there is no need to (manually) adjust automatic airway segmentation methods to include smaller airways in order to obtain an accurate Pi10 measurement.
**Emergency Radiology (Chest Emergencies)**

**SSJ06-01** Predicting Pulmonary Embolus in ED Patients with Isolated Below-the-Knee Deep Vein Thrombosis

**Tuesday, Dec. 1 3:00PM - 3:10PM Location: N227**

**Participants**

Martin L. Gunn, MBChB, Seattle, WA (Moderator) Research support, Koninklijke Philips NV; Spouse, Consultant, Wolters Kluwer NV; Medical Advisor, TransformativeMed, Inc; Mariano Scaglione, MD, Castel Voltumo, Italy (Moderator) Nothing to Disclose

**Method and Materials**

In this IRB-approved, HIPAA compliant study, ED lower extremity ultrasounds from 2005-2015 were reviewed to identify patients with isolated BKDVT. Medical records were reviewed for either PE protocol or conventional protocol chest CT within 1 month of the index ultrasound to assess for PE. Key clinical factors at presentation were determined, including venous territories involved and history of DVT, malignancy, medical risk factors (e.g. smoking, genetic predisposition, medications, travel), recent surgery/hospitalization, and respiratory symptoms/pain. Chi Square test was performed to compare utility of clinical factors in assessing risk of PE in patients with BKDVT, with statistical significance set at p<0.05.

**Results**

135 studies were identified with isolated BKDVT, with patients of average age 57.1 +/- 17.2 (mean +/- SD) with a range of 21-93, including 51% male, 49% female. BKDVT was identified in the posterior tibial (50%), peroneal (42%), gastrocnemius (19%), anterior tibial (2%), and soleal (1%) veins. Patients either had 1 (84%) or 2 territories (16%) involved, with 8% bilateral. 50 patients (37%) underwent chest CT in the prescribed period. No difference was seen in age (p=.232), gender (p=.774), or territories involved (p=.830) in those who underwent CT versus those who did not. Of those with CT, 31 (62%) had PE. Presence of two territories (e.g. posterior tibial and peroneal) was associated with higher likelihood of PE (p=0.018). Other clinical factors were not meaningful, including history of DVT (p=.232), malignancy (p=.756), medical risk factors (p=.255), recent surgery/hospitalization (p=1.00), symptoms (p=.773), and bilaterality (p=.637).

**Conclusion**

ED patients presenting with isolated BKDVT have a very high incidence (62%) of concurrent PE. While the utility of predictive factors is limited due to this high incidence, presence of BKDVT in two venous territories was highly associated with PE.

**Clinical Relevance/Application**

ED patients with isolated below-the-knee deep vein thrombosis have a much higher rate of PE than traditionally expected.

**SSJ06-02** Ultra-low-dose Chest CT with Iterative Reconstructions vs Chest X-Ray in Emergency Settings. Is it the Beginning of a New Era? Preliminary Observations

**Tuesday, Dec. 1 3:10PM - 3:20PM Location: N227**

**Participants**

Francesco Macri, MD, Nimes, France (Presenter) Nothing to Disclose
Joel Greffier, Nimes, France (Abstract Co-Author) Nothing to Disclose
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Cornelia Freitag, Nimes, France (Abstract Co-Author) Nothing to Disclose
Gian Franco Gualdi, MD, Roma, Italy (Abstract Co-Author) Nothing to Disclose
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Jean-Paul Beregi, MD, Nimes, France (Abstract Co-Author) Nothing to Disclose

**Purpose**

To evaluate the diagnostic power of the ultra-low-dose CT (ULD-CT) of the chest compared to the chest X-ray (CXR) at the emergency room (ER).
METHOD AND MATERIALS

Patients with dubious CXR performed at the ER searching for pneumothorax, fractures and pneumopathy who underwent a ULD-CT within 48 hours. ULD-CT acquisition was performed on a 64 slices MDCT (Somatom Definition AS+, Siemens) with 100 kVp ± 20 (depending on the patient constitution) and fixed 10 mAs, without injection of intravenous iodinated contrast media. Images were reconstructed with Sinogram-AFFirmed-Iterative-Reconstructions (SAFIRE, Siemens) with S4 and I50f for pulmonary parenchyma and with S3 and I30f for the mediastinum. A radio-physicist evaluated the dose differences between CXR and ULD-CT. Two radiologists independently evaluated the diagnostic quality of the images and the diagnostic degree of confidence.

RESULTS

A total of 136 patients (M 72; F 64) with a mean age of 63 years (± 20.5) and a mean BMI 23.6 kg/m2 (± 5.1) were enrolled. The effective dose for CXR was 0.133 ± 0.132 mSv, 59% lower than CXR French Diagnostic Reference Levels (fDRL): 0.225 mSv. The effective dose for ULD-CT was 0.189 ± 0.035 mSv, 97% lower than chest CT fDRL: 6.65 mSv. ULD-CT revealed a higher quantity of small pneumothoraxes and fractures and better depicted the pneumopathies compared to CXR. Readers recorded a high score of diagnostic confidence level for ULD-CT. Diagnostic decision-making was possible even on noisy CT images.

CONCLUSION

ULD-CT with iterative reconstructions, with an irradiation dose close to CXR, allowed a reliable study of the patients with the suspicion of pneumothorax, fractures and pneumopathy.

CLINICAL RELEVANCE/APPLICATION

Ultra-low-dose chest CT with iterative reconstructions improves the management of the ER patients with suspicion of pneumothorax, fractures and pneumopathy by reducing the delay of diagnosis and avoiding redundant exposure.

SSJ06-04  Sickle Cell Patients Undergoing CT Pulmonary Angiography in the Emergency Department: An Analysis

Tuesday, Dec. 1 3:30PM - 3:40PM Location: N227

Participants
David D. Bates, MD, Boston, MA (Presenter) Nothing to Disclose
Z Liu, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Christina A. LeBedis, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Nagaraj-Setty Holalkere, MD, Boston, MA (Abstract Co-Author) Owner, imaginglink, LLC

PURPOSE

CT Pulmonary angiography (CT PE) is the gold standard for diagnosis of pulmonary emboli (PE). However, in suboptimal conditions, contrast enhancement is inadequate for diagnostic purposes, and scans often need to be repeated. In this study we evaluate the utility of Dual Energy CT (DECT PE) non-linear blending technique in patients with suspected PE in comparison to a standard 100 kVp scan.

METHOD AND MATERIALS

Thirty-five patients between September 19, 2013 and 2014 with a suspected PE, underwent a standardized high-pitch DECT PE protocol to generate standard 100kVp (DECT-100) and non-linear blended images (DECT-OC). Visualization of the pulmonary arteries on the two image sets was scored on a Likert scale from 1 to 5 by two readers (Score of 5 = excellent sharp visualization of anatomical structures, no image noise and artifacts; score of 1 = poor visualization of anatomical structures, and severe image noise and artifacts). Each segment was assessed for diagnostic ability of possible PE. Mean and standard deviation of CT values within pulmonary arteries, muscle, and air were recorded, and signal to noise (SNR) and contrast to noise (CNR) ratios were generated as a quantitative index of image quality. Student t-test and Wilcoxon rank sum test were used for statistical analysis, and p<0.05 was considered significant.

RESULTS

Visualization scores were significantly better on all segments (Main, left and right, lobar, segmental and subsegmental pulmonary arteries) on the DECT-OC images for both readers (p<0.0001). In the 490 pulmonary artery segments evaluated, 34 were non-diagnostic on the DECT-100 images, whereas only 7 were non-diagnostic on the DECT-OC images (p<0.0001). Mean SNR was 97% higher (27.67 vs. 54.53, p<0.0001) and mean CNR was 105% higher (14.76 vs 30.27, p<0.0001) on the DECT-OC images.

CONCLUSION

The application of a DECT non-linear blending technique for the diagnosis of PE helps significantly improve SNR, CNR, and arterial visualization in comparison to a standard 100 kVp protocol, yielding substantially improved diagnostic image quality.

CLINICAL RELEVANCE/APPLICATION

Non-linear blended DECT PE allows optimal visualization of the pulmonary vasculature leading to improved detection of PE, and may be especially useful in suboptimal studies to avoid repeat scans.

SSJ06-03  Dual-Energy CT of Chest in Pulmonary Angiography: Maximizing Optimal Contrast Enhancement with a Non-Linear Blending Technique

Tuesday, Dec. 1 3:20PM - 3:30PM Location: N227

Participants
Teresa I. Liang, MD, Vancouver, BC (Presenter) Nothing to Disclose
Ismail T. Ali, MBChB, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Memoona Mian, MD, FRRC, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Patrick D. McLaughlin, FFRRCSI, Cork, Ireland (Abstract Co-Author) Speaker, Siemens AG
Savvas Nicolaou, MD, Vancouver, BC (Abstract Co-Author) Institutional research agreement, Siemens AG

PURPOSE

CT Pulmonary angiography (CT PE) is the gold standard for diagnosis of pulmonary emboli (PE). However, in suboptimal conditions, contrast enhancement is inadequate for diagnostic purposes, and scans often need to be repeated. In this study we evaluate the utility of Dual Energy CT (DECT PE) non-linear blending technique in patients with suspected PE in comparison to a standard 100 kVp scan.

METHOD AND MATERIALS

Thirty-five patients between September 19, 2013 and 2014 with a suspected PE, underwent a standardized high-pitch DECT PE protocol to generate standard 100kVp (DECT-100) and non-linear blended images (DECT-OC). Visualization of the pulmonary arteries on the two image sets was scored on a Likert scale from 1 to 5 by two readers (Score of 5 = excellent sharp visualization of anatomical structures, no image noise and artifacts; score of 1 = poor visualization of anatomical structures, and severe image noise and artifacts). Each segment was assessed for diagnostic ability of possible PE. Mean and standard deviation of CT values within pulmonary arteries, muscle, and air were recorded, and signal to noise (SNR) and contrast to noise (CNR) ratios were generated as a quantitative index of image quality. Student t-test and Wilcoxon rank sum test were used for statistical analysis, and p<0.05 was considered significant.

RESULTS

Visualization scores were significantly better on all segments (Main, left and right, lobar, segmental and subsegmental pulmonary arteries) on the DECT-OC images for both readers (p<0.0001). In the 490 pulmonary artery segments evaluated, 34 were non-diagnostic on the DECT-100 images, whereas only 7 were non-diagnostic on the DECT-OC images (p<0.0001). Mean SNR was 97% higher (27.67 vs. 54.53, p<0.0001) and mean CNR was 105% higher (14.76 vs 30.27, p<0.0001) on the DECT-OC images.

CONCLUSION

The application of a DECT non-linear blending technique for the diagnosis of PE helps significantly improve SNR, CNR, and arterial visualization in comparison to a standard 100 kVp protocol, yielding substantially improved diagnostic image quality.

CLINICAL RELEVANCE/APPLICATION

Non-linear blended DECT PE allows optimal visualization of the pulmonary vasculature leading to improved detection of PE, and may be especially useful in suboptimal studies to avoid repeat scans.
To analyze the data for patients with sickle cell disease being evaluated in the emergency department with CT pulmonary angiography.

METHOD AND MATERIALS

This retrospective study was approved by our Institutional Review Board. Patients with sickle cell disease were evaluated with CT pulmonary angiography (CTPA) 42 times in the Emergency Department over 26 months beginning in November 2011. Clinical data and imaging were reviewed and compared with patients from the same period. Studies were classified as positive for acute pulmonary embolus, negative for acute pulmonary embolus, or indeterminate. Wells’ scores were calculated for each sickle patient as well as a control group based on the medical records. Statistical analysis was performed.

RESULTS

Patients with sickle cell undergoing CTPA in the emergency department were significantly more likely to have either ‘Moderate’ or ‘High’ risk Wells’ scores (53.7% vs. 31.0, p < 0.05), more likely to be female (76.19% vs. 62.79%, p < 0.05), and had lower mean age (31.74 vs. 55.26 years, p < 0.05). No statistically significant difference was observed for the rate of acute PE between sickle cell patients and the ER population (7.14% vs. 10.67%).

CONCLUSION

Sickle cell patients are younger and are more likely to be female than the general population of patients undergoing CTPA in the ED. Sickie cell patients are also more likely to be categorized as either ‘Moderate’ or ‘High’ risk based on Wells’ criteria than a control group. No significant difference in the rate of acute PE was observed for sickle patients compared with the general population of patients when undergoing CTPA in the ED.

CLINICAL RELEVANCE/APPLICATION

Sickle cell patients are younger, more likely to be female and more likely to be classified as Moderate or High Risk based on Wells’ criteria when being evaluated with CTPA in the emergency department (ED). Despite the higher risk profile, no difference was observed in the rate of acute PE for sickle cell patients, though the small sample size limits sensitivity for the detection of a true difference in the incidence of acute PE. Younger and female, sickle cell patients as a group may be at higher risk for the stochastic effects of ionizing radiation. Our study suggests that risk stratification models used in clinical decision pathways for the evaluation of PE in the general population may not be appropriate for use in sickle cell patients.

SSJ06-05 The Impact of Maximum Aortic Wall Thickness on Patient Outcomes in Acute Type A Intramural Hematoma

Tuesday, Dec. 1 3:40PM - 3:50PM Location: N227

Participants
Michael K. Atalay, MD, PhD, Providence, RI (Presenter) Nothing to Disclose
Ashley A. Tuttle, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose
Grayson L. Baird, MS, Providence, RI (Abstract Co-Author) Nothing to Disclose
Dennis Kwon, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose
Neel sodha, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose

PURPOSE

Aortic intramural hematoma (IMH) is an uncommon acute aortic injury that can heal spontaneously or progress to potentially life-threatening complications. Maximum IMH thickness (Tmax) and luminal compression ratio (LCR) have been proposed as potentially useful metrics for identifying patients who are more likely to experience complications. The aim of this study was to correlate Tmax and LCR with patient outcomes in all Type A IMH cases performed in a large tertiary referral center over 11 years.

RESULTS

Over the study period, 54 thoracic IMH cases were captured in PACS, 23 (43%) of which were Type A and 31 (57%) Type B. Mean Type A patient age was 77±12 years and 13 (57%) of the 23 patients were female. Outcomes in 7 patients were unknown (1 Type A, 6 Type B). Of those remaining, 7 (32%) Type A cases and 10 (40%) Type B cases showed regression on serial follow-up imaging. A significant interaction for regression was observed for IMH Type and Tmax (p=0.039). For each millimeter increase in Tmax the odds of regression for Type A IMH decreased 26%. The Tmax for 50% probability of Type A regression was 8.6 mm. The mean Tmax for those Type A cases showing regression was 8.6 mm and for those showing progression 14.6 mm (p=0.015). There was no significant correlation between LCR or Dmax and patient outcomes for Type A IMH.

CONCLUSION

Maximal aortic wall thickness predicts the odds of spontaneous resolution or stability of Type A IMH and may in turn impact clinical management.

CLINICAL RELEVANCE/APPLICATION

The maximal aortic wall thickness in Type A IMH may potentially be used as a metric for adverse outcomes to guide medical versus surgical management.

SSJ06-06 Effect of Patient Lung Volume on Contrast Volume Administration During Computed Tomography Pulmonary Angiography

Tuesday, Dec. 1 3:50PM - 4:00PM Location: N227

Participants
Charbel Saade, PhD, Beirut, Lebanon (Presenter) Nothing to Disclose
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Saade, PhD, Beirut, Lebanon (Abstract Co-Author) Nothing to Disclose
Atalay, MD, PhD, Providence, RI (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the effect of patient lung volume and contrast volume on pulmonary artery opacification using a patient-specific contrast formula during pulmonary multidetector CT angiography.

METHOD AND MATERIALS
IRB approval for this prospective study was obtained. CTPA was performed on 120 patients with suspected PE using a 64-channel computed tomography scanner and a dual-barrel contrast injector. Patients were assigned to two protocol groups: protocol A, the department’s conventional protocol, employed a fixed 80 mL contrast volume, intravenously injected at 4.5 mL/s; protocol B used a patient-specific contrast formula based on patient cardiovascular dynamics. Both protocols used a 50 mL saline flush at 4.5 mL/s and a craniocaudal scan direction. The mean cross-sectional opacification profile of eight central and eleven peripheral pulmonary arteries and veins were measured for each patient and arteriovenous contrast ratio (AVCR) calculated for each lung segment. Mean lung volume were quantified using a computer aided detection software. Protocols were compared using Mann-Whitney U non-parametric statistics. Inter-observer variations were investigated using Kappa methods.

RESULTS
A number of pulmonary arteries demonstrated increases in opacification (p<0.03) for protocol B compared with A whilst opacification in the heart and all veins was reduced in protocol B (p=0.05). Subsequently, increased AVCR in protocol B compared with A was observed at all anatomic locations (p<0.0002) where this ratio was calculated. Mean contrast volume demonstrated a reduction in protocol B (33±9 mL) compared to A (80±1mL). In protocol B larger lung volumes were significantly correlated to larger volumes of contrast (p<0.03). Inter-observer variation was observed with protocol B compared with A with the latter metric increasing from κ = 0.28 to 0.71 respectively.

CONCLUSION
Significant improvements in visualisation of the pulmonary vasculature can be achieved with low contrast volume. Patient lung volume is significantly correlated to contrast volume administration employing a patient-specific contrast formula.

CLINICAL RELEVANCE/APPLICATION
Matching patient lung volume and contrast injection timing with vessel dynamics significantly improves vessel opacification and reduces contrast dose in the assessment of pulmonary embolism (PE) during computed tomography pulmonary angiography (CTPA).
SSJ07-01 Reproducibility of Magnetic Resonance Enterography Scores for the Assessment of Disease Activity in Crohn’s Disease Using Central Readers

Participants
Michael S. Gee, MD, PhD, Jamaica Plain, MA (Moderator) Nothing to Disclose
Tracy A. Jaffe, MD, Durham, NC (Moderator) Nothing to Disclose

Sub-Events

Participants
Jordi Rimola, MD, Barcelona, Spain (Presenter) Consultant, F. Hoffmann-La Roche Ltd; Consultant, Takeda Pharmaceutical Company Limited
Cynthia S. Santillan, MD, San Diego, CA (Abstract Co-Author) Consultant, Robarts Clinical Trials Research Group
Stuart A. Taylor, MBBS, London, United Kingdom (Abstract Co-Author) Research consultant to Robarts plc
Karin van Gemert-Horsthuis, MD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Barrett G. Levesque, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Brian Feagan, London, ON (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the reproducibility of two MRE disease activity instruments, the MaRIA and London indices, when centrally read by four expert gastrointestinal body imaging radiologist readers in a multi-center trial setting.

METHOD AND MATERIALS
Four central reader radiologists at different centers in Europe and North America reviewed 50 MRE sequences of patients with a spectrum of Crohn's disease activity and location. Readers assessed the MaRIA and London indices, pre-specified individual MRE findings, and a global rating of severity based on a visual analogue scale (VAS). Intraclass correlation coefficients (ICCs) for intra- and inter-rater agreement were calculated for each assessment.

RESULTS
Intra-rater ICCs (95% confidence intervals) for the MaRIA, London, London Extended indices and the VAS were 0.89 (0.84 to 0.91), 0.84 (0.76 to 0.88), 0.81 (0.71 to 0.85) and 0.86 (0.81 to 0.90). Corresponding inter-rater ICCs were 0.71 (0.61 to 0.77), 0.50 (0.32 to 0.62), 0.56 (0.40 to 0.64), and 0.71 (0.62 to 0.77). The correlation between each reader's VAS and the MaRIA, London, and London Extended indices were 0.79 (0.71 to 0.85), 0.68 (0.58 to 0.77) and 0.67 (0.58 to 0.76), respectively. These results indicate that there was "almost perfect" intra-rater reproducibility of centrally read MaRIA and London indices. Inter-rater agreement was "substantial" for the MaRIA and "moderate" for the London indices.

CONCLUSION
The MaRIA index appears to have the best operating characteristics which further supports its implementation as an instrument for use in clinical trials.

CLINICAL RELEVANCE/APPLICATION
Magnetic resonance enterography (MRE) will likely be increasingly utilized in clinical trials to improve Crohn’s disease (CD) patient selection and because it may be more responsive to clinically important changes in inflammatory status than either symptom-based or endoscopic instruments. Reproducibility is a critical property of MRE CD activity indices if they are to be used as outcome measures in clinical trials.

SSJ07-02 Genetic Polymorphisms Associated with MR Enterography Imaging Features of Crohn’s Disease

Participants
Cinthia Cruz, MD, Boston, MA (Presenter) Nothing to Disclose
Abra Guo, Boston, MA (Abstract Co-Author) Nothing to Disclose
James H. Thrall, MD, Boston, MA (Abstract Co-Author) Board Member, Mobile Aspects, Inc; Board Member, WorldCare International Inc; Consultant, WorldCare International Inc; Shareholder, Antares Pharma, Inc; Shareholder, iBio, Inc ; Shareholder, Peregrine Pharmaceuticals, Inc
Vijay Yajnik, MD,PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Michael S. Gee, MD, PhD, Jamaica Plain, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate for associations between genetic loci related to Crohn's disease (CD) behavior and imaging features of disease.

METHOD AND MATERIALS
IRB approved HIPAA compliant single institution study of 76 patients with established CD who underwent MRE for disease evaluation. Scans were performed from 2009-2015 on a 1.5T clinical scanner using standard MRE protocol with oral and intravenous
31 females and 22 males were analyzed (mean age 40 years ranging 20-83). Activity was classified as active in 37(70%), chronic in 8 (15%), and normal in 8(15%) patients; behavior was classified as inflammatory(I) in 27 (60%), structuring(S) in 6(13%), and fistulizing(F) in 12(26%) patients; mean length of involvement was 14.9 +/- 3.6 cm. Out of 168 SNP tested, the highest incidence was observed for IL23(100%) followed by PTNP22(91%) and IL31RA-IL6ST(74%). HLA and CARD9(20%) were only observed in patients with active disease on imaging with a highly significant association (p=0.009). IL31R-IL6ST showed a significantly lower incidence in chronic disease (p=0.03). Among MRE imaging features, HLA and CARD9 mutations were most significantly associated with BWT (p=0.02), with ME and T2 also significant (p=0.04). MAP3K8 and TNFR showed a significantly higher associations with F disease (p<0.001) and (p=0.03) with evidence of abscess (4/37).

CONCLUSION

Multiple SNPs are associated with CD activity on MRE, with HLA and CARD9 significantly associated with active disease, fistulizing behavior and presence of abscesses. BWT, ME, and T2 are individual imaging features showing significant genetic associations.

CLINICAL RELEVANCE/APPLICATION

CD patient genotype impacts on imaging phenotype depicted by MRE.

SSJ07-03  Bowel Imaging with PET/MR Enterography: First Results

Tuesday, Dec. 1 3:20PM - 3:30PM Location: E353A

Participants
Karsten J. Beiderwellen, MD, Essen, Germany (Presenter) Speaker, Siemens AG; Speaker, Bracco Group
Sonja Kinne, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Lukas Lenga, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Benedikt Gomez, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Heusch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Jost Langhorst, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Bockisch, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Thomas C. Lauenstein, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate hybrid PET/MR enterography for the diagnostic assessment of intestinal pathologies.

METHOD AND MATERIALS

43 patients with Crohn's disease, bowel malignancies or fever of unknown origin (female: n=20, male: n=23, age: 51±13 years [20-74 years]) underwent PET/MR enterography (Biograph mMR, Siemens) with either [18F]FDG (n=34) or [68Ga]-DOTATOC (n=9). For small bowel distension 1500 ml of an oral contrast solution containing mannitol and locust bean gum were ingested. PET was acquired as list mode for 8 min per bed. The MR protocol encompassed: a) coronal TrueFISP; b) coronal T2w HASTE with fat saturation; c) coronal T1w 3D VIBE pre and post gadolinium; d) axial and coronal T1w 2D FLASH post-gadolinium. Datasets were acquired as list mode for 8 min per bed. The MR protocol encompassed: a) coronal TrueFISP; b) coronal T2w HASTE with fat saturation; c) coronal T1w 3D VIBE pre and post gadolinium; d) axial and coronal T1w 2D FLASH post-gadolinium. Datasets were evaluated regarding co-registration of anatomical structures based on a 3-point ordinal scale (3: good co-registration, 2: slight misregistration, 1: significant misregistration) and image quality using a 4-point scale (1: non-diagnostic - 4: excellent quality). Furthermore, visualization of intestinal and extraintestinal pathologies was described.

RESULTS

PET/MR enterography resulted in a high overall image quality (mean score MRI: 3.3, PET: 2.4) with good results for PET and MRI co-registration (mean: 2.5 - 2.9). An excellent visualization of small and large bowel pathologies was achieved including inflammatory lesions (in 18 patients) as well as malignant lesions (in two patients). Furthermore, extraintestinal pathologies such as lymph node metastases (in two patients) were identified.

CONCLUSION

Integrated PET/MR enterography represents a technically robust examination allowing for good co-registration of bowel structures.

CLINICAL RELEVANCE/APPLICATION

The new method enables a multimodal assessment of bowel lesions in inflammatory as well as malignant disease. The simultaneous data acquisition might be of advantage in the interpretation of PET/MR in comparison to independently acquired PET and MRI data sets due to potential bowel motion artifacts and different patient positioning.
Patients with Crohn's disease are at risk of high radiation exposure, particularly from CT imaging. Symptomatic Crohn's patients are often scanned repeatedly due to broad differential diagnoses associated with the presenting complaint. While CT is a valuable tool in the assessment of Crohn's disease and its complications, we must be cognizant of its overutilization. Herein, we evaluated the utilization rate and indications for CT imaging of Crohn's patients at our institution.

**METHOD AND MATERIALS**

We performed a retrospective chart review of 100 consecutive Crohn's disease patients who received a CT scan from 2000 to 2015. All incidences of radiation from CT imaging were noted. The total number of CT scans were tallied. CT scans were categorized by indication; the total number of normal studies was also obtained.

**RESULTS**

100 patients with Crohn's disease were evaluated, 53 female and 47 male, a mean age of 48, with a range of 22 to 88 years. In this study population 491 CT scans were performed. The indications for the imaging studies included assessment of nonspecific abdominal or pelvic pain (46.8%), evaluation of suspected Crohn's flare or Crohn's-related complications (30.5%), surgical complication or surgical follow up (9.5%), flank pain (5.2%), trauma (0.4%), or other (7.6%). In this population, the average number of CT scans performed was 4.9, with a range of 1 to 23. A total of 43 patients received >= 5 CTs, 12 received >= 10 CTs, 4 received >= 15 CTs and 2 received >= 20 CTs. Of the 491 CT scans performed, 135 (27.5%) were reported as normal or with stable chronic changes related to the patients underlying Crohn's disease.

**CONCLUSION**

The average number of CT scans per patient in this population approached 5 scans with a maximum of 23 scans in a single patient. Prior studies have shown that radiation above 50mSv (~5 CT scans) increases the risk of cancer, which is particularly pertinent for the Crohn's patient population. Of the scans performed a significant proportion were recorded as normal or with stable chronic changes from Crohn's disease, thus not providing a cause for the patient's symptoms.

**CLINICAL RELEVANCE/APPLICATION**

Our findings elucidate there is considerable room for reducing the use of CT imaging in symptomatic Crohn's patients, given the significant number of scans with normal or stable chronic findings.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator

**SSJ07-05 Head-to-head Prospective Evaluation of Small Bowel Distension and Patient Tolerance of a New Enteric Contrast Agent for Enterography**

*Tuesday, Dec. 1 3:40PM - 3:50PM Location: E353A*

**Participants**

Amy B. Kolbe, MD, Rochester, MN (Presenter) Nothing to Disclose
Adam Froemming, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Shannon P. Sheedy, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Chi Wan Koo, MD, Mankato, MN (Abstract Co-Author) Nothing to Disclose
Krishna Pundi, BS, Rochester, MN (Abstract Co-Author) Nothing to Disclose
David Bruining, MD, Rochester, MN (Abstract Co-Author) Research Grant, Given Imaging Ltd Consultant, Bracco Group
Jeanne Tung, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
W. S. Harmsen, MS, Rochester, MN (Abstract Co-Author) Nothing to Disclose
John M. Barlow, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Jeff L. Fidler, MD, Rochester, MN (Abstract Co-Author) Research Grant, Beekley Corporation
Joel G. Fletcher, MD, Rochester, MN (Abstract Co-Author) Grant, Siemens AG;

**PURPOSE**

To evaluate a new mannitol and sorbitol-containing flavored beverage (FB) as an enteric contrast agent for enterography compared to commercially available low Hounsfield barium sorbitol suspension (BS) for side effects, patient taste and willingness to repeat the exam, and small bowel distension.

**METHOD AND MATERIALS**

10 normal subjects ingested 5 different drinking algorithms on separate days (FB2: 1000 mL FB + 350 mL water; FB3: 1500 mL FB; BS2: 900 mL BS + 450 mL water; BS3: 1350 mL BS + 150 mL water; W3: 1500 mL water), with agents ingested over 45 minutes. Coronal SSFSE images were obtained through the bowel at 50 and 60 minutes following initiation of drinking. Subjects completed a questionnaire evaluating side effects, patient taste and willingness to repeat the exam. GI radiologists evaluated MR images using qualitative and quantitative scores for the jejunum, mid-ileum, and terminal ileum, blinded to imaging algorithm and time. Radiologists then ranked algorithms in order of preference based on distension of enteric contrast-filled bowel. Analyses were performed using ANOVA, pairwise Fisher's LSD, with p-values reporting overall significance of the 5 algorithms.
RESULTS

There was no significant difference in nausea or vomiting among regimens (p=0.20 and 0.42), but FB3 and V3 resulted in mild cramping (p=0.001). Using a 10 point scale, subjects rated taste of BS2 (mean=3.9) and BS3 (4.7) worst (p < 0.0001). Willingness to repeat drinking algorithm was highest for FB2 (9.8) and W3 (9.7) (p<0.05). There were significant overall differences in subjective small bowel distention for 2/3 readers (p=0.003, p<0.02), with both W3 regimens ranked significantly worse (Figure). For quantitative analyses, there was no significant difference in the diameter of the most distended small bowel loop for any segment or reader (p>0.23), with one reader identifying smaller representative loop diameters for W3 in the jejunum and ileum (p<0.03).

CONCLUSION

FB has a similar side effect profile and results in equivalent small bowel distention compared with BS. Normal subjects rated taste and willingness to repeat the exam with the new FB agent significantly higher.

CLINICAL RELEVANCE/APPLICATION

By improving taste and maintaining side effect profile and small bowel distention, a new flavored beverage oral contrast agent with sorbitol can result in improved willingness to undergo repeat enterography exams.

PURPOSE

The purpose of this study is to harness our expanding understanding of the basic mechanisms of Inflammatory Bowel Disease (IBD) in order to develop more accurate and useful avenues of molecular imaging and Crohn's disease diagnosis.

METHOD AND MATERIALS

A cohort of 82 Crohn's disease (CD) patients who underwent endoscopy and CT enterography (CTE) was examined for 5 predetermined CT findings - mural hyperenhancement, bowel wall thickening, increased mural fat attenuation, mural stratification and combs sign and 5 predetermined lab measurements - fecal calprotectin, fecal lactoferrin, C-reactive protein (CRP), fecal elastase and serum IgA. For Fecal Calprotectin (FC) a lab value of 16 (mcg/g) or less were set as 16, CRP of 5 (mg/L) or less were set as 5 and Stool elastase (SE) of 500 (μg/g) or more were set as 500. Relationships between the variables and whether there was Active IBD were evaluated. Fisher's exact tests were performed on discrete variables while Wilcoxon rank sum tests were performed on continuous variables.

RESULTS

Of the 5 evaluated clinical lab values, fecal calprotectin (FC) and CRP were the most useful predictors of active IBD. Both FC and CRP demonstrated statistically significant smaller median values in non-active IBD than active IBD. Utilizing logistic regression models and ROC curves, we determined threshold cutoff values of 142 (mcg/g) for FC and 5.4 (mg/L) for CRP. Following determination of individual variable threshold values, we then combined the two and developed the following predictive algorithm: If FC < 142 and CRP < 5.4 then categorize the case as "No IBD"; Otherwise categorize as "Yes IBD". Utilizing this algorithm, the sensitivity for active IBD was 92.86%, specificity was 77.78%, PPV of 86.67%, NPV of 87.57% and an accuracy of 86.96%.

CONCLUSION

This work demonstrates that combining CTE and clinical labs can be a powerful tool in the diagnosis of IBD, and that the most useful lab values in CT enterography evaluation of IBD cases are fecal calprotectin and CRP. Therefore, we propose all CT enterography should also include evaluation of FC and CRP for specific numerical thresholds when considering IBD in the differential diagnosis.

CLINICAL RELEVANCE/APPLICATION

CTE findings for IBD are difficult to interpret, therefore, a methodology for incorporating clinical lab values with CTE findings is critical for accurate initial diagnosis and disease surveillance.
**SS08**

**Gastrointestinal (CT Dose Reduction)**

Tuesday, Dec. 1 3:00PM - 4:00PM Location: E352

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**AMA PRA Category 1 Credit™**: 1.00
**ARRT Category A+ Credit**: 1.00

**FDA** Discussions may include off-label uses.

**Participants**

Vahid Yaghmai, MD, Chicago, IL (Moderator) Nothing to Disclose
Mannudeep K. Kalra, MD, MD, Boston, MA (Moderator) Nothing to Disclose

**Sub-Events**

**SS08-01 Low Dose Gemstone Spectral CT Imaging in Abdominal Patients: Evaluation of Whether the Virtual Non-enhanced Images from Contrast-enhanced Spectral CT Could Replace True Non-enhanced for Radiation Dose Reduction**

Tuesday, Dec. 1 3:00PM - 3:10PM Location: E352

**Participants**

Hai-Feng Duan, MMed, Xianyang, China (Presenter) Nothing to Disclose
Yongjun Jia, MMed, Xianyang City, China (Abstract Co-Author) Nothing to Disclose
Taiping He, Xianyang, China (Abstract Co-Author) Nothing to Disclose
Zhanli Ren, Xianyang, China (Abstract Co-Author) Nothing to Disclose
Xirong Yu, Xianyang City, China (Abstract Co-Author) Nothing to Disclose
Youmin Guo, Xian, China (Abstract Co-Author) Nothing to Disclose
Yang Chuangbo, MMed, Xianyang City, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate if the virtual nonenhanced (VNE) images generated from the contrast-enhanced low dose spectral CT images could replace the true nonenhanced (TNE) for radiation dose reduction.

**METHOD AND MATERIALS**

Images of 50 consecutive adults (36 males and 14 females, ages: 21-79 years) who underwent 3-phase abdominal CT were retrospectively analyzed. TNE CT was performed with conventional 120kVp. The contrast-enhanced scans in arterial phase (AP) and portal venous phase (VP) were performed with low dose spectral CT mode. VNE images were generated from AP (VNEA) and VP (VNEP) spectral CT images. 2 board-certified radiologists reviewed both TNE and VNE images for image quality and lesion detection. Mean CT value, signal-noise-ratio (SNR) and contrast-noise-ratio (CNR) for liver, pancreas, spleen, kidney and muscle were measured. Lesion detection rate, subjective image rating and radiation dose were assessed and compared.

**RESULTS**

Both TNE and VNE images satisfied clinical needs for lesion detection and image quality. The image quality scores were 4.78±0.47, 4.56±0.76 and 4.68±0.59 for TNE, VNEA and VNEP, respectively with no difference. There was no difference for the lesion detection rate (number) with the plain CT scan (66.8% (135), 63.4% (128) and 65.8% (133), respectively) (p>0.05). CT number (in HU) in liver, pancreas, spleen, kidney and muscle were, respectively, (52.00±7.38, 34.00±6.41, 46.35±5.99, 30.03±4.48 and 45.56±7.80) on TNE, (53.01±6.13, 35.99±6.73, 49.74±5.74, 31.91±3.86, and 44.22±7.10) on VNEA and (56.17±5.87, 36.60±7.12, 50.94±4.55, 32.61±3.66, and 46.03±6.92) on VNEP. There was slight bias for CT numbers on VNE. However, the absolute CT number difference between VNE and TNE was less than 5HU, with the largest at VP for the spleen. VNEA had better CT number fidelity with the smallest difference for the liver. CNR values in 3 groups were similar. VNE images provided statistically higher SNR.

The potential dose reduction for replacing TNE with VNE was 30.12%.

**CONCLUSION**

VNE image generated from the contrast-enhanced abdominal low dose spectral CT provides adequate image quality for lesion depiction, high CT number fidelity and 30% dose reduction compared with TNE.

**CLINICAL RELEVANCE/APPLICATION**

VNE images generated from the contrast-enhanced abdominal spectral CT may be used to replace TNE images to provide adequate image quality for lesion depiction and 30% dose reduction.

**SS08-02 Evaluation of Contrast Enhancement and Image Quality: A Comparison Study between Different Tube Voltages and Iodine Concentrations in Upper Abdominal Dynamic CT Scans in Minipigs**

Tuesday, Dec. 1 3:10PM - 3:20PM Location: E352

**Participants**

Maoping Hu, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Zaiyi Lu, Guangzhou, China (Presenter) Nothing to Disclose
Chang Hong Liang, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Xiao Mei Lu, MMed, Shenyang, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the enhanced effects of abdominal vessels and liver parenchyma and the image quality in abdominal dynamic CT
scans using different tube voltages and different concentrations of contrast agents at identical iodine delivery rate.

METHOD AND MATERIALS
Six minipigs underwent repeated upper abdominal dynamic enhanced CT scans (256-slice CT scanner) under 4 protocols: group A (270 mgI/mL, 80kVp + iterative reconstruction (IR, iDose4) algorithm), group B (370 mgI/mL, 80kVp + IR algorithm), group C (270 mgI/mL, 120kVp + FBP algorithm), and group D (370 mgI/mL, 120kVp + FBP algorithm). The total iodine dose (600 mg I/kg) and iodine delivery rate (0.92 mg I/s) of injected contrast agents were the same in all groups. The enhanced attenuations of abdominal aorta, portal vein, and liver parenchyma were measured and the image noise, SNR, and CNR in peak enhancement of liver parenchyma were determined. The subjective image quality was evaluated by two radiologists.

RESULTS
There were no significant differences in peak enhanced attenuations of abdominal aorta, portal vein, and liver parenchyma between 80kVp groups or 120kVp groups respectively (all P > 0.05). The attenuations of vessels in 80kVp were significantly higher than in 120kVp (all P < 0.05). There were no significant differences in image noise, SNR, and CNR of liver parenchyma between groups (all P > 0.05). The subjective image quality scores were no significant difference.

CONCLUSION
Different concentrations of iodinated contrast agents given an injection protocol with the same iodine delivery rate and total iodine dose achieved the same enhancement of the abdominal vessels and liver parenchyma, 80 kVp with IR (iDose4) algorithm acquired acceptable image quality.

CLINICAL RELEVANCE/APPLICATION
The injection protocols and bolus characteristics of iodinated contrast agent should be optimized to achieve best enhancement and reduce radiation dose meanwhile.

SSJ08-03 Objective Image Quality and Detectability of Simulated Low-Contrast, Low-Attenuation (LCLA) Liver Lesions on CT without and with an Integrated Circuit (IC) Detector and Iterative Reconstruction (IR): Effect of Radiation Exposure and Subject Size

Tuesday, Dec. 1 3:20PM - 3:30PM Location: E352

Participants
Ajit H. Goenka, MD, Cleveland, OH (Presenter) Institutional Research Grant, Siemens AG
Brian R. Herts, MD, Cleveland, OH (Abstract Co-Author) Research Grant, Siemens AG
Frank Dong, PhD, Solon, OH (Abstract Co-Author) Equipment support, Siemens AG Software support, Siemens AG
Nancy A. Obuchowski, PhD, Cleveland, OH (Abstract Co-Author) Research Consultant, Siemens AG Research Consultant, Hologic, Inc Research Consultant, Cardiovascular Ultrasound Services, Inc Research Consultant, Elucid Bioimaging Inc
Andrew Primak, PhD, Malvern, PA (Abstract Co-Author) Employee, Siemens AG
Wadid Karim, RT, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Mark E. Baker, MD, Cleveland, OH (Abstract Co-Author) Research Consultant, Bracco Group; Researcher, Siemens AG; Research support, Siemens AG

PURPOSE
To assess image quality and LCLA liver lesion detection in semi-anthropomorphic phantom using either discrete circuit (DC) detector and FBP or IC detector and IR at varied radiation exposures and phantom diameters.

METHOD AND MATERIALS
A phantom without and with 5-cm thick fat-mimicking ring (30- and 40-cm diameters) and containing liver inserts with 4 spherical lesions was scanned with 5 exposure settings [30-cm phantom: 200 (CTD1vol 13.5 mGy), 150, 100, 50, and 25 eff mAs; 40-cm phantom: 400 (CTD1vol 26.9 mGy), 300, 200, 100, and 50 eff mAs] on two CT scanners, one equipped with DC and other with IC detector. Images were reconstructed with FBP and IR (SAFIRE; S3) respectively. Image noise and lesion CNR were averaged at each mAs. Four radiologists evaluated lesion presence on a 5-point diagnostic confidence scale. Data analyses included ROC curve analysis, and noninferiority analysis (margin -0.10).

RESULTS
Image noise was significantly lower with IC-IR than with DC-FBP (P < .001) with greater reduction in 40-cm phantom and at lower exposures. Lesion CNR was significantly higher with IC-IR than with DC-FBP (P < .001). When compared to DC-FBP at highest exposures, mean reader accuracy with IC-IR was noninferior up to 50% (100 eff mAs) and 25% (300 eff mAs) exposure reductions for 30- and 40-cm phantoms respectively (adjusted P < .001 and P = .04). IC-IR improved readers' confidence in presence of a lesion (average difference 0.17 points) (P = .029) independent of phantom size or exposure level. At any given exposure level, however, there was no significant difference between mean AUCs with IC-IR and DC-FBP for either of 2 phantoms.

CONCLUSION
Moderate exposure reductions maintained non-inferior diagnostic accuracy for both detector-reconstruction combinations. Lesion detection in 40-cm phantom was inferior at smaller exposure reduction than in 30-cm phantom. IC-IR improved objective image quality and lesion detection confidence but did not result in superior diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION
Impact of noise-reduction on threshold radiation exposure below which diagnostic information may be lost depends on the combination of patient size and imaging task. LCLA lesion detectability in simulated patients with larger girths is more sensitive to increased noise at reduced radiation exposures than in simulated smaller patients. Task-specific measures are critical in determining the clinical utility of newer noise-reduction technologies.

SSJ08-04 The Use of Low Tube Voltage and ASIR Reconstruction to Improve Image Quality of CT Angiography for Tumor Blood Supply Arteries Under Low Concentration Contrast Condition

Tuesday, Dec. 1 3:30PM - 3:40PM Location: E352

Participants
Wadih Karim, RT, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Mark E. Baker, MD, Cleveland, OH (Abstract Co-Author) Research Consultant, Bracco Group; Researcher, Siemens AG; Research support, Siemens AG

PURPOSE
To assess the combination of patient size and imaging task. LCLA lesion detectability in simulated patients with larger girths is more sensitive to increased noise at reduced radiation exposures than in simulated smaller patients. Task-specific measures are critical in determining the clinical utility of newer noise-reduction technologies.
Comparison of Attenuation Based Automated versus Empirical Method for Tube Voltage Selection in Abdominal-pelvic CT Examinations

Tuesday, Dec. 1 3:40PM - 3:50PM Location: E352

Participants
Li Ye, Dalian, China (Presenter) Nothing to Disclose
Ailian Liu, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Shifeng Tian, Dalian, China (Abstract Co-Author) Nothing to Disclose
Yijun Lu, Dalian, China (Abstract Co-Author) Nothing to Disclose
Jinghong Liu, MD, PhD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Ting Zhang, Da Lian, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the use of low tube voltage and adaptive statistical iterative reconstruction (ASIR) algorithm to improve image quality and diagnostic confidence for tumor blood arteries under low contrast medium concentration.

METHOD AND MATERIALS
Fifty-eight patients (body mass index (BMI) ≤ 22 kg/m²) with suspected gastrointestinal tract malignant tumors CT scans were randomly divided into two groups. Group A (21 men and 11 women, ages 40-90 years) was scanned with 80kVp and low concentration of contrast medium (270mgI/ml) and reconstructed with 50% ASIR. Group B (22 men and 4 female, ages 40-76 years) underwent scanning with conventional 120 kVp and high concentration of contrast medium (350 mgI/ml). CT value and standard deviation (SD) of the tumor blood supplying artery and fat in anterior abdominal wall were measured, and contrast-to-noise ratio (CNR) and value were calculated. Image quality was evaluated by two radiologists using a 5-point rating scale. The inter-observer agreement was estimated by using weighted kappa statistics and Intra-class correlation coefficients (ICC) test. Image quality scores were compared by the Mann-Whitney U test. The paired Student t tests was used to compare the difference in CT value, SD value, CNR and CT dose index (CTDInv) value between group A and B.

RESULTS
There was no difference in sex, age, BMI between two groups. The subjective image quality score of tumor blood supplying arteries of group A was better than that of group B (4.7 Vs. 4.3) with very good inter-observer agreement (Kappa value>0.80; ICC value>0.75). The CT value and CNR of group A (249.76±44.51HU and 9.31±1.89) were higher than those of group B (249.76±44.51HU and 9.31±1.89) (all P<0.001). The CTDIvol of group A (5.24±1.15 mGy) was lower than that of group B (13.47±4.73 mGy) (P<0.001).

CONCLUSION
For patients with BMI ≤22 kg/m², the low tube voltage and low contrast medium concentration scanning with 50% ASiR algorithm can reduce radiation dose and contrast medium concentration without sacrificing image quality.

CLINICAL RELEVANCE/APPLICATION
Low tube voltage with 50% ASiR algorithm may be used for CT angiography of slim patients with adequate image quality to dramatically reduce radiation and contrast dose.

Comparison of Attenuation Based Automated versus Empirical Method for Tube Voltage Selection in Abdominal-pelvic CT Examinations

Tuesday, Dec. 1 3:40PM - 3:50PM Location: E352

Participants
Faezeh Sodagari, MD, Chicago, IL (Presenter) Grant, Siemens AG
Adeel R. Seyed, MD, Chicago, IL (Abstract Co-Author) Grant, Siemens AG
Atilla Arslanoglu, MD, Chicago, IL (Abstract Co-Author) Grant, Siemens AG
Cecil G. Wood III, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Vahid Yaghmai, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the performance of attenuation based automated tube voltage (kV) selection software with known empirical method for kV selection in abdominal-pelvic CT examinations.

METHOD AND MATERIALS
The study was HIPAA compliant and IRB approved. Eighty patients who underwent abdominopelvic CT examinations were included in the study. All patients were scanned on the same CT scanner using automated kV selection. Lateral-width of the patient was determined. and patients were grouped based on their lateral-widths. Each lateral width group corresponded to an optimal kV (lateral-width based kV selection). Comparison was made between the kV selected using the automated selection software and the optimal kV based on lateral-widths.

RESULTS
Attenuation based automated kV selection resulted in a lower optimal tube potential in 32 out of 80 (40%) patients when compared with kV selection based on patient lateral-width (P<0.0001). None of the patients were scanned with a higher kV using automated selection. Agreement between the two methods of kV selection was fair (k-coefficient=0.28, 95% CI: 0.15 - 0.41).

CONCLUSION
Attenuation based automated tube voltage selection may be a more effective method for radiation dose reduction when compared to tube voltage selection based on patient width.

CLINICAL RELEVANCE/APPLICATION
Attenuation-based automated tube voltage selection allows greater reduction in radiation dose compared to empirical methods.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying
In this study, we evaluated the impact of kV assist associated with Adaptive Statistical Iterative Reconstruction (ASiR) on dose and image quality in hepatic enhanced CT scan. The study included 46 patients who underwent CT angiography for upper abdomen using a 64-row CT scanner (GE Discovery CT 750 HD). Patients were divided into two groups using kV assist technique. Group A (n=23, BMI: 20.72±2.37) and group B (n=23, BMI: 22.31±1.82) underwent CT scan with 120kVp and low tube kVp (≤100kVp), respectively. Data of group B were reconstructed with a fixed blending level (50% and 0% respectively) of ASiR for each image set. The baseline was 120 kVp, noise index (NI)=12.0 (5mm).

The CT values of abdominal fat layer, aorta (AR) and liver were measured. The contrast noise ratio (CNR) of AR and SMA were calculated respectively. The CT dose index volume (CTDIvol) of each patient were recorded. The dose length produce (DLP) was recorded and effective radiation dose was calculated.

RESULTS

The mean CTDIvol and effective radiation dose in group B (6.06 ±2.80mGy, 2.31 ±1.06mSv) were significantly lower than group A (9.26±4.69mGy, 3.81 ±2.31mSv) (p<0.05). The mean CT value of liver in group A (70.33±8.09Hu) was not significantly different with that in group B (73.94±10.83Hu) (p>0.05), respectively. The SNRs of liver in group B (50% ASiR) (9.33±2.07) were higher than in group A (7.57±1.61) (p<0.05).

CONCLUSION

KV assist recommended optimal scan protocol, and approximately 39% radiation dose was reduced without degradation of image quality.

CLINICAL RELEVANCE/APPLICATION

KV assist helps to improve patient care through personalized protocols and simplify scan technique optimization.
Participants
Frank H. Miller, MD, Chicago, IL (Moderator) Nothing to Disclose
Donald G. Mitchell, MD, Philadelphia, PA (Moderator) Consultant, CMC Contrast AB

Sub-Events
SSJ09-01  MR Elastography of the Liver: Comparison of GRE and EPI Sequences
Tuesday, Dec. 1 3:00PM - 3:10PM Location: E350

Participants
Mathilde Wagner, MD, PhD, Paris, France (Presenter) Nothing to Disclose
Temel K. Yasar, New York, NY (Abstract Co-Author) Nothing to Disclose
Cecilia Besa, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Jad M. Bou Ayache, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Octavia Bane, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Maggie M. Fung, MEng, Bethesda, MD (Abstract Co-Author) Employee, General Electric Company
Bachir Taouli, MD, New York, NY (Abstract Co-Author) Consultant, Guerbet SA

PURPOSE
To compare 2D-GRE (gradient recalled echo) liver MR-Elastography (MRE) with 2D-SE-EPI (echoplanar imaging) MRE in terms of image quality (IQ) and liver stiffness (LS) measurements.

METHOD AND MATERIALS
36 patients with chronic liver disease or focal liver lesion (M/F:23/13, mean age 57.8 y) who underwent 3T liver MRI (MR750, GE) using 2D-GRE and 2D-SE-EPI liver MRE were enrolled in this single-center IRB approved study. Both sequences were acquired in the axial plane, with 4 slices (same location), 10 mm thickness, a 60Hz mechanical motion, similar FOV (2D-GRE: TR/TE 50/20, 256x80, 60 MEG frequency, ASSET 2 / SE EPI: TR/TE 1000/55.4, 80x80, 155Hz MEG frequency, ASSET 2). Scan time for EPI MRE was 4 sec and 14 sec for GRE MRE (for each slice). One radiologist placed ROIs in the liver parenchyma for measurements of LS (kPa). ROIs were drawn as large as possible, avoiding voxels with less than 95% confidence level on the confidence map, large vessels, parenchyma edge and fissures. IQ scores were assessed by a second radiologist using a four-point scale (0: no observable wave propagation/no confidence map; 3: excellent wave propagation in liver/confidence map covering more than 50% of liver slice). Mean LS values and IQ scores between EPI and GRE MRE were compared using Wilcoxon test. Reproducibility of LS between these two sequences was assessed with intraclass coefficient correlation (ICC), coefficient of variability (CV) and Bland-Altman limits of agreement (BALA).

RESULTS
In 4 patients, GRE MRE completely failed while there was no case of failure with EPI MRE. IQ scores were significantly higher using EPI versus GRE MRE(score 14.4 vs 8.6, P<0.0001). ROI size was significantly higher using EPI than GRE MRE (56.06 cm² vs. 14.47 cm², P<0.0001). LS measurements were not significantly different between the EPI and GRE MRE (3.41±1.36 kPa vs 3.42±1.56 kPa, P=0.51), were significantly correlated (ICC=0.908, P<0.0001) and showed a high reproducibility (mean CV=10.2% (0.2-28.2), bias=0.09±0.63 kPa (BALA[-1.15;1.32]).

CONCLUSION
IQ scores of EPI MRE were significantly higher than GRE MRE, with faster acquisition and equivalent measurements. Larger ROI in EPI MRE allows more comprehensive liver sampling.

CLINICAL RELEVANCE/APPLICATION
GRE MRE is the most common approach for LS assessment. EPI MRE performs superior in terms of IQ and liver coverage with less breath-holds. This approach might improve the performance of MRE.

SSJ09-02  Associations between Nonalcoholic Fatty Liver Disease (NAFLD) Histologic Features and Magnetic Resonance Elastography (MRE)-estimated Liver Stiffness in Adults without Fibrosis
Tuesday, Dec. 1 3:10PM - 3:20PM Location: E350

Participants
Alexandra A. Schlein, BS, San Diego, CA (Presenter) Nothing to Disclose
Chun Chieh K. Luo, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Kang Wang, PhD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Paul Manning, MSc, La Jolla, CA (Abstract Co-Author) Nothing to Disclose
Jonathan C. Hooker, BS, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Catherine A. Hooker, BS, San Diego, CA (Abstract Co-Author) Nothing to Disclose
William Haufe, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Tanya Wolfsen, MS, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Anthony Garnet, PhD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Kevin J. Glaser, Rochester, MN (Abstract Co-Author) Intellectual property, Magnetic Resonance Innovations, Inc; Stockholder, Resoundant, Inc
Magnetic resonance elastography (MRE) has been established as a noninvasive method of estimating liver stiffness and thereby inferring hepatic fibrosis. The purpose of this work is to assess whether the other hepatic pathologies that are observed in NAFLD; steatosis, inflammation, and ballooning, have independent, significant affects on MRE estimated stiffness, and to assess whether they are possible confounds of the stiffness estimation.

METHOD AND MATERIALS
In this IRB approved study, adults receiving standard-of-care liver biopsy for NAFLD were consented and underwent MRE at 3T within 180 days of biopsy. MRE was performed using three methods (2D at 60 Hz, 3D at 40 Hz, and 3D at 60 Hz), from which MRE-estimated liver stiffness values were calculated. Histologic features were scored based on NASH CRN criteria; subjects with histologically-determined fibrosis were excluded. Associations between liver stiffness and inflammation or ballooning were assessed using t-tests. The association between liver stiffness and steatosis was assessed using Spearman rank correlation analysis.

Multivariate linear regression analysis was used to test MRE stiffness against histologic features adjusted for age, BMI, and ALT.

RESULTS
Sixty-four adults (30 M; mean age 49.5 yrs, range 18.5 to 75.8 yrs) were enrolled in this study. Multivariate linear regression analysis showed a negative correlation of steatosis with log of 3D MRE-estimated liver stiffness at 40 Hz (-0.064, p = 0.043) and 60 Hz (-0.068, p = 0.018). Univariate analyses of MRE-estimated liver stiffnesses for all three methods showed no association with inflammation (p = 0.08 to 0.11), ballooning (p = 0.51 to 0.63), or steatosis (rho = 0.29 to 0.39).

CONCLUSION
Hepatic steatosis has an independent, statistically significant association with the MR elastographic estimation of liver stiffness when BMI, ALT, and age are controlled for. Inflammation and ballooning do not have a statistically significant association with liver stiffness.

CLINICAL RELEVANCE/APPLICATION
This association between steatosis and liver stiffness is a possible confound in the MRE estimation of liver stiffness, and should be accounted for when MRE is used to estimate fibrosis in adult patients.

**SS090-03 Noninvasive Hepatic Fibrosis Staging Using Magnetic Resonance Elastography: The Usefulness of the Bayesian Prediction Method**

**Tuesday, Dec. 1 3:20PM - 3:30PM Location: E350**

Participants
Shintaro Ichikawa, MD, Chuo-Shi, Japan (Presenter) Nothing to Disclose
Utaro Motosugi, MD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose
Hiroyuki Morisaka, MD, Kofu, Japan (Abstract Co-Author) Nothing to Disclose
Katsuhiro Sano, MD, PhD, Chuo, Japan (Abstract Co-Author) Nothing to Disclose
Tomoki Ichikawa, MD, PhD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose
Hiroshi Onishi, MD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To evaluate the usefulness of the Bayesian prediction method (BPM) for noninvasive hepatic fibrosis staging (HFS) using magnetic resonance elastography (MRE).

**METHOD AND MATERIALS**
Chronic liver disease patients (n = 309) were included and fibrosis staging and MRE was performed. Receiver operating characteristic analysis was used to determine the optimal cut-off stiffness value (cut-off method; COM) of MRE to distinguish between fibrosis stages. A uniform distribution was assumed for pre-MRE probability of stages using the BPM. The MRE stiffness value determined the post-MRE probability and confidence of HFS. The distinguishing ability of COM and BPM were compared in all patients (Bayesian-all) and in patients with strong confidence (≥ 90%) with BPM (Bayesian-strong).

**RESULTS**
The ability to distinguish between hepatic fibrosis stages was not significantly different between COM and Bayesian-all. In patients who had strong confidence with BPM, the sensitivity and negative predictive value (NPV) of Bayesian-strong for diagnosing ≥ F2, ≥ F3, and F4 were significantly higher than with COM (sensitivity: COM vs. Bayesian-all for ≥ F2, 94.5% vs. 99.1% (P = 0.0041); ≥ F3, 89.6% vs. 99.4% (P = 0.0001); F4, 89.3% vs. 100% (P = 0.0018); NPV: ≥ F2, 78.8% vs. 93.9% (P = 0.0059); ≥ F3, 85.0% vs. 98.7% (P < 0.0001); F4, 93.4% vs. 100% (P = 0.0009)). The specificity of Bayesian-strong for diagnosing F4 was significantly higher than that of COM (97.3% vs. 100% (P = 0.0428)).

**CONCLUSION**
BPM has better distinguishing ability than COM for HFS using MRE if the confidence is strong.

**CLINICAL RELEVANCE/APPLICATION**
A liver biopsy followed by histopathological assessment is a common approach for staging liver fibrosis. However, a biopsy can
cause several complications. Consequently, noninvasive methods have been developed for assessing hepatic fibrosis. Recent studies have indicated that MRE is a promising, highly reproducible tool with advanced diagnostic capacity for the non-invasive staging of hepatic fibrosis. Hepatic fibrosis can be assessed more correctly by using BPM.

**SSJ09-04 Direct Comparison of 3 Elastometry Devices (Fibroscan, Acoustic Radiation Force Impulse, Supersonic Shearwave Imaging) for the Non-Invasive Diagnosis of Liver Fibrosis in Chronic Liver Diseases**

Tuesday, Dec. 1 3:30PM - 3:40PM Location: E350

**Participants**

Victoire Cartier, MD, Angers, France (Presenter) Nothing to Disclose

Jerome Bousier, Angers, France (Abstract Co-Author) Nothing to Disclose

Jerome Lebogot, MD, Angers, France (Abstract Co-Author) Nothing to Disclose

Frederic Bertrais, Angers, France (Abstract Co-Author) Nothing to Disclose

Isabelle Fouchard-Hubert, Angers, France (Abstract Co-Author) Nothing to Disclose

Sandrine Bertrais, Angers, France (Abstract Co-Author) Nothing to Disclose

Paul Cales, MD, PhD, Angers, France (Abstract Co-Author) Research Consultant, Echosens SA

Christophe Aube, MD, PhD, Angers, France (Abstract Co-Author) Speaker, Bayer AG Support, General Electric Company

**PURPOSE**

Liver stiffness measurement using elastography allows for a non-invasive diagnosis of liver fibrosis with immediate results at bedside. We aimed to evaluate and compare the feasibility and the diagnostic accuracy Fibroscan (FS), Acoustic Radiation Force Impulse (ARFI), and Supersonic Shearwave Imaging (SSI) for the non-invasive diagnosis of liver fibrosis.

**METHOD AND MATERIALS**

192 patients with chronic liver disease, liver biopsy, FS, ARFI and SSI were included. Metavir F staging on biopsy was taken as the reference for liver fibrosis. Result for each elastographic device was the median of 10 valid measurements. Diagnostic cut-offs were calculated to maximize the sum of sensitivity + specificity.

**RESULTS**

Cause of chronic liver disease was NAFLD in 55.7% of cases, viral hepatitis: 16.1%, alcohol: 16.7%, and others: 11.5%. Fibrosis stage prevalence was: F0: 23.4%, F1: 37.0%, F2: 19.3%, F3: 13.5%, F4: 6.8%. Failure of liver stiffness measurement (no valid measurement) occurred in 18 patients (9.4%) with FS, no patients with ARFI, and 3 patients (1.6%) with SSI (p=0.001 between FS and SSI). Results for the 3 devices were available in 171 patients. Obuchowski indexes were: FS: 0.89±0.018, ARFI: 0.76±0.027, SSI: 0.78±0.025 (FS vs ARFI or SSI: p<=0.020). AUROC for significant fibrosis (Metavir F>=2) were: FS: 0.86±0.027, ARFI: 0.74±0.039, SSI: 0.78±0.036 (p=0.006; FS vs ARFI or SSI: p=0.021). Diagnostic cut-offs for F>=2 were: FS: 8.0 kPa, ARFI: 1.29 m/s, SSI: 1.85 m/s. Using this cut-offs, diagnostic accuracy for F>=2 was: FS: 76.0%, ARFI: 70.2%, SSI: 77.2% (p=0.204). AUROC for cirrhosis were: FS: 0.94±0.027, ARFI: 0.89±0.048, SSI: 0.87±0.035 (p=0.011; FS vs ARFI or SSI: p=0.010). Diagnostic cut-offs for cirrhosis were: FS: 16.6 kPa, ARFI: 1.87 m/s, SSI: 1.93 m/s. Using this cut-offs, diagnostic accuracy for cirrhosis was: FS: 90.6%, ARFI: 79.5%, SSI: 75.4% (p=0.001, FS vs others: p=0.001).

**CONCLUSION**

ARFI and SSI have better feasibility and similar accuracy for the diagnosis of significant fibrosis than FS. However, FS has the best accuracy for the diagnosis of cirrhosis.

**CLINICAL RELEVANCE/APPLICATION**

Non-invasive diagnosis and evaluation of liver fibrosis in chronic liver diseases using acoustic based elastography.

**SSJ09-05 Fibrosis in Nonalcoholic Fatty Liver Disease: Noninvasive Assessment Using CT Volumetry**

Tuesday, Dec. 1 3:40PM - 3:50PM Location: E350

**Participants**

Nobuhiro Fujita, MD, PhD, Fukuoka, Japan (Presenter) Nothing to Disclose

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Hiroshi Honda, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose

Yuhiishi Takayama, MD, Fukuoka, Japan (Abstract Co-Author) Research Grant, FUJIFILM Holdings Corporation

Daisuke Okamoto, MD, Fukuoka City, Japan (Abstract Co-Author) Nothing to Disclose

Koichiro Morita, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To elucidate the morphological change in nonalcoholic fatty liver disease (NAFLD) with fibrosis stage using CT volumetry and to evaluate its diagnostic performance of CT volumetry for discriminating fibrosis stage in patients with NAFLD.

**METHOD AND MATERIALS**

A total of 38 patients with NAFLD (F0, 11; F1, 5; F2, 1; F3, 9; and F4, 12) who underwent contrast-enhanced CT were enrolled. On the basis of CT imaging, the volumes of total, left lateral segment, left medial segment, caudate lobe, and right lobe of the liver were calculated automatically and manually with a dedicated liver application. The relationship between the volume percentage of each area and fibrosis stage was analyzed using Spearman’s rank correlation coefficient. Receiver operating characteristic (ROC) curve analysis was performed to determine the accuracy of CT volumetry for discriminating fibrosis stage.

**RESULTS**

The volume percentages of caudate lobe and left lateral segment significantly increased with fibrosis stage (r = 0.815, P < 0.001, and r = 0.465, P = 0.003, respectively). Contrarily, the volume percentage of the right lobe significantly decreased with fibrosis stage (r = -0.563, P < 0.001). The volume percentage of caudate lobe had the best diagnostic accuracy for staging fibrosis and...
the area under the ROC curve values for discriminating fibrosis stage were as follows: ≥F1, 0.896; ≥F2, 0.929; ≥F3, 0.955; and ≥F4, 0.923. The best cut-off for advanced fibrosis (F3-F4) was 4.789% with sensitivity of 85.7% and specificity of 94.1%.

CONCLUSION
The volumes of caudate lobe and left lateral segment increase, and that of right lobe volume decreases with fibrosis stage in NAFLD. The volume percentage of caudate lobe calculated by CT volumetry is a useful diagnostic parameter for staging fibrosis in patients with NAFLD.

CLINICAL RELEVANCE/APPLICATION
CT volumetry is a powerful clinical tool to help diagnose fibrosis stage in NAFLD noninvasively. It may be useful in monitoring and making treatment decisions in patients with NAFLD.

SSJ09-06 Application of Ultrasound Texture Analysis For Detection of Liver Fibrosis

Tuesday, Dec. 1 3:50PM - 4:00PM Location: E350

Participants
David Podhaizer, MD, Boston, MA (Presenter) Nothing to Disclose
Hei Shun Yu, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Baojun Li, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Jorge A. Soto, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Stephan W. Anderson, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Avneesh Gupta, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the ability of ultrasound texture analysis to predict varying degrees of hepatic fibrosis in patients with known chronic liver disease.

METHOD AND MATERIALS
Following IRB approval, a retrospective chart review was performed on patients who underwent non-targeted ultrasound guided liver biopsies to include 29 patients with chronic liver disease (20 males, 9 females, mean age of 52 years old, range of 19 to 81 years old). For each patient, a single region of interest (ROI) was selected on two to three separate sonographic images that were obtained from the ultrasound guided liver biopsy examinations and the results were averaged. The ROIs were selected from the right lobe of the liver and excluded vessels and bile ducts. Texture analysis was performed on the ROIs using an in-house MATLAB-based program that extracted 45 texture features. Pearson product-moment correlation coefficients were calculated comparing texture features and degrees of hepatic fibrosis.

RESULTS
Of the 29 patients with chronic liver disease, the following Ishak fibrosis stages were represented, based on liver biopsy: Ishak 0, n=4; Ishak 1, n=4; Ishak 2, n=4; Ishak 3, n= 4; Ishak 4, n=4; Ishak 5, n=4; Ishak 6, n=5. Comparisons of the texture features with the degrees of hepatic fibrosis demonstrate strong correlations between Ishak fibrosis stage and Histogram texture features (r-values ranging up to -0.89), GLRL features (r-values ranging up to 0.80), Laws' features (r-values ranging up to 0.93), and GLGM features (r-values ranging up to -0.80). Weak correlation between texture features and degrees of fibrosis were demonstrated with 2-D features (r-values ranging up to 0.36) and GLCM features (r-values ranging up to -0.47).

CONCLUSION
Sonographic texture features demonstrate strong correlation with Ishak liver fibrosis scores. This suggests that texture analysis of ultrasound images has the potential to non-invasively predict varying degrees of hepatic fibrosis.

CLINICAL RELEVANCE/APPLICATION
Texture analysis can potentially be applied to ultrasound as a non-invasive method to diagnose and monitor progression of liver fibrosis.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator
SS10-01  MR-guided In-bore versus MRI/Ultrasound Fusion Plus TRUS-guided Prostate Biopsy: A Prospective Randomized Trial in Patients with Prior Negative Biopsies

Tuesday, Dec. 1 3:00PM - 3:10PM Location: E353C

Participants
Aytekin Oto, MD, Chicago, IL (Moderator) Research Grant, Koninklijke Philips NV; 
Temel Tirkes, MD, Indianapolis, IN (Moderator) Nothing to Disclose

Sub-Events

SS10-02  Accuracy of Targeted Prostate Biopsy Using MR-ultrasound Fusion to Guide Biopsies Directed to Focal Lesions Suspicous for Malignancy: A Retrospective Study of 286 Patients

Tuesday, Dec. 1 3:10PM - 3:20PM Location: E353C

Participants
Guilherme C. Mariotti, MD, Jundiai, Brazil (Presenter) Nothing to Disclose
Tatiana Martins, MD, Belo Horizonte, Brazil (Abstract Co-Author) Nothing to Disclose
Marcos R. Queiroz, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Thais Mussi, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Rodrigo Gobbo, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Ronaldo H. Baroni, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Targeted MR-guided Prostate Biopsy: Are Two Biopsy Cores per MRI Lesion Required?

Tuesday, Dec. 1 3:20PM - 3:30PM Location: E353C

Participants
Lars Schimmoeller, MD, Duesseldorf, Germany (Presenter) Nothing to Disclose
Michael Quentin, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Christian Ansov, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Frederic Dietzel, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Dirk Blondin, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Hiester, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Robert Rabenalt, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Peter Albers, MD, PhD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS

A single-institutional, IRB approved retrospective analysis of 286 patients in our database, which underwent targeted prostate biopsies using MR-ultrasound fusion from August 2013 to January 2015. We included all patients with suspected prostatic cancer based on clinical or laboratory findings (positive digital rectal examination or high PSA) submitted to multiparametric MRI and US-MRI fusion prostate biopsy. We excluded 7 patients with MRI-biopsy interval >= 6 months, 17 patients that underwent biopsy for staging of known cancer or active surveillance and 1 patient for whom clinical data was unavailable.

RESULTS

A total of 261 patients were included. Of these, 45 patients (17%) underwent previous negative transrectal US-guided biopsies. Table 1 summarizes demographic data of our casuistic. Pre-procedure MRI followed a Likert scale for suspicion: Likert 1: 1 patient (0.4%); Likert 2: 18 patients (6.9%); Likert 3: 100 patients (38.3%); Likert 4: 75 patients (28.7%); Likert 5: 67 patients (25.7%). Overall positivity of the biopsies for tumors was 59% (154 cases), with 79% (123 cases) significant cancer (Gleason>=7), 19% (30 cases) non-significant cancer (Gleason 6) and 1 case of STUMP. Analyzing only the Likert 4 and 5 cases, in a total of 142 cases, the overall positivity was 76% (108 cases), with 90% (96 cases) significant cancer (Gleason>=7), 10% (11 cases) non-significant cancer (Gleason 6) and 1 leiomyoma. In our institution, the positivity of US-guided random biopsies, in a large sample of other patients in the same period (331 patients), was around 52%.

CONCLUSION

Our study demonstrates a significant improvement in the performance of prostate biopsy with US-MRI fusion compared to random US-guided biopsies, with potential clinical impact.

CLINICAL RELEVANCE/APPLICATION

Random prostate biopsies performed on a sextant-basis have a high incidence of false-negative results, and often diagnose microfocal lesions with low clinical significance. Targeted prostate biopsies using MR-ultrasound fusion have shown to detect clinically significant lesions and increase the accuracy of the procedure, with better clinical outcomes.
and K (trans) change significantly following ablation. Early focal enhancement on DCE-MR Images at the ablation zone at 12-month Immediate post-contrast MR images are helpful for identification of the ablation defect. Quantitative MR parameters such as ADC CONCLUSION

month T2 and ADC images.

cancer, no focal lesion (other than diffuse and ill-defined changes secondary to ablation) was noted at the ablation site on 12-month MRI were significantly higher than the baseline ADC values (p<0.05). There was not significant change in Ve (p>0.05). In 2/4 cases with residual cancer, focal early enhancement was noted on 12-month DCE-MR Images. Other than 1 case with residual K (trans) values were significantly lower on post-procedure MRI`s compared to baseline values (p<0.05). Mean ADC values on 3-month and 12-month MRI were recorded and compared between the follow-up studies and between patients with and without residual disease.

RESULTS

were recorded and compared between the follow-up studies and between patients with and without residual disease.

12 months. Qualitative and quantitative MpMRI findings including size and appearance of ablation defect, ADC, K(trans) and Ve

cases. Focal atrophy/scarring was noted at the site of ablation in 10/36 and 20/24 sites on 3-month and 12-month MRI. Mean

month T2 and ADC images.

107 patients who had a multiparametric (mp) MRI before (RP) were selected. The largest lesion (index lesion) was measured on T2-MRI (Fig 1A) and ADC map and was classified with the ESUR-PI-RADS scoring system. A region of interest (ROI) was drawn in the center of each target, on the ADC map. A single ADC ROI was correlated to histologically index proven lesion. The index lesions pointed out by mp MRI were matched on RP specimens and were run in Myriad’s Research Laboratory in accordance with the Prolaris™ protocol in order to perform CCP score

CONCLUSION

By mapping image features to gene expression data we were able to show that diffusion imaging and tumor size offer a potential for in vivo non invasive assessment of prognostic cancer aggressiveness. However CCP score related to high risk of lethal cancer did not, completely match with the mpMRI tumour map and Gleason score in 7% of patients. These results previously suggested by large scale genomic analysis suggest that the further management of early stages PCa could strongly benefited of targeted biopsy with molecualr analysis

CLINICAL RELEVANCE/APPLICATION

This radio genomic correlation suggest that management of PCa could strongly benefit from both MRI targeted biopsy and subsequent molecular analysis.

SSJ10-05 Multi-parametric MRI (MpMRI) Findings after Focal Laser Ablation for Prostate Cancer (Pca)

Participants

Aytekin Oto, MD, Chicago, IL (Presenter) Research Grant, Koninklijke Philips NV; ; ; Shiyang Wang, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose Xiaobing Fan, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose Stephen Thomas, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose Amberene Youssif, MBBS, Chicago, IL (Abstract Co-Author) Nothing to Disclose Gregory S. Karczmar, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose Tatjana Antic, Chicago, IL (Abstract Co-Author) Nothing to Disclose Scott Eggner, Chicago, IL (Abstract Co-Author) Research Grant, Visualase, Inc Speakers Bureau, Johnson & Johnson

PURPOSE

to describe the quantitative and qualitative MpMRI findings following focal laser ablation of Pca

METHOD AND MATERIALS

27 patients with 36 cancer foci on baseline MRI, underwent MRI guided focal laser ablation were prospectively followed with, immediate (36/36 sites), 3-month (36/36 sites) and 12-month (24/36 sites) post-procedure 3T MpMRI and TRUS guided biopsy at 12 months. Qualitative and quantitative MpMRI findings including size and appearance of ablation defect, ADC, K(trans) and Ve were recorded and compared between the follow-up studies and between patients with and without residual disease.

RESULTS

36 cancer foci were ablated in 27 patients. Ablation defect was clearly visible on 36/36, 11/36 and 0/24 sites on the immediate, 3-month and 12-month post-contrast DCE-MR images respectively, with a gradual decrease in size on 3 month MRI even in visible cases. Focal atrophy/scarring was noted at the site of ablation in 10/36 and 20/24 sites on 3-month and 12-month MRI. Mean K(trans) values were significantly lower on post-procedure MRI’s compared to baseline values (p<0.05). Mean ADC values on 3-month MRI were significantly higher than the baseline ADC values (p<0.05). There was not significant change in Ve (p>0.05). In 2/4 cases with residual cancer, focal early enhancement was noted on 12-month DCE-MR Images. Other than 1 case with residual cancer, no focal lesion (other than diffuse and ill-defined changes secondary to ablation) was noted at the ablation site on 12-month T2 and ADC images.

CONCLUSION

Immediate post-contrast MR images are helpful for identification of the ablation defect. Quantitative MR parameters such as ADC and K (trans) change significantly following ablation. Early focal enhancement on DCE-MR Images at the ablation zone at 12-month
SSJ10-06  Primary and Secondary Prostate Biopsy Settings: Differences When Performing Targeted MR-guided Biopsies

Tuesday, Dec. 1 3:50PM - 4:00PM Location: E353C

Participants
Frederic Dietzel, Dusseldorf, Germany (Presenter) Nothing to Disclose
Lars Schirmhoeller, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
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Peter Albers, MD, PhD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
This study evaluates the MR-guided in-bore biopsy (IB-GB) in patients, who were either biopsy naive (primary biopsy) or who had undergone at least one previous negative trans-rectal ultrasound-guided biopsy (secondary biopsy) with regard to cancer detection rate, tumor localization and lesion size.

METHOD AND MATERIALS
In total, 1,602 biopsy cores from 297 patients (66.1±7.8y; median PSA 8.2ng/ml; prostate volume 58±30ml) in primary (n=160) and secondary (n=137) prostate biopsies settings were evaluated in this retrospective study. All patients received diagnostic prostate MRI (T2WI, DWI, DCE) at 3T. All lesions described on MRI were biopsied with IB-GB and examined histologically.

RESULTS
In 148 patients 511 cores were positive for prostate cancer (PCa). Clinically significant PCa was found in 82.4% (any Gleason pattern ≥4). PCa detection rate for patients with primary biopsies was 55.6% and 43.1% for secondary biopsies. In patients with primary vs. secondary biopsies, PCa was located peripherally in 62.5% vs. 49.5% (p=0.04), in the transition zone in 27.3% vs. 27.5% (p=0.53), and in the anterior stroma in 10.2% vs. 22.9% (p<0.01). Higher grade PCa (Gleason score ≥4+3=7) occurred apically in 38.5% (p=0.01). PCa detection rates for patients with smaller prostate volumes (<30ml vs. 30-50ml vs. >50ml; p<0.01) or larger lesion sizes (>0.5cm3 vs. 0.5-0.25cm3 vs. <0.25cm3; p<0.01) were significantly higher.

CONCLUSION
In primary and secondary prostate biopsies PCa detection rates were significantly higher for larger lesions and smaller prostate glands. In secondary biopsies, PCa was anteriorly located at a significantly more frequent rate. Higher grade PCa was detected in both settings in an apical location more often.

CLINICAL RELEVANCE/APPLICATION
MRI-guided in-bore biopsy led to high detection rates, especially of clinically significant PCa, in primary and secondary prostate biopsies.
Genitourinary (Multimodality Imaging of Pregnancy and Pelvic Floor)
Tuesday, Dec. 1 3:00PM - 4:00PM Location: E353B

SSJ11-01
Dynamic Contrast-enhanced MRI Combined with Diffusion Weighted Imaging in Differential Diagnosis of Malignant Gestational Trophoblastic Neoplasia and Postpartum Retained Placental Tissue

Participants
Elizabeth A. Sadowski, MD, Madison, WI (Moderator) Nothing to Disclose
Mary C. Frates, MD, Sharon, MA (Moderator) Nothing to Disclose

Sub-Events
SSJ11-02
Variable Sonographic Features and Imaging Underdiagnosis of Partial Molar Pregnancy

Participants
Julia Savage, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Katherine E. Maturen, MD, Ann Arbor, MI (Abstract Co-Author) Consultant, GlaxoSmithKline plc; Medical Advisory Board, GlaxoSmithKline plc
Erika Mowers, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Katherine Pasque, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Ashish P. Wasnik, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Vanessa Dalton, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Jason Bell, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
pregnancy and available ultrasound images between January 1, 2001 to December 31, 2011. Clinical data, ultrasound images and reports were reviewed.

RESULTS
Mean age of women was 30.45 ± 6.97 years of age (range: 16-49), with 1.25 ± 1.49 prior pregnancies (range: 1-11). Mean gestational age (GA) by last menstrual period was 74.45 ± 19.07 days (range: 39-138) and median serum beta-hCG was 64,400 (range: 447-662,000), with expected positive correlations between mean sac diameter (MSD) vs. beta-hCG (r=0.45, p=0.004) and MSD vs. GA (r=0.54, p<.0001). Pathologic results showed 49 partial and 23 complete moles. By imaging, partial moles were more commonly described as having a discrete gestational sac (85.7 vs 21.7%, p<.0001), yolk sac (48.9 vs. 4.6%, p=0.0003), or fetal pole (57.1 vs. 0%, p<.0001), while complete moles were more likely to show clearly abnormal tissue in the uterus (82.6 vs. 20.8%, p<.0001) and to be prospectively diagnosed as molar pregnancy by the dictating radiologist (86.9 vs. 40.82%, p=0.0002).

CONCLUSION
Partial molar pregnancy is associated with a highly variable sonographic appearance and frequent detection of recognizable products of conception, which may contribute to its underdiagnosis by imaging. Complete molar pregnancy is more strikingly abnormal and thus recognizable by imaging, and commonly diagnosed prospectively.

CLINICAL RELEVANCE/APPLICATION
Suspicion of hydatidiform mole in failed pregnancy has impacts on clinical management including: need for uterine evacuation, submission of products of conception to pathology, and serum b-hCG surveillance; failure to prospectively suggest or diagnose molar pregnancy may negatively impact patient care.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Katherine E. Maturen, MD - 2014 Honored Educator

SSJ11-03 Performance of Translabial Ultrasound versus Pelvic Floor MRI in the Detection of Transvaginal Mesh Implant Complications

Tuesday, Dec. 1 3:20PM - 3:30PM Location: E353B

Participants
Karoly Viragh, MD, Los Angeles, CA (Presenter) Nothing to Disclose
Seth A. Cohen, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Shlomo Raz, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Steven S. Raman, MD, Santa Monica, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The goal of the study was to determine the efficacy of 2D and 3D dynamic translabial ultrasound versus pelvic floor MRI in the detection of transvaginal mesh implant complications.

METHOD AND MATERIALS
With IRB approval and HIPAA compliance, a retrospective observational study was performed to correlate the intraoperative findings of transvaginal mesh implant complications (perforation, extrusion, fluid collections) with the standard pre-operative translabial ultrasound and pelvic floor MRI evaluations in women who were treated with suburethral transvaginal mesh implant for stress urinary incontinence or pelvic organ prolapse. The pre-operative translabial ultrasound and MRI examinations were reviewed with attention to technical details. The sensitivity of ultrasound in identifying complications was calculated. The location of the transvaginal mesh with respect to the bladder and urethra was also evaluated (extraluminal, intramural, intraluminal). Factors for technical improvement were identified.

RESULTS
The study cohort included 200 women (mean age 55 years) with transvaginal mesh implants for who underwent 2D and 3D dynamic translabial ultrasound, pelvic floor MRI and mesh excision at our institution between 2007 and 2013. Descriptive statistics were provided. 17 patients were found to have perforation into the urethra and/or bladder during surgery. None were found to have extrusion or significant fluid collections. Translabial ultrasound had a sensitivity of (12/17) 70.5%, whereas detection of mesh fragments by MRI was challenging even in retrospect. Limitations were due to suboptimal visualization of the mesh fragments, which could be improved with pre-procedural hydration for bladder distention and the use of vaginal gel to better image the suburethral space.

CONCLUSION
2D and 3D dynamic translabial ultrasound is a powerful real-time method for transvaginal mesh localization and for visualizing complications, most importantly perforation into the urethra and/or bladder, which allows for better surgical planning and pre-operative patient counseling.

CLINICAL RELEVANCE/APPLICATION
Translabial ultrasonography is a powerful real-time diagnostic technique for the evaluation of female pelvic floor dysfunction and is more sensitive than MR in detecting transvaginal mesh perforation.
underwent hysterectomy with pathology demonstrating placenta accreta. 256 MRI exams were reviewed.

RESULTS

bulging into the bladder, and loss of the myometrial margin. heterogeneous signal intensity, abnormal vascularization and thickened nodular contour along the urinary bladder surface, uterine established MRI findings, and suspicion for parametrial involvement. prior uterine surgery. Indications for MRI included abnormal appearance of the placenta on ultrasound, history of prior cesarean delivery, and history of MRI reports were reviewed for placental location, presence or absence of abnormal placentation according to Criteria included the presence of dark intraplacental bands, heterogeneous signal intensity, abnormal vascularization and thickened nodular contour along the urinary bladder surface, uterine bulging into the bladder, and loss of the myometrial margin. MRI was considered positive even if only one of these criteria were present. Comparison was made with findings at either delivery or operation, and pathology reports.

RESULTS

quantitative parameters were analyzed using parametric and nonparametric tests.

RESULTS

separate assessment of the US findings with respect to their sensitivity (Ss), specificity (Sp), NPV and PPV respectively are as follows: EP change in size 53%, 57%, 45%, 55%, shape 89%, 75%, 85%, 78%, echogenicity 87%, 78%, 85%, 90%, avascularity 79%, 90%, 85%, 88%; and absent or small hemoperitoneum 90%, 86%, 87%, 78%; A combination of at least three of these findings was most accurate with Ss 95%, Sp 96%, PPV 95%, NPV 90%. Presence of fetal heart activity, increased size of yolk sac and gestational sac, large amount of hemoperitoneum were strong US predictors of failure of MTX treatment with Ss 100%, Sp 100%, PPV 100%, NPV 99%

CONCLUSION

A combination of at least three US findings including stable shape and echogenicity, avascularity and absence or small amount of hemoperitoneum are best US predictors of successful MTX treatment of EPs. Detection of fetal heart activity, large hemoperitoneum, and increase in size of gestational and yolk sac are strong US predictors of a failure of MTX treatment. Change in size of the EP after MTX treatment is not a reliable predictor of either treatment success or failure.

CLINICAL RELEVANCE/APPLICATION

US findings aid in prediction of successful treatment of ectopic pregnancy using a single dose methotrexate protocol

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Leslie M. Scoult, MD - 2014 Honored Educator

SSJ11-05  Accuracy of MRI in the Prenatal Diagnosis of the Abnormally Adherent Placenta: Comparison with Findings at the Time of Delivery

Participants

Sherelle L. Laifer-Narin, MD, Englewood, NJ (Presenter) Nothing to Disclose
Sidney Z. Brejt, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Sarah Goodman, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Jason Wright, New York, NY (Abstract Co-Author) Nothing to Disclose
Jeffrey H. Newhouse, MD, Bronxville, NY (Abstract Co-Author) Research Consultant, PAREXEL International Corporation

PURPOSE

To evaluate the accuracy of magnetic resonance imaging in diagnosing invasive placentation.

METHOD AND MATERIALS

A retrospective review of all patients referred for MRI of the placenta from December 2004 to December 2014 was performed. Indications for MRI included abnormal appearance of the placenta on ultrasound, history of prior cesarean delivery, and history of prior uterine surgery. MRI reports were reviewed for placental location, presence or absence of abnormal placentation according to established MRI findings, and suspicion for parametrial involvement. Criteria included the presence of dark intraplacental bands, heterogeneous signal intensity, abnormal vascularization and thickened nodular contour along the urinary bladder surface, uterine bulging into the bladder, and loss of the myometrial margin. MRI was considered positive even if only one of these criteria were present. Comparison was made with findings at either delivery or operation, and pathology reports.

RESULTS

256 MRI exams were reviewed. 144 exams were negative both on MRI and delivery/pathology. 8 exams interpreted as normal on MRI underwent hysterectomy with pathology demonstrating placenta accreta. 80 exams were interpreted as positive for abnormal
placentation, and were diagnosed as accreta, increta, or percreta on delivery/pathology. 24 cases interpreted as positive on MRI had normal placental delivery and pathology. MR diagnosis of abnormal placentation had a sensitivity of 91%, specificity of 86%, PPV of 77%, NPV of 95%, and an accuracy of 87.5%.

CONCLUSION
Placental adhesive disorder is a significant cause of maternal morbidity and mortality. Prenatal MRI is accurate in evaluating invasive placentation in patients at high risk for this condition.

CLINICAL RELEVANCE/APPLICATION
MRI can provide topographic information specifically in cases with lateral extension into the parametrical regions. Identification of abnormal placentation assists the clinician in planning the mode of delivery, extent and location of surgical incision, and determining the need for multidisciplinary involvement and assistance.

SSJ11-06 3T Pelvic MRI Thresholds for Pelvic Organ Prolapase before and after First Childbirth

Tuesday, Dec. 1 3:50PM - 4:00PM Location: E353B

Participants
Mark E. Lockhart, MD, Birmingham, AL (Presenter) Nothing to Disclose
Holly Richter, MD, Birmingham, AL (Abstract Co-Author) Research Grant, Pelvalon, Inc; Consultant, Pelvalon, Inc; Consultant, Kimberly-Clark Corporation; Royalties, UpToDate, Inc
Gordon W. Bates, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Timothy M. Beasley, PhD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Desiree E. Morgan, MD, Birmingham, AL (Abstract Co-Author) Research support, General Electric Company

PURPOSE
To evaluate the usefulness of published 3T MRI parameters suggesting pelvic organ prolapse before and after first childbirth

METHOD AND MATERIALS
In this IRB-approved HIPAA-compliant prospective cohort study, patients presenting for reproductive assistance were recruited to complete validated questionnaires, clinical pelvic exams, baseline dynamic 3T MRI, and repeat MRI 6 months after delivery. Subjects were nulliparous women, at least 19 years age, and asymptomatic by Pelvic Floor Distress Inventory-20. Predetermined published thresholds or 2 SD beyond means in the literature for pelvic prolapse on MRI were evaluated. Also, a 10% change from baseline to postpartum was considered a significant change. Using 120 cc rectal gel and pelvic phased array coil over the pelvis, static 3mm axial and coronal T2 FSE sequences were followed by 10 mm thick dynamic sagittal HASTE at rest and during strain. The 10 mm sagittal sequence then evaluated pelvic floor mobility during evacuation of the rectal gel. MRI parameters were measured by a fellowship-trained radiologist, blinded to clinical data.

RESULTS
19 subjects (mean age 31 years) completed baseline clinical and MRI studies, and 10 (mean age 30.5 years) of them completed postpartum clinical and MRI studies. None developed significant pelvic floor symptoms by the PFDI-7 and PISQ-12 questionnaires after childbirth. None had levator tears at baseline; two subjects developed tears postpartum. Mean pelvic floor mobility was increased in patients after childbirth and 17 pelvic soft tissue parameters increased by greater than 10% postpartum. At baseline 7/133 (5.3%), 8/209 (3.8%), and 79/209 (37.8%) of pelvic soft tissue measurements exceeded published thresholds (indicating prolapse) at rest, strain, and evacuation, respectively, majority in the anterior compartment. After pregnancy and childbirth, 4/70 (5.7%), 6/110 (5.5%), and 51/110 (46.4%) exceeded thresholds at rest, strain, and evacuation, respectively, in this asymptomatic population. Osseous parameters remained unchanged.

CONCLUSION
Although published soft tissue parameters work well for rest and strain MR imaging, their values in evacuatory series are frequently exceeded, even in asymptomatic nulliparous and primiparous women.

CLINICAL RELEVANCE/APPLICATION
In nulliparous and primiparous women, the evacuatory phase will commonly exceed published MRI thresholds for pelvic organ prolapse and therefore results should be used with caution.
**Participants**
Jonathan James, BMBS, Nottingham, United Kingdom (Moderator) Nothing to Disclose
Edward Y. Lee, MD, MPH, Boston, MA (Moderator) Nothing to Disclose

**Sub-Events**

**SSJ12-01** Health Service, Policy and Research Keynote Speaker: Assessing Individual Performance in Radiology

Participants
Jonathan James, BMBS, Nottingham, United Kingdom (Presenter) Nothing to Disclose

**SSJ12-02** Framing Bias Effects on Retrospective Reviews of Radiological Reports

Participants
Jeffrey D. Robinson, MD, MBA, Seattle, WA (Presenter) Consultant, HealthHelp, LLC; President, Clear Review, Inc;
Daniel S. Hippe, MS, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company

**PURPOSE**
When reviewing difficult exams, radiologists often disagree on the severity of a potential error. In the legal setting, this is often attributed to retrospective or framing bias. This study examines the effect of framing bias on radiologists' perceptions when evaluating potential errors.

**METHOD AND MATERIALS**
This study was IRB approved. Eleven de-identified exams that had been subject of malpractice litigation and four uncontested control exams were divided into four review sets each containing three litigation (L) exams and one control (C) and their accompanying reports. Volunteers solicited from the ACR directory were randomly assigned to one of four groups (P,D,Q,N). Group P was told that they had been retained by a malpractice plaintiff's attorney; D that they had been retained by a defense attorney; Q that a neighboring hospital requested an outside QA review and N was given no context. Subjects were also randomly assigned to one of the four review sets, and asked for each exam if the radiology report failed to meet the standard of care (failure). The rates at which each group judged each type of exam to be a failure were compared using a multivariate, mixed-effect, logistic regression model.

**RESULTS**
The study was completed by 102 radiologists, yielding 368 reviews (276 L, 92 C). Together, all four groups rated L exams as failures in 57% of assessments, and C exams in 27% (p= 0.006). The difference in ratings between L and C exams was most pronounced in Group P (62% vs. 26%, p=0.013) and Group N (66% vs. 18%, p=0.003). Within the subgroup of L exams, Group P was significantly more likely to judge an exam a failure than the Group D (62% vs 48%, p= 0.032). The Q and N groups were not significantly different than the other groups.

**CONCLUSION**
Framing bias plays a significant role in retrospective review. Told that the exams they were reviewing were problematic, reviewers rated 27% of control exams below the standard of care. Simulated plaintiff’s experts rated litigation exams below the standard of care significantly more frequently than simulated defense experts rated the same exams. These differences in performance highlight the effect such bias plays in actual expert witness review.

**CLINICAL RELEVANCE/APPLICATION**
Since framing bias can significantly affect reviewers’ impressions, blinding a reviewer to the nature of the exam being reviewed should increase the objectivity of the reviewer's judgment.

**SSJ12-03** Performance Testing for Radiologists Interpreting Chest Radiographs

Participants
Yan Chen, Loughborough, United Kingdom (Presenter) Nothing to Disclose
Jonathan James, BMBS, Nottingham, United Kingdom (Abstract Co-Author) Nothing to Disclose
Leng Dong, Loughborough, United Kingdom (Abstract Co-Author) Nothing to Disclose
Alastair G. Gale, PhD, Loughborough, United Kingdom (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The aim was to develop a system to assess the image interpretation performance of radiologists in identifying signs of malignancy
on chest radiographs.

**METHOD AND MATERIALS**

A test set of 30 digital chest radiographs was chosen by an experienced radiologist consisting of 11 normal and 19 challenging abnormal cases. The abnormal cases all had biopsy proven pathology; the normal cases had at least 2 years of imaging follow up. 14 radiologists with a range of experiences were recruited. Participants individually read the test set displayed on a standard reporting workstation, with their findings entered directly onto a laptop running specially designed reporting software. For each case they were given the relevant clinical information and were asked to mark any perceived abnormality and rate their level of suspicion on a 5-points scale (normal, benign, indeterminate, suspicious or malignant). On completion of the test, participants were given instant feedback and had the opportunity to review cases were there was disagreement with the expert opinion and pathology. The time taken for the participants to complete the test was recorded. Differences between the participants' performance were assessed using ROC analysis.

**RESULTS**

The experience of the participants in reporting chest radiographs ranged from 1 to 26 years (Mean=9 yrs, Mdn=5 yrs). Participants' performance (ROC score) varied significantly between 2 groups (6 post-fellowship consultants, and 8 radiology residents). Radiology residents' performance as measured by ROC score was significantly poorer compared to post-fellowship consultants (Mean- RS=0.76, Mean- PFC=0.93, p=.003). There was a positive correlation between image interpretation performance (ROC Mean=0.85, SD=0.11) and years of reading experience (Mean=9, SD=5.58), r=.573, p<.05, n=14. There was a trend for radiology residents to take longer to complete the task (Mean=26.51s) compared to post-fellowship consultant radiologists (Mean=19.65s), but this did not quite reach statistical significance (p=.07).

**CONCLUSION**

This pilot study demonstrates that it is possible to devise a method for performance testing the reporting of chest radiographs.

**CLINICAL RELEVANCE/APPLICATION**

Chest radiographs are the first line imaging test for patients with chest symptoms suspicious of malignancy, this pilot study demonstrates that it is possible to devise methods to test performance of the reporting radiologist.

**SSJ12-04  Do Socioeconomic Disparities Exist in Radiology? Multivariate Analysis of Socioeconomic Factors Impacting Access to Imaging Services**

**Tuesday, Dec. 1 3:30PM - 3:40PM Location: S102D**

**Participants**  
Omid Khalilzadeh, MD, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Alvin Y. Yu, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Emmanuel Carrodugas, BS, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Anand M. Prabhakar, MD, Somerville, MA (Abstract Co-Author) Nothing to Disclose  
Synho Do, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Garry Choy, MD, MS, Boston, MA (Abstract Co-Author) Nothing to Disclose  
James A. Brink, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Efren J. Flores, MD, Boston, MA (Presenter) Nothing to Disclose

**PURPOSE**

Racial disparities are known to exist in medicine, but little has been studied in radiology. One way to examine this is to look at missed radiology appointments or missed care opportunities (MCO) which result in delayed diagnoses and negatively impact patient care. Moreover, MCO in radiology may be a symptom of missed appointments in other specialties. The reason for missing appointments is multifactorial, and socioeconomic factors may play an important role. In this study, we investigated the demographic factors associated with radiology missed appointments.

**METHOD AND MATERIALS**

Demographic data of 975,539 ordered radiologic imaging exams at our institution in the calendar year 2014 was collected. The dataset included: ethnicity/race, primary language, insurance status, and reasons for cancellation of the appointment. The association of different factors with radiology MCOs was evaluated. Multivariate logistic regression models were implemented to evaluate the independent relationship between radiology MCOs and various factors.

**RESULTS**

MCO was the most common reason for not completing a radiologic exam (41.5%). Overall, there was about 5% MCO (42,854) in radiology appointments during the calendar year 2014. A primary language other than English (OR: 1.2), Black ethnicity (OR: 1.8, relative to White) and Hispanic ethnicity (OR: 1.5, relative to White) were significantly associated with higher odds of MCO on a radiology appointment. Among different scan type, the odds of MCO was significantly higher for CT angiograms (OR: 2.8, P<0.001). These associations remained significant after multiple adjustments for potential confounding variables.

**CONCLUSION**

There was a high number (42,854) of radiology MCO in the past year at our institution. Non-English primary language and Hispanic ethnicity significantly correlate with likelihood of missing a radiology appointment. Our results identify patients who are at risk for MCO and provide opportunities for intervention that will improve the patient's experience and address healthcare disparities. Possible interventions to bridge the gap include telephone reminders in the patient's native language, scheduling radiology procedures with radiologists that come from similar background, assistance in coordination of transportation, among others.

**CLINICAL RELEVANCE/APPLICATION**

Socioeconomic disparities exist in radiology. Further research in this area is paramount to examine the impact to healthcare access.

**SSJ12-05  Prevalence of Unanticipated Events Associated with MRI Examinations: A Benchmark for MRI Quality, Safety, and Patient Experience**

**Tuesday, Dec. 1 3:30PM - 3:40PM Location: S102D**

**Participants**  
Emmanuel Alvin Y. Yu, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Khalilzadeh, MD, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Garry Choy, MD, MS, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Synho Do, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Do, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose  
Efren J. Flores, MD, Boston, MA (Presenter) Nothing to Disclose

**PURPOSE**

A test set of 30 digital chest radiographs was chosen by an experienced radiologist consisting of 11 normal and 19 challenging abnormal cases. The abnormal cases all had biopsy proven pathology; the normal cases had at least 2 years of imaging follow up.
To determine the prevalence of unanticipated events (UE) associated with MRI examinations in a multi-center academic radiology department.

**METHOD AND MATERIALS**

UE reported by MRI technologists for examinations performed between June 2013 and November 2014 on 17 scanners in an university- (UH) and community-affiliated (CH) hospitals of single health system were retrospectively reviewed. Events were categorized into: (1) orders and scheduling (no/improper order, insurance problem, scheduling mechanical scanner failure, improper preparation instruction/study protocol); (2) delays in scan (late patient arrival/transport, anesthesia/pathology procedure delays, delays in getting correct protocol or checking images); (3) foreign bodies (unanticipated metal/foreign body/pacemaker); (4) non-contrast related (NONCON) patient events (claustrophobia, patient discomfort, body habitus, pregnancy, nausea, pain, motion, need for sedation/general anesthesia, inability to complete the exam, patient dissatisfaction, patient fall, code called for resuscitation); (5) contrast related (CON) patient events (reaction, extravasation, lack of IV access, patient refusal of contrast); (6) technical acquisition issues (fat saturation, breath-holding, contrast bolus timing, mechanical scanner failure). Each category was compared between scanners located in UH vs. CH, and scanners that are solely used for outpatient services (OP) vs. those used for outpatients and inpatients (OP/IP).

**RESULTS**

34,587 MRI examinations were assessed (87% UH; 59% OP) with 5,760 (17%) UE; (1.9% of patients had more than one category events). Rates of UE for each category were as follows: 1.8% orders and scheduling [0.06% patient arriving wrong day, and 0.03% patient call-back], 3.3% delays in scan, 0.5% foreign bodies, 10.4% NONCON events, 1.3% CON events, and 1.5% technical issues. Most frequent patient issues were motion, claustrophobia, and need for sedation. UH exams had higher reported rate of UE. OP exams had higher rates of orders and scheduling problems and delays in scans, while OP/IP exams had more patient related and technical issues (all P<0.05).

**CONCLUSION**

UE associated with MRI exams are common (17%), with the majority being patient related issues.

**CLINICAL RELEVANCE/APPLICATION**

Unanticipated patient events are common. Awareness of the prevalence and types of unanticipated events by MRI staff provides opportunities for practice improvement.

**SSJ12-06 Technologist-directed Radiograph Repeats: Frequency and Associations**

**Participants**

Jill E. Jacobs, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Andrew B. Rosenkrantz, MD, New York, NY (Presenter) Nothing to Disclose
Joseph J. Sanger, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Marc Parente, New York, NY (Abstract Co-Author) Nothing to Disclose
Danny C. Kim, MD, White Plains, NY (Abstract Co-Author) Nothing to Disclose
Michael P. Recht, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The decision to repeat a suboptimal radiograph by the technologist at the time of acquisition, prior to radiologist review, is an infrequently assessed but potentially significant source of excess patient radiation. We assessed the technologist-directed radiograph retake rate in our hospital network.

**METHOD AND MATERIALS**

We created an analysis tool to track all technologist-directed radiograph rejections for 52 CR and DR imaging device networks in 9 of our hospital-based imaging centers. The tool captured all acquired images and the reject reason in a reject log file (RLF). All RLFs were downloaded monthly to an encrypted USB flash drive, renamed in standardized convention, and uploaded to a protected network share drive. Information Technology staff reviewed all RLFs to ensure completeness and validity. RLFs were then imported into a Reject Analysis Database. Analysis was performed for a 6 month period (6/1/14-11/30/14). Retake rate by case (RRC) was number of retaken exposures (NR) acquired as a percentage of the total number of cases (TC) performed where RRC=(NR/TC)*100. Retake rate by exposure (RRE) was number of retaken exposures (NR) acquired as a percentage of the total number of expected exposures (EE) for all performed examinations where RRE=(NR/EE)*100. Data was stratified by date, site, imaging device, body part, and reject reason.

**RESULTS**

Overall technologist-directed RRC and RRE were 3.4% and 1.8%, respectively. Body part RRC and RRE, respectively were: chest (5.9%, 4.4%); abdomen (3.3%, 1.6%); joint (3.0%, 1.3%); spine (2.6%, 1.2%); skull (1.8%, 1.0%); skeletal survey (1.6%, 0.8%), and unspecified (5.0%, 3.5%). For hospital portable devices, RRC was 9.2% overall (12.5% abdomen; 8.8% chest) and RRE was 9.2% overall (10.8% abdomen and 9.0% chest). The most common reason for repeat exposures was positioning error (2.3% overall) for both portable and non-portable examinations.

**CONCLUSION**

To determine the prevalence of unanticipated events (UE) associated with MRI examinations in a multi-center academic radiology department.

**METHOD AND MATERIALS**

UE reported by MRI technologists for examinations performed between June 2013 and November 2014 on 17 scanners in a university- (UH) and community-affiliated (CH) hospitals of single health system were retrospectively reviewed. Events were categorized into: (1) orders and scheduling (no/improper order, insurance problem, scheduling mechanical scanner failure, improper preparation instruction/study protocol); (2) delays in scan (late patient arrival/transport, anesthesia/pathology procedure delays, delays in getting correct protocol or checking images); (3) foreign bodies (unanticipated metal/foreign body/pacemaker); (4) non-contrast related (NONCON) patient events (claustrophobia, patient discomfort, body habitus, pregnancy, nausea, pain, motion, need for sedation/general anesthesia, inability to complete the exam, patient dissatisfaction, patient fall, code called for resuscitation); (5) contrast related (CON) patient events (reaction, extravasation, lack of IV access, patient refusal of contrast); (6) technical acquisition issues (fat saturation, breath-holding, contrast bolus timing, mechanical scanner failure). Each category was compared between scanners located in UH vs. CH, and scanners that are solely used for outpatient services (OP) vs. those used for outpatients and inpatients (OP/IP).

**RESULTS**

34,587 MRI examinations were assessed (87% UH; 59% OP) with 5,760 (17%) UE; (1.9% of patients had more than one category events). Rates of UE for each category were as follows: 1.8% orders and scheduling [0.06% patient arriving wrong day, and 0.03% patient call-back], 3.3% delays in scan, 0.5% foreign bodies, 10.4% NONCON events, 1.3% CON events, and 1.5% technical issues. Most frequent patient issues were motion, claustrophobia, and need for sedation. UH exams had higher reported rate of UE. OP exams had higher rates of orders and scheduling problems and delays in scans, while OP/IP exams had more patient related and technical issues (all P<0.05).

**CONCLUSION**

UE associated with MRI exams are common (17%), with the majority being patient related issues.
Rates of technologist-directed radiograph retake vary by body part and are higher for portable examinations.

**CLINICAL RELEVANCE/APPLICATION**

Technologist education to identify and correct sources of imaging error is necessary to reduce retake rates and decrease excess patient radiation.
**SSJ13**

**Informatics (Enterprise Integration and Business Analytics)**

Tuesday, Dec. 1 3:00PM - 4:00PM Location: S402AB

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

**Participants**
William W. Boonn, MD, Penn Valley, PA (Moderator) Founder, Montage Healthcare Solutions, Inc; President, Montage Healthcare Solutions, Inc; Shareholder, Nuance Communications, Inc; Shareholder, Merge Healthcare Incorporated
Bhavya Rehani, MD, San Francisco, CA (Moderator) Nothing to Disclose
Gary J. Wendt, MD, MBA, Middleton, WI (Moderator) Medical Advisory Board, McKesson Corporation; Medical Advisory Board, HealthMyne; Owner, WITS(MD), LLC;

**Sub-Events**

SSJ13-01  **The Clinical Decision Support Mandate: A Pilot Project Using Epic’s Best Practice Alerts for PE-CTA Study Orders to Prepare the Hospital Staff**

Tuesday, Dec. 1 3:00PM - 3:10PM Location: S402AB

**Participants**
Alexander Goehler, MD, PhD, New Haven, CT (Presenter) Nothing to Disclose
Jeffrey C. Weinreb, MD, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Christopher Moore, MD, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Allen Hsiao, New Haven, CT (Abstract Co-Author) Nothing to Disclose

**Background**

The Protecting Access to Medicare Act (2014) mandates that starting in Jan 2017, physicians ordering advanced diagnostic imaging exams must consult appropriate-use criteria through a Clinical Decision Support (CDS) system. We aimed to evaluate obstacles to broader application through a pilot.

**Evaluation**

We chose the Emergency Department (ED) as a closed, controlled but scalable environment. Based on a survey of 191 ED providers, PE-CTA studies were considered to be over-utilized by 78% of the respondents. An interdisciplinary committee developed a diagnostic pathway that combined established risk scores and local practice patterns. We then developed a Best Practice Alerts (BPA) within the Epic RIS ordering system (Epic Radiant, 2014) to provide guidance to healthcare providers based on the algorithm. This allowed us to incorporate data from the EHR and direct interactions with the ordering party via a check list. We also developed an automated reporting structure for quality performance measurement that allows for direct provider feedback and is scalable as CDS indications increase.

**Discussion**

The algorithm is integrated as a mandated questionnaire in every CTA-PE study order in the ED (figure). If answers are concordant with the clinical pathway, the study order will be placed without further interaction. If answers are discordant with the pathway, alternative scenarios are recommended. If the user agrees, orders are automatically adjusted. If they are rejected, a reason is required. From 01/2012 until 03/2015, 6,472 PE studies were performed in our EDs among which 8.3% were positive. 39% never had a d-dimer and 4% were conducted despite a negative d-dimer. Within 5 days of our BPA roll-out, 33 PE-CTAs were conducted. 73% were concordant with the recommendation, 6% were positive. In Nov 2015, we expect to have 1,400 studies with detailed analyses on appropriate use, study yield and user feedback.

**Conclusion**

Successful implementation of CDS requires broad awareness among the majority of hospital staff. Epic’s BPA provides an approach to quickly establish a local foundation while “off-the-shelf” applications are being reviewed.

SSJ13-02  **An Investigation of Radiologist EMR Usage at a Large Multi-Facility Payer-Provider Healthcare Organization**

Tuesday, Dec. 1 3:10PM - 3:20PM Location: S402AB

**Participants**
Brian J. Kolowitz, DSc, MBA, Pittsburgh, PA (Presenter) Nothing to Disclose
Anna L. von Reden, MA, BEng, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose

**Background**

The Protecting Access to Medicare Act (2014) mandates that starting in Jan 2017, physicians ordering advanced diagnostic imaging exams must consult appropriate-use criteria through a Clinical Decision Support (CDS) system. We aimed to evaluate obstacles to broader application through a pilot.

**Evaluation**

We chose the Emergency Department (ED) as a closed, controlled but scalable environment. Based on a survey of 191 ED providers, PE-CTA studies were considered to be over-utilized by 78% of the respondents. An interdisciplinary committee developed a diagnostic pathway that combined established risk scores and local practice patterns. We then developed a Best Practice Alerts (BPA) within the Epic RIS ordering system (Epic Radiant, 2014) to provide guidance to healthcare providers based on the algorithm. This allowed us to incorporate data from the EHR and direct interactions with the ordering party via a check list. We also developed an automated reporting structure for quality performance measurement that allows for direct provider feedback and is scalable as CDS indications increase.

**Discussion**

The algorithm is integrated as a mandated questionnaire in every CTA-PE study order in the ED (figure). If answers are concordant with the clinical pathway, the study order will be placed without further interaction. If answers are discordant with the pathway, alternative scenarios are recommended. If the user agrees, orders are automatically adjusted. If they are rejected, a reason is required. From 01/2012 until 03/2015, 6,472 PE studies were performed in our EDs among which 8.3% were positive. 39% never had a d-dimer and 4% were conducted despite a negative d-dimer. Within 5 days of our BPA roll-out, 33 PE-CTAs were conducted. 73% were concordant with the recommendation, 6% were positive. In Nov 2015, we expect to have 1,400 studies with detailed analyses on appropriate use, study yield and user feedback.

**Conclusion**

Successful implementation of CDS requires broad awareness among the majority of hospital staff. Epic’s BPA provides an approach to quickly establish a local foundation while “off-the-shelf” applications are being reviewed.
Background
This investigation captures the current state of EMR usage at a large multi-facility payer-provider healthcare organization. Prior research suggests low levels of EMR usage by radiologists due to incomplete information, misinformation, and technical difficulties accessing information.

Evaluation
This study is divided into two phases. Phase one involved contextual observation of 41 radiologists interpreting 344 clinical exams over a 3-month period. Results of these observations led to phase 2: the development of an application that captures radiologist usage of clinical content (Figure 1) across multiple EMRs, and relates usage statistics to key patient and exam identifiers. Phase one of the study is complete and phase two is in progress. Of the 344 case observations, 41 were ED exams, 66 were inpatient exams, and 269 were outpatient exams (Table 1). Radiologists relied solely on imaging for only 8% of the exams. In all other instances radiologists accessed a summarized view of EMR/RIS (40%), prior imaging reports (24%), and other clinical documentation (28%) within the EMR. Within the EMR, Office Notes (11%) and Exam Prescription (7%) were the predominate sources followed by Surgical Notes (2%), Labs (2%), ER notes (2%), Progress Notes (1%), history and physical (1%), consult notes (1%), correspondence (<1%), and Non-Surgical Procedure Notes (<1%).

Discussion
The results of phase one suggest frequent EMR usage which appears to contradict prior research. Phase two data collection is in progress and will capture a broader set of usage metrics than in-person observation during clinical interpretation. This dataset will be used to inform the creation of a new radiologist centric information hierarchy based on relationships between procedure type, modality, and other patient/exam demographics.

Conclusion
Observational research shows that radiologists frequently use a variety of clinical data during image interpretation depending on exam type and the clinical context under which the exam was ordered. This work is providing extremely valuable data to help direct development of tools that can intelligently present EMR data to radiologists rather than requiring them to conduct manual searches.

SSJ13-03 Implementation of an Online Screening/Check-in Process Prior to MRI Studies: An Idea from the Airline Industry

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S402AB

Awards
Trainee Research Prize - Resident

Participants
Ali Pirasteh, MD, Dallas, TX (Presenter) Nothing to Disclose
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Cecilia Hernandez, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Seth Toomay, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Travis Bronkgard, MD, Dallas, TX (Abstract Co-Author) Advisory Board, Hewlett-Packard Company; Advisor, McKesson Corporation
Ivan Pedrosa, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate whether implementing a web-based screening and check-in process for MRI appointments will improve the workflow and patient turn-around time and reduce the operational cost in the Radiology Department.

METHOD AND MATERIALS
This IRB-approved, HIPAA-compliant study consisted of a prospective collection of the interview/screening duration prior to MRI for all outpatients over a six-week period after implementation of an online screening (OS) questionnaire. 773 patients were divided into OS (200 patients; 86 male; average age 54.4 years) and traditional screening (TS) (573 patients; 255 male, average age 54.3 years) groups. Differences in interview/screening duration were calculated with a generalized linear model with log link function with additional adjustments for differences in prevalence of possible causes of delay between both groups. Impact on operational cost was calculated by the amount of extended working hours of technologist per day and reported in cost-savings per year.

RESULTS
26% of patients utilized the OS. The average interview/screening duration for the OS group (12.0 minutes, standard deviation (SD) = 7.1) was significantly lower than that of the TS group (14.1 minutes, SD = 12.3, p = 0.004); 2 minutes shorter (p = 0.03) adjusting for differences in prevalence of potential causes of delay between the two groups. There was no difference in the median interview/screening duration for the OS (10 min) and TS groups (11 min) (p = 0.18). The cost reduction in technologist working hours was $21,000 per year, assuming a 100% utilization rate of the OS process.

CONCLUSION
Implementation of an online screening process prior to MRI results in faster patient screening, has the potential to result in cost savings, and provides a patient-centered, more efficient solution for screening prior to MRI examinations.

CLINICAL RELEVANCE/APPLICATION
An online MRI screening system can be implemented as an effective method in reducing delays and patient interview turn-around, has high potential for reduction in costs and possible increase in patient satisfaction.
NO PATIENT LEFT BEHIND: NOVEL APPLICATION OF PREDICTIVE ANALYTICS TO IMPROVE PATIENT ACCESS AND EFFICIENCY OF IMAGING RESOURCES

Tuesday, Dec. 1 3:30PM - 3:40PM Location: S402AB

Daniel Forsberg, PhD, Linkoping, Sweden (Presenter) Nothing to Disclose
Beverly Rospo, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Jeffrey L. Sunshine, MD, PhD, Pepper Pike, OH (Abstract Co-Author) Research support, Siemens AG Travel support, Siemens AG Travel support, Koninklijke Philips NV Travel support, Sectra AB Travel support, Allscripts Healthcare Solutions, Inc

PURPOSE

A missed care opportunity (MCO), defined as missing a health care appointment, impairs short and long term patient care. There are many factors that explain why MCOs occur. This study attempts to define a new paradigm for implementing value-based care in radiology: 'Patient connectivity' as a quantitative measure of patient access to healthcare resources. A real-world analogy is cell phone connectivity to a network - imagine the number of bars of reception. This study suggests a novel predictive model derived using machine learning techniques for quantification of "Patient Connectivity Index" (PCI) and prediction of MCOs in radiologic patient-care. This will allow us to better understand the patient population we serve and improve patient access by personalizing health care delivery.

METHOD AND MATERIALS

Data from 0.5 million outpatient radiologic exams performed at our institution in the calendar year 2014 was analyzed. Data was obtained and combined from Radiology Order Entry, Electronic Medical Record, City Data, and Google Maps. The dataset was divided into a learning (66%) and test set (33%). Multivariate multilevel regression analysis was used to define a "connectivity" measure based on these factors of the learning set, and the resulting predictive model was used to validate the accuracy of the model on the test set. Specifically, the following variables were implemented in this model: Age, Gender, Distance to hospital and transportation, Insurance, Primary Language, Ethnicity/Race, Time of year, ICD9 codes, and referral pattern.

RESULTS

Missing radiology appointments were significantly (p<0.01) associated with lower educational level, lower income, language barriers and certain ethnic backgrounds in our predictive model. The PCI (connectivity range 1-20%) could determine the predicted probability of MCOs with a good degree of accuracy.

CONCLUSION

Connectivity is a dynamic, multifactorial, co-dependent, and patient-specific measure of health care access. Many factors relate to another with linear and non-linear effects, resulting in MCOs. Moreover, external events and disease progression also affects PCI. This study suggests a predictive platform which will pinpoint bottlenecks to connectivity and facilitate specific interventions for increasing patient access and connectivity to the healthcare network.

CLINICAL RELEVANCE/APPLICATION

In increasing patient access and connectivity to the healthcare network.

This study suggests a predictive platform which will pinpoint bottlenecks to connectivity and facilitate specific interventions for increasing patient access and connectivity to the healthcare network.
This work represents a tangible opportunity to deliver value-based imaging beyond the reading room.

**SSJ13-06  Personalized Characterization of Nodule Cancer Risk Beyond Lung-Rads 1.0 with NLST Data**

**Participants**
Michael A. Morris, MD, MS, Baltimore, MD (Presenter) Nothing to Disclose
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Jean Jeudy JR, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Eliot L. Siegel, MD, Severna Park, MD (Abstract Co-Author) Research Grant, General Electric Company; Speakers Bureau, Siemens AG; Board of Directors, Carestream Health, Inc; Research Grant, XYBIX Systems, Inc; Research Grant, Steelcase, Inc; Research Grant, Anthro Corp; Research Grant, RedRic Technologies Inc; Research Grant, Evolved Technologies Corporation; Research Grant, Barco nv; Research Grant, Intel Corporation; Research Grant, Dell Inc; Research Grant, Herman Miller, Inc; Research Grant, Virtual Radiology; Research Grant, Anatomical Travelogue, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, Toshiba Corporation; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Bayer AG; Research, TeraRecon, Inc; Medical Advisory Board, Bracco Group; Researcher, Bracco Group; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Researcher, Microsoft Corporation

**CONCLUSION**

Lung cancer risk within Lung-RADS categories is modified by additional nodule characteristics and patient historical information. A convenient interface for clinicians to interact with large datasets may aid in evaluating additional characteristics affecting the risk of lung cancer compared to a matched cohort in real time.

**Background**
Lung-RADS 1.0 was developed as a criteria to modernize and standardize recommendations for lung nodule follow-up for patients eligible for lung cancer screening which builds on the Fleischner Society recommendations. A custom web interface previously showed additional patient characteristics from the NLST clinical dataset could provide a more personalized prediction of cancer risk. In this follow-up study, the authors use the same approach if additional characteristics could improve the Lung-RADS prediction from matched cohorts.

**Evaluation**
A custom web based interface to allow the user to interact with the NLST clinical dataset in real time was created. The largest nodule in each lobe for each patient was organized by slice number and location. These nodules were tracked until cancer was diagnosed or until the last screening study available. If cancer originated in the same lobe as a nodule, the nodule was considered malignant. Lung-RADS categories predict cancer risks that range from <1% for category 2 nodules to >15% for category 4B and 4X nodules. The occurrence of cancer diagnosis was compared to the Lung-RADS predicted rate across matched cohorts with similar personal histories and nodule characteristics. The web interface allows users to compute a personalized cancer risk based on these additional discriminators by querying the NLST dataset for matched cohorts in real time.

**Discussion**
Lung-RADS characterizes nodules with greater detail than the Fleischner Criteria, however features that increase suspicion for malignancy are not clearly defined and additional factors that may significantly modify cancer risk such as a patient's personal history are excluded. Harnessing large datasets such as the NLST could aid in comparing matched cohorts to identify additional important factors in further personalizing the prediction for a nodule's cancer risk.
**Molecular Imaging (Prostate/Neuroendocrine Tumors)**

**SSJ14-01 Promising Role of Ga-68 PSMA PET/CT over Conventional Imaging in Staging and Restaging of Carcinoma Prostate**

**Tuesday, Dec. 1 3:00PM - 3:10PM Location: S504CD**

**Participants**
Peter L. Choyke, MD, Rockville, MD (Moderator) Researcher, Koninklijke Philips NV Researcher, General Electric Company Researcher, Siemens AG Researcher, iCAD, Inc Researcher, Aspyrian Therapeutics, Inc Researcher, ImaginAb, Inc Researcher, Aura Biosciences, Inc
Vikas Kundra, MD, PhD, Houston, TX (Moderator) License agreement, Introgen Therapeutics, Inc

**PURPOSE**
1) To study the utility of Ga-68 Prostate Specific Membrane Antigen (PSMA) Positron Emission Tomography/Computed Tomography (PET/CT) for staging and restaging of Carcinoma Prostate (CaP).
2) To compare the efficacy of Ga-68 PSMA PET/CT with Contrast Enhanced Computed Tomography (CECT) and F18 Sodium Fluoride (NaF) PET/CT for lesion detection

**METHOD AND MATERIALS**
Retrospective audit of prospectively maintained data of 25 patients of CaP (3 for staging and 22 with biochemical failure for restaging) who underwent Ga-68 PSMA PET/CT, CECT and F18 NaF PET/CT scan. The imaging findings were analyzed on lesion-lesion and patient-patient basis for concordance and discordance.

**RESULTS**
All the 3 cases imaged for staging evaluation demonstrated Ga-68 PSMA uptake at the site of primary while CECT demonstrated lesion in only 1 patient. In cases with suspected biochemical failure, local recurrence was detected in 59% (13/22) patients on Ga-68 PSMA PET/CT as against 9 % (2/22) detected on CECT. In 25 patients studied, Ga-68 PSMA PET/CT detected 43 metastatic nodes compared to 29 detected on CECT. Ga-68 PSMA detected additional metastases in sub cm sized nodes in 24% (6/25) patients. Ga-68 PSMA had incremental value in detecting occult extranodal metastases involving urinary bladder, pararectal nodule and peritoneal deposit in 8% (2/25) patients. In 25 patients, Ga-68 PSMA PET/CT detected additional lesions on skeletalelimination in 109 skeletal lesions were detected on Ga-68 PSMA while F18 NaF PET/CT demonstrated17 lesions. Concordance in imaging findings of Ga-68 PSMA PET/CT and F 18 Fluoride PET/CT was noted in 68% (17/25) patients. Ga-68 PSMA PET/CT had an incremental value in staging of 1 patient where it detected lytic and marrow metastases. In restaging group, 7 patients showed additional lesions on F18 NaF PET/CT.

**CONCLUSION**
Ga-68 PSMA PET/CT is superior in detection of primary, nodal and soft tissue metastases as compared to conventional imaging techniques. However, F18 NaF PET/CT appears to detect more skeletal lesions in patients with biochemical failure in our study and further prospective trials are warranted to confirm these findings.

**CLINICAL RELEVANCE/APPLICATION**
Ga-68 PSMA PET/CT has an incremental value as a one stop shop in staging and restaging of carcinoma prostate

**SSJ14-02 18F-fluoro-4-thia-palmitate (18F-FTP) PET Imaging for Evaluation of Exogenous Fatty Acid Metabolism in Prostate Cancer: Implications for Treatment Optimization**

**Tuesday, Dec. 1 3:10PM - 3:20PM Location: S504CD**

**Participants**
Pedram Heidari, MD, Boston, MA (Presenter) Nothing to Disclose
Shadi A. Esfahani, MD, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose
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Massimo Loda, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Umar Mahmood, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;

**PURPOSE**
Upregulation of de novo lipogenesis is a major metabolic change in CaP development, and correlates with tumor progression and...
Upregulation of de novo lipogenesis is a major metabolic change in PCa development, and correlates with tumor progression and poor prognosis. Differentiation of diet-derived versus de novo fatty acid (FA) utilization in PCa is essential in designing anti-lipogenic therapeutics. We aim to evaluate the use of 18F-fluoro-4-thia-palmitate (18F-FTP) PET for assessment of exogenous FA utilization by PCa.

METHOD AND MATERIALS

14C incorporation into lipids of LNCaP cells by a glucose donor (marker of de novo lipogenesis) was measured by a beta-counter after treatment with vehicle, IPI-9119, or C75. Growth inhibition rescue of LNCaP cells was performed using Cell Titer Glo assay after incubation with IPI-9119 alone or in the presence of BSA or of BSA-conjugated palmitate. For in-vitro 18F-FTP uptake study LNCaP cells were incubated with IPI-9119, C75, Etomoxir, SSO, DMSO, and combination of IPI-9119 with Etomoxir or C75 for 24 hours. The cells were then incubated with 18F-FTP and harvested to measure retained activity corrected for cell count. IACUC approval was obtained. Mice with subcutaneous LNCaP xenografts were fasted. PET data was acquired in list mode after injection of 18F-FTP. The SUVmean and tracer influx constant were measured.

RESULTS

14C incorporation in lipids decreased to approximately 25% of control using both IPI-9119 and C75 indicating FASN inhibition. LNCaP growth inhibition was aborted by BSA-conjugated palmitate. 18F-FTP uptake significantly increased with IPI-9119 treatment, while C75, etomoxir, SSO treatment reduced 18F-FTP uptake. 18F-FTP PET demonstrated significantly decreased uptake in LNCaP tumors following treatment with C75 and etomoxir compared to control (SUVmean=0.20±0.01, 0.25±0.2, and 0.40±0.02, respectively).

CLINICAL RELEVANCE/APPLICATION

We demonstrated that metabolic imaging using 18F-FTP can be used to assess the exogenous FA utilization by PCa. As expected, IPI-9119 (selective FASN inhibitor) increased the exogenous FA (18F-FTP) uptake while C75, which induces a host of metabolic modulations other than FASN inhibition paradoxically reduces 18F-FTP uptake. Etomoxir (FAO inhibitor) and SSO (FA transporter inhibitor) reduce 18F-FTP uptake as expected.

SSJ14-03 Feasibility of Hyperpolarized 13C-Pyruvate Magnetic Resonance Spectroscopy for Pancreatic Cancer Diagnostic Imaging

Participants
Stephanie K. Carlson, MD, Rochester, MN (Presenter) Royalties, Medspira, LLC
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Fergus J. Couch, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Slobodan I. Macura, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
John D. Port, MD, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Malgorzata Marjanska, PhD, Minneapolis, MN (Abstract Co-Author) Nothing to Disclose
Claire E. Bender, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose

PURPOSE

Hyperpolarized (HP) 13C magnetic resonance spectroscopic imaging (MRSI) is a recently developed technique that allows the detection of injected 13C-labeled agents and their metabolites in real-time. The purpose of this study was to identify and explore potential metabolic pathways in pancreatic ductal adenocarcinoma (PDAC) that could be targeted with HP-13C MRSI to increase the diagnostic accuracy of pancreatic cancer imaging.

METHOD AND MATERIALS

We performed gene expression profiling using laser capture microdissection and RNAseq on histologically-confirmed primary PDAC tumors and normal pancreas tissue from 21 patients. A promising, highly upregulated and imageable metabolic pathway (the conversion of pyruvate to lactate) was identified. To further explore this pathway in vivo, mice bearing genetically-engineered PDAC tumors were injected with 200 microliters of 80 mM [1-13C]-pyruvate. Tumors were quench-frozen and excised 30 s post-injection. Spectroscopic data on tumor lysates was obtained using 1H and 13C nuclear magnetic resonance. Studies were approved by our IRB and IACUC.

RESULTS

Gene expression studies showed that transcripts encoding transporters and enzymes responsible for cellular import of pyruvate, export of lactate, and conversion of pyruvate to lactate are almost universally upregulated in PDAC compared to normal pancreas, while competing pathways of mitochondrial pyruvate metabolism and cytoplasmic pyruvate to alanine conversion are consistently low. NMR analysis of PDAC tumors showed a tumor metabolic signature consistent with a very high lactate concentration and high lactate-to-alanine ratio. Quantitative analysis after injection of [1-13C]-pyruvate showed a 4.8-fold enrichment of intratumoral [1-13C]-lactate over natural abundance, indicating that ~5% of the total lactate in the tumor at 30 s post-injection was derived from the injected [1-13C]-pyruvate.

CONCLUSION

PDAC tumors have a pyruvate-lactate metabolic signature that can be quantitated with 13C-pyruvate NMR. Further exploration of HP-13C-pyruvate MRSI for PDAC is warranted.

CLINICAL RELEVANCE/APPLICATION

A new molecular imaging strategy for PDAC used in conjunction with existing morphological imaging could transform patient management in clinically-challenging scenarios.
**System for Patients with Neuroendocrine Tumours: Direct Comparison to Multiphase Contrast-enhanced PET/CT**

**Tuesday, Dec. 1 3:30PM - 3:40PM Location: S504CD**

**Participants**
Ferdinand F. Seith, BSC, Tuebingen, Germany (Presenter) Nothing to Disclose
Christian la Fougere, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Christina Pfannenberg, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolaou, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG
Nina Schwenzer, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Cornelia Brendle, MD, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose
Christina Schraml, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
In patients with neuroendocrine tumours (NET), kidney failure is a common complication of radionuclide therapy. It is known that multiphase contrast-enhanced PET/CT is superior to non-enhanced PET/CT in diagnosing metastases with low or no tracer uptake as well as small lesions especially in the liver. However, due to the superior soft tissue contrast of MRI it is possible that non-enhanced PET/MR offers the same information as contrast-enhanced PET/CT. The aim of the study was therefore to evaluate a fast protocol in PET/MR without contrast agent in direct comparison to multiphase contrast-enhanced PET/CT as gold standard.

**METHOD AND MATERIALS**
39 Patients (22 female, 58±13 years) were examined in multiphase contrast-enhanced 68Ga-DOTATATE-PET/CT in a clinical setup and in PET/MR subsequently. 2 blinded readers investigated PET/MR examinations of the abdomen with 3 different setups: T2HASTE+PET (30min), T2HASTE+TSET2+PET (35min) and T2HASTE+TSET2+DWI+PET (35min). The T2HASTE was acquired under free breathing with continuous table move. DWI was acquired with two b-values (0, 800 s/mm²). Metastatic lesions were defined as functional and/or morphological suspicious lesions or lymph nodes. The results were compared with the contrast-enhanced PET/CT, follow-up examinations and histopathology, if available.

**RESULTS**
T2HASTE sequences were of diagnostic quality in all patients. DWI suffered from artefacts especially in the upper regions of the liver. Compared with contrast-enhanced PET/CT high agreement was found with T2HASTE+TSET2+DWI+PET.

**CONCLUSION**
A protocol for PET/MR including T2HASTE, TSET2, DWI and PET seems to provide comparable results compared with multiphase contrast-enhanced PET/CT. With an estimated time of 35 min for a whole body examination, this might serve as a legitimate alternative to contrast-enhanced PET/CT for patients with kidney failure in the future.

**CLINICAL RELEVANCE/APPLICATION**
In patients with neuroendocrine tumours (NET) and kidney failure, fast non-enhanced PET/MR protocols can serve as a legitimate alternative to multiphase contrast-enhanced PET/CT examinations.

**SSJ14-05 Qualitative and Quantitative Comparison of 68Ga-DOTATATE PET/CT and PET/ MRI in Neuroendocrine Tumours**

**Tuesday, Dec. 1 3:40PM - 3:50PM Location: S504CD**

**Participants**
Francesco Fraioli, MD, London, United Kingdom (Presenter) Nothing to Disclose
Alshaima Alshammari, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Evangelia Skoura, Athens, Greece (Abstract Co-Author) Nothing to Disclose
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Sophia Michopoulos, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Jamshed Bomanji, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Ashley M. Groves, MBBS, Hitchin, United Kingdom (Abstract Co-Author) Investigator, GlaxoSmithKline plc; Investigator, General Electric Company; Investigator, Siemens AG; ;

**PURPOSE**
Many Neuroendocrine tumours (NET) show high somatostatin receptor avidity. The aim of this study is to compare 68Ga-DOTATATE PET/CT with 68Ga-DOTATATE PET/MRI imaging in patients with known NET, and assess the confidence in anatomic lesion detection and localization. Furthermore, the value of each sequence of MRI was separately evaluated.

**METHOD AND MATERIALS**
We analysed the data of 38 NET patients. Cross over of both 68Ga-DOTATATE PET/CT and PET/MRI scans were performed. MR protocol was as follows: T1 MPR, pre and post gadolinium injection, T2 haste, DWI (b0, 500, 1000). Two observers for 68Ga-DOTATATE PET/MRI and one observer for 68Ga-DOTATATE PET/CT, independently, reviewed the images and inter observer and inter modality correlation was assessed by using interclass correlation.

**RESULTS**
Our initial data showed good inter modality correlation between 68Ga-PET/CT and PET/MRI. All lesions considered as malignant in PET/CT were equally depicted in PET/MRI in the compared regions. Both modalities, revealed liver metastases in the same number of patients (18 patients), and bone metastases in 7 patients. However, counting the number of liver lesions in each patient, 68Ga-DOTATATE PET/MRI was able to recognize more lesions in 3 patients. On the other hand, more lung lesions were detected in the lung in the CT component compared to MRI component (7 lesions versus 4). The contrast and DWI sequence of PET/MRI did not have a significant effect on final outcome, but in a selected number of cases these images confirmed and helped to further characterize and detect more lesions. Inter observer reliability was equally very good in both modalities.
CONCLUSION
This study demonstrates the potential of 68Ga-DOTATOC PET/MRI in patients with NET, with special advantages in the characterization of liver lesions.

CLINICAL RELEVANCE/APPLICATION
68Ga-DOTATOC PET/MRI can help in diagnosis and staging of patients with NET, with special advantages in the characterization of liver lesions.

SSJ14-06 68Ga-DOTATOC Uptake in Somatostatin Expressing Tumors is Directly Related to Specific Activity: Implications for Receptor Quantitation Imaging

Tuesday, Dec. 1 3:50PM - 4:00PM Location: S504CD

Participants
Pedram Heidari, MD, Boston, MA (Presenter) Nothing to Disclose
Dominik Berzaczy, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Alicia Leece, Boston, MA (Abstract Co-Author) Nothing to Disclose
Shadi A. Esfahani, MD, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose
Umar Mahmood, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;

PURPOSE
The importance of specific activity (SA) has been previously shown in functional PET imaging studies. We hypothesized that tracer uptake, measured using semiquantitative (SUV) or quantitative (Patlak plot) parameters, would vary considerably according to SA in cancer receptor imaging. This study aims to evaluate the effect of SA on PET parameters used for quantitation of 68Ga-DOTATOC uptake in somatostatin receptor (SSTR) tumor models.

METHOD AND MATERIALS
In-vitro, SSTR2 expression level was assessed using Western blot across multiple cancer lines including IMR32, Capan1, A549 and AR42J, and was normalized for β-actin expression. The SSTR2/β-actin ratio was correlated to in-vitro 68Ga-DOTATOC uptake normalized for cell counts. AR42J and IMR32 normalized 68Ga-DOTATOC uptake was plotted against 68Ga-DOTATOC SA ranging from 0.2 to 20 Ci/g and correlation was assessed. The in-vitro studies were performed in triplicate. For in-vivo studies Institutional Animal Care and Use Committees approval was obtained. Subcutaneous AR42J xenografts were implanted in Nu/Nu mice. Dynamic PET scans in list mode were acquired following injection of 68Ga-DOTATOC with a wide range of SAs (0.3 - 50 Ci/g). Net tracer influx (Ki), SUVmax and SUVmean were plotted against the SA to establish the correlation between quantitative parameters and SA. Patlak-plot was used to calculate the tracer influx constant for the tumor ((Ki= (k1 × k3 / k2 + k3)).

RESULTS
We observed a consistent ratio between 68Ga-DOTATOC uptake per cell and SSTR2/β-actin level across the cell lines (R2=0.95, p<0.024). In-vitro we demonstrated a linear correlation between SA and 68Ga-DOTATOC uptake per cell in IMR32 (R2=0.98, P<0.015) and AR42J (R2=0.99, P<0.005). We found that Ki, SUVmax, and SUVmean decreased in a linear fashion with reduction in SA. Quantitative 68Ga-DOTATOC PET parameters had a direct linear correlation with SA (R2=0.89, p<0.001 for Ki, R2=0.66, p<0.0001 for SUVmax and R2=0.82 and p<0.0001 for SUVmean).

CONCLUSION
68Ga-DOTATOC uptake is strongly correlated to SSTR2 expression for each given SA. However, 68Ga-DOTATOC uptake in SSTR-expressing tumors increases in a linear fashion with increase in SA, over the range studied.

CLINICAL RELEVANCE/APPLICATION
68Ga-DOTATOC uptake by tumors can vary widely with change in specific activity. Quantitation for radiotherapy dosimetry and response assessment is improved with correction for specific activity.
**SSJ15**

**Musculoskeletal (Quantitative MR Applications)**

Tuesday, Dec. 1 3:00PM - 4:00PM Location: E451A

**Participants**
Martin Torriani, MD, Boston, MA (Moderator) Nothing to Disclose
Gregory Chang, MD, New York, NY (Moderator) Speaker, Siemens AG

**Sub-Events**

**SSJ15-01**  **Quantitative MRI Perfusion Analysis of Osteoid Osteomas Pre- and Post Microwave Ablation using an Open Source Software Tool (UMMPerfusion)**

Tuesday, Dec. 1 3:00PM - 3:10PM Location: E451A

**Participants**
Michael Kostrzewa, MD, Mannheim, Germany (Presenter) Nothing to Disclose
Patrick Diezler, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Henzler, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Nils Rathmann, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (Abstract Co-Author) Institutional research agreement, Siemens AG
Steffen J. Dehl, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To quantitatively evaluate blood perfusion of osteoid osteomas prior and after percutaneous microwave (MW) ablation in time-resolved imaging with stochastic trajectories (TWIST) MRI sequences using an open source software tool.

**METHOD AND MATERIALS**

In 17 patients (11 males, 6 females, mean age 26y) with osteoid osteomas percutaneous, CT guided, MW ablation was performed (Medwaves, San Diego, California, USA). Lesions measured on average 5 ± 2mm in diameter. Lesion diameter dependent MW ablation parameters were: 16 Watts, 915MHz, 80°C for 45 to 160 seconds. Prior to and after MW ablation 3D dynamic contrast enhanced MRI imaging was performed with 3D TWIST gradient echo sequences (Siemens Healthcare). Mean plasma flow (PF, ml/100ml/min), mean volume of distribution (VD, ml/100ml) and mean transit time (MTT, sec) were measured within the lesion in the pre and post MW ablation MRI TWIST data using an open source software tool for quantitative MRI perfusion analysis (UMMPerfusion, OpossUmm, Germany).

**RESULTS**

16 patients were free of symptoms within one week after treatment, one patient had decreased but persisting symptoms after MW ablation. No minor or major adverse events were observed according to SIR criteria. Mean PF, VD and MTT were 253 ± 226ml/100ml/min, 63 ± 60ml/100ml and 17 ± 12sec prior to ablation and 55 ± 64ml/100ml/min, 23 ± 39ml/100ml and 17 ± 12sec after ablation respectively. In a paired t-test there was no statistically significant change in MTT prior to and after ablation (p>0.05), whereas PF (p=0.002) and VD (p=0.02) decreased significantly. In the patient with persisting symptoms continuously high values for PF (229ml/100ml/min) and VD (118ml/100ml) were found in the MRI after MW ablation in a small portion of the lesion, this was attributed to imprecise needle placement and to too short ablation time.

**CONCLUSION**
Treatment success of percutaneous MW ablation of osteoid ostomes can be reliably quantified by MRI perfusion analysis, especially by evaluating pre and post procedural PF and VD within the lesion. MRI perfusion analysis helps to identify small remnants of perfused osteoid osteoma tissue after MW ablation.

**CLINICAL RELEVANCE/APPLICATION**
Quantitative MRI perfusion analysis is clinically valuable in the evaluation of treatment success of percutaneous MW ablation for osteoid osteomas.

**SSJ15-02**  **A Phase I Study to Assess the Feasibility of Quantitative Molecular Imaging of ACL Grafts**

Tuesday, Dec. 1 3:10PM - 3:20PM Location: E451A

**Participants**
Katherine Binzel, PhD, Columbus, OH (Presenter) Nothing to Disclose
Robert Magnussen, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Wenbo Wei, Columbus, OH (Abstract Co-Author) Nothing to Disclose
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Christopher C. Kaeding, MD, Columbus, OH (Abstract Co-Author) Consultant, Biomet, Inc

**PURPOSE**
Injury to the anterior cruciate ligament (ACL) commonly requires reconstruction with a graft to restore stability and function. The rate at which graft ligamentization occurs is not well delineated by magnetic resonance imaging (MRI). This initial study aims to...
demonstrate the feasibility of combined MRI with dynamic positron emission tomography (PET) in order to evaluate the graft healing process following reconstructive surgery.

**METHOD AND MATERIALS**

MRI was performed on a 3T Achieva on 20 patients post-ACL reconstruction. Dynamic PET/CT was acquired on a Gemini TF 64 and/or new digital detector PET/CT system, Vereos TF (all Philips Healthcare, Cleveland, OH). An in-house fabricated cushion was used to match positioning during PET acquisitions to that of the dedicated MRI knee coil. A single bed position centered on the knees was acquired continuously for 75 minutes using an ultra-low dose 3 mCi 18F-fluorodeoxyglucose (FDG) protocol. Patients were grouped according to time since surgery, 0-6 months, 6-12 months, 12-24 months, and 24 months or greater. Standardized uptake values (SUVmax) were measured for regions of interest placed over the proximal, middle, and distal portions of the graft, the femoral and tibial tunnels, the posterior cruciate ligament (PCL), and quadriceps muscle for reference. Matched ROIs were drawn in the contralateral knee.

**RESULTS**

Dynamic PET images were readily co-registered to MRI for all patients. In the 0-6 month group, the average slope of the metabolic uptake curve was 0.20 in the distal graft, 0.21 in the mid graft, 0.27 in the proximal graft, and 0.28 in the femoral tunnel. In the 24+ month group the averages were 0.06, 0.05, 0.07, and 0.03, respectively. In addition to decreasing slopes of the uptake curves over time, patients with longer recovery times were seen to have SUVs more comparable to those in healthy knees than those who more recently had ACL repair.

**CONCLUSION**

We demonstrated that the quantitative evaluation of ACL graft ligamentization and healing is feasible by molecular imaging co-registered to MRI. Digital PET appears to enable further FDG dose reduction making a combined molecular imaging PET/MRI approach to assess ACL graft viability clinically feasible.

**CLINICAL RELEVANCE/APPLICATION**

A first-in-human study evaluating ACL graft healing with quantitative molecular imaging using combined PET/MRI.

**SS115-03 MRI Defined Ecologic Habitats in Extremity Soft Tissue Sarcomas: Characterization and Quantification of Tumor Heterogeneity and Potential Implications on Patient Outcomes-Early Experience**

**Tuesday, Dec. 1 3:20PM - 3:30PM Location: E451A**

Participants

Meera Raghavan, MD, Tampa, FL (Presenter) Nothing to Disclose

Hamidreza Farhidzadeh, Tampa, FL (Abstract Co-Author) Nothing to Disclose

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Robert J. Gillies, PhD, Tampa, FL (Abstract Co-Author) Nothing to Disclose

Robert A. Gatenby, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

We propose a novel computer-aided, spatially-explicit image analysis of magnetic resonance (MR) examinations to classify extremity STS based on radiologically defined spatial sub-regions, or “habitats.” The identification of spatially distinct habitats can quantify and characterize the ecologic basis of intratumoral heterogeneity and may be helpful to guide targeted biopsy, tailor therapeutic options and offer prognostic information.

**METHOD AND MATERIALS**

T1-w gadolinium enhanced and fluid-sensitive MR images were assessed from pretreatment scans of 36 patients with extremity STS. There were three main steps: tumor segmentation based on pixel signal intensity; pixel and texture analysis within each distinctive habitat; and prediction of metastatic disease and histologic therapy response. Patient outcomes such as progression free survival (PFS), overall survival (OS), and presence of metastases were also assessed.

**RESULTS**

Habitat color maps (HCM) demonstrated spatially distinct intratumoral subregions (Fig. 1). Metastatic disease was classified correctly with 86.11% accuracy based on five texture features, and histologic necrosis with 75.75% accuracy based on four features. Specific subregions were also predictive for metastatic disease and histologic response to therapy. The post contrast T1 high/T2 low subregion was prognostic for overall survival (p = 0.036).

**CONCLUSION**

This technique can define distinct habitats within each STS based on MR imaging features and allows spatial variations to be assessed and quantified. We demonstrate the role of advanced clinical image analysis in providing critical insight into the evolutionary and ecologic landscape of STS. The preliminary results presented here show that distinct intratumoral subregions or habitats within STS can be identified and quantified and give useful clinical and prognostic information which can shape personalized and adaptive therapeutic regimens.

**CLINICAL RELEVANCE/APPLICATION**

Change in size alone does not accurately reflect response to therapy and tumor biology of STS. We have developed an image analysis technique to non-invasively characterize and quantify tumor subregions on MR imaging. The identification of these radiologically defined habitats can give insight into the evolutionary and ecologic dynamics which are the basis of heterogeneity in STS. This can in turn offer more tailored personalized treatments to patients.

**SS115-04 Quantitative Magnetic Resonance Imaging of Meniscal Pathology**

**Tuesday, Dec. 1 3:30PM - 3:40PM Location: E451A**

Participants
Clinical multidetector computed tomography (MDCT) has been used to evaluate bone quality. The purpose of this study was to:

**PURPOSE**

To determine the capability of conventional and UTE quantitative MR values to detect meniscal pathology in cadaveric meniscal samples.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative MR values may correlate with structural and biochemical meniscal alterations, complementing currently limited techniques in early diagnosis and postoperative evaluation of the meniscus.

**SS315-05 Correlation of Age Dependent Whole Body Fat and Whole Body Skeletal Muscle Volume on DIXON MR Sequences in a Healthy Population with Normal BMI**

*Tuesday, Dec. 1 3:40PM - 3:50PM Location: E451A*

Participants
- Erika J. Ulbrich, MD, Zurich, Switzerland (Presenter) Nothing to Disclose
- Daniel Nanz, PhD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
- Olof Dahlqvist Leinhard, PhD, Linköping, Sweden (Abstract Co-Author) Consultant, AMRA AB
- Magda Marcon, MD, Udine, Italy (Abstract Co-Author) Nothing to Disclose
- Michael A. Fischer, MD, Stockholm, Sweden (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To test a correlation of age- and gender-dependent reference standards of MR normative values of total adipose tissue (TAT), abdominal subcutaneous adipose tissue (ASAT) with the corresponding lean muscle tissue (LMT).

**METHOD AND MATERIALS**

Fat and water MR whole body images were acquired with a 2-point mDIXON sequence (Repetition time/echo time, 4.2 msec/1.2 msec, 3.1 msec) at 3 Tesla (Ingenia, Philips) in 80 healthy volunteers with normal BMI (18.5 to 25.5 kg/m2) aged between 20 and 60 years (10 men/10 women per decade). Volumes were measured from TAT, ASAT and LMT by a semi-automatic segmentation algorithm allowing separate quantification of each compartment (Advanced MR Analytics, AMRA, Linköping, Sweden). Pearson and Spearman correlations between Volume and several body measures were calculated. ANOVA was used to test for Volume differences among age subgroups. Prospective IRB approved study with written informed consent.

**RESULTS**

Overall mean Volume (liter) ± standard deviation for women/men: 20.8±5.2/19.5±6.3 (TAT) and 15.7±2.2/23.2±3.3 (LMT). TAT/height2 and LMT/height2 didn’t show any age dependency for women/men (p = 0.973/0.557 and p = 0.483/0.539, respectively) nor TAT/height2 and LMT/height2 differences among age subgroups for both gender. There was significant correlation between TAT/height2 and body mass index (BMI) for women/men (p < 0.001 both), but not between LMT/height2 and BMI (p = 0.276/0.634). LMT/height2 correlated with TAT/height2 (p = 0.038/0.005) and ASAT/height2 (p = 0.011/0.002), but not with VAT/height2 (p = 0.205/0.252).

**CONCLUSION**

Women had higher TAT and lower LMT than men, but without significant age dependence. LMT/height2 correlated with TAT/height2 and ASAT/height2, but not with BMI.

**CLINICAL RELEVANCE/APPLICATION**

Normative values of LMT allow to determine muscular trophic in patients and might help to diagnose myopathy. Side Note for reviewer only please: Volunteers of this abstract are identical to Abstract number 15013444, but as the topic of fat quantification is very complex, we decided to put the data in two abstracts with the first dealing with the age dependent different fat volumes and the second abstract dealing with the correlation of the skeletal muscle volumes and the different fat volumes.

**SS315-06 Effect of Iterative Reconstruction Algorithms on Measurement of Trabecular Bone Microstructure with Clinical MDCT: A Cadaver Study Using Micro-CT as the Reference Standard**

*Tuesday, Dec. 1 3:50PM - 4:00PM Location: E451A*

Participants
- Miyuki Takasu, MD, Hiroshima, Japan (Presenter) Nothing to Disclose
- Chikako Fujikoma, RT, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
- Masao Kiguchi, RT, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
- Chihiro Tani, MD, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
- Yoko Kaichi, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
- Kazuo Awai, MD, Hiroshima, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Medical Advisor, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Nemoto-Kyouindo; ; ;
- Nobuhito Nango, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
- Masafumi Machida, Musashimurayama, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Effect of iterative reconstruction algorithms on measurement of trabecular bone microstructure with clinical MDCT: A cadaver study using micro-CT as the reference standard.
Clinical multidetector computed tomography (MDCT) has been used to evaluate bone quality. The purpose of this study was to determine the efficacy of iterative reconstruction (IR) for measuring bone architecture through a comparison with micro-computed tomography (micro-CT) as the gold standard.

**METHOD AND MATERIALS**

L1 and L2 vertebrae of 10 fresh human cadavers were scanned by 64-section MDCT (LightSpeed VCT; reconstruction kernel, BONEPLUS; IR, ASiR; collimation, 64×0.625 mm), 80-section MDCT (Aquilion One Vision Edition; FC30, ADIR3D, 80×0.5 mm), and micro-CT (TOSCANER). Reconstructed voxel sizes were 0.2 × 0.2 × 0.16 mm for MDCT and 0.052 × 0.052 × 0.072 mm for micro-CT. Images were reconstructed using standard filtered back-projection and IR algorithms. Four patterns of CT images were reconstructed: without IR (IR (0%)), with 25-30% of IR (weak), with 50% of IR (mild), and with high-dose protocol without IR (120kV and 250mAs, HD). Trabecular parameters and tissue bone mineral density (tBMD) of the central 10-mm-thick portion of the vertebrae were calculated. Relationships between MDCT- and micro-CT-derived trabecular indices were compared using Pearson’s correlation coefficient.

**RESULTS**

Metric parameters and tBMD measured by 64-section MDCT correlated better with micro-CT values with IR (mild) ($r=0.611-0.948$) than with IR (0%) ($r=0.703-0.945$). The correlation coefficients were significantly different ($p<0.05$). Non-metric parameters showed better correlations with micro-CT values with IR (0%) ($r=0.712-0.883$) than by IR (30% and 50%) ($r=0.694-0.871$). For 80-section MDCT, five of seven morphological parameters and tBMD correlated better with micro-CT values with IR (0%) ($r=0.698-0.914$) than with IR (25% and 50%) ($r=0.663-0.888$, $p<0.05$). For three of eight parameters by 64-section MDCT and six out of eight parameters with 80-section MDCT, the correlation coefficients were lowest with the HD protocol.

**CONCLUSION**

IR improved the correlation between 64-section MDCT and micro-CT-derived metric parameters. In the assessment of trabecular microstructure, IR algorithms showed different strengths according to the vendor and category of trabecular parameters.

**CLINICAL RELEVANCE/APPLICATION**

To ensure the accurate measurement of trabecular bone microstructure by clinical MDCT, it is important to select the appropriate reconstruction algorithm and imaging protocol.
**Musculoskeletal (Bone Strength, Fragility and Stress Fractures)**

Tuesday, Dec. 1 3:00PM - 4:00PM Location: E450B

**SSJ16-01** 3 T MRI-based Metrics of Proximal Femur Microarchitecture and Strength Can Discriminate between Subjects with and without Fragility Fractures When BMD Cannot

**Participants**

Bruce B. Forster, MD, Vancouver, BC (Moderator) Travel support, Siemens AG; Travel support, Toshiba Corporation;

Leon Lenchik, MD, Winston-Salem, NC (Moderator) Nothing to Disclose

**Method and Materials**

This study had institutional review board approval. We recruited 22 females with fragility fractures (mean age=67.1±6.1 years) and 22 healthy female controls without fracture (mean age=64.1±6.5 years). All subjects underwent high-resolution 3T MRI of the non-dominant hip. We performed digital topological and finite element analyses within 10x10x10 mm³ femoral neck volumes-of-interest to assess: trabecular number, thickness, plate-to-rod ratio, connectivity; and elastic modulus (metric of bone strength). All subjects underwent DXA of the same hip. We performed receiver operating characteristics (ROC) analyses to assess discriminatory performance.

**Results**

For MRI, femoral neck elastic modulus, trabecular plate-to-rod ratio, and connectivity could discriminate between subjects with and without fractures (area under the curve (AUC)=0.75-0.87, p<0.05), but trabecular thickness and number could not (AUC=0.46-0.53, p>0.78). For DXA, femoral neck and total hip BMD T-scores could not discriminate between the two groups (AUC=0.47-0.49, p>0.80).

**Conclusion**

Metrics of proximal femur microarchitecture and strength may be able to detect high fracture risk individuals even when BMD cannot.

**Clinical Relevance/Application**

MRI based analysis of bone microarchitecture and strength may provide better measures of bone quality than Dual-Energy x-ray absorptiometry (DXA).

**SSJ16-02** Long-term Radiographic Follow-up of Bisphosphonate-related Femur Fractures

**Participants**

Jennifer L. Favinger, MD, Seattle, WA (Presenter) Nothing to Disclose

Daniel S. Hippe, MS, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company

Alice S. Ha, MD, Seattle, WA (Abstract Co-Author) Grant, General Electric Company

**Purpose**

Although the initial appearance of atypical femur fractures associated with bisphosphonate use has been well documented, there are no prior studies evaluating long-term radiographic follow up of how these fractures change over time. It has been shown that bisphosphonates remain in bone for years after drug discontinuation, suggesting these fractures might not heal with the same pattern as normal bone.

**Method and Materials**

In this retrospective study, bisphosphonate-related fracture radiographs and CTs were reviewed by two radiologists for presence of a fracture line, callus, and the characteristic cortical beak. Indications of healing were defined as the fracture line or cortical beak appearing distinctly less conspicuous, though not necessarily absent, compared to the prior study. Kaplan-Meier (KM) curves were used to analyze the time to first indication of healing. KM curves were compared between groups using the logrank test.
RESULTS

47 femurs with a bisphosphonate-related femur fracture were identified in 28 women, average age 65 years. 85% took a bisphosphonate for greater than 5 years, 59% for greater than 10 years. Median follow up time was 1.7 years with a median of 6 exams per femur. Median time to beak healing was 265 weeks. Median time to fracture line healing was 56 weeks in the 31 femurs with a baseline fracture. Healing rates of the beak (p = 0.03) and fracture line (p = 0.07) tended to be higher in those who discontinued bisphosphonate by 1 week after the initial exam compared to those who discontinued later. However, even in this group that discontinued earlier, only 53% demonstrated fracture line healing and 24% demonstrated beak healing at 6 months follow up.

CONCLUSION

Despite drug discontinuation, bisphosphonate-related fractures fail to show normal radiographic healing patterns in long-term follow-up, in keeping with recent pathology studies that showed persistent intrasosseous drug presence years after drug discontinuation. These fractures demonstrate abnormally long healing time with less than 5% of patients showing any form of fracture healing at 6 weeks, and less than 50% showing any healing at 26 weeks. Therefore, these patients remain at high risk for displaced fractures and non-union.

CLINICAL RELEVANCE/APPLICATION

Atypical femur fractures are associated with significant morbidity and demonstrate abnormal or incomplete healing even years after drug discontinuation.

SSJ16-03  Does Intravenous Contrast Administration Affect Bone Mineral Density Assessment Using Multi-detector Computed Tomography?

Tuesday, Dec. 1 3:20PM - 3:30PM Location: E450B

Participants
Sabarish Narayanasamy, MBBS,MD, Aligarh, India (Presenter) Nothing to Disclose
Jitender Singh JR, MD, Aligarh, India (Abstract Co-Author) Nothing to Disclose
Saifullah Khalid, MD, Aligarh, India (Abstract Co-Author) Nothing to Disclose
Paul A. Sathiadoss, MBBS, Aligarh, India (Abstract Co-Author) Nothing to Disclose
Breethaa J. Selvaramani, Aligarh, India (Abstract Co-Author) Nothing to Disclose
Mohd. Khalid, MBBS, MD, Aligarh, India (Abstract Co-Author) Nothing to Disclose

PURPOSE

The aim of our study was to evaluate whether contrast media administration has significant influence on Computed tomography (CT) derived bone density measurements by comparing the unenhanced and contrast enhanced CT examinations.

METHOD AND MATERIALS

89 patients (47 Males and 42 Females; Mean age ± SD, 53 ± 10.6) who underwent both unenhanced and contrast enhanced CT examinations in the same setting between January 2014 and January 2015 were retrospectively selected. The only exclusion criterion was patients less than 40 years of age. CT attenuation values in Hounsfield units were measured in the first lumbar (L1) vertebra (using simple non-angled ROI) in both the unenhanced and contrast enhanced examinations. Comparisons were made between the measurements using appropriate statistical methods.

RESULTS

The mean CT attenuation value in the contrast enhanced phase (Mean ± SD, 186.7 ± 49.7) was significantly higher as compared to the unenhanced phase (170.1 ± 52.2, p = 0.000). The mean CT attenuation values were higher in males as compared to females in both unenhanced (Males vs Females; 180.8 ± 52.1 vs 158.2 ± 50.1, p=0.04) and contrast enhanced phases (192.2 ± 50.9 vs 180.5 ± 48.1, p = 0.27). When a threshold of 160HU or less is used to define osteoporosis, measurements in the contrast enhanced phase resulted in 8% false negatives.

CONCLUSION

Our study demonstrates that intravenous contrast administration significantly affects the Bone Mineral density assessment using CT. This must be factored in, when CT is used as a screening tool for osteoporosis.

CLINICAL RELEVANCE/APPLICATION

There are significant differences in CT attenuation values depending on the phase of image acquisition and therefore standardized image acquisition protocols must be used for bone density assessment.

SSJ16-04  Multi-modality Imaging for Tumor Localization in Patients with Tumor-induced Osteomalacia: A Retrospective Analysis of Five Cases

Tuesday, Dec. 1 3:30PM - 3:40PM Location: E450B

Participants
Kersten Peldschus, MD, Hamburg, Germany (Presenter) Nothing to Disclose
Thomas Brunhhorst, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Christian Wisotzki, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Thorsten Derlin, MD, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Michael Arming, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Stefan Breer, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this retrospective study was to evaluate imaging findings of patients with tumor-induced osteomalacia who underwent multi-modality imaging to localize the underlying tumor.
RESULTS
Out of the five patients (50.4±7.3 y/o, 3 female, 2 male) 111In-octreotide scintigraphy revealed a suspicious lesion in 2 patients, whereas 68Ga DOTATATE PET/CT demonstrated tumor suspicious tracer enhancement in all 5 patients (mean SUVmax 14.9±10.0). Contrast-enhanced MRI could confirm tumors lesions (mean diameter 2.5±1.6 cm) in all cases. After surgical removal histopathological analysis revealed three mesenchymal tumors of mixed connective tissue variant and two odontogenic fibroma, endothelium rich type. On MRI the mean size of tumors identifiable with 111In-octreotide scintigraphy was 4.5±6.0 cm versus 1.2±0.1 cm for tumors detectable only with 68Ga DOTATATE PET/CT. Complete surgical removal was achieved in all patients, no recurrence was observed during 1-year follow-up.

CONCLUSION
In patients with tumor-induced osteomalacia 68Ga DOTATATE PET/CT was able to detect significantly smaller tumors than 111In-octreotide scintigraphy. Subsequent MRI (and CT) were required to further characterize the tumors for surgical treatment planning.

CLINICAL RELEVANCE/APPLICATION
In patients with suspected tumor-induced osteomalacia 68Ga DOTATATE PET/CT may allow the detection of small tumors that are negative on 111In-octreotide scintigraphy.

SSJ16-05  The Effect of Body Mass Index on Bone Mineral Density and Trabecular Bone Score

Tuesday, Dec. 1 3:40PM - 3:50PM Location: E450B

Participants
Cristian G. Monaco, MD, San Donato Milanese, Italy (Presenter) Nothing to Disclose
Carmelo Messina, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Poloni, Milano, Italy (Abstract Co-Author) Nothing to Disclose
Giovanni Di Leo, San Donato Milanese, Italy (Abstract Co-Author) Travel support, Bracco Group
Luca Maria Sconfienza, MD, PhD, San Donato Milanese, Italy (Abstract Co-Author) Nothing to Disclose
Francesco Sandanelli, MD, San Donato Milanese, Italy (Abstract Co-Author) Speakers Bureau, Bracco Group Research Grant, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific

PURPOSE
Trabecular Bone Score (TBS) measured on lumbar spine dual energy x-ray absorptiometry (DXA) provides an indirect index of trabecular microarchitecture. According to proponents, TBS is adjusted to the patient’s body mass index (BMI). In obese patient, bone mineral density (BMD) is usually increased due to image noise related to soft tissue superimposition. Our aim was to investigate the effect of BMI on BMD and TBS.

METHOD AND MATERIALS
After ethics committee approval, we retrospectively reviewed the last 197 DXA examinations performed at our institution. For each patient, data on TBS, BMI, and BMD were registered. An experienced reader evaluated all examinations. TBS and BMD were automatically averaged from L1 to L4. T-score was categorized according the WHO criteria. The presence of osteoarthrosis was determined when a difference of more than a 1.0 T-score was found between two adjacent vertebrae, in agreement to the International Society for Clinical Densitometry guidelines. Correlation was estimated using the Pearson coefficient and multivariate regression using TBS as dependent variable. Data were presented as mean±standard deviation.

RESULTS
T-score diagnosis was normal in 54 patients (27.4%), osteopenia in 95 (48.2%), and osteoporosis in 48 (24.4%). Overall, BMI was 26.4±5 kg/m2; BMD 0.877±0.153 g/cm2; TBS 1.224±0.117 mm-1. Osteoarthrosis was evident in 55 (28%) patients. Bivariate correlation analysis between TBS and BMI was significant (r = 0.396, P<.001); this correlation was higher in patients with BMI≥30 kg/m2 (r = 0.501, P=.015) than in those with BMI<30 kg/m2 (r = 0.207, P=.006). The correlation between TBS and BMD was: r=0.313 (P<.001), overall; r=0.431 (P=.040), in patients with BMI<30 kg/m2; r=0.408 (P<.001), in patients with BMI<30 kg/m2. Multivariate regression analysis confirmed that BMI and BMD are independently associated to TBS (P<.001), both overall and only in patients without osteoarthrosis.

CONCLUSION
The higher the BMI the lower the TBS. BMI and BMD were independent predictors of TBS.

SSJ16-06  Stress Fracture Diagnosis on Conventional Radiography and MRI: Variations Based on Fracture Location, Patient Age, and Time to MRI

Tuesday, Dec. 1 3:50PM - 4:00PM Location: E450B

Participants
Gregory S. Matthews, MD, Winston-Salem, NC (Presenter) Nothing to Disclose
Scott D. Wuertz, MD, MS, Winston-Salem, NC (Abstract Co-Author) Nothing to Disclose
Maha Torabi, MD, Winston Salem, NC (Abstract Co-Author) Nothing to Disclose
Pushpender Gupta, MBBS, Winston-Salem, NC (Abstract Co-Author) Author, Reed Elsevier
PURPOSE
To determine if the diagnosis of stress fracture on conventional radiographs (CR) and MRI is influenced by fracture location, age of patient, and time between CR and MRI.

METHOD AND MATERIALS
Imaging studies of patients with suspected stress fractures over a five year period were evaluated. Only patients with CR and MRI studies less than 3 months apart were included. Stress fractures were categorized into three anatomic regions: 1) foot/ankle, 2) tibia/distal femur, 3) pelvis/proximal femur. Sensitivity and specificity of CR was determined by region. Odds ratios (95% CI) between patient age and positive CR and MRI diagnosis were determined. Also, odds ratio between days between CR and MRI and positive diagnosis of fracture was determined.

RESULTS
285 patients (mean age, 41 years; age range, 4-91 years) with clinical suspicion of stress fracture were evaluated with both CR and MRI. Based on CR, stress fractures were diagnosed (or highly suspected) in 61/295 (20.7%) of patients, including 25/144 (17.4%) in foot/ankle, 19/49 (38.8%) in tibia/distal femur, and 17/91 (18.7%) in pelvis/proximal femur. Based on MRI, stress fracture or stress reaction was diagnosed in 133/295 (45.1%) of patients, including 82/144 (56.9%) in foot/ankle, 26/49 (53.1%) in tibia/distal femur, and 25/91 (27.5%) in proximal femur/pelvis. Sensitivity of CR was 23% in foot/ankle, 31% in tibia/distal femur, and 12% in pelvis/proximal femur. Specificity of CR was 90% in foot/ankle, 52% in tibia/distal femur, and 79% in pelvis/proximal femur. For each decade of life, the odds of a positive CR diagnosis increased by 21% (OR: 1.21; 95% CI: 1.04,1.40), whereas the odds of a positive MRI diagnosis decreased by 14% (OR: 0.86; 95% CI: 0.76,0.97). There was no significant relationship between days between CR and MRI and positive diagnosis of fracture.

CONCLUSION
The diagnosis of stress fracture varies by fracture location and age of patient.

CLINICAL RELEVANCE/APPLICATION
Approach to imaging of stress fractures should take into account fracture location and age of patient.
PURPOSE
There is a growing body of evidence supporting the application of volumetric PET/CT parameters and partial volume effect correction (PVC) in the prognostication of patients with non-small cell lung cancer (NSCLC). The aim of this secondary analysis was to assess the ability of pretreatment volumetric PET/CT measures, along with PVC, to predict locoregional control (LRC) and overall survival (OS) in patients enrolled in ACRIN 6668/RTOG 0235.

METHOD AND MATERIALS
Patients with inoperable stage IIB/III NSCLC and evaluable pretreatment FDG-PET/CT scans were included. Pretreatment Metabolic Tumor Volume (MTV), SUVmax, SUVmean, Total Lesion Glycolysis (TLG = SUVmean * MTV), pvcSUVmean and pvcTLG (pvcSUVmean*MTV) were quantified using semiautomatic adaptive contrast-oriented thresholding and local background PVC algorithms. The relationship between PET/CT indices and patient outcomes was assessed using Cox proportional hazards regression and time-varying models.

RESULTS
Of 234 eligible patients, 38 were excluded mainly due to inadequate image quality, leaving 196-151 depending on the measured PET indices. PVC parameters were very highly correlated with their non-corrected counterparts (median correlation 0.98, range 0.96 to 0.997). Pretreatment MTV, TLG and pvcTLG (both primary tumor (PT) and whole body (WB)) were independent predictors of OS, while SUVmax, SUVmean and pvcSUVmean were not prognostic using either PT or WB measures. PVC and non-PVC indices yielded similar hazard ratios of 1.17 (95% CI 1.05-1.31 p=0.004), 1.20 (95% CI 1.06-1.34 p=0.003), 1.24 (95% CI 1.06-1.44 p=0.007), 1.27 (95% CI 1.08-1.50 p=0.004) for PT TLG, PT pvcTLG, WB TLG and WB pvcTLG, respectively. Similar results were observed after subsetting the entire cohort based on tumor size. Similar to OS, MTV and TLG were independent predictors of LRC, although their prognostic ability decreased during long-term follow-up.

CONCLUSION
Pretreatment volumetric PET/CT parameters including MTV and TLG are strong predictors of OS and LRC for NSCLC; however, the association with LRC appears to diminish over time. For this particular cohort, PVC did not appear to enhance the prognostic ability of PET/CT indices. The significance of PVC in treatment monitoring remains to be clarified.

CLINICAL RELEVANCE/APPLICATION
Pretreatment volumetric FDG-PET/CT parameters are strong independent predictors of overall survival and locoregional control in patients with locally advanced NSCLC treated with chemoradiation therapy.
Early Prediction of Chemotherapeutic Response with Volumetric FDG PET Parameters in Recurrent Gynecological Malignancies

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S505AB

Participants
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Purpose
To evaluate if volumetric parameters (VPs) of FDG PET were useful in predicting treatment response early after chemotherapy in recurrent gynecological malignancies.

Method and Materials
This study included 35 patients with recurrent gynecological malignancies (19 uterine, 12 ovarian, 2 peritoneal, and 2 others). FDG PET/CT exam was performed before (pre) and after 1 cycle of chemotherapy (post1c). Metabolic tumor volume (MTV, SUV threshold 2.5) and total lesion glycolysis (TLG) were measured by two readers (R1, R2) using a semi-automatic gradient segmentation method. Intra-class correlation coefficient (ICC) and Bland-Altman analyses were performed.

Results
There was excellent correlation between non-PSF and PSF reconstruction PET/CT values [ICC≥0.950 for all parameters, P<0.0001]. Bland-Altman analyses comparing PSF with non-PSF images showed the average biases (%) of +11.14 (R1) and +11.1 (R2) for SUVmax, +7.04 (R1) and +7.54 (R2) for SUVmean, +7.03 (R1) and +7.06 (R2) for SUVpeak, -2.62 (R1) and +3.17 (R2) for TLG, and -9.61 (R1) and -10.43 (R2) for MTV. Percentage changes in PSF versus non-PSF indices were not related to the site of the lesions (P>0.05). Close agreement was observed between two readers [ICC ranged between 0.908-0.997, P<0.0001].

Conclusion
The PSF reconstruction increases the SUVmax, SUVmean and SUVpeak, as expected, while it tends to produce lower values for MTV and has variable effect on TLG. This can be attributed to the ability of PSF reconstruction to better discern tumor uptake from activity spill-out.

CLINICAL RELEVANCE/APPLICATION
Reconstruction method of PET/CT should be carefully considered in reporting quantitative parameters, subsequent lesion classifications and comparisons for therapy assessment.
SUvmax in predicting treatment response after the last cycle in pts with recurrent gynecological malignancies. Potential of MTV and TLG dealing with whole-body lesions was also demonstrated in this study.

**CLINICAL RELEVANCE/APPLICATION**

Early changes of volumetric FDG PET parameters after 1 cycle of chemotherapy were useful in predicting final treatment response in pts with recurrent gynecological malignancies.

**SSJ17-04**  
**Assessment of Whole-body Metabolic Tumor Burden of Nerve Sheath Tumors in Neurofibromatosis Type 1 Using 18F-FDG PET/CT**  
**Tuesday, Dec. 1 3:30PM - 3:40PM Location: SS05AB**

**Participants**

Johannes M. Salamon, MD, Hamburg, Germany (Presenter) Nothing to Disclose  
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**PURPOSE**

To determine the metabolically active whole-body tumor volume and whole body total lesion glycolysis on 18F-fluorodeoxyglucose positron emission tomography/computed tomography (18F-FDG PET/CT) in individuals with neurofibromatosis type 1 (NF1) using a three-dimensional (3D) segmentation and computerized volumetry technique. And to compare these parameters in NF1 patients with benign (BPNSTs) and malignant peripheral nerve sheath tumors (MPNSTs).

**METHOD AND MATERIALS**

Eighteen NF1 patients with malignant PNSTs and 18 age- and sex-matched NF1 controls with benign PNSTs examined by 18F-FDG PET/CT were included (20 men; 16 women; age, 36.6 ± 12.3 years; range 16.5 to 68.7 years). Whole-body metabolic tumor burden (mTB), whole-body total lesion glycolysis (TLG) and a set of semi-quantitative imaging-based parameters were analyzed on a per-patient and a per-lesion basis. The Mann-Whitney U test, the Spearman correlation coefficient and ROC analysis were used for statistical analyses. Histopathological evaluation and clinical / radiological follow-up examinations served as the reference standards.

**RESULTS**

Whole-body mTB and whole-body TLG were significantly higher in NF1 patients with MPNSTs compared to patients with BPNSTs at different SUvmax cut-offs (2.0, 2.5, 3.5 and 4.0, p < 0.0001). MPNST demonstrated both a significantly higher metabolic tumor volume and TLG than BPNSTs (p < 0.0001). ROC analysis showed that metabolic tumor volume and TLG could be used to differentiate between benign and malignant tumors. Neither age nor gender were significantly correlated with whole-body mTB and whole-body TLG.

**CONCLUSION**

Whole-body mTB and whole-body TLG are different between NF1 patients with BPNST and MPNST. Moreover, malignant tumors have higher metabolic tumor volume and TLG than benign tumors. Further evaluation in prospective studies is required to determine the potential clinical impact and prognostic significance of these novel PET parameters in the context of NF1.

**CLINICAL RELEVANCE/APPLICATION**

New volumetric imaging parameters of peripheral nerve sheath tumors in NF1 such as mTB and TLG provide the basis for investigating biomarkers for early detection of MPNST and may help reducing unnecessary biopsies or surgery.

**SSJ17-05**  
**Determination of the Degree of Colorectal Carcinoma differentiation by Characterizing Tumor Heterogeneity with Textural Features on 18F-FDG PET/CT**  
**Tuesday, Dec. 1 3:40PM - 3:50PM Location: SS05AB**

**Participants**

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Jie Tian, PhD, Beijing, China (Presenter) Nothing to Disclose

**PURPOSE**

The aim of the study is to assess the usefulness of the tumor heterogeneity characterized by texture features and other commonly used semi-quantitative indices extracted from 18F-FDG PET images to determine the differentiated degree of cancer cells in colorectal adenocarcinoma (CA) patients.

**METHOD AND MATERIALS**

We retrospectively studied the PET/CT images of 42 patients with pathologically proven CA (26 male and 15 female; mean age, 60±13 years), and the differentiation was graded on a scale of poor, moderate, or well differentiated. Firstly, the primary tumor was segmented with an improved level set method. Based on the traditional Chan-Vese (CV) model, we imposed gradient field constraint to exclude the effect of the adjacent bladder for some rectal tumors. Secondly, fifty-four 3D texture features (based on histogram analysis, concurrence matrix (CM), gray level size zone matrix (GLSZM), run length matrix (RLM), neighbourhood grey level difference matrix(NGLD) and texture spectrum (TS)) were studied besides of SUVs (SUvmax, SUvmean, SUvpeak) and metabolic tumor volume (MTV). A 64-gray-level quantization was used, and local features (features based on CM and RLM) were computed over 13 directions. Then one-way analysis of variance (ANOVA) followed by multiple comparisons was employed to test the features for the statistical significance of group differences. In addition, the robustness of the features with respect to the segmentation methods was validated.
RESULTS
Three of the forty-eight features, difference variance (DV) and information correlation1 (IC1) based on CM and low gray level run emphasis (LGRE) based on GLSZM showed significant differences between any two groups (P<0.05). Through Student’s test, there were no significant differences of the features between the manual segmentation and the proposed method (p>0.05).

CONCLUSION
Texture analysis of FDG PET could determinate the degree of colorectal carcinoma differentiation potentially, which also means the texture features may be another prognostic factors and can provide supplementary information for developing treatment plan.

CLINICAL RELEVANCE/APPLICATION
The texture features could determine the differentiated degree of cancer cells in colorectal adenocarcinoma (CA) patients, and could be another prognostic factors for personalized medicine.

Tuesday, Dec. 1 3:50PM - 4:00PM Location: S505AB

Participants
Tram Nguyen, Odense, Denmark (Presenter) Nothing to Disclose
Poul-Erik Braad, Odense C, Denmark (Abstract Co-Author) Nothing to Disclose
Poul Flemming Hollund-Carlsen, Odense, Denmark (Abstract Co-Author) Nothing to Disclose

PURPOSE
Quantitative PET relies on reproducible and accurate target delineation. This study investigated the unassessed variation between different commercial software packages that generally use threshold approaches. Method variability was also tested against in-house implemented methods.

METHOD AND MATERIALS
PET scans of the NEMA/IEC phantom with different target-to-background ratios (TBRs) (5:1, 10:1, 20:1, infinite) and human 18F-NaF PET images (6 vertebrae of various shapes and inhomogeneity with/without bone abnormalities) were used. Region-of-interest (ROI) analysis with the ROVER (ABX, Radeberg, Germany) and PETVCAR (GE Healthcare) software was performed along with in-house implementations. Cross-platform reproducibility was assessed by applying the same common 40% of peak value threshold method on all platforms. Cross-method variability was tested among the adaptive threshold (AT) method of ROVER, the estimated threshold (ET) by PETVCAR, and in-house implemented region growing with non-peak-based threshold (RG) and non-threshold level set (LS) methods.

RESULTS
Overall, consistent cross-platform results were obtained with some estimated mean activity deviations (~0.1-0.3 kBq/mL) and volume variations (~0.02-0.4 mL) at TBR5 and target size < 15 mm. At higher levels, ROVER deviated slightly from the other platforms with their near identical estimates. The peak-based method failed to segment inhomogeneous vertebrae well. Different methods yielded variations in estimated phantom activity (p ~ 0.6-0.9) and volumes (p ~ 0.8-0.95) that became marked at low contrast and targets < 35 mm. LS generally gave the best estimates, especially at high contrast and targets > 20 mm. Above TBR10, ET captured volumes the best, but overall underestimated activity levels the most. For vertebrae delineation, ET measurements, especially target volumes, deviated the most due to segmentation limitations.

CONCLUSION
Non-threshold or locally adaptive threshold methods had better performance range than peak-based thresholding across contrast, target size, and inhomogeneity. The cross-platform and cross-method variations introduced bias that has to be accounted for in any quantitative analysis design.

CLINICAL RELEVANCE/APPLICATION
Work like this is essential to elucidate critical aspects of quantification that will have decisive clinical impact along with the growing role of PET for prediction and therapy planning/evaluation.
Neuroradiology (Advances in Intracranial CT, MR Angiography and Perfusion)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: N226

NR CT MR
AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00
FDA

Discussions may include off-label uses.

Participants
Rajan Jain, MD, Northville, MI (Moderator) Nothing to Disclose
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Sub-Events

SSJ18-01 A Task-Driven Parameter Optimization Method for Cerebral CT Perfusion Imaging

Tuesday, Dec. 1 3:00PM - 3:10PM Location: N226

Participants
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Guang-Hong Chen, PhD, Madison, WI (Abstract Co-Author) Research funded, General Electric Company; Research funded, Siemens AG

PURPOSE
CT perfusion (CTP) imaging offers great opportunities in improving patient selection for endovascular therapy of acute ischemic stroke due to its potential in differentiating ischemic penumbra from the infarct core. However, several challenges in CTP such as poor image quality and high radiation dose have severely reduced its clinical value. This work introduces a task-driven framework to optimize CTP system parameters for improved imaging performance and reduced radiation dose.

METHOD AND MATERIALS
The proposed framework quantitatively relates image quality metrics (e.g., noise power spectrum or NPS) of the final CTP functional maps with CTP system parameters such as radiation dose and post-processing filter strength. This was achieved by developing a cascaded chain model for the CTP imaging system. To address the limitation of zero-frequency metrics such as the contrast-to-noise ratio (CNR), the framework used the task-based detectability index to quantify the CTP imaging performance. Using this framework, optimization of the post-processing denoising filter was performed for different radiation dose levels, and the optimized system parameters were validated using an in vivo canine stroke model.

RESULTS
The NPS predicted by the proposed framework had excellent agreement with the experimental data (relative RMSE<2% for all CTP maps). This indicates that the “noisiness” of the CTP maps can be quantitatively related to CTP system parameters and dose levels. Compared with the CNR that favored the strongest spatial filters, the task-based detectability led to much more reasonable optimal filter selection. With these optimized protocols, numerical simulation results demonstrate a relative increase of 101% (95% CI: [23%, 179%]), 172% (95% CI: [67%, 277%]), or 256% (95% CI: [76%, 436%]) in terms of detectability index for CBV, CBF, and MTT maps, respectively. Visual inspection of the in vivo canine results agreed with the simulation results.

CONCLUSION
The task-driven framework has successfully guided the optimization of CTP imaging systems, potentially enabling a fundamental improvement in the quality and reliability of CTP-based parametric perfusion measurements.

CLINICAL RELEVANCE/APPLICATION
It is highly desirable for endovascular therapy, which has demonstrated its benefits in recently published clinical trials, to be able to reliably distinguish the penumbra from the infarct core during patient selection.


Tuesday, Dec. 1 3:10PM - 3:20PM Location: N226

Participants
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Thomas Niederstadt, MD, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Uta Hanning, MD, Muenster, Germany (Presenter) Nothing to Disclose
Still no consent could be agreed about imaging of Acute Ischemic Stroke (AIS) in the posterior circulation. To our knowledge there exist only two studies investigating the efficacy of Computed Tomography Perfusion (CTP) for stroke detection in the posterior circulation. A recent study proposes an increase of diagnostic accuracy by additional CTP to protocols including only computed tomography angiography (CTA) and noncontrast computed tomography (NCCT), where another blinded study recognized no significant difference in the detection of supratentorial and infratentorial stroke lesions. However patient populations were relatively small. We therefore conducted a research containing a large number of consecutive patients to evaluate the diagnostic value of CTP in acute posterior circulation stroke.

METHOD AND MATERIALS

We retrospectively evaluated data of consecutive ischemic stroke patients admitted between January 1st 2012 and March 31st 2015 at a tertiary care center. The inclusion criteria for this study were (1) suspected ischemic stroke of the posterior circulation as defined in the Oxfordshire classification; (2) NCCT, CTA and CTP performed on admission; and (3) CT performed <9 hours after symptom onset. For statistical analysis we used three logistic regression models: (1) NCCT, (2) NCCT + CTA-SI and (3) NCCT + CTA-SI + CTP.

RESULTS

198 patients with suspected posterior circulation stroke fulfilled the inclusion criteria. Admission NCCT detected 26 (19%), CTA-SI 65 (48%), and CTP 109 (80%) of the 136 patients with an infarct in the posterior circulation on follow up imaging. Model 3 (area under the curve (AUC) from the receiver operating characteristic curve (ROC-curve)=0.90; 95% CI, 0.85-0.94) predicted an infarct in the posterior circulation territory better than models 1 (AUC from ROC-curve=0.597; 95% confidence interval, 0.52-0.67) and 2 (AUC from ROC-curve =0.74; 95% confidence interval, 0.67-0.81).

CONCLUSION

Our findings in a large cohort of consecutive patients show that CTP detects significantly more ischemic strokes in the posterior circulation than CTA and NCCT alone.

CLINICAL RELEVANCE/APPLICATION

Computed Tomography Perfusion should be added to standard CT- protocols for detection of ischemic stroke in the posterior circulation.

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**SSJ18-04** Choosing the Right Arterial Input Function Selection Mode for T1-DCE MRI in the CNS

**Tuesday, Dec. 1 3:20PM - 3:30PM Location: N226**

**Participants**

Samuel Barnes, PhD, Detroit, MI (Abstract Co-Author) Nothing to Disclose

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Eu-Meng Law, MBBS, Los Angeles, CA (Abstract Co-Author) Speakers Bureau, Toshiba Corporation; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, FUJIFILM Holdings Corporation;

Berislav Zlokovic, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose

Russell E. Jacobs, PhD, Pasadena, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The purpose of this study is to determine optimal parameters for acquisition and processing of DCE-MRI to detect small changes in near normal low BBB permeability in the human brain. Dynamic contrast-enhanced (DCE) MRI gives quantitative and semi-quantitative information about the integrity of the blood-brain barrier (BBB). Subtle changes of BBB integrity has been implicated in conditions such as Alzheimer’s disease, traumatic brain injury and Multiple Sclerosis. The parameter of interest in BBB integrity is the transfer constant Ktrans, which describes the transfer rate of molecules from plasma space into interstitial space; however, optimal methods to collect and analyze DCE data in order to detect subtle changes to BBB integrity remain unclear.

**METHOD AND MATERIALS**

A contrast-to-noise ratio metric (K-CNR) was developed to evaluate for Ktrans precision and accuracy estimation as a function of imaging parameters commonly encountered in a DCE-MRI study. Using the K-CNR, the effects of kinetic model selection, scan duration, temporal resolution, signal drift and length of baseline on the estimation of low permeability values were evaluated with clinically consistent simulations.

**RESULTS**

The Patlak model was shown to give the highest K-CNR at low Ktrans. The Ktrans transition point, above which other models gave superior results, was highly dependent on scan duration and tissue extravascular extracellular volume fraction (ve). The highest K-CNR for low Ktrans was obtained when Patlak model analysis was combined with long scan times (10-30 minutes), modest temporal resolution (<60 seconds/image), and long baseline scans (1-4 minute). Signal drift as low as 3% was shown to affect the accuracy of Ktrans estimation with Patlak analysis.

**CONCLUSION**

DCE acquisition and modeling parameters are interdependent and should be optimized together for the tissue being imaged. Appropriately optimized protocols can detect even the subtlest changes in BBB integrity and may be used to probe the earliest changes in neurodegenerative diseases such as traumatic brain injury, Alzheimer’s disease and Multiple Sclerosis.

**CLINICAL RELEVANCE/APPLICATION**

We analyzed the effects of DCE-MRI acquisition parameters and model selection to detect subtle changes in blood-brain barrier permeability, which are implicated in several neurodegenerative diseases.
Purpose

When applying T1-DCE MRI in the CNS, the right selection technique for the arterial input function (AIF) is a disputed question. AIF selection bias is a major obstacle for clinical implementation of the method. This study is aimed to determine the AIF selection mode that allows the most coherent and robust results of T1-DCE parameters.

Method and Materials

76 patients with various brain lesions underwent a T1-DCE scan MRI at 3.0 T (Philips Achieva TX, 8-channel head coil): 36 axial slices, TE=1.7 ms, 2 dual flip angle series, dynamic sequence: 50 scans; 12 scans/min.; contrast agent (CA) gadobutrol (0.1 mmol/kg BW; Bayer Healthcare). T1-DCE parameters Ktrans and ve were calculated with Intellispace software (Philips Healthcare). Regions of interest (ROI) were placed in different image slices. The manual AIF was derived from a 7x7 pixel ROI. 4 classical AIF selection modes were tried: (1) a Parker model based selection (MB), manual AIF selection in (2) the terminal ACI, (3) the blood vessel closest to the lesion (CV) and (4) the superior sagittal sinus (SSS, Fig. 1). Reliability of the AIF was approximated by presence of the expected curve shape, peak CA concentration and plausibility of calculated ve (<100%). Ktrans values resulting from all AIF selection methods were compared for consistency between cases.

Results

1085 ROI in brain tissue were the basis of all calculations. Using the SSS AIF, ve is significantly less overestimated compared to ACI or CV AIF (p<0.001). ROI CA peaks falsely exceed AIF peaks significantly more often in ACI or CV AIF than in SSS AIF (p<0.0001). CA peaks are significantly higher in SSS AIF (p<0.001). For glioma, the range of Ktrans values based on SSS AIF correlates best with expected ranges. Peak CA values correlate poorly between AIF selection methods except for ACI and CV AIF (r=0.515); T1-DCE parameters differed highly depending on AIF selection method (p<0.001).

Conclusion

A ROI placement in the SSS for manual AIF selection produces significantly more trustworthy results compared to other selection methods in T1-DCE MRI. ROI placements in the ACI and the CV frequently underestimate the peak arterial concentration of contrast agent and consecutively distort T1-DCE parameters.

Clinical Relevance/Application

This technical analysis study of effects of AIF selection on T1-DCE parameters is of value for all radiologists using T1-DCE MRI in the CNS concerning interpretation and validation of their results.

SSJ18-06 Acceleration-selective Arterial Spin Labeling (ASASL) MR Angiography for Visualization of Distal Cerebral Arteries in Moyamoya Disease

Tuesday, Dec. 1 3:50PM - 4:00PM Location: N226

Participants
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Kazufumi Kikuchi, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Makoto Obara, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Hiroshi Honda, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose

Purpose

Time-of-flight (TOF)-MR angiography (MRA) frequently fails to visualize distal arteries to the steno-occlusive lesion because of the slow or retrograde flow. In this study, we evaluated the utility of acceleration-selective arterial spin labeling (ASASL)-MRA in depiction of distal arteries in moyamoya disease.

Method and Materials

Fifteen patients with moyamoya disease (age 26.1 ± 23.9 year-old; 6 males, 9 females) were examined with both TOF- and ASASL-MRA on a 3T MR scanner. All patients underwent cerebral digital subtraction angiography (DSA). The ASASL-MRA consists of control (T2-preparation without motion-sensitized gradient: MSG) and label (with MSG) parts followed by 3D T1-weighted gradient-echo sequence. In the label part, MSG employs a motion compensation design to selectively detect spins with acceleration component in arteries. The TOF-MRA was obtained in the same geometry and acquisition time (6min13sec) as ASASL-MRA. In both MRAs, the number of distal MCA branches (#vessel) was counted by a line profile analysis and the contrast-to-noise ratio (CNR) was measured in peripheral branches in each hemisphere on an image of maximum intensity projection with 90mm thickness. Based on the DSA findings, the degree of steno-occlusion of ICA or the development of leptomeningeal anastomosis (LMA) was classified into two grades. The #vessel and CNR were compared between the two MR methods. Increment in #vessel between the two MR methods (#vesselASASL-#vesselTOF) was evaluated based on the DSA findings.

Results

The average #vessel obtained with ASASL-MRA (16.9±4.9, P<0.0001) was larger than that with TOF-MRA (7.2±4.5). The average CNR with ASASL-MRA (20.4±8.0, P<0.0001) was higher than that with TOF-MRA (9.2±9.2). The increment in #vessel was higher in hemispheres with severe IC stenosis (11.0±4.0, P<0.01) than those with mild stenosis (6.8±2.4). The increment in #vessel was higher in hemispheres with well-developed LMA (11.4±3.9, P<0.01) than those with mildly developed LMA (6.8±2.2).
CONCLUSION
The ASASL-MRA improved the visualization of peripheral arteries distal to the steno-occlusive site reflecting collateral flow via LMA in moyamoya disease.

CLINICAL RELEVANCE/APPLICATION
ASASL-MRA serves as a non-invasive technique to evaluate the status of branches distal to the affected main trunk representing the LMA collateral flow. The method might be useful in the planning of bypass surgery.
SSJ19

Neuroradiology/Head and Neck (ENT Oncology)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: N228

Participants
Ashley H. Aiken, MD, Atlanta, GA (Moderator) Nothing to Disclose
Barton F. Branstetter IV, MD, Pittsburgh, PA (Moderator) Nothing to Disclose

Sub-Events

SSJ19-01 Lymph Node Imaging Reporting and Data System for Ultrasound and Real-time Elastography of Cervical Lymph Node: A Pilot Study

Tuesday, Dec. 1 3:00PM - 3:10PM Location: N228

Participants
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Jung Hee Son, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To analyze ultrasound (US) and real-time elastography (RTE) features of cervical lymph node and propose a structural reporting system for lymph node.

METHOD AND MATERIALS
Between 2013 and 2014, 291 consecutive patients underwent US guided biopsies and follow-up for cervical lymph nodes were enrolled in a single institution. US features were analyzed as follows; shape, margin, echogenicity, echogenic hilum, gross necrosis, calcification, matting and vascular pattern. RTE features were analyzed; elasticity score and strain ratio. By logistic regression analysis, a score for each significant factor was assigned and multiplied by the β coefficient, and then fitted probability of malignancy was calculated. The risk of malignancy of lymph node was determined, based on the number of suspicious features.

RESULTS
Imaging features to be significantly associated with malignancy were round shape, not circumscribed margin, hyperechogenicity, absence of hilum, presence of gross necrosis and calcification, peripheral/mixed vascularity, elasticity score 3 and 4, and high strain ratio (p< 0.05). The fitted probability and risk of malignancy increased, as a number of suspicious features increased. Lymph node imaging reporting and data system (LNRADS) was established using a 5-point scale; 1 (probably benign), 2 (low suspicion for malignancy), 3 (moderate suspicion for malignancy), 4 (high suspicion for malignancy), and 5 (highly suggestive for malignancy). The risk of malignancy according to LNRADS categories was as follows; 1: 3.3%, 2: 10.9%, 3: 26.7%, 4: 51.8%-74.4%, 5: 90.6%-98.8%.

CONCLUSION
LNRADS was proposed using risk stratification of cervical lymph node according to the number of suspicious US and RTE features.

CLINICAL RELEVANCE/APPLICATION
LNRADS will help to determine the optimal strategies for management of cervical lymph node.

SSJ19-02 How Can We Differentiate Follicular Nodular Lesions with Ultrasonographic Features?

Tuesday, Dec. 1 3:10PM - 3:20PM Location: N228

Participants
Sun Hye Jeong, MD, Bucheon, Korea, Republic Of (Presenter) Nothing to Disclose
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Eun Hye Lee, MD, Bucheon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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PURPOSE
We retrospectively evaluated the ultrasonographic (US) features used to differentiate follicular nodular lesions of thyroid gland (or follicular cell-derived thyroid nodules) and tried to identify specific US features of nodular hyperplasia (NH).

METHOD AND MATERIALS
The study included 178 patients (mean age 46.6 (range 17-82) years) with surgically confirmed NH (n=100), follicular adenoma (FA) (n=56), or follicular carcinoma (FC) (n=22). Two radiologists retrospectively analyzed the US features. To determine the predictors of follicular-patterned lesions, univariate and multivariate multinomial logistic regression analyses were conducted. Receiver operating characteristic (ROC) analyses were performed to determine the effectiveness of the final model at predicting NH, FA, and FC. The inter-observer agreement was calculated.

RESULTS
Tumor diameter, margin, echotexture, cystic changes, calcification, hypoechoic rim, and vascularity were significant in the
univariate analyses. The multivariate multinomial logistic regression analyses revealed that tumor diameter (FA: \( p=0.002 \), odds ratio (OR) =1.75, 95% confidence interval (CI) 1.22, 2.51; FC: \( p=0.001 \), OR=2.02, 95% CI 1.32, 3.10), absence of cystic changes (FA: \( p=0.017 \), OR=2.21, 95% CI 0.80, 6.13; FC: \( p=0.001 \), OR=17.74, 95% CI 4.00, 78.73), and spongiform appearance (FA: \( p=0.234 \), OR=0.31, 95% CI 0.04, 2.15; FC: \( p<0.001 \), OR=1673.46, 95% CI 671.35, 4171.38) differed significantly among the three follicular nodular lesions, with NH as a reference group. The area under the curve (AUC) for NH, FA, and FC was 0.844, 0.858, and 0.705, respectively. The sensitivity for NH, FA, and FC was 0.698, 0.868, and 0.755, respectively, and the specificity was 0.820, 0.690, and 0.580. Using this model, the diagnostic accuracy of the original data was 72.6%. The inter-observer agreement was moderate to almost perfect.

**CONCLUSION**

Tumor diameter, cystic changes and spongiform appearance differed significantly among follicular nodular lesions. Using the US criteria, there was moderate diagnostic ability for NH, FA, and FC.

**CLINICAL RELEVANCE/APPLICATION**

Tumor diameter and the presence of cystic changes differed significantly among NH, FA, and FC (or follicular nodular lesions).

**SSJ19-03**  
**The Added Diagnostic Value of DW-MRI to Conventional Parameters in Characterization of Cervical Lymphadenopathy**

**Tuesday, Dec. 1 3:20PM - 3:30PM Location: N228**

**Participants**

A M Aboelsouad, MSc, Assiut, Egypt (Presenter) Nothing to Disclose

Haisam A. Atta, MD, Assiut, Egypt (Abstract Co-Author) Nothing to Disclose

Mohamed M. Abd Ellah, MD, Innsbruck, Austria (Abstract Co-Author) Nothing to Disclose

Hisham M. Imam, MBBC, MD, Assiut, Egypt (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To assess what can DW-MRI add to conventional parameters (Short axis diameter, presence or absence of hilum and presence or absence of necrosis) in prediction of malignant cervical lymphadenopathy.

**METHOD AND MATERIALS**

The study population included 72 patients having cervical lymphadenopathy underwent MRI with diffusion on 1.5T machine before they underwent biopsy. The cutoff short axis diameter (determined by ROC curve and Youden index), presence or absence of hilum, presence or absence of necrosis and cutoff ADC value (determined by ROC curve and Youden index) were assessed and finding their ability to predict malignant cervical lymphadenopathy each parameter alone, all parameters and comparing DW-MRI efficacy with that of conventional parameters.

**RESULTS**

The short axis diameter achieved 72.13%, 45.45 %, 88%, 22.73% and 68.06% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Absent hilum criterion achieved 63.9%, 27.3%, 83%, 12% and 58.3% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Present necrosis criterion achieved 21.3%, 72.7%, 81.3%, 14.3% and 29.2% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Combined conventional criteria achieved 86.9%, 0%, 82.8%, 0% and 73.6% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. The DWI with its cutoff ADC achieved 80.33%, 63.64%, 92.45%, 36.84% and 83.33% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. The combined conventional parameters and DWI achieved 98.4%, 0%, 84.5%, 0% and 83.3% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Present necrosis criterion achieved 21.3%, 72.7%, 81.3%, 14.3% and 29.2% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Absent hilum criterion achieved 63.9%, 27.3%, 83%, 12% and 58.3% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively.

**CONCLUSION**

DWI is carrying the highest sensitivity, specificity and accuracy among all conventional parameters, each alone and nearby lower sensitivity with higher specificity and accuracy than combined conventional parameters, thus use of DWI added significant diagnostic value to the ability of conventional parameters to predict malignant cervical lymphadenopathy with no extra time consuming.

**CLINICAL RELEVANCE/APPLICATION**

DW-MRI is non invasive and non time consuming method that can predict malignancy in cervical lymphadenopathy and its addition to conventional parameters increases their sensitivity with no significant extra time consuming.

**SSJ19-04**  
**Proposal for an MRI-based Score to Differentiate Pleomorphic Adenoma and Warthin Tumor in Patients with Benign Parotid Neoplasms**

**Tuesday, Dec. 1 3:30PM - 3:40PM Location: N228**

**Participants**

Beatrice Sacconi, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

Angelo Iannarelli, Rome, Italy (Abstract Co-Author) Nothing to Disclose

Renato Argio, Rome, Italy (Presenter) Nothing to Disclose

Marta Bottero, Rome, Italy (Abstract Co-Author) Nothing to Disclose

Emanuela Basile, Rome, Italy (Abstract Co-Author) Nothing to Disclose

Piero Cascone, Rome, Italy (Abstract Co-Author) Nothing to Disclose

Carlo Catalano, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

Mario Bezzi, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate the diagnostic efficacy of an MRI-based score in the differential diagnosis between parotid pleomorphic adenoma (PA) and Warthin tumor (WT).
METHOD AND MATERIALS
Twenty patients (M=10, F=10; mean age=63.5 years, range=35-87) complaining of long-standing (stable for at least 3 months) painless parotid mass underwent a 3T MR (Discovery MR750, GE); T2-weighted, DWI and T1-weighted sequences before and after contrast administration (Gadobenic acid, 0.1 ml/kg) were performed. The lesions were evaluated by three radiologists in consensus using a complex score based on three-point scales rating four different MR features (T2-signal intensity, Apparent Diffusion Coefficient values, enhancement pattern, bilateral/multiple location); total scores of ≤3 and >3 were respectively considered as suggestive of PA or WT. Final diagnosis was based on pathology reports after US-guided fine-needle-aspiration cytology (FNAC) or surgical resection.

RESULTS
Twenty-four lesions were imaged; three lesions were excluded because of MR features suggesting less common histotypes (lipoma, sialolipoma, haemangioma, all confirmed at surgery). Radiologists correctly identified 6/6 PAs and 13/13 WTs; two lesions, defined as PAs, revealed to be an oncocytoma and a granulomatous lymph node (diagnostic accuracy 90.5%).

CONCLUSION
The score allowed the differential diagnosis in all cases of PAs and WTs; an oncocytoma and a granulomatous lymph node were misdiagnosed, but the incidence of benign lesions other than PA and WT is expected to be low. These data need to be confirmed in larger patient cohorts.

CLINICAL RELEVANCE/APPLICATION
In case of benign parotid lesions, the surgical plan depends on histology. MRI can suggest tumor histology in case of uncertain cytologic diagnosis and provide information over the entire neoplasm.

PURPOSE
To evaluate the diagnostic value of the combination of echo-planer diffusion-weighted MR imaging (DWI), dynamic contrast enhanced MR imaging (DCE-MRI) and conventional MR imaging in the characterization of solid neoplasms from parotid gland.

METHOD AND MATERIALS
148 subjects (101 benign and 47 malignant) involved with parotid gland tumors were recruited in the study. Prior to surgery and pathologic verification, conventional maxillofacial MR imaging, DWI with b factor of both 0 and 1000 s/mm2 and DCE-MRI were performed on each subject. Logistic regression analysis was performed to see differences of morphological MR features (margin,shape,envelope and signal intensity of masses) between benign and malignant groups. Mean ADC value was calculated from ADC map, and then ADC threshold values between benign and malignant tumors was obtained. Time-intensity curve (TIC) with parameters were obtained from DCE-MRI. Sensitivity, specificity, accuracy, and positive and negative predictive values were calculated for the combination of relative parameters.

RESULTS
Ill-defined margin,irregular shape, no envelope, ADC value lower than cut-off point of 1.12×10-3mm2/s and TIC pattern with time to peak less than 120s and low washout ratio(<30%)were the valuable parameters for predicting malignancy (P=0.005, 0.004, 0.001, <0.001, <0.001, respectively). However, no significant difference was found in signal intensity of tumors between benign and malignant lesions. A combination of ADC value and TIC pattern yielded a sensitivity, specificity, accuracy, and positive and negative predictive values of 91.5%, 97.0%, and 95.3%, respectively. Positive and negative predictive value for distinguishing benign and malignant tumors was 93.5% and 96.1% respectively.

CONCLUSION
Conventional MR imaging combined DWI and DCE-MRI has the ability to improve the diagnostic accuracy in distinguishing between benign and malignant parotid gland tumors.

CLINICAL RELEVANCE/APPLICATION
It will be helpful for clinical diagnosis of Parotid gland tumors.
PURPOSE
To investigate the value of intravoxel incoherent motion (IVIM) diffusion-weighted (DW) imaging biomarkers for monitoring the early response to ZD6474 in an experimental tumor model by quantitative assessments of tumor microcirculation parameters with histopathological validation.

METHOD AND MATERIALS
Twenty-four female BALB/c nude mice bearing human nasopharyngeal carcinoma xenografts were scanned at baseline and after 1, 3, and 7 days of treatment with ZD6474 (n = 12) or vehicle (n = 12) at a 3T magnetic resonance imager using a custom-built 8-channel receiver coil with 2.5cm inner diameter. For IVIM DW imaging, parameters including apparent diffusion coefficient (ADC), true diffusion coefficient (D), perfusion fracture (f), and blood pseudodiffusion coefficient (D*) were measured with 12 b-values ranging from 0 to 2000 s/mm². All IVIM DW imaging parameters at different time points were compared between the treated and control groups using Student's t tests or Mann-Whitney tests. Parameters were also analyzed within the treated group by one-way analysis of variance (ANOVA). The relationships between histopathological staining for Ki-67, TUNEL, or CD31 and all IVIM parameters were evaluated by Spearman's rank correlation.

RESULTS
The percent change of the perfusion-related parameters f and D* decreased significantly in the treated group as early as the 1-day follow-up compared with those in the control group. In contrast, the diffusion-related parameters ADC and D were significantly higher in the treated group compared with the control group beginning on day 3 (P < 0.05). The substantial decreases in f at day 1 and D* at day 3 were moderately correlated with the smaller increase in tumor size over the week-long study (r = 0.66 and 0.58, respectively; P < 0.05 for both). Moderate correlations were found between microvessel density and the perfusion-related parameters f and D* and between increased TUNEL index or decreased Ki-67 index and the diffusion-related parameters ADC and D.

CONCLUSION
IVIM DW imaging was sensitive to ZD6474-induced changes in the tumor microenvironment. In particular, the f parameter had the potential to allow early prediction of tumor response to anti-angiogenic treatment.

CLINICAL RELEVANCE/APPLICATION
IVIM DW imaging was sensitive to ZD6474-induced changes in the tumor microenvironment. In particular, the f parameter had the potential to allow early prediction of tumor response to anti-angiogenic treatment.
**SSJ20**  
**Neuroradiology (Neuro-Oncology)**  
**Tuesday, Dec. 1 3:00PM - 4:00PM Location: N229**

**Participants**  
Chad A. Holder, MD, Atlanta, GA (Moderator) Nothing to Disclose  
Adam E. Flanders, MD, Penn Valley, PA (Moderator) Nothing to Disclose

**Sub-Events**

**SSJ20-01 Non-invasive Detection IDH1 Gene Status in Astrocytoma by DSC MRI: A Retrospective Study of 91 Lesions**  
**Tuesday, Dec. 1 3:00PM - 3:10PM Location: N229**

**Participants**  
Wen Li Tan, MD, Shanghai, China (Presenter) Nothing to Disclose  
Dao Ying Geng, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose  
Songhua Zhan, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose  
Ji Xiong, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose  
Wei Yuan Huang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose  
Jin Song Wu, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**  
To investigate the value of dynamic susceptibility contrast (DSC) magnetic resonance imaging (MRI) in the noninvasive evaluation of isocitrate dehydrogenase (IDH) 1 status in astrocytoma.

**METHOD AND MATERIALS**  
We retrospectively analyzed the preoperative DSC MRI data of 91 lesions with pathologically confirmed astrocytoma. We obtained the normalized maximum ratios of relative cerebral blood volume (rCBV) of tumor parenchymata. The enrolled astrocytoma patients were divided into six groups according to the World Health Organization (WHO) classification method and IDH1 gene status. We compared the differences in the rCBV ratio of tumor parenchyma between the IDH1 gene mutant and wild-type groups of WHO grades II, 3 and IV and plotted receiver operating characteristic (ROC) curves for imaging indicators showing statistically significant differences.

**RESULTS**  
The IDH1 gene mutant and wild-type groups of WHO grades II, II and IV astrocytoma showed statistically significant differences in the rCBV ratio. In WHO grade II astrocytoma, the area under the ROC curve value for the rCBV ratio was 0.83, and the cutoff value was 2.20; in WHO grade III astrocytoma, the area under the ROC curve value for the rCBV ratio was 0.86, and the cutoff value was 3.14; in WHO grade IV astrocytoma, the area under the ROC curve value for the rCBV ratio was 0.94, and the cutoff value was 5.63.

**CONCLUSION**  
The rCBV ratio value provided by DSC MRI provides a new imaging method for the noninvasive evaluation of the IDH1 status in astrocytomas of various WHO grades.

**CLINICAL RELEVANCE/APPLICATION**  
DSC MRI can noninvasively judge the IDH1 gene status of astrocytomas.

**SSJ20-02 IDH Mutation Status in Human Glioma is Associated with Differential Activation of Hypoxia and Angiogenesis Related Signaling and is Non-invasively Predictable with rCBV-imaging**  
**Tuesday, Dec. 1 3:10PM - 3:20PM Location: N229**

**Participants**  
Philipp Kickingereder, Heidelberg, Germany (Presenter) Nothing to Disclose

**PURPOSE**  
The recent identification of isocitrate dehydrogenase (IDH) mutations in gliomas and several other cancers suggests that this pathway is involved in oncogenesis; however effector functions are complex and yet incompletely understood. To study the regulatory effects of IDH on hypoxia-inducible-factor 1-alpha (HIF1A), a driving force in hypoxia-initiated angiogenesis, we performed mRNA-expression and functional, as well as genotype/imaging phenotype correlation analysis.

**METHOD AND MATERIALS**  
We studied differential mRNA-expression profiles from 288 samples with low-grade and anaplastic gliomas from The Cancer Genome Atlas (TCGA) of HIF1A and related downstream signaling on a single-gene and pathway level, as well as upstream biological causes and probable downstream effects between mutant and wild-type IDH tumors. Genotype/imaging phenotype correlation analysis was performed in a separate (local) dataset with relative cerebral blood volume (rCBV) MRI - an estimate of tumor angiogenesis - in 72 treatment-naïve patients with low-grade and anaplastic gliomas.

**RESULTS**
We show decreased expression of HIF1A-target genes on a single-gene and pathway level, strong inhibition of upstream regulators such as HIF1A and downstream biological functions such as angio- and vasculogenesis in IDH-mutant tumors. Our radiogenomic imaging approach revealed increased levels of rCBV in IDH wild-type tumors, where a one-unit increase in rCBV corresponded to a two-thirds decrease in the odds for an IDH-mutation and correctly predicted IDH mutation status in 87% of patients.

CONCLUSION
Together, these findings show that IDH-mutation status is associated with a distinct angiogenesis transcriptome signature which correlates with rCBV-imaging findings and highlight the potential future role of radiogenomics for noninvasive profiling of cancer genomic key events.

CLINICAL RELEVANCE/APPLICATION
IDH-mutation status in human glioma is associated with a distinct angiogenesis transcriptome signature which correlates with rCBV-imaging findings and highlight the potential future role of radiogenomics for noninvasive profiling of cancer genomic key events.

SSJ20-03 The Added Prognostic Value of ADC in Glioblastomas Treated with Temozolomide: Correlation with MGMT Promoter Methylation Status and Survival Analysis

Participants
Yoon Seong Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ho Joon Lee, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Mina Park, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sung Soo Ahn, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jinna Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Seung-Koo Lee, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
The added prognostic value of ADC in patients with glioblastoma treated with temozolomide, and relationship between ADC and MGMT promoter methylation status are controversial. We investigated the added prognostic value of ADC in combination with MGMT in glioblastomas treated with temozolomide, and the association between ADC and MGMT promoter methylation status, using histogram analysis.

METHOD AND MATERIALS
This retrospective study consisted of 72 consecutive patients who underwent preoperative DTI for glioblastoma, and operation followed by CCRT with temozolomide. The histogram parameters of ADC, including mean, minimum, 5th (p5), 25th (p25), 50th (p50), 75th (p75), 95th (p95) percentile and maximum values, skewness and kurtosis were calculated from entire enhancing tumors. Univariate analyses for overall survival (OS) were performed with ADC parameters according to MGMT methylation status and other clinical factors. Multivariate Cox regression was performed to build prognostic models with and without ADC parameters. The performance of each model was compared using Harrell's concordance index. In addition, the difference of ADC histogram parameters according MGMT promoter methylation status was assessed using Student t-test.

RESULTS
In univariate analysis, only lower p75 of ADC was significantly associated with worse OS in overall patients, and lower mean and p75 of ADC in patients with unmethylated MGMT. No parameters of ADC were significantly prognostic in patients with methylated MGMT. Other significant prognostic factors were age and enhancing tumor volume, as well as MGMT methylation status. In multivariate analysis, mean and p75 of ADC were independently prognostic in patients with unmethylated MGMT. The performance of prognostic models were significantly improved when mean and p75 of ADC were added to dichotomize the patients with unmethylated MGMT. Any of ADC parameters was significantly different according MGMT methylation status.

CONCLUSION
Lower ADC histogram parameters were associated with worse prognosis of glioblastomas treated with temozolomide, especially those with unmethylated MGMT. ADC histogram parameters may have the added prognostic value in combination with MGMT in patients with glioblastoma.

CLINICAL RELEVANCE/APPLICATION
Preoperative ADC histogram analysis has the added prognostic value in combination with MGMT methylation status, in patients with glioblastoma treated with temozolomide.

SSJ20-04 The Role of Advanced CT and MRI Perfusion Imaging in Differentiating Diagnosis between Gliomas Masquerading as Acute Cerebral Stroke- Eight-year Experience in a Single Institution

Participants
Xiang Liu, MD, Rochester, NY (Presenter) Nothing to Disclose
Wei Tian, MD, PhD, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Sven E. Ekholm, MD, Rochester, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
Stroke mimics could account for 3 - 13% of patients primarily diagnosed and treated as acute stroke, thrombolysis in stroke mimics is not only unnecessary and costly, but will delay a correct diagnose/treatment and may result in complications, including hemorrhage. Gliomas could present similar clinical symptom and conventional neuroimaging finding as acute brain stroke. The purpose of this study is to evaluate the value of advanced CT and MRI perfusion imaging in such differential diagnosis.

METHOD AND MATERIALS
CT and/or MR perfusion imaging findings in 1096 cases with suspected acute stroke onset in eight years of period were reviewed.
There were 22 cases with pathology confirmed gliomas, presenting acute onset of symptoms and conventional neuroimaging findings similar as acute stroke. The ratios of relative cerebral blood volume (rCBV), relative cerebral blood flow (rCBF), and mean transit time (MTT) were evaluated and compared with these stroke patients.

RESULTS

These 22 stroke-mimicking gliomas are malignant, including 13 Anaplastic astrocytomas, WHO grade II; and 9 glioblastomas, WHO Grade IV. All these gliomas showed non-enhancement or mild enhancement in post-contrast T1WI, and increased rCBV, rCBF and MTT compared to contralateral references, (p<0.001, paired t-test). The mean rCBV, rCBF and MTT values of ischemic stroke lesions were significantly lower than contralateral hemisphere (p<0.001, paired t-test). The ischemic lesions with re-perfusion could present mixed decreased and increased perfusion within the lesions. The maximal rCBV ratio (1.83±0.57, p=0.022) and rCBF ratio (2.91±0.82, p<0.001) of gliomas were significantly higher than ischemic lesions with re-perfusion (maximal rCBV ratio 1.16±0.13, maximal rCBF ratio 1.35±0.18; mann-whitney U test)

CONCLUSION

Our study shows that the gliomas mimicking symptom and imaging of acute stroke present higher perfusion than acute cerebral ischemic lesions. Carefully interpretation of multi-parameters derived from advanced CT and MRI perfusion imaging is useful in differentiating between gliomas mimicking acute stroke lesions.

CLINICAL RELEVANCE/APPLICATION

The perfusion imaging is important and adjuvant tool for accurate diagnosis in differentiating between gliomas mimicking acute stroke lesions.

SSJ20-05 Clinical Performance Characteristics of Multivoxel Magnetic Resonance Spectroscopy in Distinguishing Between True Progression and Pseudoprogression in a Series of Patients with High-Grade Glial Neoplasm

Tuesday, Dec. 1 3:40PM - 3:50PM Location: N229

Participants

Jason M. Johnson, MD, Houston, TX (Presenter) Nothing to Disclose
Rutvij J. Shah, MBBS, Houston, TX (Abstract Co-Author) Nothing to Disclose
Leena M. Ketonen, MD, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Dawid Schellinghout, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Komal B. Shah, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Norman E. Leeds, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Ashok J. Kumar, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Rivka R. Coen, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE

Rates of pseudoprogression (PsP) following chemoradiotherapy can be as high as 30% and can present a significant clinical and diagnostic burden. Early differentiation between true progression (TP) and PsP affects management decisions particularly in the era of progressive individualized treatments. We sought to review the clinical performance characteristics of MRS in a group of high-grade glial based neoplasm presenting for differentiation of PsP from TP.

METHOD AND MATERIALS

66 patients with high-grade glial neoplasm (GBM or AA) imaged during 2014 with MRI of the brain including multivoxel MRS with TE of 144 ms were evaluated. Patients were required to have either pathology follow-up or six-months of clinical and imaging follow-up to assess for accuracy. MRS solely was assessed for choline to NAA ratio within suspicious tissue as well as relative choline within suspicious tissue to normal brain parenchyma. A threshold of 2 for Cho/NAA and of >1.5 for relative choline concentrations were used as a guideline. Prior imaging and concurrent anatomic brain sequences were not reviewed.

RESULTS

Out of the 66 cases reviewed 23 patients were removed from further analysis due to unreliable MRS data. Of the remaining 33 cases (mean age 56 years, 19 males), high-grade glial neoplasm was suspected in 16 cases and not suspected in 17 cases. 15 out of 16 cases suspicious for TP were correct. MRS not thought to be consistent with TP was correct in 16/17 cases. Sensitivity = 93.8%; Specificity = 94.1%; PPV = 93.8%; NPV= 94.1%. The majority of excluded cases were due to calvarial lipid contamination into the shim box. Modest choline elevations were seen in many voxels of suspicious tissue.

CONCLUSION

High-quality multivoxel MRS used as a guideline. Prior imaging and concurrent anatomic brain sequences were not reviewed.

CLINICAL RELEVANCE/APPLICATION

High-quality multivoxel MRS is an excellent predictor of high-grade glial neoplasm versus pseudoprogression. Rigorous choline elevation thresholds for tumor versus radiation necrosis must be applied due to the common presence of modestly elevated choline concentrations in the post-treated tissue. Relying upon choline to NAA ratios alone should be done cautiously when a comparative voxel of normal appearing brain is not available for review.

SSJ20-06 Investigating Dynamic Susceptibility-weighted Contrast-enhanced (DSC) Perfusion MR Imaging in Posterior Fossa Tumors: Differences and Similarities with Supratentorial Tumors

Tuesday, Dec. 1 3:50PM - 4:00PM Location: N229

Participants

Matia Martucci, MD, Rome, Italy (Presenter) Nothing to Disclose
Simona Gaudino, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Annibale Botto, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Anna D'Angelo, Rome, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

DSC perfusion is routinely used in brain tumor imaging, for its added value in glioma grading and tumor differentiation. However, compared to supratentorial tumors (ST), there are only few data about its reliability and its cut-off values for infratentorial tumors (IT). Thus, the aims of our study were: 1) to assess the accuracy of DSC perfusion in the evaluation of IT, for glioma grading and tumor differentiation 2) to evaluate differences and similarities with ST.

METHOD AND MATERIALS

This retrospective study included 114 patients (3-85 years) with a pathologically proven diagnosis of brain tumor (40 IT, 70 ST), divided in 4 groups: high grade glioma (HGG), low grade glioma (LGG), metastases (MET), primary central nervous system lymphoma (PCNSL). rCBV, mean and min PSR were calculated. For statistical analysis lesions were divided according to the location and histology. Mann-Whitney U test was used to test the differences; accuracy, sensitivity, specificity, PPV and NPV for rCBV and PSR were calculated from ROC curves.

RESULTS

For IT, rCBV had high accuracy in differentiating HGG from LGG (p<0.001) and PSR (mean and min) resulted significantly higher in PCNSL and HGG compared to MET (p<0.001), showing a good accuracy (AUC>0.9). Comparing IT with ST, some perfusion parameters resulted similar: high rCBV in HGG, high mean PSR in PCNSL, low mean PSR in MET. Main differences between ST and IT were: the optimum threshold value of rCBV (3.05 for ST, 1.89 for IT), the mean PSR significantly higher in LGG than in HGG in ST (p=0.001) and a trend of higher perfusion values in ST. Exchanging of rCBV threshold values between ST and IT decreased both sensitivity and specificity.

CONCLUSION

rCBV and PSR are helpful in grading and differentiating IT. The overall behaviour of perfusion parameters was similar between ST and IT, but some differences in rCBV and PSR were demonstrated. The difference of rCBV threshold value between ST and IT -to distinguishing HGG from LGG- might be of high clinical relevance, and in our opinion deserves consideration.

CLINICAL RELEVANCE/APPLICATION

Our study suggests that different rCBV cut-off values should be applied in IT. In fact, our results demonstrated a different optimum threshold value of rCBV for IT (1.89) compared to ST (3.05).
**TEACHING POINTS**

A region-setting CT system is a prototype of a diagnostic CT applying the conformal irradiation method, and can strongly reduce the radiation dose outside the ROI. However, there has been no reporting about physical implementation of this system. Therefore, we developed the prototype of a region-setting CT system using a multileaf collimator (MLC). The aim of this exhibit is to show the possibility of our prototype CT for clinical use. The teaching points of this exhibit are:

1. The image quality of the region-setting CT is equivalent to that of conventional CT.
2. A region-setting CT cuts the radiation dose outside ROI by 70%.

**TABLE OF CONTENTS/OUTLINE**

1. The principle of a region-setting CT method
2. Explanation of a region-setting CT system - Block diagram and appearance of the experimental system - Procedure of scanning and image reconstruction algorithm
3. Quantitative evaluation of acquired volume image
4. Radiation dose - Conventional CT scan vs. a region-setting CT scan

**PDF UPLOAD**


**SSJ21-02 Diagnostic Accuracy and Radiation Dose Reduction Achievable in Digital Subtraction Angiogram with Elimination of Pre-contrast Images by Simultaneously Triggering X-ray and Contrast Injection**

**PURPOSE**

To assess the feasibility, measure diagnostic accuracy and estimate radiation dose reduction by using the first post-contrast image as a mask in digital subtraction angiogram (DSA) compared to conventional DSA that uses a pre-contrast image as mask.

**METHOD AND MATERIALS**

In this retrospective study, 30 consecutive patients (18 male, 12 female) who had cavogram during IVC filter placement were included (24-iodinated contrast, 6- CO2). In the control group, conventional DSA runs were automatically generated using a pre-contrast image as the mask. In the experimental group, from the same DSA runs, pre-contrast images were removed and by re-masking, the first post-contrast image was assigned as the new mask. In the control group, total number of images, number of pre-contrast images and radiation dose per run were recorded. IVC signal to noise (SNR) was measured in both groups. Following metrics were collected independently by two radiologists: Image quality (scale of 1 to 5; not acceptable to excellent subtracted images), diagnostic confidence (scale of 1 to 5; thrombus is definitely present to definitely absent) and suitability for IVC filter placement (scale of 1 to 4; suitability cannot be determined to suitable for infra-renal filter). Paired t-test was used for analysis.

**RESULTS**

In the control group, 23 images per run were obtained (SD 6, range 10-33). Kerma area product and reference point air kerma per run were 2371 µGym2 (SD 1486, range 306-6273) and 86 mGy (SD 53, range 12-241) respectively. On an average, 7 pre-contrast images were acquired per run (SD 2, range 1-11) and this estimates to 32% (SD 9%) radiation dose. SNR (mean 32.9 vs. 32.5, p=0.87), image quality (mean 3.95 vs 3.85, p=0.33), diagnostic confidence (mean 4.78 vs 4.81, p=0.48) and suitability for IVC filter
Effect of Cardiac Phase-Based Tube Current Modulation on Dose Efficiency in a Clinical CT Scanner

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S403A

Participants
Adam Budde, MS, Madison, WI (Presenter) Employee, General Electric Company
Kriti Sen Sharma, PhD,BEng, Woburn, MA (Abstract Co-Author) Employee, General Electric Company
Brian E. Nett, PhD, Waukesha, WI (Abstract Co-Author) Employee, General Electric Company

PURPOSE
A novel method for improving dose efficiency in cardiac scans has been developed and implemented on a clinical CT scanner. The method modulates the tube current based on knowledge of the weighting function applied to sinogram data in half-scan reconstructions. We assess the image quality and dose efficiency of this method on a wide-cone CT scanner (Revolution CT, GE Healthcare).

METHOD AND MATERIALS
Phase-based tube current modulation improves dose efficiency by delivering reduced dose to views that are down-weighted during the reconstruction process. A comparison of this method and the clinical baseline, a constant mA protocol, was performed on a 20 cm water phantom. Since the modulation adjusts based on the amount of phase padding prescribed by the user, a further comparison was performed across clinically-used paddings. Image noise at the center of the phantom was measured through region of interest measurements of image pixel variance. 2D noise power spectrums were also measured and, to quantitatively assess noise isotropy, an NPS radial symmetry metric was calculated as the (max-min)/max of the tangential average of the 2D NPS. All scans used cardiac reconstructions with a gantry rotation period of 280 ms and had equal dose, as determined by the integral of the mA.

RESULTS
Using 50 ms phase padding, the equal dose mA modulation reduced the image variance by 29.3% at the center reconstructed phase, 26.7% at the reconstructed phases 25 ms from center, and by 12.9% at the reconstructed phases 50 ms from center. When phase padding was reduced from 50 ms to 0 ms, the image variance at the center reconstructed phase showed an improved reduction of 36.8% from the constant mA value. The NPS radial symmetry metric of the center recon was consistent going from constant mA to the 50 ms phase padding modulation case (0.43 to 0.44), but improved on the 0 ms phase padding case (0.31), indicating some noise isotropy improvement.

CONCLUSION
Phase-based dose modulation improves dose efficiency in cardiac scans on a clinical CT scanner.

CLINICAL RELEVANCE/APPLICATION
Radiation dose reduction is achieved on cardiac scans of a clinical CT scanner without compromising image noise levels through phase-based tube current modulation.

Image noise of protocol A and B in dual-phase mode (10.70±2.65) (8.83±2.38) HU and (11.27±3.82) (8.82±2.25) HU respectively.
image noise of protocol A and B in dual-phase were\( \{10.0 \pm 2.6\}\) (8.3±4.2 mL HU and \(\{11.2 \pm 3.8\}\) (8.8±4.2 mL HU, respectively. However, CNR values obtained in group A vs in group B were comparable or higher in both LAP (19.9±9.8 vs 18.6±4.6 in CA, p<0.05; 1.1±1.13 vs 1.13±1.25 in liver, p<0.05; and 3.8±1.64 vs 2.64±1.42 in pancreas, p<0.05) and PVP (8.6±3.03 vs 7.6±2.88 in PV, p<0.05; 4.3±1.67 vs 3.92±1.85 in liver, p<0.05; and 2.91±1.46 vs 2.25±1.45 in pancreas, p<0.05). Besides, the difference of the subjective rating scores in protocol A and B were statistically insignificant (p=0.554). Effective dose in group A was significantly lower than that in group B (4.6±2.4mSv vs 6.4±3.1mSv, p=0.02) and was decreased by 30.31%. Percentages of 80kVp, 100kVp, 120kVp and 140kVp scans using KV assist were 31%, 56%, 11% and 0% for group A1, while 0%, 0%, 35%, and 65% for group A2. The radiation dose reduction in group A1 and A2 were 30.18% and 22.71% compared with group B1 and B2.

**CONCLUSION**

Abdominal enhanced CT scans using KV assist can provide better image quality and 30.31% radiation dose reduction. Radiation dose reduction on patients with BMI<24 kg/m² was more than patients with BMI≥24 kg/m².

**CLINICAL RELEVANCE/APPLICATION**

KV assist allows low kVp scans automatically applied on patients with low to moderate BMI and provides good image quality with lower radiation dose.

**SSJ21-05 Optimization of Soft-Tissue Imaging in CT with the Aid of Additional Tin Filtration**

**Tuesday, Dec. 1 3:40PM - 3:50PM Location: S403A**

**Participants**

Marcel L. Dijkshoorn, RT, Rotterdam, Netherlands (Presenter) Consultant, Siemens AG

Ronald Booij, RT, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose

Marcel Van Straten, PhD, Rotterdam, Netherlands (Abstract Co-Author) Research collaboration, Siemens AG

**PURPOSE**

To assess the dose reduction potential of an x-ray tube with additional tin (Sn) filtration in non-enhanced thoracic and abdominal CT.

**METHOD AND MATERIALS**

Eight anthropomorphic thorax and abdomen phantoms varying from 10x15cm² to 30x40cm² (QRM, Germany) were scanned on a CT scanner (SOMATOM Force, Siemens) with 11 different beam qualities (70, 80, ..., 150 kV, and 100Sn and 150Sn kV) at a fixed 32 cm CT dose index (CTDI) of 3mGy. Images were reconstructed with an iterative reconstruction algorithm (ADMIRE) at strength 0 and 3 using soft tissue, bone and lung kernels. The contrast-to-noise ratio divided by the square root of the dose (CNRD) was used as the parameter to be optimized. Contrast was assessed with the aid of tabulated mass attenuation coefficients. Noise was measured in lung and equivalent tissue. Besides the reported CTDI, dose was measured with an ionization chamber in the centre and periphery of the phantoms.

**RESULTS**

Image contrast was virtually independent of kV and therefore assumed to be constant over all scans. Measured dose relative to the reported CTDI value was approximately 2.5 times higher for the paediatric thorax phantoms at 70 kV. For higher voltages and larger phantom sizes, differences between measured and reported doses ultimately diminished. Optimal CNRD was found at 100Sn. Based on the measured dose and averaged over all phantoms and kernels, the use of 100Sn resulted in a dose reduction of 22% (range 7%-32%). For high resolution kernels in relatively large phantoms, dose reduction potential was less (up to a factor of two) or even absent. Dose reduction amount was independent of ADMIRE strength. Radiation output in terms of mGy/mAs was 11 times lower at 100Sn than at 100 kV. This prohibits the use of 100Sn in large patients and relatively high dose studies. In general, the use of a tube voltage without tin filtration was then the second best choice for the highest CNRD. The beam quality 150Sn was of use in the largest abdomen phantom only.

**CONCLUSION**

Tin filtration at 100 kV results in the most optimal beam quality for the complete range of patient sizes. Due to tube limitations this might not always be an option depending on the baseline reference dose of the scan protocol.

**CLINICAL RELEVANCE/APPLICATION**

Best results of added tin filtration are to be expected in smaller sized patients and dedicated low dose soft tissue non-enhanced studies such as screening and lung nodule follow-up.

**SSJ21-06 Has the Radiation Dose of the X-ray Equipment Currently Used for Cardiac Intervention Procedures Been Reduced? A Longitudinal and Cross-sectional Study**

**Tuesday, Dec. 1 3:50PM - 4:00PM Location: S403A**

**Participants**

Yohei Inaba, PhD, Sendai, Japan (Presenter) Nothing to Disclose

Koichi Chida, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose

Masayuki Zuguchi, MD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose

**TEACHING POINTS**

- To understand the importance of measuring/optimizing the radiation dose cineangiography and fluoroscopy of x-ray systems used for intervention procedure (IR).
- To clearly the entrance doses of x-ray equipment used for IR today and in the past.
- To clarify the image quality of cineangiography and fluoroscopy of many IR equipment.

**TABLE OF CONTENTS/OUTLINE**

Radiation dose measurement in x-ray systems used for IR - The entrance doses with cineangiography and fluoroscopy were measured. - The entrance doses for many IR x-ray systems in 2014, 2007, and 2001 were compared. Image quality evaluation for cineangiography and fluoroscopy - The spatial resolution and low contrast detectability were quantified in many IR systems. - Relationship between image quality and radiation dose were investigated. SUMMARY: Even today, many case reports have
documented radiation injury resulting from IR. Therefore, the patient dose should be kept as low as reasonably achievable, especially in IR. Although today, the entrance doses of x-ray equipment used for IR tend to be lower than previously, some equipment has a high radiation dose. Adequate parameters, such as the dose mode and additional filters, are necessary. In addition, checking the image quality of IR x-ray systems is significant issue. It is important to optimize the radiation dose and image quality.

PDF UPLOAD

Dose Optimization of a Novel Single-source Dual-energy CT Technique Using Split Filter Technique: In Vitro Assessment of Low-contrast Detectability, Image Quality and Iodine Quantification

**PURPOSE**

To optimize the radiation dose of a dual-energy technique on a single-source CT scanner using a split filter (TwinBeam Dual-Energy, Siemens) by assessing the low-contrast detectability, image quality and iodine quantification.

**METHOD AND MATERIALS**

The study used two different phantoms: a custom liver phantom containing 45 low-contrast lesions, placed in a water container mimicking an intermediate-sized patient (diameter: 30 cm) and an abdominal dual-energy phantom (both QRM, Moehrendorf, Germany) with six different iodine concentrations (2.3, 4.5, 5.3, 8.3, 15.8 and 23.5 mg/ml) and added fat ring (outer dimensions: 35 cm x 25 cm). The phantoms were scanned on a single-source scanner (SOMATOM Edge, Siemens) with (A) single-energy mode at 120 kVp and 130 ref mAs, (B) dual-energy mode at AuSn120 kVp and 640 ref. mAs (default protocol of the manufacturer) and (C) with a dose-optimized dual-energy mode at AuSn120 kVp and 420 ref. mAs (dose-neutral to the single-energy mode). Lesion detection was performed by three radiologists independently. Image noise, CNR and CTDIvol were assessed. Software provided by the vendor was used for iodine quantification. Descriptive statistics and Fisher exact test were applied.

**RESULTS**

The CTDIvol measured 7.3, 10.3, and 6.7 mGy for protocol A, B and C, respectively. The image noise was 25% and 13% lower and the CNR 31% and 14% higher with protocol B and C, respectively, compared with protocol A. There was no significant difference in lesion detection rate between the protocols (80%, 78.5%, 80.7% for protocol A, B and C, respectively (p=1.0)). The error of measurement for the iodine quantification ranged for protocol B from 2.2 to 14.7% and for protocol C from 2.2 to 9.4%.

**CONCLUSION**

The phantom study revealed that the novel split filter technique allows dose-neutral dual-energy acquisition on a single-source CT scanner at similar image quality and diagnostic accuracy compared with single-energy while providing the added value of the dual-energy mode.

**CLINICAL RELEVANCE/APPLICATION**

Since the split filter dual-energy technique on a single-source CT scanner benefits from the added information like virtual non-contrast, iodine quantification or stone characterization and the dose-neutral aspect, it can replace single-energy protocols in clinical routine.
The aim of this study was to evaluate and assess human anatomy (using cadaveric specimens) at clinically relevant dose rates on a prototype, whole-body, photon-counting-detector CT scanner.

METHOD AND MATERIALS

A prototype, whole-body CT scanner (Siemens Healthcare, Forchheim, Germany) was installed in our laboratory. The system is built on a Definition Flash dual-source platform, where the "A" tube/detector subsystem uses a conventional energy integrating detector (EID) and the "B" tube/detector subsystem uses a photon-counting detector (PCD). Following biospecimen committee approval and a thorough physics performance evaluation (dose, spatial and low-contrast resolution, CT number accuracy, etc.), a series of scans was performed on a fresh-frozen human cadaver (head and neck, chest, abdomen/pelvis and extremity scans), three cadaveric heads, a cadaveric arm, and a cadaveric leg at clinically relevant doses (140 kV, 200-220 mAs, 0.5 - 1 s rotation time). Images were acquired using two energy thresholds (25 and 65 keV), resulting in the generation of two threshold datasets and two energy bin datasets. Scans were repeated using the EID and identical scan parameters. The EID data were used for data completion to avoid truncation artifacts when the anatomy was outside the PCD field of view (27.5 cm). Side by side comparisons were made between the EID and PCD images.

RESULTS

Phantom measurements of image and dose performance demonstrated equivalent image quality and dose between the two systems, with the exception of section sensitivity profile, which was better on the PCD due to the smaller detector pixel size (0.5 mm vs 0.6 mm). PCD images of the cadaveric anatomy were judged to be equivalent to the EID images, with the exception of improved quality in regard to beam hardening: the high energy [65,140 keV] PCD images demonstrated notably decreased beam hardening, particularly in the skull. Ring artifacts, which are common in PCD CT systems, were not present.

CONCLUSION

The evaluated prototype whole-body PCD CT system was capable of clinical levels of image quality at clinical dose rates.

CLINICAL RELEVANCE/APPLICATION

The ability to perform whole-body CT scanning using photon-counting detector technology will facilitate clinical investigations of this new technology.

SSJ22-03 Compressed Sensing-Based Computed Tomography Perfusion Imaging: Preliminary Study

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S403B

Participants
Esraeil Enjilela, PhD, London, ON (Presenter) Nothing to Disclose
Ting-Yim Lee, MSc, PhD, London, ON (Abstract Co-Author) Research Grant, General Electric Company Royalties, General Electric Company
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Aaron So, PhD, London, ON (Abstract Co-Author) Nothing to Disclose

Background

CT perfusion (CTP) of the heart comprised of dynamic scanning over time (~ 30 s) as injected contrast agent perfuses through the myocardium to allow for perfusion imaging based on modeled deconvolution. However, dynamic scanning can result in radiation doses as high as 20 mSv. To reduce radiation dose, we developed a low x-ray dose CTP method for quantitative CT myocardial perfusion (MP) imaging from sparsely sampled low-intensity x-ray projections using a compressed sensing (CS) based algorithm. The feasibility of this approach for myocardial perfusion imaging was demonstrated in a pig. We performed prospective ECG-triggered dynamic CT imaging on a 70 kg farm pig at 140 kV and 80 mA/28 mAs (standard mA). For standard mA, CTP images were reconstructed from all (984) and from one-third (328) of available projections with filtered backprojection (FBP) and CS respectively. For low mA, CTP images were produced with one-half (492) of projections with CS reconstruction. Quantitative MP maps from five consecutive 5 mm slices of the porcine heart were generated with CT Perfusion software (GE Healthcare). MP measurements from regions in the lateral free wall of the MP maps of these five slices and from ex-vivo gold standard microsphere measurements were compared.

Evaluation

Compared with full view FBP MP maps, CS MP maps had biases of -0.01 (95% CI -0.05 - 0.03) and -0.05 (95% CI 0.16 - 0.07) mL/min/g, respectively, at standard and low mA. When CS MP maps were compared against ex-vivo microsphere MP measurements, the mean bias was found to be -0.12 (95% CI -0.26 - 0.03) and -0.15 (95% CI -0.04 -0.26) mL/min/g, respectively, at standard and low mA.

Discussion

Our study demonstrated that when sparsely sampled low-intensity x-ray projections are coupled with CS image reconstruction, quantitative MP maps with low bias can be generated with eight times lower radiation dose than that of our current technique.

Conclusion

The drastic reduction in radiation dose with our low-intensity sparse view scheme could facilitate the clinical use of CTP for MP imaging.

SSJ22-04 Dose or Noise Reduction for Dynamic CT Perfusion: 4D Adaptive Time-Intensity Profile Similarity (aTIPS) Bilateral Filters (BF)

Tuesday, Dec. 1 3:30PM - 3:40PM Location: S403B

Participants
Francesco Pisana, Heidelberg, Germany (Presenter) Doctoral student, Siemens AG
Thomas Henzler, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
The results of this phantom study suggest that the addition of the selective photon shield improves image quality and the CLINICAL RELEVANCE/APPLICATION also improved. At matched scanner output, the image quality of unenhanced CT of the chest is improved when using the selective photon shield with protocol B relative to A (46.6 ± 1.5 vs 37.8 ± 0.9, p < .01), representing a median increase of DI of 20.1 [19.7-23.6]%.

Image noise decreased with protocol B relative to A (60.9 ± 3.3 HU vs 79.7 ± 9.0 HU, p < .01), representing a median reduction of 10.3 ± 1.2, p < .01), representing a median increase in CNR of 30.7 [30.4-37.3]%.

Additionally, a more advanced task-based DI was calculated for a 10-mm diameter task with the purpose to simulate lung nodules. DI is an image quality metric which incorporates into a single calculation the noise, noise power spectra, contrast-dependent spatial resolution, an eye filter, and task functions of varying contrast and size. All measurements were repeated five times. Paired-t tests were used for statistical comparisons.

The DI of tasks of 10mm diameter increased representing a median reduction of 10.3 ± 1.2, p < .01), representing a median increase in CNR of 30.7 [30.4-37.3]%.

CONCLUSION

4D aTIPS-BF significantly increases the CNR while preserving perfusion signal and spatial resolution.

CLINICAL RELEVANCE/APPLICATION

The possibility to reduce image noise (or alternatively patient dose) when employing the aTIPS-BF filter would make quantitative dynamic CT perfusion more robust, potentially leading to a higher clinical acceptance in daily routine.

SSJ22-05 Impact of Selective Photon Shielding in Image Quality and Detectability Index for Unenhanced CT of the Chest: Study in a Five-year Old Anthropomorphic Phantom

Tuesday, Dec. 1 3:40PM - 3:50PM Location: S403B

Participants
Juan Carlos Ramirez-Giraldo, PhD, Malvern, PA (Presenter) Employee, Siemens AG
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Bernhard Schmidt, PhD, Forchheim, Germany (Abstract Co-Author) Employee, Siemens AG

PURPOSE

Evaluate the impact in image quality and detectability index (DI) of the use of selective photon shielding added to an x-ray tube in unenhanced CT of the chest using an anthropomorphic phantom.

METHOD AND MATERIALS

A tissue-equivalent anthropomorphic five-year old phantom underwent a simulated nonenhanced CT examination of the chest using a third-generation dual-source CT system using two protocols: (A) 100 kV and (B) 100 kV with a selective photon shield which consists of an additional piece of filtration (e.g. tin material) placed in between the x-ray beam and the patient. All scans used 196 x 0.6 mm collimation, pitch = 1.2, and 0.5 s rotation time. Both scans used automatic exposure control, and were set to operate at the same volume CT dose index of 0.6 mGy. Images were reconstructed with a sharp lung kernel at 3 mm thickness. For image quality evaluation, standard measurements of noise and contrast-to-noise ratio (CNR) between air and soft tissue were calculated.

RESULTS

Image noise decreased with protocol B relative to A (60.9 ± 3.3 HU vs 79.7 ± 9.0 HU, p < .01), representing a median reduction of 23.0[22.0 - 23.2]%, while CNR between air and soft tissue increased with protocol B relative to A (13.4 ± 0.7 vs 10.3 ± 1.2, p < .01), representing a median increase in CNR of 30.7 [30.4-37.3]%.

At matched scanner output, the image quality of unenhanced CT of the chest is improved when using the selective photon shield as demonstrated by standard metrics such as noise and CNR, while the detectability index of simulated lung nodules of 10 mm was also improved.

CONCLUSION

At matched scanner output, the image quality of unenhanced CT of the chest is improved when using the selective photon shield as demonstrated by standard metrics such as noise and CNR, while the detectability index of simulated lung nodules of 10 mm was also improved.

CLINICAL RELEVANCE/APPLICATION

The results of this phantom study suggest that the addition of the selective photon shield improves image quality and the detectability of relevant tasks such as lung nodules in pediatric unenhanced CT of the chest.

SSJ22-06 Determining the Minimal Required Ultra Low Dose CT for Reliable Attenuation Correction of F-18 FDG PET-CT: A Phantom Study
PURPOSE
To investigate minimal required sub mSv ultra low dose CT and corresponding tube current and voltage for reliable attenuation correction and semi-quantitation in FDG PET-CT in an effort for radiation dose reduction.

RESULTS
The minimal required ultra low dose of CT for precise quantification in all spheres (±10%) were determined by a combination of 100kVp and 10mA for 0.5s, 0.2mGy measured CTDIvol and 0.31mSv estimated effective dose, or 80kVp and 20mA for 0.5s, 0.22mGy and 0.34mSv. Using the data, we could determine the CT parameters for reliable attenuation correction of PET with significant radiation dose reduction.

CONCLUSION
Our phantom study provided guidance in using ultra low dose CT for precise attenuation correction and semi-quantification of FDG PET imaging, which can further reduce CT dose and radiation exposure to patients in clinical PET-CT studies. The new iterative reconstruction algorithms available in CT should be further investigated to improve the image quality of the ultra low dose CT images to provide also acceptable anatomical information in the PET-CT study.

CLINICAL RELEVANCE/APPLICATION
Based on the data, we can further reduce the radiation dose to sub mSv using an ultra low dose CT for reliable attenuation correction in clinical FDG PET-CT studies.
SSJ23-01 Accelerated Real-Time Cardiac MRI Using Iterative SENSE Reconstruction: Comparing Performance in Sinus Rhythm and Atrial Fibrillation

Tuesday, Dec. 1 3:00PM - 3:10PM Location: S404AB

Participants
R. Jason Stafford, PhD, Houston, TX (Moderator) Nothing to Disclose
Ho-Ling Liu, PhD, Houston, TX (Moderator) Nothing to Disclose

Sub-Events
SSJ23-01 Accelerated Real-Time Cardiac MRI Using Iterative SENSE Reconstruction: Comparing Performance in Sinus Rhythm and Atrial Fibrillation

Tuesday, Dec. 1 3:00PM - 3:10PM Location: S404AB

Participants
Bradley D. Allen, MD, Chicago, IL (Presenter) Nothing to Disclose
Maria Carr, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Varun Choudhary, MD, BS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
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Jeremy D. Collins, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
James C. Carr, MD, Chicago, IL (Abstract Co-Author) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

PURPOSE
To compare accelerated real-time CMR using sparse sampling in space and time and non-linear iterative SENSE reconstruction (RT IS SENSE) with standard real-time CMR (RT) and standard segmented CMR (SEG) in a cohort of patients in persistent atrial fibrillation (AF), sinus rhythm, and healthy volunteers.

METHOD AND MATERIALS
A total of n=27 patients were included: 11 patients with AF (age: 67 ± 8 years), 10 patients in sinus rhythm (age 64 ± 12 years), and 6 healthy volunteers (age: 38 ± 11 years). CMR was performed at 1.5T (MAGNETOM Aera and Avanto, Siemens, Germany). Short axis 2D bSSFP cine images covering the left ventricle with 10 mm interslice gaps were acquired with the SEG (GRAPPA accel factor 2, TR 42msec, 1.8x1.8x6 mm3), RT (GRAPPA accel factor 3, TR 62msec, 3.0x3.0x9x7 mm3), and RT IS SENSE (accel factor 9.9-12, TR 42msec, 2.0x2.0x7mm3). Quantitative left ventricular (LV) functional analysis was performed. A reviewer blinded to acquisition type scored images for overall image quality and artifact using a 5-point Likert scale. All findings were compared using a repeated measures ANOVA with Bonferonni post-hoc correction for the entire cohort and AF and sinus subgroups.

RESULTS
In the combined cohort, RT IS SENSE image quality was superior to RT (4.4±0.8 vs. 3.7±0.5, p = 0.01), with a trend toward superiority relative to SEG (3.9±1.2, p = 0.10). There was no difference in artifact between RT IS SENSE (4.4±0.7) and RT (4.9±0.3, p = 0.18) or SEG (3.9±1.4, p = 0.16). In the sinus subgroup, RT IS SENSE image quality was higher than RT (4.9±0.3 vs 3.5±0.5, p = 0.001) and trended higher than SEG (4.3±1.1, p = 0.10). In the AF subgroup, RT IS SENSE image quality was superior to SEG (4.7±0.5 vs. 3.0±1.1, p <0.001) and trended toward superiority relative to RT (3.9±0.3, p = 0.09). There was reduced artifact in RT IS SENSE compared to SEG (4.4 ±0.7 vs. 3.0±1.2, p = 0.002). For the complete cohort and in subgroups, there was no significant difference between LV ejection fraction (p = 0.66) or cardiac volumes between any of the acquisitions.

CONCLUSION
Highly accelerated real-time CMR using sparse sampling with iterative SENSE reconstruction results in improved image quality and reduced artifact, especially in patients with persistent AF.

CLINICAL RELEVANCE/APPLICATION
Real-time CMR using sparse sampling and iterative SENSE reconstruction provides high image quality and improved temporal/spatial resolution relative to standard real-time CMR.

SSJ23-02 Fast Field-Cycling MRI: Demonstration of New Technology for T1-Dispersion Contrast

Tuesday, Dec. 1 3:10PM - 3:20PM Location: S404AB

Participants
David Lurie, Aberdeen, United Kingdom (Presenter) Nothing to Disclose
Lionel M. Broche, PhD, Aberdeen, United Kingdom (Abstract Co-Author) Nothing to Disclose
Gareth R. Davies, MSc, DPhil, Aberdeen, United Kingdom (Abstract Co-Author) Nothing to Disclose
Nicholas R. Payne, BSc, Aberdeen, United Kingdom (Abstract Co-Author) Nothing to Disclose
Peter J. Ross, BSc,MSc, Aberdeen, United Kingdom (Abstract Co-Author) Nothing to Disclose
Vasileios Zampetoulas, BSc,MSc, Aberdeen, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE
We have designed and constructed two prototype human-scale scanners which use Fast Field-Cycling (FFC) to measure the
variation of tissues’ spin-lattice relaxation time (T1) as a function of magnetic field strength ("T1-dispersion"), in the range 0.001 T to 0.1 T. T1-dispersion is shown to be sensitive to disease state.

METHOD AND MATERIALS

In an FFC-MRI scanner the magnetic field B0 is switched between three levels during the scan. Initially B0 is set at a high level in order to polarize the spins. It is then switched to a low value for a time of the order of T1, so that the spins evolve. B0 is then switched back to a high value, gradients are applied and NMR signals detected. By repeating the pulse sequence at different “evolution” B0 values, T1-dispersion can be measured and employed as a contrast generator. Detection always occurs at the same field, so no retuning of radiofrequency coils is needed. The FFC-MRI scanner used was designed and constructed in-house, using commercially-available and home-built modules. The whole-body magnet uses a double coaxial design, in which the polarization and detection B0 fields are generated by a Halbach-ring permanent magnet (59 mT). This field is opposed by an inner "offset" resistive magnet in order to generate the lower, evolution B0 values. The evolution field is controlled by changing the current in the offset coil; switching between field levels can be done in ca. 30 ms. Measurements were made on healthy volunteers and on surgically-excised tissues from patients undergoing joint-replacement surgery (normal and osteoarthritic (OA) joints) and resection of breast and musculoskeletal tumours. Full ethical approval was granted, and patient consent was obtained.

RESULTS

Measurements on healthy volunteers show that good quality FFC-MRI images can be obtained. The figure shows inversion-recovery calculated-T1 FFC-MRI images of a volunteer’s brain, at 49 mT and 59 mT evolution B0 values; total acquisition time was 28 min. T1-dispersion plots (T1 versus evolution B0) showed significant differences between normal and diseased tissues, in both OA and in cancer.

CONCLUSION

This work shows that FFC-MRI is a new imaging modality which can, for the first time, use T1-dispersion as an endogenous MR contrast mechanism which is invisible in conventional MR. Early results show sensitivity of T1-dispersion to disease state.

CLINICAL RELEVANCE/APPLICATION

Study shows relevance to osteoarthritis and cancer.

SSJ23-03 A Piecewise Model for Diffusion-weighted Imaging of Prostate at 1.5T

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S404AB

Participants
Debo Zhi, BS, Hefei, China (Presenter) Nothing to Disclose
Nan He, Hefei, China (Abstract Co-Author) Nothing to Disclose
Fenfen Li, BS, Hefei, China (Abstract Co-Author) Nothing to Disclose
Bensheng Qiu, PhD, Hefei, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

The aim of this study was to investigate four diffusion-weighted imaging (DWI) models, including monoexponential diffusion model, biexponential diffusion model, statistical diffusion (SDM) model and diffusion kurtosis imaging (DKI) model, and to design a new piecewise model to precisely fit DWI signals of healthy prostate at 1.5 Tesla.

METHOD AND MATERIALS

DWI of prostate with multiple b-values ranging from 0 to 3000 s/mm² at 1.5 T was performed on 11 healthy young men. DWI signals were fitted into four diffusion models in the full range and three segments of b-values respectively. The fitness degrees of the four diffusion models in the full range and the three segments of b-values were calculated for comparison, and then a new piecewise model for prostate DWI with different b-values was proposed.

RESULTS

In the full range of b-values, the calculated fitness results showed that the diffusion kurtosis and statistical diffusion model were better fitting than the monoexponential diffusion model. The biexponential diffusion model was as good as the diffusion kurtosis and statistical models and was better fitting than the monoexponential diffusion model. In the three b-value segments, the results showed that the biexponential diffusion model was better than the kurtosis and statistical models with b-values smaller than 500 s/mm² and larger than 1000 s/mm², and the kurtosis and statistical model were better than the biexponential diffusion model with b-value ranging from 500 to 1000 s/mm².

CONCLUSION

The four mathematical models revealed different diffusion behaviors on the three b-value segments, and can be combined into a piecewise diffusion model that can fit DWI signals of prostate more precisely. This new model could potentially reveal more biological characteristic that would be helpful for the diagnosis of prostate diseases.

CLINICAL RELEVANCE/APPLICATION

A piecewise model was proposed to precisely fit DWI decay signals, and could be applied to the data analysis, attributing to improvement of sensitivity and accuracy of diagnosis of prostate cancer.

SSJ23-04 Reduction in Metal Susceptibility Artifact from Hip Prostheses Using QISS with Fast Low Angle Shot Readout

Tuesday, Dec. 1 3:30PM - 3:40PM Location: S404AB

Participants
Ian Murphy, MBBS, MRCS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
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Marcos P. Botelho, MD, Chicago, IL (Presenter) Nothing to Disclose

**PURPOSE**
Quiescent-interval single-shot (QISS) magnetic resonance angiography (MRA) has been shown to be an accurate non-contrast technique for the evaluation of peripheral arterial disease (PAD). QISS MRA applies RF pulses to suppress background and venous signal and then relies on the quiescent interval to allow refreshment of arterial spins. The standard QISS technique uses a bSSFP readout. Unfortunately, the bSSFP readout is highly sensitive to off-resonance effects, which is problematic when QISS is used to evaluate elderly patients with PAD who also have prostheses, such as the one for hip or knee. In these patients, QISS MRA may be severely degraded in the vicinity of the prosthesis. We hypothesized that QISS MRA using a fast low angle shot (FLASH) readout would reduce these artifacts and thereby improve the depiction of the arteries located near the prosthesis.

**METHODOLOGY AND MATERIALS**
The study was approved by the IRB and used written, informed consent. Imaging was performed on 1.5 Tesla system (MAGNETOM Avanto, Siemens AG, Erlangen, Germany). A standard body phantom with a femoral component hip prosthesis placed above the phantom was imaged to test the potential of QISS FLASH for reducing magnetic susceptibility artifact. No fat suppression was applied. Imaging was then carried out on patients with and without arterial disease.

**RESULTS**
A marked reduction was observed in the extent of the distortion caused by the metallic artifact using QISS with FLASH readout compared with bSSFP readout in 6 patients scanned at 1.5T (Figure 1). In two cases it allowed visualization of a vessel which was otherwise uninterpretable.

**CONCLUSION**
QISS using a high bandwidth FLASH readout reduces magnetic susceptibility artifact and improves image quality near metallic prostheses as compared with QISS using a bSSFP readout. Although the use of a high-bandwidth readout requires multiple signal averages to boost the signal-to-noise ratio, overall study time is only modestly increased since the FLASH readout is just needed for a limited region near the prosthesis.

**CLINICAL RELEVANCE/APPLICATION**
This new technique may allow non-contrast MRA evaluation of vessels and stenoses that would otherwise be obscured by artifact from hip prostheses and other metallic implants.

**SS223-05 Comparison of Different Mathematical Models of Diffusion-weighted Imaging of Normal Prostate at 1.5 T and 3.0 T**

**Tuesday, Dec. 1 3:40PM - 3:50PM Location: S404AB**

**Participants**
Debo Zhi, BS, Hefei, China (Presenter) Nothing to Disclose
Yuping Chen, Hefei, China (Abstract Co-Author) Nothing to Disclose
Bensheng Qiu, PhD, Hefei, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To find out which diffusion-weighted imaging (DWI) model, including the monoexponential model, the biexponential model, the statistical diffusion model, the diffusion kurtosis model and the stretched-exponential model, can fit diffusion-weighted signals of healthy prostate precisely at 1.5T and 3.0T.

**METHOD AND MATERIALS**
Eighteen health subjects (ten subjects at 1.5T, eight subjects at 3.0T) were included in this study. DWI of prostate was performed with multiple b-values ranging from 0 to 2100s/mm². Region of interests (ROIs) were drawn on the transition zone of prostate guided by T2-weighted images. Five DWI models were fitted to diffusion-weighted decay signals using a nonlinear squares fitting algorithm of Levenberg-Marquardt. The degree of fitness and parameters of the five DWI models were calculated for comparison.

**RESULTS**
The fitting curves for prostate DWI signals of the five models showed that the diffusion-weighted signals at 3.0T decreased faster than that at 1.5T. The adjusted R-squares showed that compared with the monoexponential model, R-squares of the other four models were larger and the R-square of the biexponential model was the largest at both 1.5T and 3.0T. Parameters of the five models showed that the parameters at 3.0T were bigger than those at 1.5T, except the parameters of statistical diffusion model and diffusion kurtosis model.

**CONCLUSION**
Our study demonstrated the biexponential model, the statistical diffusion model, the diffusion kurtosis model and the stretched-exponential model fitted better than the monoexponential model and the biexponential model showed best fitness for the diffusion-weighted signals of healthy prostate at extended b-values at both 1.5T and 3.0T. The parameters of the other four models except for the monoexponential model maybe reveal more biological characteristic.

**CLINICAL RELEVANCE/APPLICATION**
Through the comparison of the five DWI models at 1.5T and 3.0T, we can find out which model fit the diffusion-weighted signals better and provide more parameters for diagnosis of prostate diseases.

**SS223-06 Increasing SNR in MRI with Multi-Tesla Pre-polarization Pulses**

**Tuesday, Dec. 1 3:50PM - 4:00PM Location: S404AB**

**Participants**
Aleksandar Nacev, PhD, Bethesda, MD (Presenter) Nothing to Disclose
Ryan Hilaman, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
PURPOSE

Improving signal-to-noise ratio (SNR) for MRI systems has traditionally been accomplished by increasing the static magnetic field, which increases the magnitude of the magnetization vector. Safety and manufacturing considerations limit the possibilities of constructing clinical MRI systems with very high static fields. An alternative approach to increasing SNR would be to apply a polarizing magnetic pulse prior to the application of a short imaging pulse sequence. Altering magnetic polarization prior to the application of an MR imaging pulse sequence with a pulsed electromagnet has long been used in earth-field (e.g., F Melton and VL Pollak, Rev Sci Instrum 1971) and field-cycling experiments (DJ Lurie et al., Mag Res. Imag. 2005). In those prior studies, the applied polarization field has either been low (e.g., been on the order of 50mT for earth field MRI) or has subtracted field strength from the main static field (in the case of field-cycling). In either prior case, the pre-polarization pulse would not lead to significant increases in SNR when added to a clinical MRI system. Alternatively, pulsed-power techniques with desktop-sized modules have attained high magnetic field magnitudes (e.g., 26T, see GS Nusinovich et al., J Infrared Milli Terahz Waves 2011), and therefore might be well suited for the development of compact clinical MRI high-performance systems that employed rapid magnetic pre-polarization.

METHOD AND MATERIALS

A cooled copper coil (energized by three car batteries) was switched with insulated-gate bipolar transistor crowbar circuitry (Eagle Harbor Technologies, Seattle WA) in order to yield 1,000 amps for several seconds, attaining transient fields of up to 4 T with adiabatic decay, followed by a spin-echo pulse sequence generated with a Radioprocessor-G system (SpinCore, Gainesville FL) in an 0.34-T static magnetic field.

RESULTS

SNR increased in expected concordance with the Bloch equation ($r=0.95$) with strength and duration of the pre-polarizing pulses.

CONCLUSION

Pre-polarized pulsed power techniques applied to low-static-field systems could yield SNR values comparable to high-field MRI devices, with low cost and physical footprint.

CLINICAL RELEVANCE/APPLICATION

Cost-effective compact high-performance organ-specific MR systems (e.g., prostate, breast, brain) could be implemented with the addition of multi-Tesla pre-polarizing pulsed-power modules.
Purpose/Objective(s): In 2013, the American Society of Therapeutic Radiology (ASTRO) released its list of Choosing Wisely Initiatives. One of these initiatives, was to use fractionation schemes which allow less than 10 fractions for the palliation of bony metastatic disease. Such schemes may use one or five fractions to treat an uncomplicated case of bone metastases. This project looks at a rural radiation practice, both before and after a decision was made to employ the Choosing Wisely guidelines whenever appropriate.

Materials/Methods: This is a non randomized, retrospective analysis of 12 months of bone metastasis treatments in a single provider practice comparing the 6 months before Choosing Wisely to the six months after Choosing Wisely. A total of 37 consecutive patients, 63 treatment sites were examined. Fifteen treatment fractions were saved before, 84 treatment fractions were saved after the guidelines were published. Results: More fractions of radiotherapy were saved when compared to the same length of time prior to the decision to employ Choosing Wisely Initiatives. This finding, however is seen in a retrospective analysis of a single physician practice, who decided to adopt the Initiative, thus built in bias existed. Before the Choosing Wisely Initiative was released, 14% of patients received shorter fraction schemes, compared with 68% after. Because of these shorter treatment schedules, and assuming similar patient charges for treatments, savings after the Initiatives were released were over 5.5 times as much as prior to the release for the patient population, as a whole ($69,000 versus $12,000). In a time when health care costs are growing faster than the GDP, any savings we can achieve can benefit society as a whole. Numerous assumptions must be made in the analysis and the numbers are subject to discussion, but no one can deny that a patient with painful bone metastases would benefit from saving almost 4 hours in the car on rural roads. Care givers may be retired, and may not lose wages, but at the average wage of $63,000, the average caregiver saved approximately $170.00 in lost wages bringing in their loved one. The average patient who recieved shortened fractionation saved 145 miles of travel and 5 hours and 35 minutes of commuting and treatment time. Other savings were seen in one patient who needed to be hospitalized for her treatment. Her hospital stay was reduced by the use of shorter fractionation. No patient in this study required retreatment, the minimum follow up period was 6 months. Many patients have passed away from their disease within this follow up period. Conclusion: Shorter fraction schemes when used as clinically appropriate do offer savings not only to health care payers, but also to patients and patients families. Consideration of Choosing Wisely Initiatives have saved patients time and expense as opposed to a similar time period before the initiative.
Purpose/Objective(s): To assess changes in distress level in cancer patients from diagnosis to end of treatment.

METHOD AND MATERIALS
Materials/Methods: All newly diagnosed cancer patients at the Charach Cancer Treatment Center, Huron Valley-Sinai Hospital, were given a baseline distress assessment using the 10 point NCCN Distress Management Tool (DT). Patients classified as not distressed (ND) if they scored 4 or less. Patients were considered distressed (D) if their score was >4 and referred to social work for further assessment. The DT was then administered to ND individuals again at the middle and end of treatment. Demographic data was collected including age, sex, tumor type, marital status, type of therapy received (chemotherapy alone, chemo/RT or RT alone) as well as items on the NCCN problem list that accompanies the DT.

CONCLUSION
Conclusion: In this study, patients who demonstrated no distress at the start of cancer treatment had no increase in distress by the conclusion of treatment. This may relate to the difficulty of capturing changes in distress in a patient survey. Given that emotional and physical problems were significant complaints in patients with distress at the start of treatment, more attention needs to directed at these issues by clinicians. [1]
Purpose/Objective(s): In breast cancer, both biological and social factors may delay the time from diagnosis to surgery and the time to initiation of radiation therapy (RT). In this study, we analyze the impact of body mass index (BMI) on time from initial diagnosis of breast cancer to surgery (TTS) and from surgery to RT (TTR) in a large cohort of breast cancer patients. Materials/Methods: A total of 1409 patients were diagnosed with breast cancer at our institution between 2004 and 2014. Of these, 1073 patients underwent surgery as first treatment and had BMI information available in the electronic health record. We classified patients as normal weight, overweight and obese by BMI (18.5-24.9, 25-29.9, ≥30 kg/m²). Results: BMI had no statistically significant impact on TTS. TTS for normal weight (N=252), overweight (N=345) and obese patients (N=476) was 35.2 days, 36.7 days and 33.7 days, respectively (p=0.555). In a subset analysis of 489 patients undergoing follow-up EBRT, BMI did have an impact on TTR. Patients with normal weight (N=104) had the lowest TTR at 64.6 days. Obese patients (N=241) reported longer TTR at 71.7 days however the finding failed to reach statistical significance (p=0.33). Patients who were classified as overweight (N=144) had a significantly higher TTR at 85.3 days (p=0.01). Conclusion: In this large retrospective analysis, BMI was associated with a delayed time from surgery to radiation in patients classified as overweight with a BMI between 25-<30. Interestingly, obese patients with a BMI over 30 did not have a statistically longer TTR; further analysis of the overweight patient subset may reveal the reason for their uniquely longer TTR. In breast cancer, several studies link a BMI over 25 to a higher breast cancer related mortality rate. Further research must be done to further explore the impact of BMI on the quality and timeliness of care as well as its potential impact on patient outcomes.

Method and Materials

Records of 50 cancer patients who utilized acupuncture between May 2013 and April 2014 were reviewed at our institution. The subset chosen for final analysis was limited to patients who underwent radiation therapy either alone or in combination with other standard cancer treatment modalities. Variables measured included gender, age, payment method, cancer type, treatment modalities, chemotherapy class, and type and number of symptoms prompting acupuncture referral.

Results

Among 50 pts analyzed in our initial set of acupuncture patients, 26 pts, 8 men (mean age = 64.5 yrs) and 18 women (mean age = 58.5 yrs) received radiation therapy. Twenty-two pts also received chemotherapy, and 15 pts among the chemoradiation cohort underwent surgery. Breast cancer pts (n=11) were the most prevalent users of acupuncture followed by head and neck (n=4) and lung cancer (n=3). Most patients (n=20) reported assistance with 1-2 symptoms with the most common symptoms being neuropathy (n=6), arthralgias (n=6), and nausea (n=6). Among the breast cancer cohort, the most common chief complaint were arthralgias (n=6), myalgias (n=5), and neuropathy (n=4) and the most commonly used chemotherapy were taxanes (n=9).

Conclusion

Among RT patients, women were more prevalent users of acupuncture with majority diagnosed with breast cancer. The majority of patients also received either concurrent or sequential chemotherapy. Neuromusculoskeletal complaints were the most common reason for acupuncture referral.

Clinical Relevance/Application

These data will be used in future analyses to further characterize symptoms in order to strengthen outcomes evaluations and tailor emphasis to cancer subpopulations' specific symptoms.

SSJ24-06 The Impact of Body Mass Index on Time from Diagnosis to Surgery and Time from Surgery to Radiation in Patients with Breast Cancer

Tuesday, Dec. 1 3:50PM - 4:00PM Location: S104A

Participants

Apar Gupta, Boston, MA (Presenter) Nothing to Disclose
Shivani Khanna, Boston, MA (Abstract Co-Author) Nothing to Disclose
Aneek Agarwal, BS, Boston, MA (Abstract Co-Author) Nothing to Disclose
Muhammad M. Qureshi, MBBS,MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose
Divya Ahuja, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ariel E. Hirsch, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Abstract

The management of cancer treatment related side-effects is a continuous challenge to patients and healthcare providers alike. In the therapeutic armamentarium, alternative medicine is slowly gaining popularity as a complementary or substitutive management option. Among well-known alternative medicine modalities, acupuncture has been shown in several studies to reduce or eliminate radiation therapy (RT) induced effects such as RT-induced xerostomia in head and neck cancer and RT-related fatigue. In this study, we analyzed the demographics among RT patients who chose acupuncture, which symptoms prompted referral, and prevalence of combined modalities among these patients.
**SSJ25**

**Vascular/Interventional (Advances in Radioembolization)**

**Tuesday, Dec. 1 3:00PM - 4:00PM Location: E351**

**Purpose**
To evaluate the effect of 90Y radioembolization (TARE) on the growth kinetics of both the treated and the contralateral untreated colorectal cancer liver metastases as well as on the portal vein (PV) diameter.

**Method and Materials**
78 chemorefractory liver metastases from colorectal cancer in 17 patients with two MDCT scans before and one after TARE were evaluated. Liver lesions were divided in two groups: 1) treated lesions and 2) untreated contralateral lobe lesions. Tumor growth kinetics of the two groups was evaluated before and one month after the unilobar TARE comparing reciprocal doubling time (RDT) based. The diameter of the PV in treated and untreated lobes were measured by two radiologists. Student's t-test was used for analysis. P<0.05 was considered significant.

**Results**
For the treated lesions, mean RDT decreased from 8.3 to -5.6 with TARE (P<0.0001), whereas for the untreated lesions, the means RDT increased from 7.5 before TARE to10.6 after TARE (P=0.028). The mean diameter of PV did not change in the treated or untreated lobes (P=0.12 and P=0.83, respectively).

**Conclusion**
Lobar / segmental TARE significantly decreases the growth kinetics for the treated metastases but may lead to increase in the growth kinetics of contralateral liver.

**Clinical Relevance/Application**
90Y radioembolization may increase in the growth rate of untreated colorectal cancer liver metastasis in the contralateral lobe. This information may be helpful in future treatment planning of contralaeral hepatic lobe metastasis.

**Honored Educators**
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Vahid Yaghmai, MD - 2012 Honored Educator
Vahid Yaghmai, MD - 2015 Honored Educator

**SSJ25-02**

**Semiautomatic Assessment of Whole-lesion Apparent Diffusion Coefficient (ADC) as an Early Predictor of Liver Tumor Response after Radioembolization**

**Tuesday, Dec. 1 3:10PM - 3:20PM Location: E351**

**Participants**
Nils Rathmann, MD, Mannheim, Germany (Presenter) Nothing to Disclose
Johannes Budjan, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Ulrike I. Attenberger, MD, Mannheim, Germany (Abstract Co-Author) Research Consultant, Bayer AG
Michael Kostrewa, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (Abstract Co-Author) Institutional research agreement, Siemens AG
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**SSJ25-03**
Quantitative Enhancement Measurements on Pre-procedure Triphasic CT Can Predict Response to Radioembolization of Colorectal Liver Metastases

*Purpose*

A semi-automatic, volume-based ADC measurement tool was evaluated as an early predictor of therapy response after radioembolization (RE) of primary and secondary liver malignancies.

*Method and Materials*

In a retrospective analysis, a total of 50 patients suffering from primary or secondary liver tumor treated with Yttrium-90 resin microspheres for RE were included. All patients underwent a baseline MR examination as well as an early follow-up MRI 1 month after intervention. The MRI protocol included diffusion-weighted imaging (DWI, b-Values 50,400,800) as well as contrast-enhanced T1 weighted sequences. Measurement of lesion diameter, mean ADC in a representative single-slice region-of-interest (ADCTRI) and mean ADC for the entire lesion volume (ADCVOL) were evaluated in both examinations. ADCVOL was measured using a semi-automatic, image analysis software (MROncotreat, Siemens Healthcare, Germany). The progression-free interval (PFI) of the individual patients, based on further MRI scans was assessed according to RECIST 1.1 criteria. Changes in lesion diameter, ADCTRI and ADCVOL between baseline and early follow up were correlated to PFI.

*Results*

Median PFI of all patients was 3.5 ± 5.8 months post RE. Patients with an increase of ADCVOL in the first control MRI showed a statistically significant longer PFI in comparison to patients with a decrease of ADCVOL (median PFI: 6.5 months vs. 2.5 months, p = 0.02). No correlation between PFI and early changes in lesion diameter or ADCTRI was found.

*Conclusion*

In contrast to lesion diameter or single-ROI ADC evaluation, semi-automatic, software-based ADC-volume measurement seems to offer a clinically valuable parameter for early assessment of therapy response in patients after RE.

*Clinical Relevance/Application*

Software-based ADC-volume assessment helps to early identify patients with tumor response already one month post therapy and therefore could help to triage patients with no response to RE to other therapy options without delay.

**Participants**

Franz E. Boas, MD,PhD, New York, NY (Presenter) Co-founder, ClarPACS

Constantinos T. Sofocleous, MD, PhD, New York, NY (Abstract Co-Author) Consultant, Sirtex Medical Ltd

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Hooman Yarmohammadi, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

Waleed Shady, MBCh, New York, NY (Abstract Co-Author) Nothing to Disclose

Sirish Kishore, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**SSJ25-04**
Use of SPECT-CT Following Administration of Technetium-99m-labelled Macroaggregated Albumin Improves Lung Shunt Fraction (LSF) Calculation and May Allow for More Accurate Dosing of Yttrium-90 (Y-90) Treatment for Liver Tumors

*Purpose*

Colorectal liver metastases (CLM) demonstrate variable response to radioembolization. This may be at least partly due to differences in tumor arterial perfusion. This study examines whether quantitative enhancement measurements on pre-procedure triphasic CT can be used to predict response of CLM to radioembolization.

*Method and Materials*

The Institutional Review Board approved this retrospective review of patients with colorectal liver metastases treated with radioembolization, who had pre-treatment PET/CT and triphasic CT, and post-treatment PET/CT. 31 consecutive patients with 60 target tumors were included in the study. For each tumor, we calculated the hepatic artery coefficient (HAC), portal vein coefficient (PVC), and arterial enhancement fraction (AEF) based on the pre-treatment triphasic CT. HAC and PVC are estimates of the hepatic artery and portal vein blood supply. AEF is the arterial phase enhancement divided by the portal phase enhancement, and it provides an estimate of the hepatic artery blood supply as a fraction of total blood supply. Metabolic response to radioembolization for each tumor was classified into two categories - response (complete or partial response), or no response (stable disease or progression) - based on the initial (4-8 weeks) post-treatment PET/CT.

*Results*

55% of CLM showed a complete or partial metabolic response. Arterial enhancement, HAC, and PVC did not predict which tumors responded to radioembolization. However, the AEF was significantly greater in responders compared to non-responders (p=0.038). AEF < 0.4 was associated with a 40% response rate, whereas AEF > 0.75 was associated with a 78% response rate.

*Conclusion*

Response to radioembolization can be predicted using the arterial enhancement fraction calculated from pre-procedure triphasic CT.

*Clinical Relevance/Application*

AEF could enable better patient selection for radioembolization procedures.

**Participants**

Colin J. McCarthy, MD, Boston, MA (Presenter) Nothing to Disclose

Daniel Tempesta JR, BS,RT, Boston, MA (Abstract Co-Author) Nothing to Disclose
PURPOSE

Due to the risk of radiation pneumonitis, dosage of Y-90 microspheres via direct injection into hepatic artery branches for radioembolization of non-resectable metastatic and primary liver malignancies is reduced when LSF, as calculated by a treatment planning Tc-99m MAA study, exceeds 10% and may be contraindicated when LSF exceeds 20%. Because SPECT-CT offers potential advantages to traditionally used planar imaging for accuracy of LSF calculation, we evaluated how values obtained by SPECT-CT could affect management.

METHOD AND MATERIALS

Patients with estimated LSF greater than or equal to 10% on planar imaging were identified. When SPECT-CT data was available, lung shunt fraction was calculated using software (syngo MI Applications, Siemens AG) and the values were compared to the planar LSF. The Student’s t-test was used to assess for statistical significance.

RESULTS

204 shunt studies in patients with non-resectable hepatic malignancy over an 11 year period were reviewed. The majority (50.9%) of patients had colorectal carcinoma liver metastases. In 28.9% (n = 59) of cases, the LSF was 10% or greater. Of these cases, 25.4% (n=15) were found to have complete SPECT-CT imaging of the chest. The lung shunt fraction was lower when calculated using SPECT-CT in all cases. The mean LSF in this group was 17.2% ± 8.4% using planar and 7.8% ± 3.6% using SPECT CT, and this difference was statistically significant (p <0.0001). By utilizing the SPECT-CT LSF, 3 patients who were ineligible on the basis of planar LSF (>20%) became potentially eligible for treatment, 9 patients became eligible for treatment without dose reduction and in 2 cases, lesser amounts of dose reduction would have been required on the basis of the SPECT-CT LSF.

CONCLUSION

Lung shunt fraction calculations performed prior to Y-90 treatment were lower when calculated using SPECT-CT in all cases in our series. Although planar imaging has traditionally been used in the calculation of LSF, repeat calculations using SPECT-CT data should be considered when such information is available, as it may allow for a higher treatment dose, or obviate the need for an intervening embolization procedure. Further work is required to assess whether utilizing SPECT-CT data alters outcomes in these patients.

CLINICAL RELEVANCE/APPLICATION

SPECT-CT can improve accuracy of lung shunt fraction calculation in Y-90 treatment planning, and may allow for more accurate dosing.

SS125-05 Total Lesion Glycolysis and Sum of Largest Diameters of Target Lesions are Independent Predictors of Survival after 90Y Radioembolization of Colorectal Liver Metastases

Tuesday, Dec. 1 3:40PM - 3:50PM Location: E351

Participants

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Nancy Kemeny, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

To identify predictors of overall survival (OS) after 90Y radioembolization of colorectal liver metastases.

METHOD AND MATERIALS

We conducted an IRB-approved retrospective review of our prospectively created and maintained 90Y radioembolization clinical database for the time period December 2009 through December 2013. We included all patients treated for colorectal liver metastases (CLM). We excluded patients without an FDG-PET/CT scan at baseline or on the first follow-up. On the baseline portal venous phase CT, up to 5 target tumors per patient were chosen and the sum of largest diameters were calculated. On FDG-PET/CT SUVmax, functional tumor volume (FTV), and total lesion glycolysis (TLG) (meanSUV x FTV) were measured for the target lesions chosen on CT and a sum for each metric was calculated for the patient. OS was calculated from the time of radioembolization until death or last follow-up. Log-rank test was used to analyze predictor of survival on univariate analysis and a Cox-regression model was used for multivariate analysis.

RESULTS

The study enrolled 47 patients with 122 target tumors; a median of 2 (range: 1-5) tumors per patient. Thirteen patients were treated in 2 sessions, and 34 were treated in 1 session. The median OS was 12.7 months (95% CI: 7.2-16.3). The one-, two-, and three-year OS rates were 51%, 22% and 15% respectively. On univariate analysis predictors of poor survival were: CEA level >200 ng/mL (P=0.001), ECOG status >0 (P=0.001), SUVmax >30 (P=0.002), TLG >600 g (P<0.001), FTV >200 cc (P<0.001), and sum of largest diameters >10 cm (P=0.001). On multivariate analysis, only the TLG >600 g (P<0.001) (HR=4.3; 95% CI: 1.8-10.1) and sum of largest diameters >10 cm (P=0.01) (HR=2.8; 95% CI: 1.3-6.2) retained significance.
CONCLUSION

High tumor metabolic activity and sum of largest diameters >10 cm of the target tumors is associated with poor survival after 90Y radioembolization of CLM.

CLINICAL RELEVANCE/APPLICATION

Measurement of total lesion glycolysis and the size of target lesions prior to 90Y radioembolization of CLM can provide prognostic information and help predict patient survival.

PURPOSE

Yttrium-90 radioembolization (Y90 RE) is a minimally invasive therapy for liver tumors. A unique anatomical response pattern to Y90 RE, termed “radiation lobectomy (RL),” occurs in a subset of treated patients and consists of marked ipsilateral liver lobe atrophy and contralateral hypertrophy. While RL has been anecdotally described, there is limited characterization of this phenomenon in the literature. This study aimed to investigate the incidence and degree of RL, identify prognostic factors for occurrence, and examine association with survival.

METHOD AND MATERIALS

This single-center, retrospective study included 141 Y90 RE-treated patients from 2006-2012. Cases of right unilobar therapy were selected (n=33), while cases of bilobar treatment and inadequate imaging follow-up were excluded (n=108). Chart and imaging review were used to collect demographic, tumor, and treatment data, and pre-/post-RE hepatic volumes were measured. RL was defined as 25% relative atrophy of treated liver lobes. Measured outcomes included RL incidence, hepatic volumetric changes, parameters associated with RL, and survival.

RESULTS

The study cohort included 23 men and 10 women (median age 62 years). 58% (n=19) and 42% (n=14) had primary tumors and metastatic disease. Median index tumor size was 6 cm, and patients underwent median 1 (range 1-4) Y90 RE sessions (75% resin, 25% glass), with median cumulative dose of 2.33 (range 1.06-10.31) GBq. RL incidence was 33% (n=11). There were no differences in median pre-RE right (1284 vs. 1240 mL) and left (521 vs. 680 mL) lobe liver volumes between RL and non-RL groups (P>0.05). The median post-RE right (344 vs. 993 mL, P=0.002) lobe liver volume was significantly lower in the RL vs. non-RL group. A significant change between pre- and post-treatment relative right (69% to 25%, P<0.001) and left (31% to 75%, P<0.001) hepatic lobe volumes occurred in the RL group, while no significant change ensued in the non-RL group (right: 64% to 53%, left: 36% to 47%). No parameters had statistical association with RL occurrence. Median survival was significantly greater in patients exhibiting RL pattern response (1036 vs. 493 days, P=0.012).

CONCLUSION

RL occurs with relatively common frequency among patients undergoing Y90 RE. While associated with enhanced survival, predictive factors for RL occurrence remains elusive.

CLINICAL RELEVANCE/APPLICATION

RL occurs in about one-third of Y90 RE cases, and confers enhanced survival.
Vascular/Interventional (Innovation in Non-hepatic Tumor Ablation)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: N230

Participants
Juan C. Camacho, MD, Atlanta, GA (Moderator) Nothing to Disclose
Naganathan B. Mani, MD, Chesterfield, MO (Moderator) Nothing to Disclose

Sub-Events

SSJ26-01  Percutaneous Soft Tissue Cryoablation of the Head and Neck: A Safe and Effective Treatment Option

Tuesday, Dec. 1 3:00PM - 3:10PM Location: N230

Participants
Hussein D. Aoun, MD, Dearborn, MI (Presenter) Nothing to Disclose
Fatima Memon, MD, Detroit, MI (Abstract Co-Author) Nothing to Disclose
Mohamed M. Jaber, MD, Detroit, MI (Abstract Co-Author) Nothing to Disclose
Barbara A. Adam, MSN, Detroit, MI (Abstract Co-Author) Nothing to Disclose
Evan N. Fletcher, MS, BA, Detroit, MI (Abstract Co-Author) Nothing to Disclose
Matthew Prus, BS, Detroit, MI (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the technical feasibility and local outcomes of cryoablation for head and neck masses. We hypothesize that head and neck cryoablation responds similarly in terms of recurrence, complication and/or healing rates, regardless of anatomic location and tumor type.

METHOD AND MATERIALS
42 CT and/or US-guided, percutaneous cryotherapy procedures were performed for 55 tumors from primary (22) and metastatic cancers (33), in 20 patients. In general, cases were selected to avoid major cranial nerves, skin, and endoluminal involvement. Tumor number and type, prior treatment regimens, ablation volumes, location, abutting vessels >3mm, recurrences, and procedural complications were noted. Complications were graded according to Common Terminology Criteria for Adverse Events Version 4.0 (CTCAE). Local tumor recurrence and involution was monitored over time with 1, 3, 6, 12 month and annual scans thereafter.

RESULTS
Percutaneous cryoablation was performed under conscious sedation, with only one patient requiring intubation due to anticipated pharyngeal swelling post-procedure. The 22 primary tumors consisted solely of squamous cell carcinoma and the metastases were from lung (11), osteosarcoma (5), renal (4), sarcoma (3), and other (10) in origin. Of the 42 total procedures, 10 procedures involved multiple tumors being ablated in the same session. Average diameters of tumor and ablation zone were 2.5 cm and 4.2 cm, respectively. Major complications (CTCAE Grade >3) occurred after 2 procedures (4.8%). Of the 2 complications, one was a facial skin debridement as a result of thorough cryoablative coverage. Mean follow-up was 1.7 years (range: 0.03-5.33 years). Although recurrence rates were higher for primary, there was no statistically significant difference in local recurrence rates for primary and metastatic tumors, 18.2% (4/22) and 3.0% (1/33) (p>0.05), respectively. All sites of cryoablation involuted to minimal scar formation after 9 months.

CONCLUSION
CT/US guided PCA is a safe, effective local cancer control option for oligo-metastatic patients with soft tissue tumors in the head and neck region. With appropriate precautions, local healing is excellent.

CLINICAL RELEVANCE/APPLICATION
Oligometastatic disease is becoming more common with improved systemic treatments. Cryoablation of tumors contributes to improved local control for many tumor types, particularly for those having 'escaped' other treatments.

SSJ26-02  Breast Tumors Treated with Imaging-guided Percutaneous Ablation: Systematic Review and Meta-analysis

Tuesday, Dec. 1 3:10PM - 3:20PM Location: N230

Participants
Giovanni Mauri, MD, San Donato Milanese, Italy (Abstract Co-Author) Consultant, Esaote SpA
Maria P. Fedeli, San Donato Milanese, Italy (Abstract Co-Author) Nothing to Disclose
Lorenzo C. Pescatori, MD, San Donato Milanese, Italy (Presenter) Nothing to Disclose
Gianni Di Leo, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Francesco Sardanelli, MD, San Donato Milanese, Italy (Abstract Co-Author) Speakers Bureau, Bracco Group Research Grant, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific
Luca Maria Sconfienza, MD, PhD, San Donato Milanese, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
The aim of this study was to systematically review studies on imaging-guided percutaneous treatment of breast tumors.

METHOD AND MATERIALS
In March 2015 a literature search was performed on MEDLINE, EMBASE and the Cochrane Database of Systematic Reviews using
MR-guided vertebral body cryoablations were performed in four healthy, juvenile Yorkshire pigs at two vertebral locations at 1.5 Tesla. Standard DCE MRI was performed 30 minutes after cryoablation (baseline) and repeated 10-13 days later (follow-up). DCE parameters were obtained using software (Dynamika, Image Analysis Ltd, London, UK) and included color-coded gadolinium maps for persistent, plateau or washout signal intensity curves, initial rate of enhancement (IRE), and maximum enhancement (ME). DEMRIQ scores were calculated as DEMRIQ_IRE = IREmean * (Number of Plateau Pixels + Number of Washout Pixels) and DEMRIQ_ME = MEmean * (Number of Plateau Pixels + Number of Washout Pixels). P values were calculated using a Wilcoxon Signed Rank test.

RESULTS
All ablation zones demonstrated initially complete absence of gadolinium perfusion, whereas the surrounding ventral bone marrow was intact. Compared to baseline, the ablation zone decreased in size at follow-up in 8/8 (100%) vertebral bodies and completely disappeared in 4/8 (50%) with parameters indicating increased narrow perfusion along the margin of the ablation zone. Comparing baseline and follow-up, mean plateau pixels increased from 750 ± 644 (range, 205-1926) to 806 ± 474 (269-1546) (p<1), mean washout pixels from 115 ± 86 (4-233) to 398 ± 316 (15-853) (p<0.11), mean DEMRIQ_IRE scores from 2.98 ± 1.53 (0.91-5.81) to 6.60 ± 3.96 (2.30-14.39) (p<0.05) and mean DEMRIQ_ME scores from 1345 ± 909 (396-2880) to 1855 ± 966 (793-3519) (p<0.05). Overall minor complication rate was 10% (6%-16%); overall major complication rate was 6% (5%-8%).

CONCLUSION
Our results suggest that DCE MRI can be used to visualize the cryoablation zone. Longitudinal changes in parameters suggest a healing response with marrow hyperperfusion along the margins of the ablation zone and centripetal healing in normal swine. Clinical relevance of these findings is ongoing.

CLINICAL RELEVANCE/APPLICATION
Longitudinal DCE MRI parameters may be a means to monitor response and healing after percutaneous cryoablation therapy.

Clinical relevance of these findings is ongoing.
Tuesday, Dec. 1 3:30PM - 3:40PM Location: N230

Participants
Patric Kroepil, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Rudiger Wessalowski, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Christoph K. Thomas, MD, Dusseldorf, Germany (Abstract Co-Author) Speaker, Siemens AG
Gerald Antoch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Rotem S. Lanzman, MD, Duesseldorf, Germany (Presenter) Nothing to Disclose

PURPOSE
Percutaneous hyperthermia catheter allow for the placement of Bowman probes for temperature measurements inside the tumor during deep regional hyperthermia treatment. The aim of this study was to evaluate the safety and effectiveness of CT-guided placement of percutaneous hyperthermia catheter in patients with sarcoma or recurrent malignancies.

METHOD AND MATERIALS
Forty-seven patients (23 female, 24 male, mean age 45.9 ± 15.7 years) scheduled for regional deep hyperthermia treatment of primary sarcoma (n=34) or recurrent malignancies (n=13) were included in this retrospective analysis. A total of 52 hyperthermia catheters were placed under CT-guidance into tumors in the upper/lower extremities (n=19), pelvis (n=16), thoracic/abdominal wall (n=7), liver/upper abdomen (n=5) and retroperitoneum (n=5). In all patients, the tumor was approached using a 13G puncture sheath under CT-guidance and a 6F percutaneous hyperthermia catheter (Somatex, Medical Technologies) was placed via the sheath inside the tumor. The duration of the intervention, technical success, periprocedural complications and the distance of the probe within the tumor were analyzed.

RESULTS
51 of 52 (98.1%) percutaneous hyperthermia catheters were placed successfully inside the tumor, whereas one catheter was placed adjacent to the tumor. Mean tumor diameter was 7.8 ± 4.6 cm and the mean catheter distance within the tumor was 6.4 ± 3.7 cm. Mean procedure time was 30.9 ± 11.0 min. Periprocedural complications were observed in 2 of 52 (3.8%) patients; one patient developed an abscess along the subcutaneous catheter pathway and one patient had a self-limiting abdominal hematoma. 2 of 52 (3.8%) catheters dislocated within 2 weeks after the procedure.

CONCLUSION
CT-guided hyperthermia catheter placement is a safe and reliable method to support treatment control in deep regional hyperthermia for cancer treatment.

CLINICAL RELEVANCE/APPLICATION
Deep regional hyperthermia is a promising salvage treatment option for sarcoma and recurrent malignancies. CT-guidance placement of hyperthermia catheter is a safe and reliable procedure and can therefore be recommended to support temperature measurements inside the tumor during deep regional hyperthermia treatment.

Tuesday, Dec. 1 3:40PM - 3:50PM Location: N230

Participants
Dong Liu, Madison, WI (Abstract Co-Author) Nothing to Disclose
Christopher L. Brace, PhD, Madison, WI (Presenter) Shareholder, NeuWave Medical Inc; Consultant, NeuWave Medical Inc; Shareholder, Symple Surgical Inc; Consultant, Symple Surgical Inc

PURPOSE
The purpose of the study was to quantitatively analyze tissue deformation during microwave ablations

METHOD AND MATERIALS
A total of 40 fiducial markers were positioned in a single plane around a triaxial microwave ablation antenna in ex vivo liver, orthogonal to the scan plane. Powers of 50-100W at 2.45GHz (4-6 per group) were applied for 10min. CT data was acquired over entire volume every 15s. CT data was processed with markers classified into outer, middle and inner lines, which were initially 22mm, 15mm and 8mm radially from, and symmetrically oriented on both sides of the antenna. Principal strain magnitude and direction was calculated in the outer, middle and inner regions by using a triangle meshing technique. Normal and shear strain were calculated such that negative strain denoted contraction and positive strain denoted expansion. Time varying strain curves were calculated to evaluate the extents of tissue deformation in each region.

RESULTS
On average, the volumetric strain peaked at first and decayed exponentially over time. All strains were negative; no evidence of tissue expansion was observed in contrast with previous reports using a similar technique. Applied energy was correlated to greater negative strain in the inner region (R2=0.9738). In addition, powers over 50W created significantly greater inner strain than 50W (-65.7% and -54.4% for 75W and 100W, respectively, compared to -38.2% for 50W; One way ANOVA, p<0.0001). In the outer region which contained the ablation periphery, volumetric strain dropped to -41.9% and -44.3% at 75W and 100W, respectively (p<0.05). Both were significantly greater than the strain of -23.7% at 50W (p<0.0001). Outer strain angles at 50W, 75W and 100W were -0.8°, -8.1° and 1.0°, respectively. It demonstrates that the strain is oriented nearly parallel to the radial axis such that the diameter of the ablation zone is contracting more than its length. This result is concordant with previous observations.

CONCLUSION
Principal strain, a mechanical indicator of tissue deformation, decreases 30-60% during microwave ablation indicating strong tissue contraction. Greater negative strain was observed at higher applied energies in the inner region of ablation zone. Higher diametric contraction indicates ablation zones appear more elongated than the original volume.
CLINICAL RELEVANCE/APPLICATION

Tissue deformation during ablation procedures has an important effect on the treatment planning and follow-up.
ABSTRACT

Purpose/Objective(s): The optimal radiation schedule for the curative treatment of prostate cancer remains unknown. Prostate cancer patients receiving definitive external beam radiation therapy (EBRT) are typically treated 5 days per week for 7-9 weeks. This prolongation of treatment time increases healthcare costs and is less convenient for patients. There is data supporting the notion that the α/β ratio for prostate cancer cells is between 1 and 3, suggesting a clinical benefit to hypofractionation. We therefore conducted a Phase I dose escalation trial in men with low to low-intermediate risk prostate adenocarcinoma.

Materials/Methods: All men with clinical T1-2c, Gleason Score (GS) 6, prostate cancer with a prostatic specific antigen (PSA) less than 10 ng/dL were eligible for this trial. Men with clinical T1-2c, GS 7 prostate cancer and/or PSA 10 - 20 ng/dL were included provided the biopsy demonstrated low volume disease (Results: From June, 2012 to December, 2014, 9 patients were accrued to the three dose cohorts with a median follow-up of 11 months (range: 2 – 30). Patients had a median age of 63, pre-treatment PSA of 4.9 ng/dL, and pre-treatment AUA score of 10. Four patients had a GS of 7. The maximum tolerated dose (MTD) was 57.6 Gy with all patients completing treatment with less than or equal to grade 2 maximum gastrointestinal, genitourinary, dermatologic or fatigue related toxicity (Table 1). Six patients have at least 1 PSA post-treatment (3 months after completion) with a median PSA decrease of 65%. One patient of the six with > 11 month follow-up had grade 2 rectal telangiectasia requiring minor endoscopic cautery. The remaining 5 patients had no grade 2 toxicity thus far. Conclusion: All three dose levels were well tolerated with no MTD identified. Further follow-up is warranted for long term toxicity and efficacy.

Table 1: Acute toxicity in patients undergoing hypofractionated radiation. Grade of ToxicityCTCAE v. 4.0

<table>
<thead>
<tr>
<th>Dose Level</th>
<th>Grade</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>54 Gy</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>57.6 Gy</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

BOOST: Genitourinary-Integrated Science and Practice (ISP) Session

Wednesday, Dec. 2 10:30AM - 12:00PM Location: S103CD

GU RO
AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
FDA

Discussions may include off-label uses.

Participants
Stanley L. Liauw, MD, Chicago, IL (Moderator) Nothing to Disclose
George B. Rodrigues, MD, London, ON (Moderator) Nothing to Disclose

Sub-Events

**MSRO42-01 Invited Speaker:**

Wednesday, Dec. 2 10:30AM - 10:40AM Location: S103CD

Participants
Rodney J. Ellis, MD, Pepper Pike, OH (Presenter) Nothing to Disclose

**MSRO42-02 A Phase I Dose Escalation Study of Hypofractionated Radiation Therapy for Favorable Risk Prostate Cancer: Acute Toxicity and Early Efficacy**

Wednesday, Dec. 2 10:40AM - 10:50AM Location: S103CD

Participants
Nicholas J. Sanfilippo, MD, New York, NY (Presenter) Nothing to Disclose
William C. Huang, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Herbert Lepor, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Silvia C. Formenti, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Benjamin Cooper, New York, NY (Abstract Co-Author) Nothing to Disclose
Smith Beverly, New York, NY (Abstract Co-Author) Nothing to Disclose
Barry Rosenstein, New York, NY (Abstract Co-Author) Nothing to Disclose
Samir S. Taneja, MD, New York, NY (Abstract Co-Author) Consultant, Eigen Consultant, GTX, Inc Consultant, Bayer AG Consultant, Healthtrons, Inc Speaker, Johnson & Johnson Investigator, STBEA Biotech NV Royalties, Reed Elsevier

**MSRO42-03 Robotic Stereotactic Body Radiation Therapy for Organ Confined Prostate Cancer**

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S103CD

Participants
Jonathan A. Haas, MD, Mineola, NY (Presenter) Speaker, Accuray Incorporated
Aaron E. Katz, MD, Garden City, NY (Abstract Co-Author) Nothing to Disclose
Seth Blacksburg, MD, MBA, New York, NY (Abstract Co-Author) Speakers Bureau, Bayer AG;
Owen Clancy, PhD, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Michael Santoro, MD, East Meadow, NY (Abstract Co-Author) Nothing to Disclose
Richard Ashley, MD, Garden City, NY (Abstract Co-Author) Nothing to Disclose
Dimitri Kessaris, MD, Manhasset, NY (Abstract Co-Author) Nothing to Disclose
Robert Mucciolo, MD, Massapequa, NY (Abstract Co-Author) Nothing to Disclose
Asoci Sanchez, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Diane Accordiono, RN, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Susan Lowery, BA, Mineola, NY (Abstract Co-Author) Nothing to Disclose
William Macmelville, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Christopher Mendez, BA, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Matthew R. Witten, PhD, Mineola, NY (Abstract Co-Author) Nothing to Disclose
ABSTRACT

Purpose/Objective(s): The unique radiobiology of prostate cancer supports a hypofractionated as opposed to a conventionally fractionated dose regimen with a potential for improved outcomes and reduced toxicities. We report on our continued experience using a robotic linear accelerator to deliver stereotactic body radiation therapy for localized prostate cancer.

Materials/Methods: From April 2006 through December 2014, a total of 1207 patients with localized carcinoma of the prostate were treated with robotic stereotactic body radiation therapy at a single institution. All patients had T1c to T2b disease. 493 patients had low risk disease. 548 patients had intermediate risk disease. 166 patients had high risk disease. Pretreatment PSAs ranged from .77 to 205. 126 patients received hormonal therapy prior to treatment at the discretion of their urologist. Treatment planning was done with CT scans fused with an MRI scan except in 31 cases where an MRI scan could not be done for medical reasons such as a pacemaker. Dose was prescribed to the 83% to 87% line, 5 mm beyond the capsule except posteriorly 3 mm. 1037 patients with low and intermediate risk disease received CyberKnife only to a dose of 3500 to 3625 cGy over 5 fractions. All patients received 1500 mg of amifostine intrarectally 50 minutes prior to each treatment fraction. Results: The median initial PSA was 6.2. The median follow-up was 33 months. The median post treatment PSA is 0.35. At the time of last follow-up, 12 patients have had a PSA failure by Phoenix biochemical definition. 1 patient with low risk disease failed. 7 patients with intermediate risk disease failed and 4 patients with high risk disease failed. There were 136 patients with a minimum follow up of at least 36 months and 56 patients with a minimum follow up of at least 48 months. There are 26 patients with a minimum follow up of 60 months. 272 patients achieved a PSA below 0.2 and 413 patients reached a PSA below 0.4. The median treatment PSA at 12 months is 0.90. The median PSA at 24 months is 0.45. The median PSA at 36 months is 0.40. the median PSA at 48 months is 0.25. The median treatment PSA at 60 months is 0.20. With a median follow up of 33 months, the biochemical disease free survival for low risk, intermediate risk, and high risk was 99.7%, 98.7%, and 97.5% respectively. 2 patients had symptomatic hematuria which resolved with hyperbaric oxygen. 2 patients required green light laser for urinary retention. 1 patient has required catheterization. 3 patients had rectal bleeding which resolved with rowasa enemas and hyperbaric oxygen.

Conclusion: Stereotactic body radiation therapy using a robotic linear accelerator continues to be extremely well tolerated and efficacious in the management of localized prostate cancer. High rates of local control can be achieved while also achieving low rates of bladder and rectal toxicity. This study confirms prior reported series with a larger number of patients.

MSRO42-04 The Effect of Radiation Timing on PSA Reduction in High Risk Prostate Cancer Patients Treated with Definitive Radiation Therapy

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S103CD

Participants
Apar Gupta, Boston, MA (Presenter) Nothing to Disclose
Steven Vemali, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ankit Agarwal, BS, Boston, MA (Abstract Co-Author) Nothing to Disclose
Muhammad M. Qureshi, MBBS, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose
Alexander E. Rand, BA, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ariel E. Hirsch, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): We previously found that neither time to treatment (TTT) nor elapsed time of treatment (ETT) had any effect on PSA velocity in patients with low- and intermediate-risk prostate cancer. In this analysis, we sought to examine the effects of TTT and ETT on PSA change in patients with high-risk prostate cancer.

Materials/Methods: We performed a retrospective review of 1,584 patients who were diagnosed with prostate cancer at our institution between January 2005 and December 2013, and found 412 patients with non-metastatic disease who completed treatment with definitive external beam radiation therapy (EBRT). A total of 146 patients who also received concurrent androgen-deprivation therapy (ADT) were included in the analysis. TTT was calculated as days between positive prostate biopsy and EBRT start date, and ETT was calculated as days between EBRT start and stop date. Demographic data on race/ethnicity, primary language spoken, insurance status, marital status, and age were also collected. Analysis of variance was performed to analyze the relationship of these factors with absolute and percentage change in pre- and post-EBRT PSA levels. Data were analyzed using a 0.05 level of significance. Results: Median age at diagnosis was 67 years (range 50-85 years); 11% had a Gleason score (GS) of 6, 49% GS 7, and 40% GS 8-10. Median TTT was 134 days and median ETT was 62 days. No demographic variable was found to be significantly related to absolute or percentage change in PSA. No optimal threshold of days from diagnosis to treatment (TTT) was identified to predict change in PSA level. ETT was significantly related to PSA change, after adjusting for demographic variables. Those who fell in the upper quartile of ETT (>64 days) were found to have a 94.2% decline in PSA, compared to 98.0% for those who fell in the lower three quartiles (p=0.03). Conclusion: A delay in treatment prior to starting EBRT did not have an effect on post-EBRT PSA level, relative to initial PSA level. However, a delay during EBRT was related to a lesser reduction in PSA decline. Further research is warranted in this area to elucidate the clinical significance of differences in PSA reduction.

MSRO42-05 Patient Inversion Therapy for Bowel (PITB) to Achieve Maximum Displacement in Radiotherapy for Prostate Cancer

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S103CD

Participants
Gordon L. Grado, MD, PhD, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
David Constantinescu, Charleston, IL (Presenter) Nothing to Disclose
Scott Thompson, CMD, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
Carrie S. Petrone, RN, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
Mary M. Grado, BSN, MS, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
Michael C. Grado, BA, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
Thayne Larson, MD, Scottsdale, AZ (Abstract Co-Author) Research Consultant, NxThera, Inc

ABSTRACT

Purpose/Objective(s): The purpose of this study was to evaluate a new and novel approach to the valuation and reduction of small bowel volume from the irradiated fields in the treatment of prostate cancer. This technique utilizes inversion therapy to either completely displace small or large bowel from the irradiated field or to significantly reduce the volume of bowel irradiated in the PTV. This procedure has potential application in multiple areas of abdominal and pelvic radiation therapy.

METHOD AND MATERIALS
Between January 2014 and March 2015, 14 consecutive patients were identified where small or large bowel was directly within the irradiated PTV. Patients were evaluated with bladder distention, patient positioning, and inversion therapy to displace bowel from the irradiated PTV. Inversion therapy had the greatest effect in displacing and maintaining displacement of bowel from the irradiated volume. Several inversion tables were evaluated prior to the procedure and the two safest devices with the most clinical experience for inversion therapy were selected for this trial. Dose volume histograms were compared with and without inversion.

RESULTS

Patients were identified with loops of bowel directly within the radiated field due to previous surgery or anatomy. Standard techniques for bowel displacement (patient positioning, bladder distention, belly-board), were ineffective at displacing sufficient bowel from the irradiated volume to affect greater radiation dose delivery. Inversion therapy was selected for bowel displacement which when combined with bladder distention maintained the displacement during the course of radiation therapy. 13/14 patients were found to have sufficient bowel displacement to allow greater radiation dose delivery to the PTV without compromising field size or prescribed dose. 1/14 patients did not benefit from this technique.

CONCLUSION

Patient inversion therapy for bowel (PITB) achieved excellent bowel displacement for radiation therapy to the pelvis. In these patients, neither the radiation therapy field nor the prescribed dose had to be compromised. Patients also had fewer bowel and bladder symptoms during the pelvic radiation therapy. This technique is determined to be useful, easily applicable, and well tolerated by patients.

CLINICAL RELEVANCE/APPLICATION

This procedure permits higher radiation therapy dose delivery to the PTV with fewer side effects and morbidity due to less small/large bowel volume irradiated.

MSRO42-06 Institutional Experience of Long-term (10-15 Years) Results with High Dose Rate (HDR) Salvage Therapy for Recurrent Prostate Cancer

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S103CD

Participants

Nevine M. Hanna, MD, Sandy, UT (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Limited treatments are available for recurrent prostate cancer patients. Modality selection can be challenging for both the patient and their physicians. HDR brachytherapy has been used extensively as a boost after external beam radiation therapy, but is increasingly being tested as salvage treated for locally recurrent prostate cancer. We report our long-term results for HDR salvage brachytherapy in patients with initially low, intermediate, and high risk prostate cancer.Materials/Methods: Patients (n=27) with a median age of 71 (57-84) years at recurrence with low- (n=10), intermediate- (n=8), and high-risk prostate cancer (n=9) treated at the California Endocurieetherapy (CET now at UCLA) between 1991 and 2009 were analyzed. Median HDR brachytherapy dose prescription was 36 (22-46) Gy in 6 (3-8) fractions. Five patients did receive additional external beam radiation therapy (EBRT) after HDR brachytherapy to an EBRT dose of 36 (36-50) Gy. Presenting disease characteristics were median recurrent PSA 8.1 (1.4-86.7) ng/mL, Gleason Score 7 (5-10), median prostate volume 23.2 (0-80) cc. Androgen deprivation therapy (ADT) was administered in 68% for a median of 6 (3-96) months. Risk groups were defined according to the NCCN guidelines. Sustained PSA nadir+2 was used to define biochemical relapse. Statistical analyses being performed are to include Kaplan-Meier analyses and univariate and multivariate Cox proportional analyses.Results: Preliminary analysis shows that the median overall follow-up time was 6.90 (0.30-15.92) years. The 5, 10 and 15 year overall survival (OS) rates were 86%, 36% and 11%, respectively. The 5, 10 and 15 year distant metastases-free survival (DMFS) rates were 68%, 29% and 11%, respectively. Biochemical progression free survival (BPFS) for the initially presenting low, intermediate and high grade patients is 122, 59, and 41 months, respectively. The 5, 10 and 15 year overall survival (OS) rates were 86%, 36% and 11%, respectively. Univariate Cox analyses and multivariate analyses are currently underway to determine the impact of ADT on these parameters.Conclusion: Our long-term data validates HDR salvage brachytherapy in recurrent prostate cancer patients as a standard treatment option which offers excellent rates of disease control.

MSRO42-07 Designing and Implementing an Innovative Phantom-Based Simulator Training Program for Prostate Brachytherapy Using Advanced Magnetic Resonance Imaging

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S103CD

Awards

Trainee Research Prize - Resident

Participants

Nikhil G. Thaker, MD, Houston, TX (Presenter) Nothing to Disclose
Tze Yee Lim, Houston, TX (Abstract Co-Author) Nothing to Disclose
Rajat Kudchadker, Houston, TX (Abstract Co-Author) Nothing to Disclose
Tharakeswara K. Bathala, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Thomas Pugh, Houston, TX (Abstract Co-Author) Nothing to Disclose
Usama Mahmood, Houston, TX (Abstract Co-Author) Nothing to Disclose
Deborah A. Kuban, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Rajat Tze Yee Lim, Houston, TX (Abstract Co-Author) Nothing to Disclose
Jihong Wang, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
R. Jason Stafford, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Thomas A. Buchholz, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
S J. Frank, MD, Houston, TX (Abstract Co-Author) Board Member, C4 Imaging LLC; Stockholder, C4 Imaging LLC; Advisory Board, Elekta AB

PURPOSE

Prostate brachytherapy (PB) is a well-established treatment for localized prostate cancer and has the potential to deliver excellent
outcomes at low cost. However, high-quality PB requires hands-on training and expertise in image-guidance, which is minimally emphasized in current radiation oncology training. Additionally, MRI holds promise of improving target delineation over CT imaging. Our objective was to design and implement a unique pilot training program that utilizes advanced MRI and a phantom simulator approach to improve the quality of PB education.

METHOD AND MATERIALS

Our existing PB phantom simulator program was adapted to introduce MRI treatment planning and post-implant evaluation. The simulator program emphasized six core areas: patient selection, simulation, treatment planning, implantation, treatment evaluation, and outcome assessment. Trainees in the simulator program were residents, fellows, or physicists. The program utilized the Iodine-125 pre-operative planning technique and a transrectal ultrasound device to implant prostate phantoms. MRI markers were substituted for spacers to allow for visualization.

RESULTS

Forty one trainees have completed the phantom simulator program to date. Ten implants were successfully conducted during the MRI-phantom simulator pilot program. MRI 3DT2 CUBE sequence could adequately delineate the prostate, seminal vesicles, rectum and bladder in the CIRS 053MM phantom. Dummy seeds could be well-visualized with post-implant CT scans. However, seed identification on MRI required a learning curve due to the need to identify MRI markers, which flanked each dummy seed (Figure). The MRI markers facilitated detection of up to 97% of seeds in implanted phantoms by identifying the signal voids between MRI markers.

CONCLUSION

This proof-of-principle educational curriculum successfully adapted a phantom simulator training program to implement advanced MRI simulation, treatment planning, and post-implant dosimetry. Analysis of implants showed that most organs could be adequately visualized with MRI and that most seeds could be identified with the aid of MRI markers. Phantom-based simulator training programs can provide a valuable educational opportunity to learn the PB process and to learn how to implement advanced image-guidance.

CLINICAL RELEVANCE/APPLICATION

Phantom-based simulator training can enhance practical expertise with advanced imaging technology and image-guide therapies.

**ABSTRACT**

**Purpose/Objective(s):** We assessed the efficacy and toxicity of stereotactic body radiation therapy (SBRT) for primary lesion of renal cell carcinoma (RCC).

**Materials/Methods:** We retrospectively reviewed 9 patients (7 male and 2 female) with stage 1 RCC treated with SBRT between 2007 and 2014. The diagnosis of RCC was judged according to imaging. The median age was 73 years old (range, 59-79). Three patients had high serum creatinine level before SBRT. Four patients had history of prior contralateral nephrectomy. The median diameter of tumor was 18 mm (range, 9-26). A total dose of 60-70 Gy in 10 fractions was administered at the 95% of planning target volume or internal target volume. Median biologically effective dose was 119 Gy (range 96-119), using an a/ß value of 10 Gy. Overall survival (OS) and local progression-free survival (LPFS) were based on Kaplan Meier estimates. Toxicity was scored according to NCI-CTCAE, version 4.0. Renal disorder was graded by referring to pretreatment renal function. Results: The median follow-up duration after SBRT was 28 months (range, 11-89). Clinical response was partial response (PR) in 5 tumors, stable disease (SD) in 4 tumors. Five tumors with PR has decreased gradually in size for 11-56 months (median, 42) after SBRT. Three patients developed distant metastases. The 2- and 3- year OS rate were 85.7% and 64.3%, respectively (median survival time, 44 months). The 3- year LPFS rate was 100%. In a case of a patient with SD tumor, autopsy was performed at 29 months after SBRT, and it showed almost complete necrosis of tumor tissues with a small amount of viable renal carcinoma cells. Three patients developed Grade 3 chronic kidney disease (CKD), 1 had Grade 2 CKD. All patients with Grade 3 CKD had high serum creatinine level before SBRT, and 2 of these patients had prior contralateral nephrectomy before SBRT. Severe toxicity for other organs at risk was not observed. Conclusion: SBRT for primary lesion of RCC resulted in acceptable LPFS and toxicity. Because of slow tumor response, we need long-term follow up to observe the effect of SBRT for RCC. Multicenter prospective study is mandatory to evaluate true local effect and toxicity and to compare SBRT versus other local treatment modalities for RCC.
Breast Imaging (Density and Risk Assessment)
Wednesday, Dec. 2 10:30AM - 12:00PM Location: Arie Crown Theater

SSK01-02 National Trends in Reporting of Breast Density in Response to Breast Density Notification Legislation
Wednesday, Dec. 2 10:40AM - 10:50AM Location: Arie Crown Theater

Participants
Jennifer A. Harvey, MD, Charlottesville, VA (Moderator) Researcher, Hologic, Inc; Researcher, VuCOMP, Inc; Researcher, Matakina Technology Limited; Shareholder, Matakina Technology Limited; Shareholder, Hologic, Inc
Emily F. Conant, MD, Philadelphia, PA (Moderator) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Martin J. Yaffe, PhD, Toronto, ON (Moderator) Research collaboration, General Electric Company Founder, Matakina International Ltd Shareholder, Matakina International Ltd Co-founder, Mammographic Physics Inc

Sub-Events
SSK01-01 Breast Density: Who is Informing the Patients?
Wednesday, Dec. 2 10:30AM - 10:40AM Location: Arie Crown Theater

PURPOSE
To assess the impact of California's Breast Density law on radiology technologists.

METHOD AND MATERIALS
Attendees of an educational conference targeted to radiology technologists in California were surveyed anonymously and voluntarily. Fisher's Exact Test was used to test for association between practice responses and technologist characteristics. Data were analyzed using SAS® software version 9.3 (SAS Institute, Cary, NC). A p-value of <=0.05 was considered significant.

RESULTS
110 of 133 attendees (83% response rate) completed the survey. 67% of respondents have noticed a change in patients' level of concern about breast density with 53% answering breast density related questions daily. The majority of respondents reported being asked what breast density means and what dense breasted patients should do subsequently (82%); specifically, 59% reported the topic of supplemental screening tests due to dense breasts as a common patient concern. More than half refer the patient to her doctor (63%) and explain that the patient may need additional imaging (55%). While 71% reported being completely/mostly comfortable, 22% were only somewhat comfortable and 5% were not comfortable in answering patient questions about breast density (2% reported not receiving any density questions). As expected, technologist level of comfort answering these questions was higher for those with >20 years of experience (79%) in comparison to those with <=20 years of work experience (57%,p=0.02) and was independent of dedicated mammography work time (p=0.304). 88% of technologists expressed an interest in further education regarding breast density.

CONCLUSION
Although the California breast density law recommends that patients discuss their breast density and supplementary screening tests with their primary care physicians, women are seeking information from radiology technologists about breast density daily. While technologists with more than 20 years of experience are more comfortable answering these questions, the majority of technologists regardless of years of experience are interested in further education about breast density and its impact on breast cancer screening.

CLINICAL RELEVANCE/APPLICATION
Breast density is of great concern to patients and providers. Radiology technologists are often the first provider the patient encounters for breast cancer screening. There is a need for additional technologist education.

Awards
Trainee Research Prize - Fellow

Participants
Manisha Bahl, MD, MPH, Durham, NC (Presenter) Nothing to Disclose
Jay A. Baker, MD, Durham, NC (Abstract Co-Author) Research Consultant, Siemens AG
Mythreyi Bhargavan-Chatfield, PhD, Reston, VA (Abstract Co-Author) Nothing to Disclose
Eugenia K. Brandt, Washington, DC (Abstract Co-Author) Nothing to Disclose
Sujata V. Ghate, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Since 2009, a total of 21 states have enacted laws that mandate notification of patients and their referring physicians if the patient’s breast density is interpreted as heterogeneously dense or extremely dense on mammography. The purpose of this study is to evaluate trends in the reporting of breast density in response to breast density notification legislation.

METHOD AND MATERIALS

Using the American College of Radiology’s National Mammography Database (NMD), we collected state-level data, month-by-month over a 20-month period, on the percentage of mammograms reported as heterogeneously dense or extremely dense and the breast cancer detection rate. Z-tests were used to calculate differences in proportions, and p-values less than 0.05 were considered statistically significant.

RESULTS

Thirteen of 17 states that had breast density notification legislation in place as of 2014 had submitted data to the NMD before and after law enactment and were thus included in the analysis. 959,648 mammograms were performed over a 20-month period, ten months before and after law enactment. There was a statistically significant decrease in the percentage of mammograms reported as dense in the month after law enactment compared to the month before (40.0% vs 43.0%, p <0.001). The percentage of mammograms reported as dense reached its nadir two months after law enactment (39.3%) but increased to 42.8% by ten months after law enactment. There was no statistically significant difference in the percentage of mammograms reported as dense in the month before law enactment compared to ten months after law enactment (43.0% vs 42.8%, p =0.65). There were no statistically significant differences in the breast cancer detection rate in the month before and after law enactment (3.9/1000 vs 3.8/1000, p =0.79) or in the month before law enactment compared to ten months after law enactment (3.9/1000 vs 4.2/1000, p =0.55).

CONCLUSION

The study found a significant decrease in the reporting of dense breasts after law enactment, but then returned to pre-legislation percentages during the study period.

CLINICAL RELEVANCE/APPLICATION

Enactment of breast density notification legislation has an immediate but not long term impact on the reporting of dense breasts on mammography.

SSK01-03 Body Mass Index, Breast Density and the Risk of Breast Cancer Development

Participants

Rasha M. Kamal, MD, Cairo, Egypt (Presenter) Nothing to Disclose
Dorria S. Salem, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Sarah A. Maksoud, MBCh, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Rasha Wessam, MD, PhD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Soha T. Hamed, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Ahmed M. Hatw, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose

PURPOSE

The relationship between body mass index (BMI), mammographic breast density and breast cancer is complex. BMI is negatively correlated with mammographic density and in the same time they are both accused of increasing the risk of breast cancer. Therefore, the aim of this study is to assess the relationship between BMI, mammographic density and breast cancer in a screened population.

METHOD AND MATERIALS

The study included 117,636 women, above the age of 45 years, who joined a National Breast Cancer Screening Program in the period from October 2007 to April 2014. All patients performed a mammography examination and the breast density was reported by 3 independent readers. The breast density was classified according to the ACR BI-RADS lexicon breast density classification from a completely fatty breast (a) to an extremely dense breast (d). The weight and height were measured and the BMI was calculated. Individuals with a BMI> 25 are considered overweight and above 30 as obese. Categorical data was expressed as frequencies and relative frequencies, measures of association were verified by calculating the relative risk (RR), Odds Ratio (OR) and confidence interval (CI). The p value was calculated using the chi square test.

RESULTS

The study included 117,636 women out of which 1048 (0.89%) cases had breast cancer. Increased BMI was associated with statistically significant increased risk of breast cancer development than normal weight individuals (p value: 0.02). The calculated RR was 1.4 (95% CI: 1.0355 - 1.896) and odds ratio was 1.4 (95% CI: 1.036 - 1.905). The mammographic breast density was not associated with an increased risk of breast cancer development. The RR was 0.959 (95%CI: 0.59 - 1.57) and OR is 0.95 (95% CI: 0.58 - 1.57). High BMI was associated with a fatty breast parenchyma (p value: 0.0001) and the calculated RR was 13.9 (95% CI: 6.4 - 30.1).

CONCLUSION

A strong negative correlation exists between BMI and breast density where as the BMI increases the breast density decreases. In the current study increased BMI was associated with an increased risk of breast cancer development while an increased breast density was not.

CLINICAL RELEVANCE/APPLICATION

Obesity is a strong risk factor for breast cancer development. Breast cancer preventive strategies should be applied with higher concern for obese women and strict weight control strategies should be implemented especially for women at higher age risks of developing breast cancer.

SSK01-04 Quantifying the Potential Masking Risk of Breast Density in Mammographic Screening

Participants

Wessam, MD, PhD, Cairo, Egypt (Presenter) Nothing to Disclose
Sarah A. Maksoud, MBBCh, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Rasha M. Kamal, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Dorria S. Salem, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Ahmed M. Hatw, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose

PURPOSE

The study included 117,636 women out of which 1048 (0.89%) cases had breast cancer. Increased BMI was associated with statistically significant increased risk of breast cancer development than normal weight individuals (p value: 0.02). The calculated RR was 1.4 (95% CI: 1.0355 - 1.896) and odds ratio was 1.4 (95% CI: 1.036 - 1.905). The mammographic breast density was not associated with an increased risk of breast cancer development. The RR was 0.959 (95%CI: 0.59 - 1.57) and OR is 0.95 (95% CI: 0.58 - 1.57). High BMI was associated with a fatty breast parenchyma (p value: 0.0001) and the calculated RR was 13.9 (95% CI: 6.4 - 30.1).

CONCLUSION

A strong negative correlation exists between BMI and breast density where as the BMI increases the breast density decreases. In the current study increased BMI was associated with an increased risk of breast cancer development while an increased breast density was not.

CLINICAL RELEVANCE/APPLICATION

Obesity is a strong risk factor for breast cancer development. Breast cancer preventive strategies should be applied with higher concern for obese women and strict weight control strategies should be implemented especially for women at higher age risks of developing breast cancer.
We computed odds ratios (OR) for breast cancer masking risk (i.e. interval versus screen detected cancer) for each of the
we grouped women into low (VDG 1/2) versus high (VDG 3/4) dense, and low (Quartile 1/2) versus high (Quartile 3/4) texture risk

RESULTS

(VDG) was determined for each image using Volpara, Matakina Technology, New Zealand.

status in a five-fold cross validation. To assess the interaction of the texture scores with breast density, Volpara Density Grade

resemble the texture of normal tissue. The method was trained and tested on raw mammograms to determine cancer detection

that a developing cancer may not only be masked because it is obscured; it may also be masked because its mammographic signs

characterize mammographic texture. The reason for focusing on mammographic texture rather than the amount of breast density is

contralateral mammograms. We developed a novel machine learning based method called convolutional sparse autoencoder to

negative and subsequently appeared as interval cancers. To obtain mammograms without cancerous tissue, we took the

PURPOSE

To compare the current method of reporting on reduced mammographic sensitivity, using the American College of Radiology (ACR)

BI-RADS density categories, with quantitatively assessed volumetric breast density (VBD).

METHOD AND MATERIALS

This IRB-approved, retrospective study included histologically confirmed DCIS, invasive ductal or invasive lobular breast cancers
detected at screening (SC; n = 654) or in the interval between screens (IC; n = 120), in women (aged > 40 y) diagnosed at a
community based breast center between Jan 2009 and Dec 2012. Women with bilateral cancer, prior breast surgery or missing raw
digital images were excluded from the analysis. Density was determined according to the ACR BI-RADS 4th edition density
categories 1-4, and an automated equivalent, Volpara Density Grade (VDG), which uses preset thresholds of VBD to assign each
category (i.e. <4.5, 4.5-7.5, 7.5-15.5, >15.5%). Sensitivity (SC/[SC + IC]) was compared between the two density measures and
within each VDG category, by dividing each category into high and low using the mid-point of each VDG thresholds (i.e. 3.75, 6, 11
and 25.5%, for VDG 1, 2, 3 and 4, respectively).

RESULTS

The decreasing sensitivity of double-reading mammographic screening across increasing ACR density categories 1 to 4 was clear for
automated BI-BRADS (95/89/83/66%) but less so for

The decreasing sensitivity of double-reading mammographic screening across increasing ACR density categories 1 to 4 was clear for

the effect of density on masking compared to BI-RADS density categories.

Quantitative VBD captures the potential masking risk of breast density more precisely compared to the widely used BI-RADS density
classification system. In the US, women with dense breasts (BI-RADS 3 and 4 density categories) comprise ~50% of all women,
and our results indicate that within these categories there is a large range in sensitivity that is not being captured using the BI-
RADS system.

CONCLUSION

Volumetric breast density shows a linear relationship with mammographic sensitivity and can be used to more accurately determine

the effect of density on masking compared to BI-RADS density categories.

SSK01-05 Assessing Breast Cancer Masking Risk with Automated Texture Analysis in Full Field Digital
Mammography

Wednesday, Dec. 2 11:10AM - 11:20AM Location: Arie Crown Theater

Participants

Mads Nielsen, PhD, Copenhagen, Denmark (Abstract Co-Author) Stockholder, Biomeq A/S Research Grant, Nordic Bioscience A/S
Research Grant, SYNARC Inc Research Grant, AstraZeneca PLC

Purpose

The goal of this work is to develop a method to assess the risk of breast cancer masking, based on image characteristics beyond
breast density.

METHOD AND MATERIALS

From the Dutch breast cancer screening program we collected 285 screen detected cancers, and 109 cancers that were screen
negative and subsequently appeared as interval cancers. To obtain mammograms without cancerous tissue, we took the
contralateral mammograms. We developed a novel machine learning based method called convolutional sparse autoencoder to
characterize mammographic texture. The reason for focusing on mammographic texture rather than the amount of breast density is
that a developing cancer may not only be masked because it is obscured; it may also be masked because its mammographic signs
resemble the texture of normal tissue. The method was trained and tested on raw mammograms to determine cancer detection
status in a five-fold cross validation. To assess the interaction of the texture scores with breast density, Volpara Density Grade
(VDG) was determined for each image using Volpara, Matakina Technology, New Zealand.

RESULTS

We grouped women into low (VDG 1/2) versus high (VDG 3/4) dense, and low (Quartile 1/2) versus high (Quartile 3/4) texture risk
score. We computed odds ratios (OR) for breast cancer masking risk (i.e. interval versus screen detected cancer) for each of the
subgroups. The OR was 1.63 (1.04-2.53 95%CI) for the high dense group (as compared to the low dense group), whereas for the high texture score group (as compared to the low texture score group) this OR was 2.19 (1.37-3.49). Women who were classified as low dense but had a high texture score had a higher masking risk (OR 1.66 (0.53-5.20)) than women with dense breasts but a low texture score.

CONCLUSION
Mammographic texture is associated with breast cancer masking risk. We were able to identify a subgroup of women who are at an increased risk of having a cancer that is not detected due to textural masking, even though their breasts are non-dense.

CLINICAL RELEVANCE/APPLICATION
Automatic texture analysis enables assessing the risk that a breast cancer is masked in regular mammography, independently of breast density. As such it offers opportunities to further enhance personalized breast cancer screening, beyond breast density.

SSK01-06 Agreement between Breast Density Estimates from Standard versus Synthetic Digital Mammograms

Participants
Brad M. Keller, PhD, Philadelphia, PA (Presenter) Nothing to Disclose
Jinbo Chen, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Lauren Pantalone, BS, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Shonket Ray, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Marie Synnestvedt, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (Abstract Co-Author) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Despina Kontos, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Mammographic density is an established risk factor for breast cancer, with legislation now mandating the reporting of a woman’s breast density in many states. However, as synthetic 2D mammograms are being used to reduce dose when screening is performed with digital breast tomosynthesis (DBT), standard-dose mammograms that have commonly been used to evaluate breast density may no longer be acquired. As such, the purpose of this study is to evaluate the agreement between breast density estimates from standard dose versus synthetic mammograms.

METHOD AND MATERIALS
We retrospectively analyzed 755 negative (BIRADS 1 or 2) DBT screening exams consecutively acquired over a four week period at our institution for which both standard dose and synthetic mammograms were available. All mammograms were acquired on a Hologic Selenia Dimensions system, and synthetic mammograms were generated using the FDA-approved Hologic “C-View” software. The "For Presentation" standard-dose and synthetic mammograms were analyzed using a publically available algorithm developed at our institution that provides validated, reproducible breast percent density (PD%) estimates from digital mammograms. Agreement between PD% estimates from the two modalities was assessed via Pearson's correlation and linear regression, and Student's paired t-test was used to evaluate the presence of a systematic difference in density estimates between the two mammogram types.

RESULTS
Breast PD% estimates made on the synthetic and standard dose mammograms were highly correlated (r=0.92, p<0.001). However, a significant difference was observed between the two mammogram types, with synthetic mammograms yielding larger PD% estimates by an average of 2.0% higher than standard dose mammograms (p<0.001), with larger disagreement in highly dense women.

CONCLUSION
Breast density estimates made from synthetic mammograms are comparable to those made from standard dose mammograms. Furthermore, fully-automated analysis of breast density from synthetic mammograms is feasible, which may become important as standard dose images are increasingly no longer required when screening with DBT.

CLINICAL RELEVANCE/APPLICATION
Synthetic mammograms may allow for accurate estimation of a woman's breast density if standard dose mammograms are not obtained in DBT screening, particularly if automated software is utilized.

SSK01-07 Associations of Dense and Fatty Breast-Tissue Heterogeneity with Breast Cancer Risk: Preliminary Evaluation Using Parenchymal Texture Measurements Driven by Breast Anatomy

Participants
Amilia Gastounioti, Philadelphia, PA (Presenter) Nothing to Disclose
Brad M. Keller, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Lauren Pantalone, BS, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Meng-Kang Hsieh, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Andrew Oustimov, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (Abstract Co-Author) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Despina Kontos, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE
We investigate the potential different contributions of dense versus fatty breast tissue in breast cancer risk assessment, using quantitative descriptors of parenchymal heterogeneity driven by breast anatomy.

METHOD AND MATERIALS
Contralateral, raw mediolateral-oblique (MLO) view digital mammograms (DMs) from 106 women with unilateral invasive breast cancer and 318 age- and side-matched controls were retrospectively analyzed. DMs were acquired with either a GE Healthcare 2000D or DS FFDM system and the “For Processing” images were used. A previously validated algorithm was used to automatically segment the dense and fatty tissue areas within the breast and estimate percent density (%PD). Parenchymal heterogeneity analysis was performed using a breast-anatomy-driven framework, in which a polar grid following the anatomy of the breast parenchyma was overlaid on the DM. Established tissue-heterogeneity descriptors were extracted (i.e., a total of 15 gray-level, non-uniformity, contrast, correlation, etc. texture features), aligned with the structure of the polar grid. The mean values of these texture descriptors over the dense and fatty breast sub-regions were estimated. Associations between heterogeneity features and breast cancer were evaluated using logistic regression and the area under the receiver operating characteristic (ROC) curve (AUC) was used to assess discriminatory capacity, where model performance was compared using the DeLong’s test.

RESULTS
Individual tissue heterogeneity features had different discriminatory capacity in dense versus fatty parenchyma. Multivariable models were equally associated with breast cancer for both dense and fatty tissue (AUC: 0.82, p<0.001), though different texture features were deemed significant for each tissue type. There was no performance improvement by adding %PD, while the strongest association was achieved when dense and fatty tissue heterogeneity features were combined (AUC: 0.87, p<0.001).

CONCLUSION
Heterogeneity features for dense and fatty parenchymal patterns, as measured using a breast-anatomy-driven framework, may hold a promising role in breast cancer risk prediction.

CLINICAL RELEVANCE/APPLICATION
Inherent biological factors, which are associated with the risk of breast cancer, might be expressed in parenchymal tissue as an interplay between dense and fatty tissue heterogeneity.

SSKO1-08 Background Parenchymal Uptake (BPU) at Molecular Breast Imaging as a Novel Breast Cancer Risk Factor

Wednesday, Dec. 2 11:40AM - 11:50AM Location: Arie Crown Theater

Participants
Carrie B. Hruska, PhD, Rochester, MN (Presenter) Institutional license agreement, Gamma Medica, Inc
Christopher G. Scott, MS, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Deborah J. Rhodes, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Amy L. Connors, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Dana H. Whaley, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Michael K. O’Connor, PhD, Rochester, MN (Abstract Co-Author) Royalties, Gamma Medica, Inc
Celine M. Vachon, Rochester, MN (Abstract Co-Author) Consultant, Pfizer Inc

PURPOSE
In prior evaluations of molecular breast imaging (MBI) for supplemental screening in dense breasts, we observed wide variability in background parenchymal uptake (BPU), which refers to the relative uptake of Tc-99m sestamibi within normal fibroglandular tissue compared to fat. In women with similar mammographic density, BPU varied from photopenic (fibroglandular uptake less intense than fat uptake) to marked (fibroglandular uptake >2 times as intense as fat uptake). Here, we investigated whether BPU is associated with subsequent breast cancer development.

METHOD AND MATERIALS
We conducted a nested case-control study among women with MBI examinations performed between the years 2005-2014. Women with breast cancer history or diagnosis within 60 days after MBI were excluded. A total of 77 incident breast cancer cases were identified through linkage our institution's tumor registry; 225 controls were matched to cases on age, MBI date, menopausal status, and follow-up. While blinded to case-control status, BPU was assessed by an expert reader according to a validated MBI lexicon into one of 4 categories: photopenic, minimal-mild, moderate, or marked. Conditional logistic analysis was performed.

RESULTS
Women with high BPU at MBI (moderate or marked) had a greater risk of breast cancer compared to women with low BPU (photopenic or minimal-mild); odds ratio (OR (95% CI) = 5.5 (2.6,11.6)). Results were unchanged with adjustment for BI-RADS density (OR = 5.5 (2.6,11.6)) and BMI (OR = 5.4 (2.6,11.4)). The association of BPU and breast cancer was stronger for cases diagnosed <3 years (OR=10.6) compared to cases diagnosed ≥3 years (OR=4.2), although power was limited.

CONCLUSION
BPU at MBI is associated with breast cancer risk. The odds of developing breast cancer was 5.5 times greater for women with high BPU compared to women with low BPU.

CLINICAL RELEVANCE/APPLICATION
Over 40% of the screening-eligible population have mammographically dense breasts. BPU is a breast cancer risk factor, based on functional behavior of fibroglandular tissue, that may help identify the subset of women with dense breasts who are most likely to benefit from supplemental screening and risk-reduction options.

SSKO1-09 Volumetric Breast Density a Strong Independent Predictor of Interval Cancer Risk

Wednesday, Dec. 2 11:50AM - 12:00PM Location: Arie Crown Theater

Participants
Stamatia V. Destounis, MD, Scottsville, NY (Presenter) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC
Ariane Chan, PhD, Wellington, New Zealand (Abstract Co-Author) Employee, Matakina Technology Limited;
Andrea L. Arieno, BS, Rochester, NY (Abstract Co-Author) Nothing to Disclose
PURPOSE
Breast density (BD) is a key factor limiting the sensitivity of mammographic screening. We sought to evaluate which patient factors might best predict the risk of being diagnosed with an interval cancer.

METHOD AND MATERIALS
This IRB-approved, retrospective analysis included histologically confirmed DCIS, invasive ductal or invasive lobular breast cancers detected at screening (SC; n = 514) or in the interval between screens (IC; n = 82). Patient histories were reviewed for women aged over 40 y, diagnosed between January 2009 and December 2012, and with raw mammographic images available. In addition to BD categories assessed visually (BI-RADS 1-4) and automatically (Volpara Density Grade; VDG 1-4), BD was assessed using a continuous measure of volumetric breast density (VBD). Univariate analyses and multivariate logistic regression (adjusting for age and menopausal status) were used to identify predictors of IC risk.

RESULTS
BD was the only independent predictor of IC risk in the multivariate analyses. Women with BI-RADS4 and VDG4 breasts were at 3.6-fold [CI 1.7 - 7.7] and 3.9-fold [CI 2.0 - 7.6] more likely to be diagnosed with an IC versus a SC, compared to women with non-dense breasts (BI-RADS/VDG 1 and 2), or 4.0-fold [CI 1.8 - 8.8] for women in the highest quartile of VBD versus the lowest. Restricted to invasive cancers only (n = 456), VDG, VBD and BI-RADS were all independent risk factors for IC versus SC (i.e. 4.7-fold [CI 2.3 - 9.7] for VDG4 versus VDG1/2; 4.5-fold [CI 1.9 - 10.6] for the highest quartile of VBD versus the lowest quartile; and 3.5-fold [CI 1.6 - 8.1] for BI-RADS4 versus BI-RADS1/2).

CONCLUSION
Although VBD, and visual and automated assessments of BI-RADS density categories are all strongly associated with being diagnosed with an IC versus a SC, volumetric methods were stronger predictors of invasive IC risk and could be used to accurately identify which women may benefit the most from supplementary imaging.

CLINICAL RELEVANCE/APPLICATION
Volumetric breast density is a strong independent predictor of interval cancer risk and, due to its continuous nature, can be used to better identify women who might benefit from adjunctive screening.
Breast Imaging (Ultrasound Diagnostics)

Wednesday, Dec. 2 10:30AM - 12:00PM Location: E450A

Participants
Susan Weinstein, MD, Philadelphia, PA (Moderator) Consultant, Siemens AG
Regina J. Hooley, MD, New Haven, CT (Moderator) Nothing to Disclose

Sub-Events

SSK02-01 Incremental Cancer Detection Utilizing Breast Ultrasound versus Breast MRI in the Evaluation of Newly Diagnosed Breast Cancer Patients

Wednesday, Dec. 2 10:30AM - 10:40AM Location: E450A

Participants
Jeri Sue Plaxo, Houston, TX (Abstract Co-Author) Nothing to Disclose
Hongying He, MD, PhD, Houston, TX (Presenter) Nothing to Disclose
Lei Huo, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Wei Wei, Houston, TX (Abstract Co-Author) Nothing to Disclose
Rosalind P. Candelaria, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Wei T. Yang, MD, Houston, TX (Abstract Co-Author) Researcher, Hologic, Inc
Henry M. Kuerer, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the incremental detection of breast cancer utilizing bilateral whole breast ultrasound (BWBUS) versus dynamic contrast enhanced MRI in patients with biopsy proven primary breast cancer.

METHOD AND MATERIALS
A retrospective database search in a single institution identified 259 patients with newly diagnosed breast cancer from 1/2011 to 8/2014, who underwent mammography, BWBUS and MRI before surgery. Patient demographics, tumor characteristics, lesions seen on mammography, BWBUS, and MRI were recorded. Histopathology of each lesion was used to determine the incremental cancer detection rate by BWBUS and MRI and to calculate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of mammography, BWBUS, and MRI. Multifocal, multicentric and contralateral disease were recorded and compared among the three imaging modalities. Effect on surgical planning was obtained from the medical records.

RESULTS
A total of 539 lesions were seen on at least one modality (mammography, BWBUS, or MRI) with histopathology, of which 393 (73%) were malignant and 146 (27%) benign. The sensitivity and specificity of mammography, BWBUS, and MRI were 77%, 89%, and 93%, and 75%, 67%, and 39%, respectively. PPV and NPV of mammography, BWBUS, and MRI were 89%, 88%, and 80%, and 55%, 69%, and 69%, respectively. MRI was significantly more sensitive than BWBUS (p=0.02). However, there was no significant difference in sensitivity between mammography plus BWBUS and MRI. In addition, mammography and BWBUS had significantly higher specificity than MRI (p<0.0001). Mammography plus BWBUS and mammography plus MRI significantly improved the detection of additional malignant foci (multifocal, multicentric or contralateral) (p<0.0001) compared to mammography alone. All three modalities combined further significantly improved the detection of additional malignant foci. However, surgical planning was not changed in the majority of the patients with multicentric disease found on MRI.

CONCLUSION
Breast MRI is more sensitive than BWBUS beyond mammography in breast cancer detection. Mammography and BWBUS are more specific than MRI. Addition of MRI improved the detection of multifocal, multicentric and contralateral disease, without altering surgical planning in the majority of patients with multicentric disease.

CLINICAL RELEVANCE/APPLICATION
The exact role of breast MRI in breast cancer detection and management needs to be further defined.

SSK02-02 The Breast Tumor Strain Ratio Is a Predictive Parameter for Axillary Lymph Node Metastasis in Patients with Invasive Breast Cancer

Wednesday, Dec. 2 10:40AM - 10:50AM Location: E450A

Participants
Jin You Kim, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Shinyoung Park, MD, Busan, Korea, Republic Of (Presenter) Nothing to Disclose
Jin Il Moon, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ji Won Lee, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the association between the breast tumor strain ratio and axillary lymph node metastasis in patients with invasive breast cancer.
METHOD AND MATERIALS

Between 2013 and 2014, 284 consecutive patients (mean age, 52.2 years; range, 24-78 years) diagnosed with invasive breast cancer (mean size, \(2.3 \pm 1.5\) cm; range, 0.2-9.0 cm) underwent ultrasound (US) elastography before surgery. The strain ratio, defined as the fat-to-tumor ratio and indicative of the relative stiffness of the breast lesion, was calculated using dedicated software within the US equipment. The associations of axillary node metastasis with the tumor strain ratio and clinicobiological variables were evaluated using univariate and multivariate logistic regression analyses.

RESULTS

Among 284 tumors, 85 (29.9%) showed axillary lymph node metastasis by surgical histopathology. The strain ratio was significantly higher in tumors with a node-positive status than in those with a node-negative status (5.19 ± 1.28 vs. 4.17 ± 1.30, respectively; \(P < 0.001\)). A receiver operating characteristic curve demonstrated that a tumor strain ratio of 3.89 was the optimal cutoff for predicting axillary nodal involvement in breast cancer (sensitivity, 91.8%; specificity, 45.7%; area under the curve, 0.701; SE, 0.032; \(P < 0.001\)). On univariate analysis, a higher strain ratio (>3.89), larger tumor size (>2 cm), higher histologic grade (grade 3), presence of lymphovascular invasion, palpability, and higher expression of Ki-67 (≥14%) were associated with a higher probability of axillary node metastasis. On multivariate analysis, a higher strain ratio (>3.89) (odds ratio (OR): 14.208; \(P < 0.001\)), presence of lymphovascular invasion (OR: 17.437; \(P < 0.001\)), and higher expression of Ki-67 (≥14%) (OR: 3.744; \(P = 0.002\)) maintained independent significance for predicting axillary lymph node metastasis.

CONCLUSION

The breast tumor strain ratio on US elastography is associated independently with axillary lymph node metastasis in patients with invasive breast cancer.

CLINICAL RELEVANCE/APPLICATION

Preoperative prediction of axillary nodal status is valuable. Implementation of US elastography during preoperative US evaluation could help predict axillary node metastasis in breast cancer patients.

SSK02-03 Differentiating Benign and Malignant Breast Tissue Using a Handheld Terahertz Probe

Wednesday, Dec. 2 10:50AM - 11:00AM Location: E450A

Participants

Maarten Grootendorst, MSc, London, United Kingdom (Presenter) Nothing to Disclose
Susan Brouwer de Koning, BSc, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Anthony J. Fitzgerald, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose
Alessia Portieri, PhD, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose
Aida Santa Olalla, MSc, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
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Michael Pepper, PhD, London, United Kingdom (Abstract Co-Author) Chief Scientific Officer, Teraview Ltd
Vincent Wallace, PhD, Crawley, Australia (Abstract Co-Author) Nothing to Disclose
Sarah Pinder, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Amie Purushotham, MD, PhD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE

To develop histopathological methods to analyse breast tissue samples scanned with a handheld TeraHertz (THz) probe, and evaluate the ability of THz time and frequency domain pulses and parameters to discriminate between benign and malignant tissue, with the aim of developing a technique to assess tumour resection margins in breast-conserving surgery.

METHOD AND MATERIALS

In all, 15 breast tissue samples (13 patients) from freshly excised wide local excision and mastectomy specimens were scanned using a handheld THz probe with a bandwidth of 0-2.0 THz (Teraview Ltd., UK). For each sample detailed pathology, including type of predominant tissue (tumour and tumour type, fibrous or adipose), type of background tissue, and cell density were obtained at 1.0mm-intervals, and correlated with THz data. Samples with a predominant tissue cell density of ≥ 60% were included. The full THz time and frequency domain pulses, as well as individual parameters, were evaluated. An area under the receiver operating characteristic curve (AUROC) analysis was performed to quantify the performance of each parameter in discriminating between tumour and fibrous tissue. Parameters with an AUROC value >0.75 were included. A Mann-Whitney U test was performed to determine whether the differences in parameter values were statistically significantly different.

RESULTS

In all, 6 invasive ductal carcinomas, 1 invasive lobular carcinoma, 4 fibrous and 4 adipose samples were used. Adipose tissue could be readily discriminated from tumour/fibrous tissue using the full time-domain pulse (Fig. 1). Tumour could be discriminated from fibrous tissue using a total of 35 parameters; all these parameters had parameter values that were statistically significantly different between tumour and fibrous (\(P<0.001\)). Especially, the power at frequency 0.18-0.29THz proved to be a strong discriminator (AUROC >= 0.97).

CONCLUSION

Time-domain pulses and parameters from handheld THz probe measurements can accurately discriminate between benign breast and malignant tissue in an ex vivo setting. More high-dense tumour samples from different tumour types and low-dense samples are needed to further evaluate this technique prior to in vivo patient studies.

CLINICAL RELEVANCE/APPLICATION

THz pulsed imaging distinguishes malignant from benign breast tissue and can potentially assess tumour margins intraoperatively in breast-conserving surgery, aiming to achieve lower re-resection rates.
To identify the relation of imaging features on ultrasound (US) and the recurrence score (RS) of the 21-gene expression assay in patients with estrogen receptor (ER) positive breast cancer.

METHOD AND MATERIALS

Institutional review board approved this study, and the requirement for informed consent was waived. 267 patients with ER-positive invasive breast cancer who underwent US and Oncotype Dx assay were included in this study. US images were independently reviewed by dedicated breast radiologists who were blind to the RS, according to BI-RADS lexicon. In addition, tumor roundness was measured by a laboratory-developed software program. The pathological data were also reviewed including immunohistochemistry results. Univariate analysis was done to assess the associations between the RS and each variables. Multiple logistic regression analysis was used to identify independent predictors of high RS (≥31).

RESULTS

Of 267 patients, 147 (55%) had low, 96 (36%) intermediate, and 24 (9%) had high RS. In univariate analysis, the parallel orientation, circumscribed margin, posterior acoustic enhancement, presence of calcification in the mass and tumor roundness was positively associated with high RS. Multiple logistic regression analysis showed that parallel orientation (OR=5.525) and tumor roundness (OR=1.699 per 10 increase) remained independent variables associated with high RS. The area under the ROC curve from the model was 0.78 in distinguishing high RS from low or intermediate RS and increased to 0.88 when combined with pathological data.

CONCLUSION

The tumor roundness and parallel orientation were independent variables that may predict a high RS in patients with ER-positive breast cancer.

CLINICAL RELEVANCE/APPLICATION

ER-positive breast cancers have distinguishing US features according to recurrence score. US can help to differentiate candidates for adjuvant chemotherapy in ER-positive cancer.

SSK02-05 Tumor Growth Rate during Wait Times for Surgery in Women with Breast Cancers Assessed by Ultrasonography

Wednesday, Dec. 2 11:10AM - 11:20AM Location: E450A

Participants
Su Hyun Lee, MD, PhD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Sung Ui Shin, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jung Min Chang, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Nariya Cho, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Woo Kyung Moon, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate tumor growth rate (TGR) during the wait times for surgery in women with invasive breast cancers and to identify clinicopathologic factors associated with TGR.

METHOD AND MATERIALS

This study was approved by our institutional review board and the requirement for written informed consent was waived. A retrospective chart review in a tertiary care center identified 1,580 women who had breast surgery for invasive carcinoma between August 1, 2013 and August 31, 2014. Among them, a total of 307 consecutive women (mean age, 53 yrs; range, 27-81 yrs) with T1-2 breast cancers eligible for TGR assessment by using ultrasonography (US) were included. All women underwent serial breast US at the time of initial diagnosis and one day before surgery as a routine protocol in our hospital. The three perpendicular diameters of tumors were measured on US images at each time point and the maximum diameter and volume of tumors were compared using paired samples t-test. TGR was quantified using the parameter of specific growth rate (SGR; %/day) and was compared with clinicopathologic variables using univariate and multivariate analyses.

RESULTS

The median time from diagnosis to surgery was 31 days (range, 8-78 days). The maximum diameter and volume of tumors at surgery (mean, 15.8 ± 6.8 mm and 1.73 ± 2.6 cc) were significantly larger than those at diagnosis (15.0 ± 6.5 mm and 1.47 ± 2.3 cc) (P<0.001, both). Tumor subtype (ER-positive [n=206], HER2-positive [n=35], and triple negative cancers [n=66]) was the only independent clinicopathologic factor associated with SGR on multivariate analysis (P=0.006). Triple negative cancers showed the highest SGR (0.980 ± 1.071) followed by HER2-positive (0.550 ± 1.219) and ER-positive cancers (0.192 ± 0.995) (P < 0.001). Clinical T stage was not significantly changed between diagnosis and surgery in ER- and HER2-positive cancers, however, higher T stage at surgery was more frequent in triple negative cancers (P=0.027).

CONCLUSION

Triple negative cancers showed the highest TGR during the wait times for surgery and clinical T stage can be upgraded between diagnosis and surgery in triple negative cancers.
CONCLUSION

Microcalcifications seem to cause an apparent strain even though the tissue is harder than normal.

RESULTS

The presence of calcifications was classified into two groups: with and without calcifications. The sensitivity for the lesions with and without calcifications was 74.2% and 84.6%, respectively (P = 0.003). When the calcifications were classified only by mammography, the sensitivity for the lesions with and without calcifications was 96.9% and 73.2%, respectively (P = 0.003).

Microcalcifications were absent in 51 (43.6%) lesions and present in 66 (56.4%) lesions. The presence of calcifications was classified into two groups: with and without calcifications. The sensitivity for the lesions with and without calcifications was 84.6% and 73.2%, respectively (P = 0.003). When the calcifications were classified only by mammography, the sensitivity for the lesions with and without calcifications was 96.9% and 73.1%, respectively. As strain elastography is based on combined autocorrelation, microcalcifications may cause an apparent strain even though the tissue is harder than normal.
Although breast ultrasound elastography shows high sensitivity, our study revealed an obvious difference in sensitivity between the lesions with and without microcalcifications.

**CLINICAL RELEVANCE/APPLICATION**

Clinicians should be careful while evaluating breast ultrasound strain elastography findings for lesions with microcalcifications on mammography.

**SSK02-08  Mass-like Focal Breast Fibrosis - A Benign Entity Mimicking Malignancy on Ultrasonography**

**Wednesday, Dec. 2 11:40AM - 11:50AM Location: E450A**

**Participants**
- Eleonora Horvath, MD, Santiago, Chile (Abstract Co-Author) Nothing to Disclose
- Aleen V. Altamirano, MD, Masaya, Nicaragua (Presenter) Nothing to Disclose
- Eduardo Soto, Santiago, Chile (Abstract Co-Author) Nothing to Disclose
- Marcela Uchida, Santiago, Chile (Abstract Co-Author) Nothing to Disclose
- Miguel A. Pinochet, MD, Santiago, Chile (Abstract Co-Author) Nothing to Disclose
- Claudia S. Silva Fuente-Alba, MD, MSc, Santiago, Chile (Abstract Co-Author) Nothing to Disclose
- Marcela Gallegos, Santiago, Chile (Abstract Co-Author) Nothing to Disclose
- Jocelyn Galvez, Vitacura, Chile (Abstract Co-Author) Nothing to Disclose
- Maria Flavia Pizzolon, MD, Vitacura, Chile (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To determine the sonographic characteristics of core biopsy-proven Mass-like Focal Breast Fibrosis (MFBF).

**METHOD AND MATERIALS**

IRB approved, retrospective study. Between April 2007 and January 2015, 3051 US-guided breast biopsies with 14G core needle, were performed, 251 of them with a diagnosis of stromal breast fibrosis. We excluded 128 cases where fibrosis was not the primary histologic diagnosis. Only MFBF cases were included, histopathologically defined as a localized area of dense fibrous tissue associated with hypoplastic mammary ducts and lobules, without vascular structures and inflammatory changes. Imaging features were tabulated and analyzed. Follow-up imaging was reviewed to document lesion stability.

**RESULTS**

In 121 women (median age: 50 years, range: 25-83) we found 123 cases of MFBF (incidence: 4%). Lesion size ranged from 4 to 35 mm (median: 10 mm), non-palpable in 94% of the cases. Eighty-seven (71%) of them developed in highly or heterogeneously dense breast (ACR 4 and 3). Only 7 (6%) were evident on mammography. We identified two distinct sonographic patterns of MFBF. Pattern A (28%): well-circumscribed, hypoechoic, avascular mass. Pattern B (72%): ill defined, irregular, avascular, markedly hypoechoic or spiculated lesion with or without a definable mass and markedly shadowing, located intraparenchymatous or under Cooper ligament. Sixty-seven (54%) lesions were reported as BI-RADS 5, 4C or 4B. MRI study was performed in 7 patients with negative outcome. One lesion was surgically removed and in 4 patients a new large (8G) core biopsy was performed due to radio-histological discordance, obtaining the same results. Patients remain in follow-up (median: 30 months, range: 2 to 94 months), without malignancy.

**CONCLUSION**

The mass-like focal breast fibrosis is a benign entity with the potential to mimic malignancy. Is important that radiologists know the specific US patterns and if proven on core needle biopsy, it may be taken as a concordant diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

We report a large series of MFBF, detailing its US-pattern. Should these US patterns be identified, it is reasonable to accept this benign histopathological diagnosis postbiopsy as concordant.

**SSK02-09 Hypoechoic Non-mass Lesion on Screening Breast Ultrasound**

**Wednesday, Dec. 2 11:50AM - 12:00PM Location: E450A**

**Participants**
- Jin Hwa Lee, MD, Busan, Korea, Republic Of (Presenter) Nothing to Disclose
- Cherie M. Kuzmiak, DO, Chapel Hill, NC (Abstract Co-Author) Research Grant, FUJIFILM Holdings Corporation;
  - Ji Hyun Lee, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
  - Jong-Young Oh, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
  - Hee-Jin Kwon, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The current ACR BI-RADS lexicon only covers mass lesions. The purpose of this study is to determine the significance of hypoechoic non-mass lesion (HNML) which is recognized during screening breast ultrasound (SBUS).

**METHOD AND MATERIALS**

An IRB approved retrospective database review was performed from March 2008 to June 2012 of patients who had SBUS. The indications of SBUS at our institution were asymptomatic patients with dense breast tissue on mammography, routine follow-up of a BI-RADS category 3 lesion with 2 years of stability or a biopsy-proven benign lesion on prior examination, and postoperative screening after surgery for breast cancer. We included patients with HNML on ultrasound and with no suspicious finding on mammography. Excluded from the study were lesions related to the past history of biopsy or operation at the area of HNML. A HNML was defined as a hypoechoic area that does not conform to the definition of a mass and has different character from that of surrounding glands or the same area in the contralateral breast. The final diagnoses were based on pathology results and clinical or sonographic follow-up more than 12 months. We calculated the incidence and likelihood of malignancy of the HNML on SBUS.

**RESULTS**
A total of 17,868 SBUS were performed on 8,856 asymptomatic patients. Ninety-six HNMLs were detected in 89 patients (1.0%). On final pathology or follow-up of HMLs, three (3.1%) lesions were malignant, 78 (81.3%) lesions were benign, and two (2.1%) lesions were high risk. In addition, there were 13 (13.5%) lesions that were lost to follow-up or without final surgical pathology. The likelihood of malignancy of a HNML on SBUS was 3.1%.

**CONCLUSION**

The likelihood of malignancy for a hypoechoic non-mass lesion on SBUS was greater than 2%. Therefore, it should be classified as a BI-RADS category 4 lesion and tissue diagnosis is warranted.

**CLINICAL RELEVANCE/APPLICATION**

Large prospective studies are needed to further validate which management recommendation is most appropriate for the HNML on SBUS.
**SSK03**

**Cardiac (Contrast Media)**

Wednesday, Dec. 2 10:30AM - 12:00PM Location: S502AB

AM A PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

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**Participants**
Ethan J. Halpern, MD, Philadelphia, PA (Moderator) Nothing to Disclose
Hans-Christoph R. Becker, MD, PhD, Stanford, CA (Moderator) Nothing to Disclose
Jean Jeudy JR, MD, Baltimore, MD (Moderator) Nothing to Disclose

**Sub-Events**

**SSK03-01 Long-term Adverse Effects of Low-osmolar Compared with Iso-osmolar Contrast Media after Coronary Angiography: A Propensity Score Analysis**

Wednesday, Dec. 2 10:30AM - 10:40AM Location: S502AB

Participants
Yuan-Cheng Wang, Nanjing, China (Presenter) Nothing to Disclose
Adrian Tang, MRCP, FRCR, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Shenghong Ju, MD, PhD, Nanjing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The long-term adverse effects of low-osmolar contrast media (LOCM) versus iso-osmolar contrast media (IOCM) remain unclear. This study aims to compare the long-term mortality, renal injury and cardiovascular events between LOCM and IOCM after coronary angiography using propensity scoring in a large retrospective cohort.

**METHOD AND MATERIALS**

12611 Cardiology patients underwent coronary angiography between January 2006 to July 2013 using either LOCM (iohexol, iopromide) or IOCM (iodixanol). For each contrast medium Primary (all-cause mortality) and Secondary outcomes (renal injury) was recorded. Propensity scoring with subsequent 1:1 matching (PSM) or re-weighting with inverse probability of treatment (IPW) was applied to minimize the selection bias between groups.

**RESULTS**

Unadjusted all-cause mortality was significantly lower with LOCM versus IOCM (hazard ratio [HR] = 0.28; 95% CI, 0.23-0.34). After propensity adjustment, all-cause mortality became comparable and lost statistical significance. LOCM subgroup analysis showed a trend to lower odds of kidney injury with iopromide vs iohexol after propensity adjustment. Chronic kidney disease (CKD) subgroups had higher mortality risk when receiving LOCM compared with IOCM (PSM: HR = 3.48, 95% CI: 1.24-9.78; IPW: HR = 4.34, 95% CI: 1.36-13.91).

**CONCLUSION**

After coronary angiography, patients receiving LOCM had comparable overall long-term mortality compared with IOCM after propensity adjustment. IOCM may have significantly lower long-term mortality in CKD cohort.

**CLINICAL RELEVANCE/APPLICATION**

LOCM had comparable long-term adverse effects to IOCM in overall population receiving coronary angiography. However, IOCM might be more advisable than LOCM for patients with CKD.

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**SSK03-02 Evaluation of Individually Body Weight Adapted Contrast Media Injection in Coronary CT-angiography**

Wednesday, Dec. 2 10:40AM - 10:50AM Location: S502AB

Participants
Casper Mihl, MD, Maastricht, Netherlands (Presenter) Nothing to Disclose
Madeleine Kok, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Sibel Altimas, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Bastiaan Ketselaer, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Joachim E. Wildberger, MD, PhD, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Marco Das, MD, Maastricht, Netherlands (Abstract Co-Author) Research Consultant, Bayer AG; Research Grant, Siemens AG; Research Grant, Koninklijke Philips NV

**PURPOSE**

Ideally, contrast media (CM) injection protocols should be customized to the individual patient. The aim of this study was to determine if software tailored CM injections result in diagnostic vascular enhancement of the coronary arteries and if attenuation values were comparable between different weight categories.

**METHOD AND MATERIALS**

265 consecutive patients referred for routine coronary computed tomography angiography (CTA) were scanned on a 2nd generation dual-source CT at 100kV. Group 1 (n=141) received an individual CM bolus based on weight categories (39-59kg; 60-74kg; 75-
Comparison of Three Iodine Concentrations in the Visualization of Coronary Arteries by CT Angiography: A Randomized European Multicenter Trial

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S502AB

RESULTS
For group 1, mean attenuation values of all segments were diagnostic (>325HU) and without statistical significant differences between different weight categories (p>0.17), proximal-distal: 449±65-373±58HU (39-59kg); 443±69-367±81HU (60-74kg); 427±59-370±61HU (75-94kg); 427±73-347±61HU (95-109kg). Mean CM volumes were: 55±6ml (39-59kg); 61±7ml (60-74kg); 71±8ml (75-94kg); 84±9ml (95-109kg). For group 2, mean attenuation values were not all diagnostic with differences between weight categories (p<0.01), proximal-distal: 611±142-408±69HU (39-59kg); 562±135-389±98HU (60-74kg); 481±83-329±81HU (75-94kg); 420±73-305±35HU (95-109kg).

CONCLUSION
Individually tailored CM injection protocols yield diagnostic attenuation in all scans and a more homogeneous enhancement pattern between different weight groups compared to a fixed injection protocol. In addition, overall CM volumes could be reduced for the majority of patients utilizing P3T software.

CLINICAL RELEVANCE/APPLICATION
Individually tailored CM injection protocols in coronary CTA allow substantial reduction of CM volume for the majority of patients while keeping images diagnostically sufficient.

Impact of Contrast Media Iodine Dose on Radiation Induced DNA Damage after Cardiac CTA

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S502AB

RESULTS
Out of the 452 patients completed for the primary analysis, 92.1% had their 18 segments fully evaluable in the iobitridol group, vs. 94.6 and 95.4% in the iomeprol and iopromide groups respectively. Non-inferiority for the primary outcome was statistically demonstrated (p<0.05). Mean image quality was good to excellent for all contrast media, and no relevant differences were observed for the other secondary endpoints between the 3 groups. The mass of iodine (in g) injected was significantly different between the 3 groups: 27.8±3.4 (iobitridol), 29.3±3.8 (iopromide) and 31.7±3.8 (iomeprol), p<0.001. The good general safety profile of products was confirmed.

CONCLUSION
Coronary CT angiography using iobitridol 350 is non-inferior to higher concentration contrast agents regarding image quality and evaluability while the amount of iodine required can be significantly reduced.

CLINICAL RELEVANCE/APPLICATION
The present study addresses the patient safety perspective based on the reduction of iodine loading while keeping adequate diagnostic capacity in coronary CTA.

Comparison of Three Iodine Concentrations in the Visualization of Coronary Arteries by CT Angiography: A Randomized European Multicenter Trial

Participants
Hans-Christoph R. Becker, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose

Purpose
To assess the diagnostic efficacy of iobitridol 350 compared to iopromide 370 and iomeprol 400 in the visualization of coronary arteries by CT.

Method and Materials
Prospective, randomized, multi-center, double blind, non-inferiority phase IV trial including 468 patients with suspected coronary artery disease (CAD) and scheduled for clinically indicated coronary CT angiography. The primary endpoint was the CT scan evaluability for CAD diagnosis in terms of quality and interpretability of images. It was based on the full evaluation of 18 coronary segments for each patient assessed by 2 off-site independent readers. Secondary endpoints were related to the safety and efficacy of the 3 contrast media (mainly image quality, stenosis assessment, and signal quantification).

RESULTS
Out of the 452 patients completed for the primary analysis, 92.1% had their 18 segments fully evaluable in the iobitridol group, vs. 94.6 and 95.4% in the iomeprol and iopromide groups respectively. Non-inferiority for the primary outcome was statistically demonstrated (p<0.05). Mean image quality was good to excellent for all contrast media, and no relevant differences were observed for the other secondary endpoints between the 3 groups. The mass of iodine (in g) injected was significantly different between the 3 groups: 27.8±3.4 (iobitridol), 29.3±3.8 (iopromide) and 31.7±3.8 (iomeprol), p<0.001. The good general safety profile of products was confirmed.

CONCLUSION
Coronary CT angiography using iobitridol 350 is non-inferior to higher concentration contrast agents regarding image quality and evaluability while the amount of iodine required can be significantly reduced.

CLINICAL RELEVANCE/APPLICATION
The present study addresses the patient safety perspective based on the reduction of iodine loading while keeping adequate diagnostic capacity in coronary CTA.

Impact of Contrast Media Iodine Dose on Radiation Induced DNA Damage after Cardiac CTA

Participants
Toon Van Cauteren, MSc, Brussels, Belgium (Presenter) Nothing to Disclose
Nico Buls, DSc, PhD, Jette, Belgium (Abstract Co-Author) Nothing to Disclose
Gert Van Gompel, PhD, Brussel, Belgium (Abstract Co-Author) Speaker, General Electric Company
Johan De Mey, Jette, Belgium (Abstract Co-Author) Nothing to Disclose

Purpose
To investigate the impact of the administered contrast media iodine dose on the radiation induced DNA double-strand breaks in peripheral blood lymphocytes after a diagnostic cardiac CTA in a porcine model.

Method and Materials
A Göttingen minipig (Ellegaard, Denmark) was scanned with a constant cardiac CTA protocol (100 kV, Auto mA, ECG gated, 0-300% phase, CTDIvol = 45 mGy) on a Revolution CT (GE Healthcare) with an inter-scan delay of one week. We assess a range of contrast media with different iodine concentrations (0-160-200-320 mg I/mL) while keeping the injection parameters constant (3 mL/s and 60 mL followed by a 12 mL saline flush). Before and 15 min after each CT scan, blood samples were collected and put on ice. The lymphocytes were isolated from these blood samples and immunofluorescence microscopy was performed to quantify the γH2AX foci.
representing the radiation induced DNA double strand breaks. At least 750 lymphocytes were analyzed for each condition. Statistical analysis was performed using an independent sample t-test.

RESULTS

We report preliminary results of the first experiments without contrast media (0 mg I/mL) and with 320 mg I/mL contrast media iodine concentration. The amount of DNA double strand breaks was significantly higher when contrast media was present (0.45 ± 0.19 foci/cell) compared to the identical scan protocol without contrast media (0.17 ± 0.15 foci/cell) (p-value < 0.001).

CONCLUSION

The presence of iodine contrast has an impact on the amount of radiation induced DNA double strand breaks. The iodine blood concentration results in a higher photoelectric effect which lead to an increase in the formation of secondary electrons responsible for the induction of DNA double strand breaks.

CLINICAL RELEVANCE/APPLICATION

Due to the iodine dose dependent side effect of contrast media, the administration should be continuously reassessed in function of the evolving CT technology.

SSK03-05 Comparison of Different Concentration Iodinated Contrast Medium in Coronary CT Angiography

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S502AB

Participants
Yanhua Duan, MD, Jinan, China (Presenter) Nothing to Disclose
Ximing Wang, PhD, Jinan, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To compare the image quality of DSCT coronary angiography by different concentration iodinated contrast medium with same iodine volume.

METHOD AND MATERIALS

In this study, 180 consecutive patients underwent DSCT coronary angiography were enrolled between Jan. 2013 to Jan. 2015 in our institute. Prospective ECG-triggered high-pitch spiral scanning mode was performed in all patients. A tube-voltage of 100 kV was adopted in all patients. All patients were assigned to 4 groups randomly according to the different concentration of contrast medium: 270 mgI/ml iodinated contrast medium (n=45, group A), 320 mgI/ml iodinated CM (n=45, group B), 350 mgI/ml iodinated CM (n=45, group C), 370 mgI/ml iodinated CM (n=45, group D). All patients were administrated with same iodine volume (296 mgI/kg body weight). A volume of 1.1 ml/kg, 0.93 ml/kg, 0.85 ml/kg and 0.8 ml/kg body weight iodinated CM (296 mgI/kg body weight) was adopted in group A, B, C and D, respectively. The injection time of CM was fixed at 12 seconds. Injection rate was calculated at total injection volume of CM divided by 12 seconds. Subjective image quality was independently assessed by two radiologists by 4-grade scoring system. Objective image quality (enhancement value, image noise, signal-to-noise ratio and contrast-to-noise ratio of RCA and LAD) was compared among groups.

RESULTS

All prospective ECG-triggering high-pitch spiral DSCT coronary angiographic scans were successful. BMI, age and heart rate were not statistically different among groups. The image quality scores of groups A, B, C and D were 2.00±0.93, 2.13±1.01, 2.85±1.23, 2.93±0.95, respectively. The subjective image quality was significantly higher in group C and D than in the other groups. Mean attenuation in RCA and LAD of group D was significant higher than that in the other groups. The image noise in group A was significantly higher than the other groups. The SNR and CNR in group A were significantly lower than the other groups.

CONCLUSION

The different concentration of contrast medium has a significant impact on the image quality with a same dose of iodine. Considered the image quality and dose of iodine together, higher-concentration of contrast medium provides better image quality of coronary arteries.

CLINICAL RELEVANCE/APPLICATION

Higher-concentration of contrast medium provides better image quality of CT coronary arteries.

SSK03-07 Contrast Media Administration in Coronary Computed Tomography Angiography- A Systematic Review and Meta-analysis

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S502AB

Participants
Casper Mihl, MD, Maastricht, Netherlands (Presenter) Nothing to Disclose
Jakub Turek, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Madeleine Kok, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Joachim E. Wildberger, MD, PhD, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Marco Das, MD, Maastricht, Netherlands (Abstract Co-Author) Research Consultant, Bayer AG; Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Research Grant, Koninklijke Philips NV

PURPOSE

Scanner related parameters, patient related factors and contrast media (CM) application parameters all significantly influence contrast enhancement of the coronary arteries. No consensus exists in the literature on the optimal CM injection protocol. Thus the aim of this review and meta-analysis is to provide an update on the effect of different CM injection parameters on the attenuation in coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS

Relevant studies published between January 2001 and May 2014 identified by Pubmed, Embase and MEDLINE were evaluated. Using
PREDEFINED INCLUSION AND EXCLUSION CRITERIA AND A DATA EXTRATION FORM, TWO REVIEWERS INDEPENDENTLY ASSESSED THE CONTENT OF EACH ELIGIBLE STUDY AFTER PRIMARY SELECTION. A POSSIBLE RELATIONSHIP BETWEEN THE PARAMETERS IODINE DELIVERY RATE (IDR), INJECTION RATE, CM CONCENTRATION, TOTAL IODINE DOSE (TID), CM VOLUME AND ATTENUATION OF THE CORONARY ARTERIES WAS ASSESSED USING MULTIVARIABLE RANDOM-EFFECTS META-REGRESSION ANALYSIS.

RESULTS
In the primary literature search, 2552 potential studies were identified. After examination, a total of 36 studies were found to be eligible for this systematic review. Extracted data on CM-, patient-, and scan-related parameters proved to be heterogeneous and often inconsistent. In a multivariable analysis, IDR and CM injection rate proved to be significantly associated with arterial enhancement of the coronary arteries (p<0.05), while CM concentration, TID and CM volume did not.

CONCLUSION
Multivariable meta-regression analysis showed that both IDR and CM injection rate are decisive for attenuation of the coronary arteries. No evidence of any association between CM concentration and attenuation levels was found.

CLINICAL RELEVANCE/APPLICATION
A thorough understanding of the factors responsible for optimal attenuation of the coronary arteries is considered an absolute requirement for optimizing CM injection protocols in the near future. Multivariable meta-regression analysis showed that both IDR and CM injection rate are decisive for opacification of the coronary arteries.

SSK03-08 Preserving Kidney Function with Ultra-low Contrast Volume CT Angiography

Participants
Alexander S. Misono, MD, MBA, Boston, MA (Presenter) Nothing to Disclose
Elie R. Balesh, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
George R. Oliveira, MD, Newton Center, MA (Abstract Co-Author) Nothing to Disclose
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Brian B. Ghoshhajra, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Ultra-low contrast volume (ULCV) technique for CT angiography (CTA) has been advocated for pre-operative workup for patients undergoing transcatheter aortic valve implantation (TAVI) as the majority of candidates have chronic kidney disease (CKD), a suspected risk factor for contrast-induced nephrotoxicity (CIN). While feasibility has been demonstrated, impact on kidney function in this vulnerable population is a topic of continued inquiry. This study aims to quantify changes in kidney function after ULCV scans.

METHOD AND MATERIALS
In this IRB-approved, HIPAA complaint study, adult ULCV CTA examinations performed from 2012-2015 at a tertiary care hospital were identified. Reports were reviewed for indication and total contrast administered. For each patient, laboratory values of creatinine (Cr) and GFR were identified pre- and post-exam. Patients were excluded if they did not have pre-exam labs within the preceding 3 months or if post-exam labs exceeded 30 days after examination. Paired t tests were performed to assess for change in kidney function between time points, with statistical significance set at p<0.05.

RESULTS
75 ULCV scans were identified, of which 56 (75%) had lab results within the prescribed timeframe. Of note, all of the exams were technically successful. The sample included patients with average age 79 +/- 12.9 (mean +/- SD) with a range of 27-95, including 52% male, 48% female. Indicators for studies were primarily for poor renal function (98%) with the majority specifically for TAVI planning (73%); 2% of patients underwent this technique for prior anaphylactoid reaction. Contrast bolus ranged from 15 to 45 cc with an average of 22.3 +/- 6.3. Post-exam labs were obtained 10 +/- 6 days after contrast CT. For the study population, post-exam Cr of 2.1 +/- 1.5 was not significantly changed from pre-exam Cr of 2.1 +/- 1.7 (p=0.248). Similarly, post-exam GFR of 32.3 +/- 10.7 was not significantly changed from pre-exam GFR of 32.1 +/- 10.8 (p=0.901).

CONCLUSION
ULCV CT angiography is likely a suitable technique in patients with poor baseline kidney function, with no detectable change in pre-versus post-exam creatinine or GFR in this cohort study.

CLINICAL RELEVANCE/APPLICATION
In patients with CKD, ULCV technique likely allows for diagnostic contrast-enhanced CT without detrimental effect on kidney function.

SSK03-09 Lower Volume of Lower Concentration Isotonic Contrast Medium for 320-Row Detector Coronary CT Angiography

Participants
Yi Liang, Wuhan, China (Presenter) Nothing to Disclose
Bolin Du, MD, Wuhan, China (Abstract Co-Author) Nothing to Disclose
Hanlin Wang, Wuhan, China (Abstract Co-Author) Nothing to Disclose
Jingxiang Tao, Wuhan, China (Abstract Co-Author) Nothing to Disclose
Jia Zhou, Wuhan, China (Abstract Co-Author) Nothing to Disclose
Yang Gao, Wuhan, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
Ultrasound contrast agents have been shown to improve diagnostic accuracy and increase specificity in coronary CT angiography (CTA) of patients with chronic kidney disease (CKD). This study aimed to determine the feasibility of the lower volume and lower concentration of contrast medium (CM) for 320-row detector CTA in patients with CKD.
To investigate the feasibility of 320 row coronary CT angiography by using lower volume of lower concentration isotonic contrast medium while maintaining image quality.

**METHOD AND MATERIALS**

64 patients whose heart beat rate are 70 bpm or less, normal cardiac rhythm, and BMI ≤ 24 kg/m² were scanned by 320 row detector dynamic volume CT using 100 kVp (lower tube voltage) and a kind of contrast medium (270mgI/mL). Prospective ECG gating technique and adaptive iterative dose reduction algorithm reconstruction were used. In group A, 22 patients in group A were injected 50 ml fixed dose of contrast medium by a rate of 5.0 ml/s; In group B, 21 patients were injected with the volume of contrast medium calculated by body weight (0.7 ml/kg), injection rate was 4.5 ml/s; In group C, 21 patients were injected with the dosage of contrast medium calculated by body weight (0.6 ml/kg) and the injection rate was 4.0 ml/s. The attenuation value, signal-to-noise (SNR), contrast-to-noise ratio (CNR), image quality and iodine intake between three groups were compared using One-Way ANOVA.

**RESULTS**

There was no significant statistic difference of age, sex ratio, BMI, heart rate between the three groups (P>0.05). However, the dosage of the contrast agent and different injection rate had statistical significance (P<0.05). The attenuation value from group A to group B and then to group C was on the decline, the CT value of group A was obviously higher than that of group B and group C, the differences were statistically significant (P < 0.05), and there was no statistically significant difference between the group B and group C (P >0.05). The image quality, SNR and CNR in three groups did not have significant difference (P >0.05). The total iodine and iodine injection rates were lowest in group C.

**CONCLUSION**

Using 320 row detector dynamic volume CT with 100kVp tube voltage and iterative reconstruction algorithm, the patients whose heart beat rates are 70 bpm or less, BMI ≤ 24 kg/m² are injected with lower concentration of contrast medium by 0.6 ml/kg dose injection give a good image quality of coronary CT angiography which can meet the diagnostic requirement. Meanwhile, it can also reduce the iodine intake and the risk of contrast induced nephrology (CIN).

**CLINICAL RELEVANCE/APPLICATION**

320 row coronary CT angiography by using lower volume of lower concentration isotonic contrast medium maintain image quality, meanwhile, it can also reduce the iodine intake and the risk of contrast induced nephrology (CIN).
SSK04-01 Dynamic First Pass CT Perfusion Imaging of the Myocardium vs. Intracoronary Transluminal Attenuation Gradient in Coronary CT Angiography for the Assessment of Coronary Artery Stenosis

Wednesday, Dec. 2 10:30AM - 10:40AM Location: S504AB

Participants
Pamela K. Woodard, MD, Saint Louis, MO (Moderator) Research Consultant, Bristol-Myers Squibb Company; Research Grant, Astellas Group; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Bayer AG; Research agreement, Siemens AG; Research Grant, Actelion Ltd; Research Grant, Guerbet SA; Robert J. Herfkens, MD, Stanford, CA (Moderator) Nothing to Disclose
Istvan Battyan, MD, PhD, Pecs, Hungary (Moderator) Nothing to Disclose

Method and Materials
34 patients with suspicion of coronary artery disease, who underwent invasive coronary angiography (CA) and assessment of intermediate coronary artery lesions (50-75% diameter reduction) by an invasive pressure wire examination (FFR) were included. All patients underwent a coronary CTA and a dynamic CTP examination under adenosine stress at a 256 slice CT scanner with an 8 cm wide detector. Myocardial blood flow was determined using the dynamic first pass CTP data. Transluminal attenuation gradient (TAG) was calculated as the linear regression coefficient between luminal attenuation and the distance of the location in the coronary artery from its origin. MBF and TAG were compared with the results CA and FFR. ROC curves were calculated. Sensitivity and specificity were calculated using Youden’s index.

Results
The area under the ROC curve was 0.92 (0.80 to 0.95) for MBF and 0.64 (0.46 to 0.793) for TAG (p=0.002). The optimal threshold using Youden’s index was 1.51 for TAG and 1.21 for MBF. Sensitivity and specificity for detection of hemodynamically relevant coronary artery lesions were 71.4 (41.9-91.4) and 73.2 (57.1-85.8) for TAG. Sensitivity and specificity were 90.9 (58.7-98.5) and 84.6 (65.1-95.5) for MBF.

Conclusion
MBF derived from dynamic CTP imaging of the myocardium is superior compared to the TAG derived from coronary CTA for the assessment of coronary artery stenosis.

Clinical Relevance/Application
In spite of being inferior compared to the MBF the TAG can be used as additional functional parameter in the assessment of coronary artery stenosis derived from coronary CTA without additional contrast agent or radiation exposure and may contribute to improve diagnostic accuracy of CTA.

SSK04-02 Detection and Differentiation of Ischemic Myocardial Lesions with Quantitative Post-mortem Cardiac 1.5T MRI

Wednesday, Dec. 2 10:40AM - 10:50AM Location: S504AB

Participants
Wolf-Dieter Zech, MD, Bern, Switzerland (Presenter) Nothing to Disclose
Nicole Schwendener, Bern, Switzerland (Abstract Co-Author) Nothing to Disclose
Anders Persson, MD, PhD, Linkoping, Sweden (Abstract Co-Author) Nothing to Disclose
Marcel Warmtjes, Linkoping, Sweden (Abstract Co-Author) Employee, SyntheticMR AB
Christian Jackowski, MD, Bern, Switzerland (Abstract Co-Author) Nothing to Disclose

Purpose
MR quantification of T1 and T2 relaxation times and proton density (PD) is feasible for characterizing tissue lesions. Since quantitative T1 and T2 values are dependent on magnetic field strength and temperature there is a need for evaluation of
quantitative values with regard to magnetic field strength and tissue temperatures. The purpose of this study was to assess the quantitative T1, T2 and PD values of ischemic myocardial lesions for a post-mortem 1.5T application and to relate quantitative values to tissue temperature.

METHOD AND MATERIALS

Eighty forensic postmortem short axis cardiac 1.5T MR examinations were quantified using a quantification sequence prior to autopsy. During the MR examination the temperature of corpses was assessed. Quantitative T1, T2 and PD values of myocardial lesions were assessed in synthetically calculated cardiac MR images. The quantitative values were related to temperature and correlated with autopsy and histology findings.

RESULTS

A total of 95 ischemic lesions were detected at histology and autopsy (early acute n=61, acute n=14, subacute n=10, chronic n=10). Of 61 histologically confirmed early acute lesions a total of 22 lesions (36.1 %) were not visible in conventional PMMR images. These lesions were targeted in MR images at the location of histologic specimens and presented with quantitative T1 and T2 values that differed significantly from the quantitative values of normal myocardium. ANOVA revealed that the quantitative values of all assessed ischemic lesions and normal myocardium differed significantly from each other. Temperature correction of quantitative values led to lower standard deviations and better differentiability of all lesions.

CONCLUSION

Postmortem 1.5T MR quantification is feasible for detection and diagnosis of different age stages of myocardial ischemia and enables to assess early acute myocardial ischemia not visible in conventional MR images. The quantification approach provides a base for computer aided detection and diagnosis of ischemic myocardial lesions.

CLINICAL RELEVANCE/APPLICATION

If quantitative values are extrapolated to 37°C diagnostic criteria validated in quantitative cardiac PMMR scans may be applied for the detection of myocardial ischemia in living patients.

SSK04-03 Imaging for Suspected Coronary Artery Disease: Recent Utilization Trends Point Downward

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S504AB

Participants
David C. Levin, MD, Philadelphia, PA (Presenter) Consultant, HealthHelp, LLC; Board of Directors, Outpatient Imaging Affiliates, LLC
Laurence Parker, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Vijay M. Rao, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE

In recent years, appropriate use criteria have been developed for cardiac imaging by both the ACR and the American College of Cardiology. Our purpose was to attempt to determine if these criteria affected utilization of the 3 major imaging tests for suspected coronary artery disease (CAD) - nuclear myocardial perfusion imaging (MPI), stress echocardiography (SE), and coronary CT angiography (CCTA).

METHOD AND MATERIALS

The nationwide Medicare Part B databases from 2001 through 2013 were studied. The CPT codes for primary MPI, SE, and CCTA were selected. Procedure volumes were tabulated for all places of service, and utilization rates per 1000 Medicare fee-for-service beneficiaries were calculated. Medicare specialty codes were used to ascertain the relative roles of radiologists and cardiologists.

RESULTS

The utilization rate per 1000 of MPI increased from 63.4 in 2001 to a peak of 88.0 in 2006, then declined to 61.9 in 2013 (-30% vs 2006 peak). In 2013, cardiologists did 77% of the MPIs; radiologists did 17%; the rest were done by other physicians. The utilization rate of SE was 12.5 in 2001 and remained relatively stable through 2010, then declined to 10.8 by 2013 (-14% vs 2010). Radiologists had essentially no role in SE. CCTA utilization could only be tracked since 2006, the first complete year codes were available for that study. The rate per 1000 that year was 1.0. It went up to 2.1 the following year, but then declined every year thereafter to 1.1 in 2013 (-48% vs peak). In 2013, radiologists did 49% of CCTAs; cardiologists did 46%; other physicians did the rest. That year, 56 times as many MPIs as CCTAs were performed.

CONCLUSION

The utilization rate of noninvasive imaging in patients with suspected CAD is declining. The cause is likely multifactorial. The decline is more pronounced in MPI than in SE. The use of CCTA has also dropped, but its rate is far lower than that of MPI and SE. CCTA is probably underused in comparison to those 2 techniques. Radiologists have no role in SE, a relatively small role in MPI, but an important role in CCTA.

CLINICAL RELEVANCE/APPLICATION

n/a

SSK04-04 Automated 3D MRI Volumetry of the Pulmonary Arteries: Evaluation in Patients with Pulmonary Arterial Hypertension and Potential for Predicting Pulmonary Hypertension

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S504AB

Awards
Trainee Research Prize - Resident

Participants
Fabian Rengier, MD, Heidelberg, Germany (Presenter) Nothing to Disclose
Stefan Woerz, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Claudius Melzig, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Sebastian Ley, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Increased pulmonary artery diameters have been shown to indicate pulmonary hypertension, but 2D diameter measurements are only a limited representation of 3D geometry. Purpose of this study was to demonstrate feasibility of 3D volumetry of pulmonary arteries based on magnetic resonance angiography (MRA), to assess pulmonary artery volumes in patients with pulmonary arterial hypertension compared to healthy volunteers, and to investigate its potential for predicting pulmonary hypertension (PH).

**METHOD AND MATERIALS**

MRA of the pulmonary arteries was acquired at 1.5T in 37 subjects (mean age 42±14 years) with a slice thickness of 1.6mm and in-plane resolution of 1.3x1.3mm². 20 patients had pulmonary arterial hypertension (WHO classification Group 1) confirmed by right heart catheterization, 17 healthy volunteers had no history of cardiovascular disease. Using in-house developed 3D model-based image analysis software, main, right and left pulmonary arteries (mPA, rPA and IPA) were automatically segmented after placement of seed points. Volumes for mPA, rPA and IPA were computed and corrected for body surface area (BSA). For comparison purposes, diameter of mPA was manually measured on axial reconstructions by an experienced radiologist.

**RESULTS**

Volumes for patients/volunteers were (in mm³/m² BSA): mPA 25570/13927 (p=0.002), rPA 10484/3087 (p<0.001) and IPA 7533/3899 (p<0.001). ROC analysis of volumes showed: mPA AUC 0.874 (95% CI 0.748-0.999, p=0.001), rPA AUC 1.0 (95% CI 1.0-1.0, p<0.001) and IPA AUC 0.899 (95% CI 0.774-1.0, p=0.001). Sensitivity, specificity, positive predictive value and negative predictive value for predicting PH were highest for rPA volume with 100%, 100%, 100% and 100% using 6000mm³/m² BSA as sex-independent cut-off, compared to 95%, 78%, 82% and 93% for mPA diameter using 29/27mm as cut-off for males/females as suggested by the Framingham Heart Study.

**CONCLUSION**

MRA-based 3D volumetry of pulmonary arteries is feasible and demonstrated significantly increased volumes for main, right and left pulmonary arteries in patients with pulmonary arterial hypertension compared to healthy volunteers. Volume of right pulmonary artery might be an accurate predictor for PH but validation in a larger study population is warranted.

**CLINICAL RELEVANCE/APPLICATION**

3D pulmonary artery volumes might be more accurate than 2D diameter measurements in the prediction and evaluation of pulmonary hypertension.

**SSK04-05** Pulmonary Arterial Hypertension is Associated with Increased T1 Relaxation Times and Decreased Left Ventricular Performance in Spite of Preserved Left Ventricular Function

**Wednesday, Dec. 2 11:10AM - 11:20AM Location: S504AB**

**Participants**

Rami Homsi, Bonn, Germany (**Presenter**) Nothing to Disclose

Julian A. Luetkens, Bonn, Germany (**Abstract Co-Author**) Nothing to Disclose

Dirk Skowasch, Bonn, Germany (**Abstract Co-Author**) Nothing to Disclose

Julia Meyer zur Heide, Bonn, Germany (**Abstract Co-Author**) Nothing to Disclose

Juergen Gieseke, DSC, Bonn, Germany (**Abstract Co-Author**) Employee, Koninklijke Philips NV

Hans H. Schild, MD, Bonn, Germany (**Abstract Co-Author**) Nothing to Disclose

Claas P. Naehle, MD, Bonn, Germany (**Abstract Co-Author**) Consultant, Medtronic, Inc

**PURPOSE**

Pulmonary arterial hypertension (PAH) mainly affects the right (RV), but also the left ventricle (LV). Strain analysis allows for detection of ventricular dysfunction even in patients with preserved ventricular function. Cardiac magnetic resonance (CMR) mapping techniques with determination of T1 and T2 relaxation times (T1 resp T2) may allow for discrimination between healthy myocardium and diffuse fibrosis in PAH patients. This study was performed to evaluate the association between myocardial changes assessed by strain analysis and by native T1 and T2 map in patients with PAH.

**METHOD AND MATERIALS**

16 Patients with PAH (8 men, 8 women, mean age 63.75y ± 13.85) and 17 healthy volunteers (8 men,9 women, mean age 57.56y ± 12.45) were examined on a 1.5 Tesla MR system (Ingenia, Philips). Native T1s were assessed using the modified Look-Locker inversion recovery sequence and T2s were assessed using a GraSE sequence. LV and RV longitudinal strain was assessed during postprocessing of standard SSFP Cine images by CMR feature tracking using a dedicated software (Diogenes, TomTec, Unterschleissheim, Germany). LV and RV function were assessed by volumetric analysis.

**RESULTS**

LV ejection fraction did not differ between PAH patients and healthy volunteers (61.26 ± 7.13 vs. 61.53 ± 6.48; p>0.05). Left ventricular T1 s however were significantly higher in patients with PAH (1050.17 ± 47.90 vs. 980.72 ± 45.5; p<0.01). LV longitudinal strain was significantly lower in patients with PAH (-17.01 ± 5.34 vs. -23.05 ± 3.57, p<0.01). RV longitudinal strain and RV Ejection fraction were both significantly lower in patients with PAH. There were no significant differences in T2 relaxation times, age, body mass index, or sex.

**CONCLUSION**

LV myocardial fibrosis as indicated by increased T1 reduces LV strain despite of normal LV function in patients with PAH.
CLINICAL RELEVANCE/APPLICATION

Increased T1 as an indicator for LV involvement in PAH may be useful to identify patients at risk and to determine the intensity of treatment even when myocardial function is preserved.

SSK04-06 Cardiac Effects of Prolonged Apnea in Elite Divers Investigated with Comprehensive Cardiac Magnetic Resonance

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S504AB

Participants
Jonas Doerner, MD, Bonn, Germany (Presenter) Nothing to Disclose
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Jean-Marc Lunkenheimer, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
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Rainer Meyer, 53115, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Hoeff, 53105, Germany (Abstract Co-Author) Nothing to Disclose
Hans H. Schid, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Claas P. Naehle, MD, Bonn, Germany (Abstract Co-Author) Consultant, Medtronic, Inc

PURPOSE

Apnea diving is getting more and more popular as a recreational sport activity and performance of apnea divers has been constantly rising in the recent years. Prolonged apnea leads to the so-called diving response (i.e. bradycardia, reduced cardiac output, peripheral vasoconstriction) which burdens the heart and leads to changes in circulation. This study investigated the effects of prolonged apnea to the heart and hemodynamic alterations using comprehensive cardiac magnetic resonance imaging (CMR).

METHOD AND MATERIALS

We investigated 17 (15 male, 2 women) elite divers using CMR at 1.5T before, during, and after apnea in air. Subjects performed two sessions: in the first cardiac function (left ventricular end-diastolic volume (LV-EDV), end-systolic volume (LV-ESV), ejection fraction (LV-EF), fractional shortening (FS)) was repeatedly measured using steady state free precision (SSFP) imaging in SAX and VLA; in the second blood flow was measured in both common carotid arteries (ACC) using phase contrast imaging. Apnea was performed in maximal inspiration.

RESULTS

Mean breath hold duration was 297s±52 in the cardiac session and 276s±78 in the flow session. Maximal apnea time reached was 8:03min. Over time, apnea (AP) resulted in a progressive increase of LV-EDV (baseline: 131±33; AP: 190±35; p<0.0001), slight decrease of LV-EF (baseline: 63±10; AP: 58±8; p=0.012) and a consecutive increase of LV-ESV (baseline: 49±20; AP: 80±18; p<0.0001), FS as a parameter of regional function also decreased significantly during apnea (baseline: 35±45; AP: 25±45; p<0.0001). Flow measurement revealed an increase of blood-flow to the brain (left ACC: baseline: 5.0±2.0; AP: 12.8±4.4; p=0.0026; right ACC: baseline: 5.1±2.2; AP: 12.4±6.3; p=0.0009).

CONCLUSION

This work reveals that prolonged apnea results in massive hemodynamic changes to the heart and an increase of blood-flow to the brain as expected from the diving reflex. In particular, apnea leads to a transient cardiac dilation, decrease of LV-EF and fractional shortening, a similar pattern as seen in patients with systolic heart failure.

CLINICAL RELEVANCE/APPLICATION

This study shows that prolonged apnea has tremendous effects to the heart and the vascular system; therefore moderate trained subjects, especially with known medical conditions, should perform maximal apnea with caution.

SSK04-07 Is it Possible to Investigate Archeological Hearts Using CT and MRI? About Five Archeological Hearts

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S504AB

Participants
Fatima-Zohra Mokrane, MD, Toulouse, France (Presenter) Nothing to Disclose
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Ramiro Moreno, MS, Toulouse, France (Abstract Co-Author) Nothing to Disclose
Anou Sewoulu, PhD, Toulouse, France (Abstract Co-Author) Nothing to Disclose
Henri G. Mousseau, MD, Toulouse, France (Abstract Co-Author) Nothing to Disclose
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Fabrice H. Dedouit, MD, PhD, Toulouse, France (Abstract Co-Author) Nothing to Disclose

PURPOSE

Five archeological hearts were found in an archeological site last year. Several graves were found in the basement of a church. In addition to different archeological bones found, five heart shaped lead polls were discovered. These findings were found in vaults from elite class families. At the opening of the polls, findings were very interesting: five well conserved hearts dating form the end on the 16th century, to the beginning of the 17th century.

METHOD AND MATERIALS

Thanks to the embalming process, archeological hearts were well conserved. Each archeological heart has been studied with CT scanner and with MRI, before and after balm extraction, and after rehydration. CT parameters were standard, using a 16 row CT scanner. MRI parameters were difficult to optimize. This was due to lack of hydration of these archeological pieces.

RESULTS

LV myocardial fibrosis as indicated by increased T1 reduces LV strain despite of normal LV function in patients with PAH.
First images acquired were very impressive, but with poor information. This was due to important vegetal embalming process. Hearts were first scanned with their balms. Then, they were carefully "cleaned." Finally, they were rehydrated. CT and MR examinations where performed for each heart. Because of an intra tissue lead diffusion, especially in infra epicardial fat, there was an impressive natural contrast on CT images. This element permitted to identify different heart structures like chambers, valves and coronary arteries. MRI images were hard to obtain because of lack of hydration. Therefore, images after rehydration were relevant and allowed to better identify myocardial muscles.

**CONCLUSION**

Study of archeological smooth tissues like heart is possible using CT and MRI, but it requires a good knowledge of the embalming process and MR technical parameters.

**CLINICAL RELEVANCE/APPLICATION**

Until now, no radiological examination of archeological hearts was described in the literature data.

**SSK04-09  Effect of Calcium Blooming in Coronary Arteries at Different Monoenergetic Levels of a Novel Spectral Detector CT and Comparison with Polychromatic Conventional Image**

**Wednesday, Dec. 2 11:50AM - 12:00PM Location: S504AB**

**Participants**

Majid Chalian, MD, Cleveland Heights, OH (Presenter) Nothing to Disclose
Bahar Mansoori, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Hamid Chalian, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Cleveland, OH (Abstract Co-Author) Institutional Research Grant, Koninklijke Philips NV

**PURPOSE**

To evaluate the extent of calcium blooming in coronary arteries at different virtual monoenergetic levels of a novel spectral detector CT (SDCT) and compare with the conventional polychromatic image.

**METHOD AND MATERIALS**

This study included 59 patients who had coronary CTA using an SDCT prototype (Philips Healthcare, Cleveland, OH, USA).
patients were found to have coronary artery calcifications and recruited in the study. Two independent readers evaluated calcified plaques for plaque diameter, plaque area, luminal diameter, and percentage of stenosis. Measurements were performed at conventional polychromatic image as well as virtual monoenergetic images from 70 to 140 keV at 10 keV intervals. The images were also evaluated qualitatively for vascular enhancement, noise, and mage quality on a 5-point scale (1 - worst, 5-best). Repeated measure ANOVA test was used to compare differences at different energy levels. Intra-class correlation coefficient (ICC) was used to evaluate inter-observer reliability.

RESULTS

Diameter of calcification, area of calcification, and degree of stenosis demonstrated gradual statistically significant ($p<0.001$) decrease at different incrementally increasing monochromatic imaging keVs from 70 to 140 keV (3.41mm to 1.55mm, 9.96mm2 to 3.39 mm2, and 70% to 30% stenosis, respectively). Also, diameter and area of lumen demonstrated gradual increase at higher monochromatic energy levels (1.56mm to 2.74mm and 4.47mm2 to 8.61mm2, respectively, $p<0.001$). Comparison of monochromatic reconstructed images with conventional polychromatic imaging also demonstrated the same pattern of changes, with progressive improvement at higher energy levels. The monochromatic images at 80 keV provided the best image quality metrics. There was excellent inter-observer reliability between two readers (ICC> 0.970). Subjective analysis showed that the image quality progressively declined above 80 keV due to decreasing vascular enhancement, with the maximum image quality seen at 80 keV (4.8 at 80 keV to 2 at 140 keV).

CONCLUSION

Calcium blooming significantly decreases at higher monoenergy levels compared to polychromatic images with resultant increased luminal size and decreased stenotic grade. 80 keV is the best level due to declining image quality at higher levels

CLINICAL RELEVANCE/APPLICATION

Use of monoenergetic images decreases the effect of calcium blooming in coronary arteries compared to polychromatic images.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
A New Subtype of COPD in Cigarette Smokers

PURPOSE

Although quantitative CT measurement of % low attenuation areas less than -950 HU (%LAA-950) is commonly used as a surrogate for emphysema, there is a subgroup of patients who meet quantitative criteria for emphysema, but who do not have visual evidence of emphysema. The purpose of this study was to determine the demographic and physiologic features of this discordant group, compared with a control group that did not have either visual or quantitative evidence of emphysema.

METHOD AND MATERIALS

2099 cigarette smokers enrolled in the COPDGene study underwent visual analysis by two trained research analysts, according to the Fleischner Society categorization of emphysema. From this group, we selected all subjects who had quantitative evidence of emphysema (%LAA-950>5%) but did not have visual evidence of emphysema (n=165). The control group comprised subjects with no visual or quantitative CT evidence of emphysema (n=677). All subjects underwent inspiratory and expiratory CT evaluation, with quantitative CT metrics. Expiratory air trapping was assessed quantitatively by measuring the % LAA <856 HU on expiration. Followup spirometry was obtained 5 years after the initial CT in 128 discordant subjects and in 448 controls. Differences between groups were evaluated using Chi-Square and Student t test as appropriate.

RESULTS

Kappa value for presence or absence of emphysema was 0.84. Compared with the control group, the discordant group were older (mean ±s.d. 62±9 vs 59±9 years, p=0.0001), more likely to be male (63% vs 38%, p<0.0001), and less likely to be African American (5% vs 21% p<0.0001). Although the FEV1 % at baseline was similar in the two groups, the FEV1/FVC ratio was significantly lower in the discordant group (0.71±.10 vs 0.77±.07 p<0.0001). On quantitative expiratory CT, the %LAA-856 was 23±12 % in the discordant group compared with 11±9% in the controls (p<0.0001). On 5 year followup, the mean decrease in FEV1 in the discordant group was 241±271 ml, compared with 178±259 ml in the control group (p=0.018).

CONCLUSION

Even in the absence of visual emphysema, quantitative CT densitometry identifies a subgroup of smokers with evidence of airway obstruction, who demonstrate progression in airway obstruction over time.

CLINICAL RELEVANCE/APPLICATION

The high proportion of LAA-950 in the discordant group may be due to sub-resolution emphysema (perhaps panlobular), or to lobular overinflation related to small airways abnormality.
To retrospectively investigate the optimal threshold for quantification of air-trapping using non-rigid registration of inspiration and expiration CT scans in COPD patients in correlation with FEF25-75% and RV/TLC.

METHOD AND MATERIALS

Institutional review board approval was obtained. From June 2005 to October 2010, 195 patients (166 COPD patients, 29 nonsmoker control) were included in our study. Inspiration and expiration CT scans were performed in the same CT scanner followed by non-rigid registration using an in-house software. Subtraction value per voxel between inspiration and registered expiration CT was obtained and volume fraction of air-trapping (air-trapping index, ATI), using variable thresholds (from 30 to 120 HU), was calculated. Calculated ATI using variable thresholds, expiration/inspiration ratio of mean lung density (E/I MLD), and the percent of lung voxels below -856HU on expiration CT (gas-trapping index, Exp -856) were correlated with pulmonary function parameters for small airway disease or air-trapping (FEF25-75% and RV/TLC).

RESULTS

All of ATI with variable thresholds were significantly correlated with both FEF25-75% and RV/TLC (all P<0.001). When correlated with FEF25-75%, the highest correlation coefficient was -0.656, using the threshold of 80HU. As for RV/TLC, as threshold increased, the correlation coefficient decreased. The highest correlation coefficient was 0.664, using the threshold of 30HU. When plotting the relation between subtraction thresholds and FEF25-75% and RV/TLC, threshold of 60 HU was suitable (r=0.649 and 0.651, respectively). Those correlation coefficients were comparable to the results with E/I MLD (r=-0.670 and 0.657 for FEF25-75% and RV/TLC, respectively) and Exp -856 (r= -0.604 and 0.565 for FEF25-75% and RV/TLC, respectively). When the optimal threshold of 60HU was applied, the measured ATI of 23 nonsmoker normal controls and COPD patients were 24.2% ± 16.8 and 65.7% ± 17.7 (P<0.001).

CONCLUSION

Optimal threshold for quantification of air-trapping using non-rigid registration of inspiration and expiration CT scans in COPD patients is 60 HU with significant correlation with FEF25-75% and RV/TLC, and is comparable to E/I MLD and Exp -856.

CLINICAL RELEVANCE/APPLICATION

Quantification of air-trapping using optimal subtraction threshold of 60 HU using non-rigid image registration of inspiration and expiration CT scans may be useful in assessing small airway dysfunction in COPD patients.

SSK05-03 Impact of Endobronchial Coiling on Segmental Bronchial Lumen in Treated and Untreated Lung Lobes: Correlation with Changes in Lung Volume, Clinical and Pulmonary Functional Tests

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S404CD

Participants

Christopher Kloth, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Wolfgang M. Thaiss, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Hendrik Ditt, Forchheim, Germany (Abstract Co-Author) Employee, Siemens AG
Juergen Hetzel, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolau, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG
Speakers Bureau, Bayer AG
Marius Horger, MD, Tuebingen, Germany (Presenter) Nothing to Disclose

PURPOSE

To assess the impact of endobronchial coiling on cross-sectional area of segment bronchi and corresponding lobe volumes both at end-inspiration and end-expiration in patients with chronic obstructive lung disease (COLD) grade IV (GOLD) by using quantitative chest-CT.

METHOD AND MATERIALS

From January 2010 to December 2014 30 patients (female=15, median age=65.36y; range 48-76y) underwent chest-CT both before and after endobronchial coiling for lung volume reduction (LVR). Two thin-slice (0.6mm) non-enhanced image data sets were acquired both at end-inspiration and end-expiration. Clinical response was defined as an increase in the walking distance (6MWT) after LVR-therapy. Additionally, we used also PFT measurements with forced expiratory volume in 1 second (FEV1), ratio of residual volume over total lung capacity (RV/TLC) and single-breath diffusion capacity for carbon monoxide (DLCOSB) for correlation.

RESULTS

In the treated segment bronchi, the cross-sectional area of the lumen showed a significant reduction (p<0.05) in inspiration and a tendency to an increased lumen in expiration (p>0.05). In the other ipsilateral lobe, the segment bronchial lumens showed no significant changes. In the contralateral lung, we found at inspiration a strong tendency towards an increased lumen (p=0.06). The lung volumes of the treated lobes directly correlated with the treated segment bronchial lumen in expiration (r=0.80, p<0.001). Clinical correlation with 6 minutes walking test (6MWT) and pulmonary function test (PFT) showed only in responders a statistically significant decrease of volume in the treated lobe. Responders showed a increase of the 6 MWT (p < 0.0001) and non-responders a significant decrease of the 6MWT (p < 0.0078). The responder subgroup showed an increase of FEV1, TLC and VC however not statistically significant.

CONCLUSION

Endobronchial coiling causes a significant decrease in the crosssectional area of treated segmental bronchi in inspiration and also a slight increase in expiration accompanied by a volume reduction whereas in the non-treated lung lobes a slightly opposite tendency was observed. 6MWT and PFT minimally, but statistically significant improved after LVR.

CLINICAL RELEVANCE/APPLICATION

Our data support the current understanding of coiling effects which claim that they stabilize and stiffen the lung parenchyma thus compensating for the loss of elasticity in the interstitium and reducing bronchial motility/collapsing.

SSK05-04 Lung Morphology Assessment of Cystic Fibrosis Using Non Contrast Proton MRI with Submillimeter Details at 1.5 Tesla

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S404CD

Participants

Details at 1.5 Tesla
RESULTS

Four subgroups were identified based on the trends in smoking habit enrolled in the ITALUNG trial of lung cancer screening.

Participants

Gael Dournes, MD, PhD, Pessac, France (Presenter) Nothing to Disclose
Julie Macey, Bordeaux, France (Abstract Co-Author) Nothing to Disclose
Fanny Menut, Bordeaux, France (Abstract Co-Author) Nothing to Disclose
Marjorie Salel, Bordeaux, France (Abstract Co-Author) Nothing to Disclose
Michel Montaudon, MD, Pessac, France (Abstract Co-Author) Nothing to Disclose
Olivier Corneloup, MD, Bordeaux, France (Abstract Co-Author) Nothing to Disclose
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Jean Francois Chatell, MD, Bourdeaux, France (Abstract Co-Author) Nothing to Disclose
Michael Fayon, Bordeaux, France (Abstract Co-Author) Nothing to Disclose
Patrick Berger, MD, PhD, Bordeaux, France (Abstract Co-Author) Nothing to Disclose
Francois H. Laurent, MD, Pessac, France (Abstract Co-Author) Nothing to Disclose

PURPOSE

The aim of the study was to assess the concordance between CT and non-contrast proton MRI for evaluation of structural cystic fibrosis (CF) changes using a respiratory-gated PETRA, a T1-VIBE and a T2-HASTE sequences.

METHOD AND MATERIALS

All consecutive CF patients under stable condition were enrolled from July 2014 to January 2015 in a single institution. All patients or their parents gave written informed consent. Patients had to complete both CT and MRI the same day. The Helbich-Bhalla score was used to assess CF severity. Concordance between CT and MRI was assessed using intraclass correlation coefficient (ICC) and Bland-Altman analysis. Intra and inter-observer reproducibility were assessed.

RESULTS

24 CF patients were enrolled (mean age=22.6±9.6, ranging from 9 to 48-year-old). Mean Helbich-Bhalla score at CT was 13.6±5.5. The concordance in overall Helbich-Bhalla score was very good using PETRA (ICC=0.99) while it was found good using VIBE and HASTE sequences (ICC=0.69 and 0.62, respectively). Bland-Altman plots showed that agreement between CT and PETRA was independent from the magnitude of score (mean difference (MD)=-0.3 [-1.7; 1.3]), whereas there was systematic underestimation using VIBE (MD=-4.9 [-0.5; -9.3]) and HASTE (MD=-5.6 [-0.4; -10.9]). Intra and interobserver reproducibility were very good for the whole imaging modalities (ICC=0.86-0.98).

CONCLUSION

In this pilot study, the Helbich-Bhalla score using PETRA matched closely with that of CT and showed higher level of concordance than either conventional T1-weighted or T2-weighted sequences. Further improvement in respiratory synchronization and acquisition time are expected, whereas future combination with functional information is warranted.

CLINICAL RELEVANCE/APPLICATION

Implication for patient care - PETRA is a clinically available sequence which provides assessment of lung structural-CF alterations with submillimeter details - Using lung MRI, non-invasive structural assessment of CF may no longer be restricted due to radiation concern for routine follow-up or under treatment.
decreased respectively from 38.2±20 at T1 to 39.21±17.4 at T3 (p<.00504), from 24.2±21.5 at T1 to 20±18.6 at T3 (p=0.0063), from 36.6±12.4 at T1 to 26.8±16.2 at T3 (p<.0001). On the contrary in the 7 re-starter PD15 g/l increased without statistical relevance (38.6±23.4 at T1 and 48.4±18.6 at T3, p=0.1897).

CONCLUSION
LDCT densitometric analysis allows a short-term evaluation of progression of pulmonary emphysema in screened subjects. The different trends in smoking habit during the follow-up seems to independently determine the lung density change with the major decrease in quitters and former smokers, possibly dependent to the absence of inflammatory smoking induced effects.

CLINICAL RELEVANCE/APPLICATION
The short-term progression of emphysema can be evaluated by LDCT analysis in asymptomatic subjects and differ depending of trends in smoking habit in the period of follow-up.

SSK05-06  Assessment of Healthy Volunteers with COPD High Risk Factors by Quantitative CT: Correlation with Pulmonary Functional Tests

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S404CD

Participants
Yi Xia, MD, Shanghai, China (Presenter) Nothing to Disclose
Yu Guan, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Li Fan, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Shiyuan Liu, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the association of quantitative CT (QCT) with spirometric measurements in healthy volunteers with COPD high risk factors between non-smoking group and smoking group.

METHOD AND MATERIALS
Seventy-four healthy volunteers were examined by PFT, inspiratory and expiratory CT. Inclusion criteria: 1. age>45y; 2. cigarette>10 pack*year; or chronic cough,sputum or dyspnea symptom;or emphysema on CT; 3. spirometry: FEV1%pred<95% and FEV1/FVC>70%; 4. informed consent acquired. The subjects were classified into 2 groups: non-smoking group(n=40) and smoking group(n=34). QCT parameters contained trachea volume, total lung volume (TLV) and emphysema index of threshold of lung area with attenuation lower than -950 HU (EI-950) on inspiratory CT; air trapping, defined as the percentage of attenuation area lower than -856 HU (LAA-856) on expiratory CT. To evaluate the correlation between QCT parameters and PFT values, Spearman correlation analysis was used. Compare the difference between non-smoking group and smoking group, t-test was used.

RESULTS
The TLV showed good correlation with FEV1, FVC and TLC(r=0.575, P<0.001;r=0.590, P<0.001;r=0.714, P<0.001) for all subjects. For non-smoking group, there were strong correlation between TLV and FEV1, FVC, TLC(r=0.498, P=0.001;r=0.580, P<0.001;r=0.757, P<0.001). However, there was no correlation between TLV and FEV1, FVC for smoking group. In addition, there was a correlation between total lung capacity (TLC) and EI-950 (r=0.236, P=0.043), between TLC and LAA-856 (r=0.265, P=0.026), respectively. For non-smoking group, the TLC had strong correlation with LAA-856(r=0.526, P=0.001); But, there was no statistical difference between TLC and EI-950 or LAA-856 for smoking group. Compared with smoking group, TLV (4.79±0.98 L vs. 3.75±1.06 L ) and trachea volume(62.3±13 cm3 vs.43.3±18 cm3) were reduced significantly in non-smoking group. Smoking group [(2.69±0.33 )L and (3.51±0.45) L] showed higher FEV1 and FVC vs. non-smoking group[ (2.28±0.52)L and 2.95±0.69](P<0.001).

CONCLUSION
There were different correlations and features between PFT and CT volume in non-smoking group and smoking group for subjects with COPD high risk factors.

CLINICAL RELEVANCE/APPLICATION
Assessment of healthy volunteers with COPD high risk factors by QCT indicate that non-smoking group and smoking group have different features, which could guide clinical management.

SSK05-07  The Airway Remodelling and Emphysema Alteration as Determined by Quantitative CT Measurement: Correlations with the Frequency of COPD Exacerbation

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S404CD

Participants
Yu Guan, MD, Shanghai, China (Presenter) Nothing to Disclose
Li Fan, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Yi Xia, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Shiyuan Liu, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
We aimed to evaluate the change of airway remodelling and emphysema in COPD exacerbations as determined by quantitative CT measurement. We aslo study the relationship between COPD exacerbation frequency and quantitative CT measures of airway remodelling and emphysema.

METHOD AND MATERIALS
Volumetric CT was acquired for 80 patients who visited the emergency department for AECOPD. All images were reconstructed with 1mm slice and retrospectively analyzed using a software program with fully-automated 3D airway extraction and emphysema analysis. Total lung emphysema index were calculated automatically at the threshold of -950HU. Airway parameters including wall thickness(WT), luminal diameter(LD) and wall area percentage(WA%) were measured in the six segmetal bronchus as follows, RB1, RB4, RB10, LB1 and LB10. The frequency of COPD exacerbation in the prior year was determined by using a questionnaire.

Statistical
analysis was performed to examine evaluate the change of airway remodelling and emphysema in COPD exacerbations and the relationship of exacerbation frequency with quantitative CT measurements.

RESULTS

Emphysema index alteration was not influenced by the frequency of COPD exacerbation in the same patient. There was no significant correlations between emphysema index alteration and COPD exacerbation frequency ($r=0.46, p=0.06$). However, the wall area percentage (WA%) and wall thickness (WT) were measured in the six segmental bronchus were associated with COPD exacerbation frequency ($r=0.74, p=0.02$; $r=0.65, p=0.03$, respectively). No significant correlations was found between luminal diameter (LD) and COPD exacerbation frequency ($r=0.53, p=0.08$).

CONCLUSION

Quantitative CT can identify the change of small airway and emphysema in COPD exacerbations which may contributed to individual treatment.

CLINICAL RELEVANCE/APPLICATION

Quantitative CT can identify the change of small airway and emphysema of COPD exacerbations which which may contributed to individual treatment.

SSK05-08  Meta-analysis of Repeatability of CT Lung Density Measures
Wednesday, Dec. 2 11:40AM - 11:50AM Location: S404CD

Participants
Sean B. Fain, PhD, Madison, WI (Presenter) Research Grant, General Electric Company Research Consultant, Marvel Medtech, LLC
Heather Chen-Mayer, PhD, Gaithersburg, MD (Abstract Co-Author) Nothing to Disclose
Alfonso Rodriguez JR, MS, Madison, WI (Abstract Co-Author) Nothing to Disclose
Jared Siemen, Coralville, IA (Abstract Co-Author) Consultant, Vida Diagnostics, Inc
Matthew K. Fuld, PhD, Iowa City, IA (Abstract Co-Author) Researcher, Siemens AG
Bermice E. Hoppel, PhD, Vernon Hills, IL (Abstract Co-Author) Employee, Toshiba Corporation
David A. Lynch, MBChb, Denver, CO (Abstract Co-Author) Research support, Siemens AG; Scientific Advisor, PAREXEL International Corporation; Consultant, Boehringer Ingelheim GmbH; Consultant, Gilead Sciences, Inc; Consultant, F. Hoffmann-La Roche Ltd; Consultant, Veracyte, Inc.
Frank N. Ranallo, PhD, Madison, WI (Abstract Co-Author) Grant, General Electric Company
Philip F. Judy, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To determine the clinically relevant change of lung density CT metrics.

METHOD AND MATERIALS

The most established measures of lung parenchymal density are "RA950" and "Perc15". The RA950 is defined here as the relative lung area (or lung voxels) at total lung capacity (TLC) with CT attenuation below -950 Hounsfield units (HU). The Perc15 is defined as the HU value at which 15 percent of all voxels have a lower density. These measures are the most common, based on studies comparing to tissue histology in resected lung and established in longitudinal studies of emphysema progression. Literature review was conducted on recent clinical studies involving repeat scans of non-diseased or stable subjects to determining bias and repeatability. A meta-analysis was performed on the repeatability coefficient (RC) inclusive of recent studies that met three major criteria: 1) The study was performed using 16 or 64 slice architectures with 3D volumetric scanning similar to the specifications. 2) The study performed CT in subjects for at least two time points in identical CT scanners with ≤4 months separating the two time points to mitigate the degree of possible disease progression. 3) The Perc15 and/or RA950 metrics were used to assess lung parenchymal density.

RESULTS

Most studies show that performing volume adjustment (VA) to compensate for the state of the lung inflation will improve the RC. Mean RCs were determined from the meta-analysis using the random effects model, shown in a summary Forest plot (Fig. 1), for before and after VA. Each study reported limits of agreement (LOA), defined as 1.96SDbias, from which the RC can be calculated. The RC is deemed the Smallest Real Difference (SRD), a reference for making clinical decisions.

CONCLUSION

Result of the meta-analysis suggests that without lung VA, a decrease in Perc15 of at least 18 HU, is required for detection of an increase in the extent of emphysema, with 95% confidence. With lung VA, this SRD value is narrowed down to 11 HU. For RA950 without VA, an increase of at least 3.7% constitutes a real change.

CLINICAL RELEVANCE/APPLICATION

Volume adjustment should be considered to improve repeatability and increase precision for longitudinal studies of emphysema progression in COPD using lung density CT.

SSK05-09  Quantitative Analysis of Pulmonary Peripheral Vessels Using CT in Healthy Subject and COPD Patients
Wednesday, Dec. 2 11:50AM - 12:00PM Location: S404CD

Participants
Sang Min Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Joon Beom Seo, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyun Jung Koo, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Namkug Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Stockholder, Coreline Soft, Inc
Jangpyo Bae, MS, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yeon-Mok Oh, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To determine the clinically relevant change of lung density CT metrics.

METHOD AND MATERIALS

The most established measures of lung parenchymal density are "RA950" and "Perc15". The RA950 is defined here as the relative lung area (or lung voxels) at total lung capacity (TLC) with CT attenuation below -950 Hounsfield units (HU). The Perc15 is defined as the HU value at which 15 percent of all voxels have a lower density. These measures are the most common, based on studies comparing to tissue histology in resected lung and established in longitudinal studies of emphysema progression. Literature review was conducted on recent clinical studies involving repeat scans of non-diseased or stable subjects to determining bias and repeatability. A meta-analysis was performed on the repeatability coefficient (RC) inclusive of recent studies that met three major criteria: 1) The study was performed using 16 or 64 slice architectures with 3D volumetric scanning similar to the specifications. 2) The study performed CT in subjects for at least two time points in identical CT scanners with ≤4 months separating the two time points to mitigate the degree of possible disease progression. 3) The Perc15 and/or RA950 metrics were used to assess lung parenchymal density.

RESULTS

Most studies show that performing volume adjustment (VA) to compensate for the state of the lung inflation will improve the RC. Mean RCs were determined from the meta-analysis using the random effects model, shown in a summary Forest plot (Fig. 1), for before and after VA. Each study reported limits of agreement (LOA), defined as 1.96SDbias, from which the RC can be calculated. The RC is deemed the Smallest Real Difference (SRD), a reference for making clinical decisions.

CONCLUSION

Result of the meta-analysis suggests that without lung VA, a decrease in Perc15 of at least 18 HU, is required for detection of an increase in the extent of emphysema, with 95% confidence. With lung VA, this SRD value is narrowed down to 11 HU. For RA950 without VA, an increase of at least 3.7% constitutes a real change. There are insufficient studies to support a meta-analysis of RA950 with VA.

CLINICAL RELEVANCE/APPLICATION

Volume adjustment should be considered to improve repeatability and increase precision for longitudinal studies of emphysema progression in COPD using lung density CT.
PURPOSE
To analyze peripheral vascular changes at CT of COPD with new method and correlate them with emphysema index (EI) and pulmonary function tests.

METHOD AND MATERIALS
Non-contrast, inspiration volumetric CT of 30 healthy subjects (M:F = 25:5; 50.6 ± 7.6yrs) and 73 COPD patients (M:F = 71:2; 64.3 ± 6.6 yrs) were included. Using in-house software, all pulmonary vessels were extracted automatically. Three imaging planes, which are 1cm, 2cm and 3cm distant from lung surface, respectively, were generated. The numbers of all vessels in each plane and per cm² (No, No_rel, respectively) were counted. The mean area of each vessel and the percentage of vessel area at image plane (Ar, Ar%, respectively) were measured. The results were compared between two groups and correlated with emphysema index (EI) and PFT.

RESULTS
At imaging plane 1cm apart from the surface, the No, No_rel and Ar% in COPD patients were significantly smaller than healthy subjects (No: 2265 ± 650 vs. 2597 ± 741; No_rel: 1.08 ± 0.35/cm² vs. 1.27 ± 0.40/cm²; Ar%: 4.84 ± 1.61 vs. 5.75 ± 1.88). In addition, No_rel and Ar% at all planes showed significant negative correlation with EI (1cm: r = -0.344, -0.353; 2cm: r = -0.438, -0.414; 3cm: r = -0.423, -0.412, respectively), FEV1 (1cm: r = 0.224, 0.211; 2cm: r = 0.222, 0.231; 3cm: r = 0.226, 0.208, respectively), FEV1/FVC (1cm: r = 0.287, 0.276; 2cm: r = 0.260, 0.274; 3cm: r = 0.270, 0.281, respectively) and DLco (1cm: r = 0.351, 0.347; 2cm: r = 0.306, 0.325; 3cm: r = 0.282, 0.325, respectively).

CONCLUSION
In COPD patients, number of pulmonary vessels and vessel area percent are significant smaller than those in healthy subjects. Quantified number per cm² and area percent of vessels significantly correlated with FEV1, FEV1/FVC and DLco.

CLINICAL RELEVANCE/APPLICATION
Detailed analysis of analysis of peripheral vascular changes is possible using volumetric CT and dedicated software. It may be helpful in the understanding of vascular changes in COPD.
SSK06

**Gastrointestinal Keynote Speaker: Update on Colon Cancer Screening and CTC**

Wednesday, Dec. 2 10:30AM - 10:40AM Location: E351

Participants
David H. Kim, MD, Madison, WI (Moderator) Consultant, Viatronix, Inc; Co-founder, VirtuoCTC, LLC; Medical Advisory Board, Digital ArtForms, Inc; Stockholder, Cellectar Biosciences, Inc
Christine O. Menias, MD, Scottsdale, AZ (Moderator) Nothing to Disclose

Sub-Events

**SSK06-02**

CT Colonography versus Flexible Sigmoidoscopy for Colorectal Cancer Screening. Outcomes of a Randomized Controlled Trial (RCT)

Wednesday, Dec. 2 10:40AM - 10:50AM Location: E351

Participants
Daniele Regge, MD, Candiolo, Italy (Presenter) Speakers Bureau, General Electric Company
Loredana Correale, PhD, Turin, Italy (Abstract Co-Author) Researcher, im3D SpA
Carlo Senore, MD, Torino, Italy (Abstract Co-Author) Nothing to Disclose
Cesare Hassan, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Gabriella Iussich, MD, Locarno, Switzerland (Abstract Co-Author) Consultant, im3D SpA
Nereo Segnan, Torino, Italy (Abstract Co-Author) Nothing to Disclose
Stefania Montemezzi, MD, Verona, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare detection rate (DR) of CT colonography (CTC) and flexible sigmoidoscopy (FS) for CRC screening.

**METHOD AND MATERIALS**

An invitation letter to participate in a multicenter randomized screening trial was mailed to people aged 50-69 years, living in the Piedmont Region, Italy and in Verona, Italy. Individuals with a history of CRC/adenomas, inflammatory bowel disease, recent colonoscopy, or two first-degree relatives with CRC were excluded from invitation by their general practitioners. Responders to the invitation were randomized to either CTC or FS and scheduled for screening procedure. CTC interpretations were remotely performed via telediagnosis, and were assisted by a Computer-aided detection software. Participants with polyps≥6-mm at CTC and those with “high-risk” distal lesions (i.e., adenomas>10-mm, or high-grade dysplasia, or villous component >20%, or >2 adenomas of any type) at FS were referred for colonoscopy (CC). The primary outcome was DR of advanced neoplasia (AN), namely, the number of participants with CRC or advanced adenomas relative to the total number of participants. Differences were expressed as relative risk (RR) with 95% CIs.

**RESULTS**

5412 people agreed to take part in the trial: 2738 randomly assigned to FS and 2674 to CTC. After excluding participants with inadequate bowel preparation, analysis included 2673 (1298 females) adequate FS examinations and 2595 (1266 females) diagnostic CTC exams. Of FS participants, 271 (10.1%) were referred to CC; compliance to CC was 86.7% (235). Of CTC participants, 264 (10.2%) were offered CC, of whom 260 (98.5%) performed the exam. DR of AN was 4.7% (127 including 9 CRCs) for FS vs. 5.1% (133 including 10 CRcs) for CTC (RR: 1.1; 95% CI: 0.9-1.4; P=0.524). DR of distal AN was 4.1% (109) for FS and 2.9% (76) for CTC (RR: 0.72; 95% CI: 0.54-0.96; P=0.025). DR of proximal AN was 1.3% (34) for FS and 2.7% (69) for CTC (RR: 2.06; 95% CI: 1.37-3.10; P<0.001). Isolated proximal AN were present in 2.3% and 0.67% of CTC and FS participants, respectively.

**CONCLUSION**

No significant differences were seen in AN detection for the two screening groups. However, DR of distal AN was 30% lower in CTC than in FS screening, while DR of proximal AN was two times higher following screening with CTC than with FS.

**CLINICAL RELEVANCE/APPLICATION**

Our study supports the hypothesis that CTC screening may have a larger impact on reduction of proximal CRC incidence than FS.

**SSK06-03**

Natural Course of Medium-sized Polyps during a 3-year Surveillance Interval: Linear and Volumetric Assessment with CT Colonography in Correlation with Histology

Wednesday, Dec. 2 10:50AM - 11:00AM Location: E351

Participants
Charlotte J. Tutein Nolthenius, Amsterdam, Netherlands (Presenter) Nothing to Disclose
Thierry N. Boellaard, MD, PhD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Volumetric growth assessment in medium-sized polyps has shown to be more reliable than linear measurements and it seems a promising biomarker for determination of clinical importance. This is however not standard practice in reporting on polyps with CT colonography (CTC) and more experience and research is needed.

**METHOD AND MATERIALS**

Ethics approval and written informed consent were obtained. After participating in an invitational population-based CTC screening trial 101 participants harbored one or two 6-9 mm polyps as the largest lesion(s) for which surveillance CTC was advised after 3 years. Participants with lesion(s) of ≥6 mm at surveillance CTC were offered colonoscopy and polypectomy. Volumetric and linear measurements were performed on index and surveillance CTC and polyps were classified into baseline growth categories according to ±30% volumetric change over the entire surveillance interval (>30% growth as progression, 30% growth to -30% decrease as stable and >-30% decrease as regression). Polypp growth was correlated to histopathological findings and other polyp characteristics.

**RESULTS**

Between July 2012 and May 2014, 78 of 101 patients underwent surveillance CTC (mean age 65.6 (SD 6.7); 51% male). After a mean surveillance interval of 3.3 years (SD 0.3; range 3.0-4.6 years) of 95 polyps 33 (35%) progressed, 36 (38%) remained stable and 26 (27%) regressed, including an apparent resolution in 13 (14%) polyps. Of 20 proven advanced adenomas, 14 (70%) progressed and 6 (30%) remained stable, compared to 13 (37%) and 16 (46%) of 35 non-advanced adenomas. No associations were found between growth categories and polyp morphology, location and size at index CTC. Other linear or volumetric thresholds used did not identify more advanced adenomas.

**CONCLUSION**

Volumetric assessment showed one-third of medium-sized polyps to progress over time emphasizing the importance of these polyps. However, growth assessment was not able to identify all advanced adenomas as one-third remained stable in size over a 3-year surveillance interval. These findings must be taken into account when deciding on proper colonoscopy referral guidelines.

**CLINICAL RELEVANCE/APPLICATION**

Volumetric assessment showed one-third of medium-sized polyps to progress over time emphasizing the importance of these polyps.
Our study confirms that CT colonography is an important tool in the diagnosis of colorectal malignancy and is an example to other institutions in monitoring CT colonography outcomes and maintaining quality standards. During this presentation we will explore the common reasons for missed malignancy on CT colonography.

SSK06-05  CT Findings of Postpolypectomy Coagulation Syndrome in Patients Who Underwent Colonoscopic Polypectomy: Comparison with Those of Perforation

Wednesday, Dec. 2 11:10AM - 11:20AM Location: E351

Participants
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PURPOSE
To describe CT findings of postpolypectomy coagulation syndrome (PPCS) and to identify the features that can distinguish it from colonic perforation after colonoscopic polypectomy.

METHOD AND MATERIALS
From January 2011 to November 2014, a total of 5542 adult (age>40yr) patient who underwent colonoscopic polypectomy were found according to search through hospital database. After reviewing the patient's medical and imaging records, eight patients (0.14%) with PPCS and six patients (0.11%) with perforation were identified. Because five patients were excluded due to absence of CT examination, four (1 male; age range, 52-75 years with mean age, 69 years) with PPCS and five patients (5 male; age range, 46-67 years with mean age, 54 years) with perforation were finally included. Two abdominal radiologists reviewed the abdominal CT images in a consensus manner. The following CT findings were assessed: presence of pneumoperitoneum or pneumoretroperitoneum, presence of fluid collection, presence of colonic wall thickening, if present, patterns, thickness and length of an involved segment, enhancement pattern of an involved segment, presence of mural defect in an involved segment, and presence of surrounding infiltration around an involved segment. Clinical findings including patient's symptom and sign were also assessed.

RESULTS
Although three patients with perforation eventually underwent surgery, all patients with PPCS were completely recovered only with conservative management. The clinical presentation including presence of abdominal pain or leukocytosis was not different between two groups. On CT, an involved colonic wall was more longer and thicker in PPCS group (mean length and width: 124 ± 81.3 mm, 16 ± 4.9 mm) than perforation group (41.4 ± 11.8mm, 7.4 ± 1.5mm). In all four patients with PPCS, CT images showed a marked low attenuation wall thickening with severe pericolic infiltration around an involved segment. None of the patients with PPCS showed free air on CT.

CONCLUSION
PPCS, a very rare complication after colonoscopic polypectomy (prevalence of 0.14%), shows severe low attenuating mural thickening. In comparison with perforation, PPCS does not demonstrate free air in peritoneal or retroperitoneal space.

CLINICAL RELEVANCE/APPLICATION
The imaging features on CT can be useful to promptly distinguish PPCS from colonic perforation.

SSK06-06  Extracolonic Findings at Screening CT Colonography: Analysis of Incompletely Characterized and Likely Insignificant (C-RADS E3) Findings

Wednesday, Dec. 2 11:20AM - 11:30AM Location: E351

Participants
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Research Consultant, Bracco Group; Research Consultant, KIT ; Research Grant, Koninklijke Philips NV

PURPOSE
To assess the incidence and outcomes of unexpected extracolonic findings at screening CTC which are likely insignificant and/or incompletely characterized (C-RADS E3), but may require further evaluation.

METHOD AND MATERIALS
7,952 consecutive patients (mean age 56.7±7.3 years, M:F 3,675:4,277) underwent first-time CTC screening over a 98-month interval. Persons with unsuspected C-RADS E3 findings were extracted and outcomes determined.

RESULTS
Previously unknown C-RADS E3 findings were identified in 9.2% (731/7,952; mean age 57.2±4.7 years; M:F 268:463) of the screening CTC population; 25 patients had multiple findings for a total of 757 E3 findings. Consideration for further imaging, if clinically appropriate, was suggested for 84% (634/757) of these findings, with clinical correlation suggested in the remainder. Dedicated follow-up imaging was obtained in 4.4% (353/7,952) of patients. Conditions requiring treatment or ongoing surveillance were diagnosed in 0.9% (72/7,952) of patients. Common extracolonic finding categories included: adnexal/uterine (24%, 185/757), lung (20%, 155/757), kidney/GU (20%, 149/757), and liver (11%, 85/757). Malignant or potentially malignant lesions were found in 0.2% (18/7,952) of patients, including renal cell carcinoma, lymphoma, breast cancer, and malignant/borderline ovarian cancer.

CONCLUSION
 Likely insignificant/incompletely characterized (C-RADS E3) findings were found in 9.2% of patients undergoing screening CTC with consideration for additional imaging suggested in the majority. Follow-up imaging was actually obtained in 4.4%, with conditions ultimately requiring treatment or ongoing surveillance diagnosed in 0.9%. Malignant or potentially malignant lesions were found in 0.2% of the total cohort.

**CLINICAL RELEVANCE/APPLICATION**

Incompletely characterized and likely insignificant extracolonic (C-RADS E3) findings are uncommon, occurring in less than 10% of patients. Fewer than 1% of patients were diagnosed with conditions requiring treatment or continued surveillance. Extracolonic malignancies are rare in this group.

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**PURPOSE**

Colonic rotation that mimics lesion mobility on CT colonography (CTC) can be particularly deceptive when it happens in unexpected locations such as the ascending colon. This study was to evaluate the effect of reducing abdominal compression during prone CTC on ascending colonic rotation that occurs with supine-to-prone positional change.

**METHOD AND MATERIALS**

Consecutive patients fulfilling following criteria were found from 1218 CTC cases (January 2013 to July 2014): a) prone CTC obtained with cushion blocks placed under the chest and pelvis to reduce abdominal compression, b) air-distended ascending colon on both supine and prone CTC, and c) colonoscopy-proven sessile polyps >=6mm in straight mid-ascending colon. Radial locations along the luminal circumference (°) of 24 polyps and 54 colonic teniae (3 teniae in each patient) in mid-ascending colon of 18 patients (M:F, 16:2; 65±12 years) were measured on supine and prone CTC images and supine-to-prone difference was determined. A coordinate system designed to offset effects of torso rotation was used. The supine-to-prone difference was given a value between -180° (- for internal rotation) and +180° (+ for external rotation). Degrees of abdominal compression (Abd comp ) and posterior displacement of mid-ascending colon (Asc disp ) in prone position were quantitatively measured and were correlated with the radial location change of ascending colonic polyps and teniae.

**RESULTS**

The radial location change was -22° to 61° (median, 10.4°) for the polyps and was similar for colonic teniae, which was smaller than the reported ascending colonic rotation. However, 50-56% of the polyps and teniae still showed external rotation >10°. The radial location change was not significantly correlated with Abd comp ( P =.131 to .287) but was correlated with Asc disp ( r =.562 to .702; P =.001 to .015). Posterior displacement of the ascending colon still occurred in prone position due to gravitational anterior displacement of other mobile abdominal contents despite the lack of abdominal compression.

**CONCLUSION**

Ascending colonic rotation on CTC occurring with supine-to-prone positional change was incompletely prevented by reducing abdominal compression during prone CTC.

**CLINICAL RELEVANCE/APPLICATION**

Careful confirmation of lesion mobility or lack of it is fundamental for accurate CTC interpretation although reducing abdominal compression during prone CTC may decrease the related pitfall in the ascending colon.

**PURPOSE**

To assess the performance of an advanced computer-aided "supine-only reading" of full-cathartic CTC in the detection of polyps in patients with average or high risk of colorectal cancer.

**METHOD AND MATERIALS**
A total of 266 CTC cases were sampled from a multi-center CTC trial for patients with average or high risk of colorectal cancer, in which patients underwent cathartic bowel preparation with 2L polyethylene glycol solution and 20mL sodium diatrizoate for tagging of residual fluid, followed by automated CO2 insufflation. A computer-aided detection (CADe) system that had been trained with cases independent from this study was used to review the CTC cases. One expert reader (2600 cases reading experience) reviewed the cases in “supine-only reading” mode, in which only the supine scans of these cases were interpreted using CADe as a second reader, and recorded all detected lesions ≥6 mm. The per-patient sensitivities and the areas under the receiver operating curve (AUC) in the detection of adenomas and carcinomas were compared between unaided and CADe-aided readings, as well as between the supine-only reading and “conventional reading” result from the trial, in which both supine and prone scans were used for interpretation of the CTC cases.

RESULTS
There were 53 and 28 patients with adenomas and/or carcinomas ≥6 mm and ≥10 mm, respectively. Corresponding per-patient sensitivities (AUCs) for CADe-aided supine-only reading were 91% (.92) and 93% (.96), respectively, whereas those of conventional reading were 90% (.91) and 93% (.96), respectively. The differences in sensitivities and AUCs were not statistically significant (Fisher's exact test, P<.5). For 6-9 mm lesions, the per-patient sensitivity (AUCs) of CADe-aided supine-only reading was 83% (.88), which was higher (McNemar's test, P<.05) than those of unaided, supine-only reading of 69% (.81).

CONCLUSION
In full-cathartic CTC, CADe-aided supine-only reading may yield an equally high performance in the detection of adenomas and carcinomas as that of the conventional, supine-prone reading. CADe may also significantly improves the detection performance of polyps 6-9 mm in size in the supine-only reading.

CLINICAL RELEVANCE/APPLICATION
Computer-aided supine-only reading has the potential to allow one-position scanning in CTC, thereby effectively reducing the radiation dose and reading time into a half of those of conventional reading.

SSK06-09 Observer Study for Detection of Lesions in Viewing CT Colonography Using a New Eye Gaze Tracking System

Wednesday, Dec. 2 11:50AM - 12:00PM Location: E351

Participants
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Shoko Tsutsui, Maebashi, Japan (Abstract Co-Author) Nothing to Disclose
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PURPOSE
Monitoring the eye tracking of the observer in the detection of lesions is important in order to understand image interpretation process for CT colonography. Head-mount eye tracker system has been used to track observers’ viewing points on radiological images. However, it is difficult to use this system casually due to a problem of an obtrusive device for observation. We investigated gaze points for image interpretation of CTC images by experts and non-experienced observers, and analyze the time and the gaze point for detection of lesions using a new eye gaze tracking system, which was designed to detect the pupil point and corneal reflection point in the dark pupil eye tracking by using two infrared cameras.

METHOD AND MATERIALS
Observers for CTC image reading commonly use virtual gross pathology (VGP) images which were obtained as a stretched views of the inner colonic surface. We used an eye gaze point sensing system (JVCKenwood Co.,Yokohama,Japan) which consisted of an eye tracking sensors with two infrared light emitting diode (LED) laser emitters combined with two infrared cameras. Observer studies were performed by two expert observers (over 13 years experience) and two non-experienced observers on nineteen VGP images including tumors, polyps and other abnormalities.

RESULTS
Eye gaze tracking data of the observers can be obtained without a device put on the head such as a headgear, with proper training of about 20 minutes. The average reading time (32.6sec) by expert observers was significantly shorter (p<0.001) than that (46.2sec) by non-experienced observers. The detection rates of target areas such as tumors by expert observers (84.18%) was higher than that of non-experienced observers (68.35%). Non-experienced observers in CTC reading were prolonged with low detection rates. On other hand, experienced observers provided shortened viewer's gaze dwells time on the target areas.

CONCLUSION
A new eye gaze tracking system for CTC images can be performed without a head-mount eye tracker. Although the reading time of expert observers was short, the target areas on VGP images were observed with a high detection rate.

CLINICAL RELEVANCE/APPLICATION
Assessment of visual inspection of virtual gross pathology images using an eye gaze tracking system with a non-head mount eye tracker.
An eye gaze tracking analysis using infrared cameras can be set-up easily. Gaze points on CTC images by experts and non-experienced observers can be determined for understanding of image readings for detection of lesions.
**Purpose**

To determine if the pancreatic signal intensity on T1 mapping can be used to diagnose mild chronic pancreatitis.

**Method and Materials**

This retrospective study analyzed patients with suspected chronic pancreatitis who underwent MRI between March 2014 and December 2014. All MRI studies were performed on 3.0 T Magnetom Verio (Siemens Medical Solutions, Malvern, PA) scanner. T1 mapping was acquired with gradient echo sequence using TR 3.87 ms, TE 1.32, flip angles of 2° and 13°, NEX of 1 and matrix of 320x168. Of 127 patients scanned, patients < 18 years age, and those with acute pancreatitis, pancreatic neoplasm, iron overload, or cystic fibrosis were excluded from the analysis. Patients were grouped as normal or mild chronic pancreatitis based on secretin-enhanced MR pancreatography using the Cambridge classification. There were 55 normal and 21 patients with mild chronic pancreatitis. Region of interest (ROI) measurements (~1cm²) were drawn in the homogenous regions of the head, body and tail of the pancreas by two independent and blinded reviewers. The two-tailed t-test was used to determine differences of T1 relaxation times between the normal and mild CP patients. Receiver operating characteristic (ROC) curve analysis was performed to determine the accuracy of the T1 relaxation time as a differentiating criterion.

**Results**

There was a significant difference (p< 0.0001) in the T1 relaxation times of the pancreas between the normal (mean 819 ms, 95%CI: 739-898) and mild chronic pancreatitis (mean: 1141 ms, 95%CI: 1027-1255) groups. T1 relaxation time cut off value of 1000 ms was 72% sensitive (95%CI: 48-89) and 75% specific (95%CI: 61-85) for the diagnosis of mild chronic pancreatitis (AUC=0.80, p<0.0001). There was substantial inter-observer agreement (kappa=0.74) of measured T1 relaxation times.

**Conclusion**

There is significant difference in the T1 relaxation times of the pancreas between the normal and mild chronic pancreatitis patients.

**Clinical Relevance/Application**

T1-mapping may be a practical imaging technique for diagnosis of mild chronic pancreatitis.
To assess the pancreatic fat fraction and ADC in healthy, obese and diabetic (type 1 and 2) subjects

METHOD AND MATERIALS
A retrospective study of abdominal MR images of 89 subjects (56 controls inclucing obese subgroup; 33 diabetics) was carried out. Two radiologists reviewed all images independently and proceed the calculation of pancreatic fat fraction through in and out-of-phase GRE T1-weighted sequences, and the ADC through diffusion with maximum b=1000. Pancreatic fat fractions and average values of ADC were obtained and compared.

RESULTS
We observed significant differences between pancreatic fat fractions of diabetics type 2 (DM2) and healthy and diabetic type 1 (DM1) individuals, with p values of 0.01 and 0.02 for men and 0.02 and 0.01 for women, with good interobserver reliability (intraclass correlation coefficients > 0.8). Obese non-diabetic subjects showed high pancreatic fat fraction similar to DM2. There was also a significant difference in ADC values between DM2 and DM1 and healthy individuals (p: 0.02 and 0.03 in males; p: 0.002 and 0.001 in females), lower in DM2.

CONCLUSION
We observed significantly higher pancreatic fat fractions in DM2, when compared to healthy and DM1 subjects. This finding favors the hypothesis of fatty infiltration of the organ as a possible associated causal factor to the pancreatic beta cells failure, although obese subjects had pancreatic fat fractions similar to DM2.

CLINICAL RELEVANCE/APPLICATION
Pancreatic fatty infiltration occurring can be evaluated by MRI and its role in Diabetes Mellitus need further assessment.
Participants
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Purpose
To evaluate the feasibility of intravoxel incoherent motion (IVIM) parameters in differentiating acute pancreatitis, autoimmune pancreatitis (AIP), neuroendocrine tumor (NET), solid pseudopapillary tumor (SPT), pancreatic ductal adenocarcinoma (PAC), and normal pancreas.

Method and Materials
The institutional board approved this retrospective study, and informed consent was waived. We evaluated IVIM diffusion-weighted images (10 b values for 0 to 900 sec/mm²) of 104 consecutive patients (mean age, 53.7 years; M:F=58:46) with pathologically confirmed pancreatic neoplasms (n=54; 15 NETs, 9 SPTs, and 30 PACs) ≥ 2cm; acute pancreatitis (n=13), AIP(n=7), and normal pancreas (n=30). The slow diffusion coefficient (Dslow), fast diffusion coefficient (Dfast), and perfusion fraction (f) were measured on two consecutive sections covering the largest part of the lesions. The differences in IVIM parameters among the diagnoses of pancreatic lesions were compared using the ANOVA test and the post-hoc Bonferroni multiple comparisons test.

Results
PAC had significantly lower f values (0.13 ± 0.06) than normal pancreas (0.24 ± 0.05), NET (0.21 ± 0.06), and acute pancreatitis (0.25 ± 0.01) and significantly lower Dfast values (20.0 ± 12.6 x 10^-3mm²/sec) than normal pancreas (48.2 ± 23.9 x 10^-3mm²/sec) (P<.05). For AIP, f value (0.14 ± 0.06) was significantly lower than that of normal pancreas (P<.05). Dfast values of acute pancreatitis (25.4 ± 14.6 x 10^-3mm²/sec), NET (26.5 ± 19.9 x 10^-3mm²/sec), and SPT (17.8 ± 9.5 x 10^-3mm²/sec) were lower than that of normal pancreas. Although the Dslow of AIP (1.06 ± 0.19 x 10^-3mm²/sec) were lower than normal pancreas (1.14 ± 0.15 x 10^-3mm²/sec) and the other pancreatic diseases, the difference was not statistically significant.

Conclusion
Perfusion related parameters (f and Dfast) are more helpful in characterizing pancreatic diseases than Dslow. PAC and AIP are characterized by decreased perfusion fraction (f) compared with normal pancreas.

Clinical Relevance/Application
IVIM is feasible for assessing the different perfusion and diffusion characteristics of pancreatic diseases.

SSK07-06 Evaluation of Pancreatic Exocrine Insufficiency by Cine-Dynamic MRCP Using Spatially Selective IR Pulse: Correlation with Severity of Chronic Pancreatitis based on Morphological Changes of Pancreatic Duct

Participants
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Purpose
Recent study showed a significantly positive correlation between secretion grades of pancreatic juice at cine dynamic MRCP with a selective inversion recovery (IR) pulse and pancreatic exocrine function test. This study evaluated pancreatic exocrine insufficiency by cine-dynamic MRCP using spatially selective IR pulse in patients with chronic pancreatitis in correlation with the severity of morphological changes of pancreatic duct.

Method and Materials
41 patients with suspected chronic pancreatitis underwent cine-dynamic MRCP with a spatially selective IR pulse. Mean secretion grading score (5-point scale) based on the moving distance of pancreatic juice inflow on cine-dynamic MRCP was assessed. Based on the previous report, cutoff value of secretion grade less than 0.70 in cine-dynamic MRCP was used for the criterion of pancreatic exocrine insufficiency. Mean secretion grades were compared with Cambridge grade which defined the severity of chronic pancreatitis based on morphological changes of pancreatic duct.

Results
In comparisons among patient groups with Cambridge grade1 (normal; n=6), 2 (equivocal; n=3), 3 (mild; n=6), 4 (moderate; n=9) and 5 (severe; n=17), median secretion grading score of Cambridge5 (score=0) was significantly lower than Cambridge1-4 (1.13, 0.55, 0.50, 0.15; P<0.001, P<0.015, P<0.002, P<0.028, respectively). In all 17 patients in Cambridge5, secretion grading score was less than 0.70. Median secretion grading score of Cambridge1 was significantly higher than Cambridge3-5 (P<0.030, P<0.011, P<0.001, respectively). In Cambridge2-4, there were no significant differences in secretion grading score between any groups. In Cambridge2, secretion grading score was less than 0.70 in 2 (67%) of 3 patients showing pancreatic exocrine insufficiency. Conversely, in Cambridge3 and 4, secretion grading score was more than 0.70 in 3 (20%) of 15 patients showing normal pancreatic exocrine function.
CONCLUSION
It should be noted that the degree of morphological changes of pancreatic duct does not necessarily reflect the severity of pancreatic exocrine insufficiency at cine-dynamic MRCP in Cambridge grade 2-4 (equivocal to moderate) chronic pancreatitis.

CLINICAL RELEVANCE/APPLICATION
Cine-dynamic MRCP with selective IR pulse may have a potential to evaluate pancreatic exocrine insufficiency in patients with Cambridge grade 2-4 (equivocal to moderate) chronic pancreatitis.

SSK07-07 Imaging Evaluation of Ablative Margin and Index Tumor Immediately after Combined Treatment of TACE and RF Ablation for Hepatocellular Carcinoma: Comparison between Multi-detector CT and MR Imaging

Participants
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PURPOSE
To prospectively compare multi-detector CT and MR imaging in assessment of ablative margin (AM) and index tumor within ablation zones immediately after combined treatment of transcatheter arterial chemoembolization (TACE) and radiofrequency (RF) ablation for hepatocellular carcinoma (HCC)

METHOD AND MATERIALS
Based on our preliminary data, necessary number of patients was estimated to be at least 30 when an α error of 0.05 and a β error of 0.2 were applied. A total of 33 consecutive patients with 45 HCCs, who had successfully undergone contrast-enhanced CT and MR imaging after RF ablation combined with TACE, was enrolled in this study. CT and MR imaging were performed within 3 and 7 hours after completion of combined therapy of TACE and RF ablation, respectively. Both CT and MR images were reviewed in consensus by two radiologists in two separate sessions regarding visual discrimination between AM and index tumor and status of AM within ablation zones. The status of AM was classified as AM plus (AM completely surrounded tumor), AM zero (AM was partly discontinuous, without protrusion of tumor beyond postulated border of ablated area) and AM minus (AM was partly discontinuous, with protrusion of tumor). Any ablation zone with AM plus or AM zero was considered as imaging evidence to predict technical effectiveness, which was based on one-month follow-up CT, as well as to represent technical success.

RESULTS
With CT and MR imaging, visual discrimination between AM and index tumor was possible in 34 (75.6%) and 40 (88.9%) of 45 ablation zones, respectively (P = .1094). Among 34 and 40 ablation zones in which status of AM could be evaluated on CT and MR imaging, AM status was categorized into AM plus (n=25 and 31, respectively), AM zero (n=9 and 8, respectively) and AM minus (n=0 and 1, respectively). The technical effectiveness was noted in all of ablation zones on one-month follow-up CT. Based on CT and MR imaging, technical success and effectiveness were determined to be achieved in 34 (75.6%) and 39 (86.7%), respectively (P=.1797).

CONCLUSION
There was no significant difference in assessment of ablative margin and index tumor within ablation zones immediately after combined treatment of TACE and RF ablation between CT and MR imaging.

CLINICAL RELEVANCE/APPLICATION
CT and MR imaging have equivalent ability to evaluate technical success immediately after combined treatment of TACE and RF ablation. Thus, MR imaging may not be necessary.

SSK07-08 Methodology for True Dynamic Contrast-Enhanced MRI of Pancreatic Lesions

Participants
Eric Paulson, Milwaukee, WI (Presenter) Nothing to Disclose
Paul M. Knechtges, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Beth A. Erickson, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose

PURPOSE
Dynamic contrast-enhanced (DCE) MR imaging offers promise to improve the diagnosis, therapy planning, and response assessment of pancreatic lesions. However, organ motion arising from respiration and peristalsis can challenge voxel-wise estimation of pharmacokinetic (PK) parameters in abdominal DCE-MRI. We introduce here a novel methodology to correct DCE-MRI datasets for interscan motion, facilitating true voxel-wise DCE-MRI in the abdomen.

METHOD AND MATERIALS
Five patients with pancreatic cancer were imaged at 3T. An anti-peristaltic agent (glucagon, 1mg IV) was administered to suppress bowel motion. Multi-flip angle breath hold images (2/5/15/25 deg) were acquired using a 3D Dixon VIBE sequence. A time series of 16 breath hold 3D Dixon VIBE images was then acquired before (3), during (1), and after (12) bolus administration of contrast (0.1 mmol/kg, Multihance). Deformable image registration (DIR) software was used to construct deformation vector fields (DVFs) required to align the fat-only Dixon (FD) images at each time point to one pre-contrast FD reference image. The DVFs were then applied to the corresponding water-only Dixon (WD) images at each time point to motion-correct the DCE-MRI time series. Baseline
T1 maps were estimated using a linearized Ernst model fit to the multi-flip angle WD images. PK parameters (Ktrans, kep, ve, vp) were estimated on a voxel-wise basis by fitting of the linearized Extended Tofts model to concentration-time curves constructed using the motion-corrected WD images.

**RESULTS**

FD images were robust against spatial and temporal variations in signal intensity arising from wash-in and wash-out of contrast, facilitating construction of DVs. Applying the FD-derived DVFs to WD successfully corrected the WD images for inter-scan motion arising from inconsistent breath holds, facilitating voxel-wise PK parameter estimation for all patients studied. The methodology facilitated extraction of late-arterial phase images for conventional radiologic interrogation.

**CONCLUSION**

The novel use of Dixon and DIR facilitates voxel-wise estimation of PK parameters from abdominal DCE-MRI datasets. Future work will incorporate Dixon with radial k-space sampling to improve intra-scan motion robustness during breath hold acquisitions.

**CLINICAL RELEVANCE/APPLICATION**

Potential to improve disease diagnosis, therapy selection and planning, and response assessment of abdominal organs (e.g., pancreas, liver, kidneys, etc).

### SSK07-09 Test-retest Reliability of 3D-EPI MR Elastography in Pancreas

*Wednesday, Dec. 2 11:50AM - 12:00PM Location: E353B*

**Participants**

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Qiyong Guo, MD, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The aim of the study is to conduct a rigorous evaluation of the repeatability of pancreas stiffness assessed by 3D echo-planar-imaging magnetic resonance elastography (3D-EPI MRE) in healthy volunteers, patients with chronic pancreatitis and pancreatic ductal adenocarcinoma (PDAC).

**METHOD AND MATERIALS**

A repeatability study using 3D-EPI MRE was conducted in 5 healthy volunteers and 8 patients confirmed by histopathologic examinations (5 with PDAC and 3 with chronic pancreatitis). Subjects were scanned by using a GE 3.0 T MR scanner to assess the mean stiffness of the tumors in PDAC cases, the parenchyma of pancreas in chronic pancreatitis cases and healthy volunteers with a multi-slice EPI pulse sequence (timepoint 1). Direct inversion algorithm with 3D post-processing was used to estimate shear stiffness and generate stiffness maps. Subjects were re-evaluated one day later (timepoint 2). Stiffness was measured by 2 independent analysts (one with three and another with one year experience of MRE measurement).

**RESULTS**

For the 2 analysts, the mean stiffness in all subjects was highly reproducible with intraclass correlation coefficient (ICC) of 0.975 (95% confidence interval [CI]: 0.944–0.989) across timepoints (r=0.973, P<0.001). Bland-Altman analysis showed mean stiffness difference was 0.01 kPa (95% agreement limits: -0.54–0.55 kPa). For the 2 timepoints, the ICC was 0.973 (95% CI: 0.940–0.988) across the 2 analysts (r=0.975, P<0.001). Bland-Altman analysis showed the stiffness difference was 0.05 kPa (95% agreement limits: -0.51–0.62 kPa). The averaging stiffness value was 1.46±0.21 kPa for chronic pancreatitis and 3.28±1.09 kPa for PDAC, in contrast with 1.11±0.08 kPa for normal pancreas.

**CONCLUSION**

3D MRE is a highly reproducible modality for assessing stiffness of pancreas.

**CLINICAL RELEVANCE/APPLICATION**

It is suggested to incorporate MRE into a standard MRI study, which offers stable and accurate stiffness of pancreas and pancreatic masses relatively.
**SSK08**

**Genitourinary (Functional Imaging of the Kidneys)**

**Wednesday, Dec. 2 10:30AM - 12:00PM Location: E450B**

**Participants**
Harriet C. Thoeny, MD, Bern, Switzerland (Moderator) Nothing to Disclose
Zhen J. Wang, MD, Hillsborough, CA (Moderator) Nothing to Disclose

**Sub-Events**

**SSK08-01 Assessing the Role of Quantification of Shear Wave Velocity and Tissue Elasticity in the Detection of Interstitial Fibrosis within the Transplant Kidney**

**Wednesday, Dec. 2 10:30AM - 10:40AM Location: E450B**

**Participants**
David Ferguson, MBChB, Vancouver, BC (Presenter) Nothing to Disclose
Amdad M. Ahmed, MBChB, FRCR, Birmingham, United Kingdom (Abstract Co-Author) Nothing to Disclose
Caitlin Schneider, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Christopher Nguan, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Alison C. Harris, MBChB, Vancouver, BC (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Novel ultrasound techniques allow for the assessment of tissue fibrosis. One such technique ( Virtual Touch IQ) allows for both qualitative and quantitative measurement of shear wave velocity to assess tissue strain and detect underlying fibrosis. Using this technique, in the setting of renal allograft failure, we aim to compare the gold standard of renal biopsy and histological grade with that of shear wave velocity measurement to evaluate for potential underlying interstitial fibrosis.

**METHOD AND MATERIALS**

Patients undergoing renal biopsy for renal graft dysfunction within the ultrasound department were enrolled prospectively over an eight-month period. In addition to routine renal ultrasound with Doppler imaging, shear wave velocity measurements using Virtual Touch IQ were obtained from the target area for renal cortical biopsy. Sufficient magnitude of the shear wave was confirmed on quality display. Biopsies were performed and reviewed by a nephropathologist, blinded to the imaging results, with histological categorization according to the Banff classification. Shear wave velocities and histological grade were compared to determine significance. Statistical analysis was performed using the Mann Whitney test and Spearman-correlation-coefficient (rho).

**RESULTS**

Fourteen patients were identified and subcategorized according to the Banff category with respect to interstitial fibrosis as normal (n=4), grade 1 (n=4), grade 2 (n=3) and grade 3 (n=3). Median shear wave velocity was demonstrated to be significantly higher in renal transplants with biopsy proven interstitial fibrosis (median=2.512m/s) than those without interstitial fibrosis (median=1.925m/s) (Mann Whitney U=4, n1=4, n2=10, p<0.05). Positive correlation was also identified between the mean shear wave velocity and Banff categories (rho= 0.731, p=0.003).

**CONCLUSION**

Preliminary data indicates that shear wave velocity within cortex of the transplant kidney correlates significantly with interstitial fibrosis in the context of renal allograft failure.

**CLINICAL RELEVANCE/APPLICATION**

Shear wave velocity analysis is a potentially valuable non-invasive tool to assess for renal allograft interstitial fibrosis.

**SSK08-02 Improved Temporal Resolution and Image Contrast for Kidney DCE-MRI by 3D Spoiled Gradient-recalled Echo Sequence with Compressed Sensing**

**Wednesday, Dec. 2 10:40AM - 10:50AM Location: E450B**

**Participants**
Kai Zhao, PhD, Beijing, China (Presenter) Nothing to Disclose
Bin Chen, Beijing, China (Abstract Co-Author) Nothing to Disclose
Jue Zhang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Xiaoying Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To verify the feasibility of combine Compressed Sensing (CS) technique in dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) of kidney.

**METHOD AND MATERIALS**

Nine healthy New Zealand rabbits underwent kidney DCE-MRI studies on a clinical 3.0T MR scanner. 3D spoiled gradient-recalled echo sequence modified with CS scheme was scanned before and after the administration of 0.05 mmol/kg of Gd-DTPA with the following parameters: TR = 3.3ms, TE = 1.3ms, FA = 15°, slice thickness = 3 mm, matrix = 128x128, FOV = 180mm and 16 slices were acquired. Four accelerations (2-x, 3-x, 4-x, 8-x) were scanned as well as the fully sampling every other day for each animal in
Graft dysfunction is a common complication following transplantation, which is associated with allograft survival. Intravoxel incoherent

PURPOSE

Protocol renal allograft biopsies improve outcomes via early detection and treatment of subclinical rejection (SCR). Shear-wave elastography (SWE) assesses quantitatively the tissue elasticity. The aim of our study was to investigate the feasibility of SWE in evaluating patients with stable renal allograft function who underwent protocol biopsies.

METHOD AND MATERIALS

95 patients (mean age, 48.3 years; range, 21-73 years) with stable renal allograft function who underwent ultrasound (US)-guided protocol biopsies at 10 days or 1 year after transplantation were enrolled in this retrospective study. All US and elasticity examinations of renal allograft were performed by a commercial scanner using a convex transducer (C5-1 ElastoPQ, Philips iU 22). SWE was performed immediately before protocol biopsies. Tissue elasticity (kPa) in the cortex was measured for all renal allografts. Protocol renal allograft biopsies improve outcomes via early detection and treatment of subclinical rejection (SCR). Shear-wave elastography (SWE) assesses quantitatively the tissue elasticity. The aim of our study was to investigate the feasibility of SWE in evaluating patients with stable renal allograft function who underwent protocol biopsies.

RESULTS

Acute rejection (AR) was pathologically confirmed in 34 patients. The mean tissue elasticity of ARs (31.0 ± 12.8 kPa) was statistically greater than that of no ARs (24.5 ± 12.2 kPa) (P < 0.001), while the resistive index values did not show statistical difference between ARs and no ARs (P = 0.112). Clinical and US variables were compared between patients with SCR and without SCR using the Student t -test. The correlation between estimated glomerular filtration rate (eGFR) and tissue elasticity was evaluated in all patients by Pearson correlation. Diagnostic performance of tissue elasticity to distinguish between patients with SCR and without SCR was analyzed using a receiver operating characteristics (ROC) curve analysis.

CONCLUSION

SWE, as a noninvasive tool, may be feasible in distinguishing between allograft with SCR and without SCR in patients with stable renal function. Moreover, it may demonstrate functional state of renal allografts.

CLINICAL RELEVANCE/APPLICATION

As a feasible technique, shear-wave elastography may help to noninvasively assess functional state of patients with stable renal allograft function.

SSK08-04 Assesment of Renal Allograft Function Early after Transplantation Using Renal IVIM with Healthy as Control

Graft dysfunction is a common complication following transplantation, which is associated with allograft survival. Intravoxel incoherent
Renal Hemodynamics and Oxygenation Evaluated by ASL, BOLD and Oxygen Extraction Fraction (OEF) Imaging in Animal Model of Diabetic Nephropathy

**METHOD AND MATERIALS**

A total of 71 subjects were performed on a 3.0T MRI scanner (MAGNETOM Trio, a Tim system, Siemens AG, Erlangen, Germany) using IVIM sequence with 11 b values (0, 10, 20, 40, 60, 100, 150, 200, 300, 500, and 700 s/mm²). Subjects were divided into 3 groups: group 1, healthy volunteers (n=19); group 2, allografts with good allograft function (eGFR≥60mL/min/1.73m², n=33); group 3, allografts with impaired allograft function (eGFR<60mL/min/1.73m², n=19). To separate the perfusion and diffusion, a bi-exponential fit was used to calculate the diffusion coefficient of slow (ADCslow); the diffusion coefficient of fast (ADCfast) and perfusion fraction (FP). Differences in IVIM parameters between the cortex and medulla in each group were compared using paired samples t test. Differences of IVIM parameters between three groups were compared using LSD test. Relationships between eGFR and IVIM parameters were assessed using spearman correlation coefficient.

**RESULTS**

The ADC, ADCslow, FP values of renal cortex were significantly higher in group 1 and group 2 compared to group 3 (all p<0.01). The ADC, ADCslow values of renal medulla were significantly higher in group 1 and group 2 compared to group 3 (all p<0.01). For allografts, significant differences in ADC, ADCslow, FP values of renal cortex and ADC, ADCslow values of renal medulla were observed between group 2 and group 3. In renal allografts, there was a significant positive correlation between eGFR and ADC, ADCslow, FP value of cortex, ADC, ADCslow value of medulla (all p<0.05).

**CONCLUSION**

The ADC, ADCslow, FP values of renal cortex and ADC, ADCslow values of renal medulla may be useful for detect renal allograft dysfunction. IVIM technique is a reliable imaging for evaluating and monitoring allograft function.

**CLINICAL RELEVANCE/APPLICATION**

IVIM technique can be used to evaluate and monitor allograft function.
Participants
Susanne Tewes, MD, Hannover, Germany (Presenter) Nothing to Disclose
Gregor Warnecke, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Mi-Sun Jang, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Frank K. Wacker, MD, Hannover, Germany (Abstract Co-Author) Research Grant, Siemens AG Gueler, MD, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Katja Huepper, Hannover, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Loss of renal function is a frequent complication after lung transplantation (lutx) and is associated with higher morbidity. Thus, imaging biomarkers to noninvasively monitor renal damage and to guide treatment strategies to preserve renal function are of clinical relevance. The purpose was to evaluate diffusion weighted imaging (DWI) and diffusion tensor imaging (DTI) for detection of renal impairment in lutx-patients.

METHOD AND MATERIALS
54 patients 14±2 days after lutx and 12 healthy volunteers underwent MRI on a 1.5T scanner. Respiratory-triggered DWI (10 b-values, 0-1000 s/mm²) and DTI sequences (20 diffusion direction, b=0,600 s/mm²) were acquired. Maps of apparent diffusion coefficient (ADC) and fractional anisotropy (FA) were calculated. Renal function was monitored daily and acute kidney injury (AKI) was defined according to AKIN-criteria within 48h after surgery. Factors contributing to AKI such as duration of surgery, immunosuppressive drugs and blood product infusion were documented. Statistical analysis comprised ANOVA and correlation analysis. Values are given as mean±SEM.

RESULTS
59% (32/54) of lutx-patients developed AKI. ADC of renal medulla was significantly lower in patients with AKI compared to patients without AKI (2.07±0.03 vs 2.17±0.04*10⁻³ mm²/s, p<0.05) and to healthy volunteers (2.07±0.03 vs 2.21±0.03*10⁻³ mm²/s, p<0.01). FA-values of renal medulla were significantly reduced compared to healthy volunteers in both groups (AKI: 0.27±0.01, no AKI: 0.28±0.01, healthy: 0.33±0.02, p<0.001), and did not differ between patients with and without AKI. ADC and FA negatively correlated with the amount of blood product infusion (r=-0.41 and r=-0.42, p<0.01) and ADC was correlated with eGFR at the day of MRI (r=-0.52, p<0.001). No correlations with duration of surgery and tacrolimus levels at the day of the MRI were observed.

CONCLUSION
Diffusion imaging showed significant renal changes in lutx-patients compared to healthy volunteers irrespective of whether AKI was diagnosed according to standard criteria. ADC reduction was stronger in patients with AKI. Amount of blood product infusion correlated with MRI parameters and may be a contributing factor to renal damage following major surgery.

CLINICAL RELEVANCE/APPLICATION
Diffusion imaging detects renal damage following major surgery and may help to improve patient management to prevent further renal damage.
ranged between 107±16 mL/100mL/min and 101±14 mL/100mL/min for the upper and lower pole, respectively.

CONCLUSION
Ultra-fast, single breath-hold renal ASL perfusion in healthy volunteers shows promising results regarding image quality and feasibility.

CLINICAL RELEVANCE/APPLICATION
Ultra-fast, single breath-hold ASL perfusion facilitates contrast-free creation of parametric perfusion maps, which can be repeated arbitrarily and hence potentially serve to monitor therapy.

SSK08-08  Diffusion-weighted Magnetic Resonance Imaging of Kidneys in Patients with Chronic Kidney Disease

Wednesday, Dec. 2 11:40AM - 11:50AM Location: E450B

Participants
Katarzyna M. Sukowska, MD, Warsaw, Poland (Presenter) Nothing to Disclose
Piotr Paźczewski, MD, Warsaw, Poland (Abstract Co-Author) Nothing to Disclose
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Dorota Piotrowska-Kownacka, Warsaw, Poland (Abstract Co-Author) Nothing to Disclose
Magdalena Durlik, Warsaw, Poland (Abstract Co-Author) Nothing to Disclose
Marek Golebiowski, Warsaw, Poland (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the apparent diffusion coefficient (ADC) values of renal parenchyma in patients in different stages of chronic kidney disease (CKD). To correlate ADC measurements with creatinine blood level, estimated glomerular filtration rate (eGFR), and ADC values obtained from healthy subjects.

METHOD AND MATERIALS
20 healthy volunteers and 34 patients in different stages of CKD were examined on a 1.5 unit (Ingenia, Philips, The Netherlands). The inclusion criteria for patients with CKD were: biopsy proven CKD and no hydronephrosis or renal artery stenosis. Blood samples to assess the serum creatinine level were taken immediately before examination. The MR examination included two diffusion weighted sequences: one with 16 b values uniformly distributed from 0 to 750; the other one with 10 b values including 6 low (0-150) and 4 high (300-900) b values. ADC values were measured with whole-kidney manually placed region of interest. Statistical analysis was performed using the Statistica software (version 10.0; Statsoft, Inc., US). Unpaired Student’s t-test were used to evaluate the differences in ADC. ROC curves were drawn to find out area under the curve for differentiation of CKD groups and cut-off ADC values were calculated so as to achieve the highest average sensitivity and specificity. To investigate the relationship between ADC values and serum creatinine / eGFR, Pearson’s correlation coefficient was calculated by bivariate correlation. All P values <0.05 were taken as statistically significant.

RESULTS
A significant positive correlation between ADC and eGFR and a negative correlation between ADC and creatinine blood level was observed. There were statistical differences between ADC values in healthy individuals and patients in moderate and severe stage of CKD. Based on ADC measurements cut-off values were established allowing for identification of patients with eGFR higher than 60 ml/min/1.73m2 and lower then 30ml/min/1.73m2.

CONCLUSION
The DWI has a potential role in assessing renal function as ADC values correlate with eGFR and the level of renal damage in severe stages of CKD.

CLINICAL RELEVANCE/APPLICATION
The ability of DWI to noninvasively assess eGFR may provide an additional tool for monitoring the course of disease and for stratifying the risk of contrast medium administration in patients with CKD.

SSK08-09  Intravoxel Incoherent Motion MRI for Differentiating Renal Hypoperfusion from Increased Cellularity after Ischemia-Reperfusion

Wednesday, Dec. 2 11:50AM - 12:00PM Location: E450B

Participants
Mike Notohamiprodjo, Munich, Germany (Presenter) Nothing to Disclose
Katharina Stella Winter, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Michael Staehler, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Andreas D. Helck, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Olaf Dietrich, PhD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Moritz Schneider, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To differentiate hypoperfusion from inflammatory hypercellularity after renal ischemia-reperfusion due to partial nephrectomy using Intravoxel Incoherent Motion MRI.

METHOD AND MATERIALS
This IRB approved prospective study was performed according to the declaration Helsinki. 15 patients with renal tumors underwent MR at 3T (Magnetom Verio, Siemens Healthcare) directly before and one week after partial nephrectomy. Diffusion weighted imaging was acquired with an EPI-sequence (10 b-values 0-800 s/mm2, 3 averages, 6 directions). IVIM-analysis was performed with homebuilt software (PMI 0.4, IDL) by biexponential fitting of the tissue Delow (mm2/s*10-3) and the pseudo-diffusion Dfast (mm2/s*10-3) as well as the perfusion component f (%). Apparent diffusion coefficient (ADC; mm2/s*10-3) was derived from monoexponential...
analysis. To compare parameters between baseline and follow-up the paired Wilcoxon signed-rank test and to compare non-nephrectomized and partially nephrectomized kidneys the non-paired Mann-Whitney U test was used.

RESULTS
In the baseline examination prior to partial nephrectomy there were no significant differences between tumor bearing and contralateral kidney, whereas the follow-up measurement showed significant differences for ADC (p<0.001), Dfast (p=0.02) and most pronounced for f (p<0.001). Partially nephrectomized kidneys showed a significant decrease of ADC (2.5±0.3 vs. 2.3±0.2, p<0.01), Dfast (8.6±1.8 vs. 7.3±1.7, p = 0.02) and again most pronounced for f (19.2±3.0 vs. 13.7±4.4 p < 0.01). There were no significant differences for Dslow (operated kidney 2.0±0.2 vs. 2.0±0.2; contralateral kidney 2.1±0.2 vs. 2.0±0.1) Non-nephrectomized contralateral kidneys expressed a significant increase of ADC (2.5±0.2 vs. 2.7±0.3, p < 0.01), and f (19.3±2.6 vs. 21.5±4.0, p = 0.03). There was no significant correlation of the alteration of each parameter to clamping time.

CONCLUSION
IVIM detects significant changes, particularly of the perfusion fraction in the operated and contralateral kidney after partial nephrectomy suggesting that ischemia-reperfusion associated diffusion restriction is correlated to hypoperfusion rather than increasing inflammatory cellularity.

CLINICAL RELEVANCE/APPLICATION
IVIM MRI suggest that renal ischemia-reperfusion associated diffusion restriction is correlated to hypoperfusion rather than increasing inflammatory cellularity.
PURPOSE
To assess the impact of a broad range of computed b-values (1,500-5,000 s/mm²) on prostate cancer detection.

METHOD AND MATERIALS
49 patients undergoing 3T prostate MRI before radical prostatectomy were included. Exams included DWI with a maximal acquired b-value of 1,000 s/mm², from which six computed DWI image sets (b-values ranging from 1,500-5,000 s/mm²) were generated. Two radiologists [R1 (attending), R2 (fellow)] independently evaluated the ADC map as well as each DW image set, blinded to the b-value, to assess dominant lesion location. Pathologic findings from radical prostatectomy served as the reference standard.

RESULTS
Sensitivity for tumor: R1-82% (ADC), 80% (b1000), 86% (b1500), 71% (b2000), 70% (b2500), 65% (b3000), 57% (b4000), 37% (b5000); R2-71% (ADC), 63% (b1000), 76% (b1500), 71% (b2000), 70% (b2500), 65% (b3000), 57% (b4000), 37% (b5000).
Sensitivity for Gleason score≥7 tumor: R1-83% (ADC), 80% (b1000), 93% (b1500), 93% (b2000), 90% (b2500), 90% (b3000), 80% (b4000), 38% (b5000); R2-75% (ADC), 68% (b1000), 78% (b1500), 78% (b2000), 70% (b2500), 60% (b3000), 38% (b4000), 38% (b5000).
Dominant lesion visual conspicuity (1-5 scale): R1-3.4±1.5 (ADC), 2.5±1.2 (b1000), 3.3±1.4 (b1500), 3.2±1.3 (b2000), 3.1±1.4 (b2500), 2.8±1.4 (b3000), 2.7±1.5 (b4000), 2.5±1.6 (b5000); R2-3.2±1.6 (ADC), 2.1±1.6 (b1000), 2.1±1.6 (b1500), 2.1±1.6 (b2000), 3.0±1.6 (b2500), 2.5±1.5 (b3000), 1.8±1.0 (b4000), 1.3±0.6 (b5000). Reader confidence (1-5 scale): R1-3.2±1.5 (ADC), 2.6±1.3 (b1000), 3.1±1.4 (b1500), 3.1±1.4 (b2000), 3.1±1.5 (b2500), 3.1±1.5 (b3000), 3.0±1.6 (b4000), 2.8±1.7 (b5000); R2-3.3±1.7 (ADC), 2.2±1.2 (b1000), 3.2±1.6 (b1500), 3.4±1.7 (b2000), 3.4±1.8 (b2500), 3.1±1.8 (b3000), 2.6±1.6 (b4000), 1.9±1.3 (b5000).

CONCLUSION
Computed b-values in the range of 1,500-2,500 s/mm² were optimal for prostate cancer detection, comparing favorably with the ADC map. b-values of 1,000 or 3,000-5,000 exhibited lower performance.

CLINICAL RELEVANCE/APPLICATION
Computed b-values of 1,500-2,500 s/mm² (but not higher) help optimize prostate DWI, thereby facilitating targeted prostate biopsy and tailored treatments based on imaging guidance.
METHOD AND MATERIALS
With REB approval, 54 men with GS 3+4=7 PCa at non-targeted TRUS-guided biopsy underwent 3-Tesla MRI and RP between 2012-2013. Outcomes at RP included: A) upgrading to GS 4+3=7 and B) organ confined disease (OCD). >0.5 mL tumors were contoured by a blinded GU radiologist by correlating ADC to RP histopathology map. Mean ADC, ADC ratio (normalized to peripheral zone), histogram analysis (10th, 25th and 50th centile ADC) and texture analysis features were compared between groups using multivariate analysis, regression modeling and ROC analysis.

RESULTS
25.9% (14/54) patients were upgraded to GS 4+3=7 and 51.9% (28/54) patients had EPE after RP. There was no difference in age (p=0.38, 0.85), PSA (p=0.96, 0.95) or % of core biopsies with Gleason pattern 4 (p=0.56, 0.89) between groups. Mean ADC (mm^2/sec), ADC ratio, 10th, 25th and 50th centile ADC were similar between GS 3+4=7 (0.94 ± 0.24, 0.58 ± 0.15, 0.77 ± 0.31, 0.94 ± 0.28 and 1.15 ± 0.24) and GS 4+3=7 tumors (0.96 ± 0.20, 0.55 ± 0.11, 0.71 ± 0.26, 0.89 ± 0.19 and 1.11 ± 0.16), p>0.05. 10th centile ADC was lower in tumors with EPE (0.69 ± 0.31 versus 0.82 ± 0.28), p=0.02, with no difference comparing all other conventional ADC parameters, p>0.05. Regression models combining texture features improved prediction of GS upgrade: A) Kurtosis+Entropy+Skewness (AUC 0.76 [SE=0.07], p<0.001; sensitivity 71%, specificity 73%) and B) Kurtosis+Heterogeneity+Entropy+Skewness (AUC 0.77 [SE=0.07], p<0.001; sensitivity 71%, specificity 78%).

CONCLUSION
Amongst Gleason score 3+4=7 prostate cancers diagnosed at TRUS-guided biopsy, mean ADC and ADC histogram analysis is not predictive of upgrading after RP, while ADC texture-analysis improves accuracy. 10th centile ADC is predictive of EPE.

CLINICAL RELEVANCE/APPLICATION
Conventional ADC analysis cannot predict upgrading of Gleason score 3+4=7 prostate cancer diagnosed at TRUS-guided biopsy; however, ADC texture-analysis improves accuracy and 10th centile ADC can predict organ confined disease.
To evaluate the prostate cancer (CaP) detection rate by multi-parametric MR imaging (MP-MRI) confirmed by whole mount histopathology (WMHP) stratified by Gleason Scores (GS) and tumor size.

METHOD AND MATERIALS

A HIPPA-compliant, IRB-approved study of 290 consecutive men who underwent prostate MP-MRI before radical prostatectomy (RP) from October 2010 to January 2015 was performed. Clinical, MP-MRI (T2W, DWI and DCE) and pathologic features (WMHP, GS, maximum diameter) were obtained. The index tumor was defined as the pathological lesion with the highest GS or largest tumor when multiple foci had identical GS. A genitourinary (GU) radiologist and a GU pathologist reviewed each case. Each tumor focus on WMHP which matched with concordant target on MP-MRI was considered detected tumor. Chi-squared tests were used to test difference in MRI tumor detection rates by tumor grade (GS=3+3 defined as low grade vs. GS>6 as high grade) and tumor size (<1 cm defined as small vs. ≥1 cm as large tumor). Logistic regression was used to test a tumor grade by tumor size in MRI detection. Statistical analyses were conducted using Stata 12.1. P-values below .05 were considered significant.

RESULTS

290 patients had 639 unique CaP foci on WMHP. Of 639 total tumors foci on pathology, 310 (48.5%) and of 290 total index lesions, 224 (77.2%) were detected on MP-MRI. MRI detected 86/326 (26.4%) of low grade tumors vs. 223/313 (71.2%) of high grade tumors, and 56/257 (21.8%) of small vs. 253/382 (66.2%) large tumors. MRI detected 44/212 (20.8%) of low grade small tumors vs. 12/45 (26.7%) of high grade small tumors, and 42/114 (36.8%) low grade large tumors vs. 211/268 (78.7%) of high grade large tumors. (p<0.05)

CONCLUSION

We found that MP-MRI missed 51.6% of all CaP. However, when CaP stratified by size and GS, larger tumors were associated with increased detection rate for both high and low grade tumors. There was also a significant size by grade interaction, such that the difference in detection rates by grade was much larger among tumors 1cm or larger. These findings suggest that the MP-MRI tends to detect larger with higher grade CaP lesions. In our study, MP-MRI detected 78.7% of all high grade large CaP foci.

CLINICAL RELEVANCE/APPLICATION

MP-MRI which combines anatomic with functional and physiologic assessment of prostate cancer has substantially improved diagnostic capabilities of detecting clinically significant prostate tumors.

SSK09-05 Distortion in Diffusion-Weighted Prostate MRI: Readout-Segmented EPI DWI vs. Single-Shot EPI DWI

Participants

Ivan Platzek, MD, Dresden, Germany (Presenter Nothing to Disclose
Angelika Borkowitz, MD, Dresden, Germany (Abstract Co-Author Nothing to Disclose
Marieta Toma, MD, Dresden, Germany (Abstract Co-Author Nothing to Disclose
Thomas Brauer, MD, Dresden, Germany (Abstract Co-Author Nothing to Disclose
Hagen K. Kitzler, Dresden, Germany (Abstract Co-Author Nothing to Disclose
Verena Plodeck, MD, Dresden, Germany (Abstract Co-Author Nothing to Disclose
Michael Laniado, MD, Dresden, Germany (Abstract Co-Author Reviewer, Johnson & Johnson

PURPOSE

The aim of this study was to evaluate the utility of segmented-readout echo planar diffusion-weighted imaging (SR EPI DWI) for prostate imaging in comparison to conventional single shot EPI DWI (SS EPI DWI), with an emphasis on distortion artifacts.

METHOD AND MATERIALS

Sixty-eight patients with suspected prostate cancer were included in this prospective study. Patient age varied between 46 and 77 y (65 y on average). All patients underwent multiparametric prostate MRI (mpMRI) at 3T, which included T2-weighted images, dynamic contrast-enhanced (DCE) images, and both SR EPI DWI and SS EPI DWI. Apparent diffusion coefficient maps (ADC) maps were generated for both SR EPI DWI and SS EPI DWI. Overall lesion classification was based on the PI-RADS scoring system proposed by the European society of Urogenital Radiology (ESUR). Distortion on ADC maps was classified on a five point scale. Furthermore, the maximum distortion in the anteroposterior direction was measured in each patient for both SR EPI DWI and SS EPI DWI.

RESULTS

ADC maps based on SR EPI DWI showed no evidence of distortion in 58/68 patients (85%), while ADC maps based on SS EPI DWI showed no distortion in 42/68 patients (61.7%). Distortion scores were higher (indicating stronger distortion) for SS EPI DWI as compared to SR EPI DWI in 19/68 patients (27.9%) and lower in only one patient (1.5%). Visual evaluation showed significantly less distortion for SR EPI DWI in comparison to EPI DWI (p = 0.0001). Average maximum distortion (1.5 ± 2.6 mm) was significantly lower
in SR EPI DWI in comparison to SS EPI DWI (4.9 ± 9.7 mm) (p < 0.0001). Ninety-six prostate lesions were detected with mpMRI in total. PI-RADS scores did not differ significantly between mpMRI including SR EPI DWI and mpMRI including SS EPI DWI (p = 0.464). Mean ADC values based on SS EPI DWI (0.93 ± 0.21) were slightly lower than those based on SR EPI DWI (0.96 ± 0.22)(p = 0.047).

CONCLUSION
SR EPI DWI of the prostate has significantly less pronounced distortion artifacts compared to SS EPI DWI. As prostate lesion detection and lesion classification based on PI-RADS scores do not change significantly when SR EPI DWI is used instead of SS EPI DWI, SR EPI DWI is a promising alternative to conventional diffusion-weighted sequences.

CLINICAL RELEVANCE/APPLICATION
The use of SR EPI DWI instead of conventional SS EPI DWI in prostate MRI reduces distortion and can help improve correlation between DWI and T2-weighted images.

SSK09-06  
Accuracy and Inter-Observer Variability of Prostate Imaging-Report and Data System (PI-RADS) Version 2.0 for Characterization of Lesions Identified on Multiparametric Magnetic Resonance Imaging of the Prostate

Wednesday, Dec. 2 11:20AM - 11:30AM Location: N228

Participants
Andrei S. Purysko, MD, Cleveland, OH (Presenter) Nothing to Disclose
Leonardo K. Bittencourt, MD, PhD, Rio De Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Brian R. Herts, MD, Cleveland, OH (Abstract Co-Author) Research Grant, Siemens AG
Antonio C. Westphalen, MD, Mill Valley, CA (Abstract Co-Author) Nothing to Disclose
Erick M. Remer, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Andrew J. Stephenson, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Jennifer Bullen, MSC, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Cristina Magi-Galluzzi, MD, PhD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Eric Klein, Cleveland, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
To measure the accuracy and inter-observer variability of PI-RADS version 2.0 for the characterization of prostate lesions identified on mpMRI.

METHOD AND MATERIALS
IRB-approved, HIPAA compliant retrospective study including 171 men (mean age: 61.5 yrs.) either being investigated for prostate cancer (n = 128) or enrolled in active surveillance (n = 43), who were examined on a 3.0 T magnet without endorectal coil, and were found to have potential targets for biopsy. Two readers with 8 yrs. of experience in abdominal imaging independently reviewed and assigned a PI-RADS V.2 assessment category to the dominant MRI targets. The reference standard was the combined results from the MR/US fusion biopsy and transrectal ultrasound guided 12-core systematic biopsy (SB) performed in all the patients and in the same procedure. Clinically significant (CS) PCa was defined as tumors with Gleason score >= 3 + 4. Receiver operating characteristic (ROC) analysis was performed.

RESULTS
PCa was detected in 49.1% (84/171) and CS PCa was detected in 32.3% (55/171) of the men. Using PI-RADS category > 3 to discriminate any PCa from non-cancerous lesions, the sensitivity (Sen), specificity (Sp) and area under the ROC curve (AUC) were 77.4%, 84.9% and 77.9% for reader 1 and 69.1%, 87.2%, and 76.0% for reader 2. Using PI-RADS category > 3 to discriminate only clinically significant PCa from clinically insignificant prostate cancer and benign lesions, the Sen, Sp, and AUC were 98.2%, 79.1%, and 91.1% for reader 1 and 92.7%, 84.4%, and 90.4% for reader 2. The inter-observer agreement coefficient was 0.68 (95% CI: 0.61-0.75).  

CONCLUSION
PI-RADS V.2 had high sensitivity, specificity and accuracy for the discrimination of clinically significant PCa from other pathology, with good inter-observer agreement.

CLINICAL RELEVANCE/APPLICATION
Lesions with a PI-RADS V.2 assessment category > 3 should be considered for targeted biopsy, while avoiding the biopsy of lesions with a category < 3 reduces the number of negative biopsies and/or detection of clinically insignificant lesions.

SSK09-07  
Predicting Organ-confined Prostate Cancer in the Era of Multiparametric MRI: Comparing the Accuracy of the Partin Tables and mpMRI

Wednesday, Dec. 2 11:30AM - 11:40AM Location: N228

Participants
Alison F. Brown, BA, Durham, NC (Presenter) Nothing to Disclose
Thomas J. Polascik, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Rachel K. Silverman, MS, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
Koe Jack Tay, MBBS,MMed, Durham, NC (Abstract Co-Author) Nothing to Disclose
Rajan T. Gupta, MD, Durham, NC (Abstract Co-Author) Consultant, Bayer AG; Speakers Bureau, Bayer AG; Consultant, Invivo Corporation

PURPOSE
To investigate the accuracy of the Partin tables and multiparametric magnetic resonance imaging (mpMRI) in predicting organ-confined (OC) prostate cancer (PCa) after radical prostatectomy (RP), and to determine if radiologic staging information from mpMRI versus digital rectal exam (DRE) to augment the Partin tables increases the predictive accuracy of this widely used nomogram.
METHOD AND MATERIALS

In this retrospective, HIPAA-compliant, IRB-approved study, 157 patients underwent 3T mpMRI with endorectal coil before RP. MpMRI was used to assess clinical stage and an updated version of the Partin tables was used to calculate the probability of each patient to harbor OC disease. Logistic regression models predicting OC disease were created using mpMRI staging alone and with PSA as a covariate. Two sets of probabilities were obtained from the Partin tables, using clinical staging from either DRE or mpMRI. The area under curve (AUC) was used to calculate the predictive accuracy of each of these four predictive methods.

RESULTS

The predictive accuracy of mpMRI alone in predicting OC disease on pathological analysis is greater (AUC=0.86) than the Partin tables (AUC=0.70), and is further improved when combined with PSA values (AUC=0.88). The accuracy of the Partin nomogram in predicting OC disease decreases (AUC=0.59) when clinical stage is based on mpMRI versus DRE.

CONCLUSION

The superior predictive accuracy of mpMRI compared to Partin tables in predicting OC disease on pathological analysis validates results of smaller previously published studies, including one from our group. Partin table probabilities are calculated using clinical stage based on DRE result, a less sensitive test than mpMRI; therefore, this frequently leads to disease understaging. Consequently, although mpMRI has been shown to more accurately predict clinical stage than DRE, using mpMRI stage in the Partin nomogram does not improve its accuracy. In conclusion, mpMRI staging information is valuable as a stand-alone test when available based on its AUC value, but should not be applied to the Partin nomogram in its existing form.

CLINICAL RELEVANCE/APPLICATION

As more accurate clinical staging information is becoming available due to mpMRI, nomograms that incorporate mpMRI stage are needed to better predict OC PCa and assist in surgical planning prior to RP.

SSK09-08  Diagnostic Differentiation of Prostate Cancer from Prostatic Hyperplasia: What Diffusion Kurtosis Imaging Can Help Us?

Wednesday, Dec. 2 11:40AM - 11:50AM Location: N228

Participants

Chen Liu, Dalian, China (Presenter) Nothing to Disclose
Ailian Liu, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Qingwei Song, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Ma Chunmei, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Meiyu Sun, Dalian, China (Abstract Co-Author) Nothing to Disclose
Zibin Tong, Dalian, China (Abstract Co-Author) Nothing to Disclose
Ye Li, Dalian, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the feasibility of the typical parameters of DKI in diagnostic differentiation of prostate carcinoma from prostatic hyperplasia.

METHOD AND MATERIALS

One hundred and thirteen patients with the suspicion of prostate disease were recruited in the study. All the patients, with written informed consent obtained, were performed MRI exams on a 3.0T scanner in a protocol containing the routine T1WI, T2WI, contrast-enhanced MRI, DWI and DKI. From the following histopathological examination, it was confirmed that prostate carcinoma was in 30 and prostatic hyperplasia in 29. MR images were reviewed and analyzed by author and one experienced radiologist who has five years experience in prostate diagnosis, using a dedicated software in Functool on GE ADW4.4 workstation. For each focus, the mean value of the parameters of DKI (MK, Ka, Kr, FA, MD, Da, Dr) and DWI(ADC) was measured: in PCa group, the area where shows low signal on T2WI image, high signal on MK image and histopathological positive was the focus, regions of interest (ROIs) drew three times in the tumor, the size of the ROI was chosen to cover the 2/3 of the tumor(fig 1) ; then the average value was used in statistics. In BPH group, three identical ROIs (70mm2)were drew in the central zone, the average value was used. In statistics. The type of time-signal intensity curve(TIC) was observed by two observers collectively. ICC test was used to examine the consistency of the measurements, Pearson test was used to examine the relevance between MD and ADC value,and student’s t-test was executed to compare the obtained parametric values with p> 0.05 concerned statistical significant. The ROC curve of all the parameters were drew and analyzed.

RESULTS

The ICC value of the DKI parameters and DWI parameter in the PCA group and BPH group were respectively, 0.963,0.935,0.959,0.905,0.970,0.909,0.967,0.977and 0.804,0.899,0.913,0.901,0.923,0.902,0.911,0.931, exhibiting an amenable consistency. The mean MK, Ka, Kr of PCA were significantly higher (p < 0.01) than the BPH, while the mean MD, Da, Dr of cancerous tissue was found to be significantly lower (p < 0.01) than the hyperplasia tissue. No statistically significant difference was observed between FA values of two groups (p >0.05). The area under the ROC curve of all parameters were higher than 0.9.

CONCLUSION

DKI demonstrated can supply many meritorious parameters, with most useful in diagnostic differentiation of prostate cancer from prostatic hyperplasia. Combining with the routine prostate MRI, DKI may help in increasing the sensitivity and specificity of cancer detection.

CLINICAL RELEVANCE/APPLICATION

Combining with the routine prostate MRI, DKI may help in increasing the sensitivity and specificity of cancer detection.

SSK09-09  Incidental Bone Lesions on Staging MRI for Prostate Cancer: Prevalence and Clinical Importance

Wednesday, Dec. 2 11:50AM - 12:00PM Location: N228

Participants
PURPOSE

To evaluate the prevalence of bone lesions identified on prostate MRI and determine the associations between their imaging features, clinical/pathologic characteristics and the presence of prostate cancer (PCa) bone metastases.

METHOD AND MATERIALS

In this IRB approved, retrospective study, the medical records of 3765 patients undergoing staging prostate MRI for newly-diagnosed (PCa) between 2000-2014 were reviewed. Amongst these, the MRI exams of all patients with bone metastases and a random selection of patients without bone metastases (matched with a 3:1 ratio to patients with bone metastases) were reviewed by 2 independent readers (R1 and R2) for presence, size and signal characteristics of bone lesions on T1-weighted sequences along with their subjective level of suspicion (1-5 Likert scale) for the likelihood of bone metastases on MRI. Prostate-specific antigen levels, biopsy Gleason Score, clinical stage and National Comprehensive Cancer Network (NCCN) risk categories were recorded. The reference standard was bone biopsy and/or at least 1-year follow-up after MRI. Associations between MRI and clinical/pathologic findings were tested using Fisher's exact and Wilcoxon Rank Sum tests. Inter-reader agreement and diagnostic accuracy for bone metastases detection were assessed using Cohen's simple Kappa statistic and areas under the receiving operating characteristics curve (AUC).

RESULTS

57 out of 3765 patients (1.5%) had bone metastases. None of the patients with low-risk PCa according to the NCCN criteria had bone metastases. Inter-reader agreement on MRI was fair to substantial (k=0.26-0.70). There was at least 1 bone lesion present on MRI in 72% (95% CI: 0.66-0.78) and 70% (95% CI: 0.64-0.76) of patients according to R1 and R2. The AUC for detecting bone metastases on MRI was 0.97 (95% CI: 0.94-1.00) and 0.90 (95% CI: 0.84-0.95) for R1 and R2. Larger lesion diameter (p<0.0001 for both) and absence of intratumoral fat (p=0.0013-0.0020) were significantly associated with bone metastases for both readers.

CONCLUSION

Bone lesions in prostate MRI are present in the majority of patients undergoing initial staging for PCa, and infrequently represent metastatic disease.

CLINICAL RELEVANCE/APPLICATION

MRI findings should be interpreted in the context of clinical features which increase the likelihood of metastatic disease.
**SSK10**

**Health Service, Policy and Research (Education)**

**Wednesday, Dec. 2 10:30AM - 10:40AM Location: S102D**

**Participants**
- Paul P. Cronin, MD, MS, Ann Arbor, MI (*Moderator*) Nothing to Disclose
- Laura M. Fayad, MD, Baltimore, MD (*Moderator*) Nothing to Disclose

**Sub-Events**

**SSK10-01  Health Service, Policy and Research Keynote Speaker: Innovative Teaching Methods in Radiology Education**

**Wednesday, Dec. 2 10:30AM - 10:40AM Location: S102D**

**Participants**
- Aine M. Kelly, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

**SSK10-02  Comparison of High-fidelity Hands-on Simulation Team Training to Lecture/computer-simulation Based Training for Both Contrast Reaction Management and Teamwork Skills**

**Wednesday, Dec. 2 10:40AM - 10:50AM Location: S102D**

**Participants**
- Carolyn L. Wang, MD, Seattle, WA (*Presenter*) Nothing to Disclose
- Sankar Chinnugounder, MD, Worcester, MA (*Abstract Co-Author*) Nothing to Disclose
- Daniel S. Hippe, MS, Seattle, WA (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company
- Ryan O'Malley, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
- Puneet Bhargava, MD, Shoreline, WA (*Abstract Co-Author*) Editor, Reed Elsevier
- Sadaf F. Zaidi, MD, Spokane, WA (*Abstract Co-Author*) Nothing to Disclose
- William H. Bush JR, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To compare the performance of teams of radiologists, technologists and nurses trained with high-fidelity hands-on simulation versus lecture/computer-based simulation training for contrast reaction management and teamwork skills on a high-fidelity severe contrast reaction scenario.

**METHOD AND MATERIALS**

Eleven nurses, 11 technologists and 11 PGY2 radiology residents were prospectively recruited for this IRB and HIPAA compliant study. Participants were arranged into teams of 3 (1 resident, 1 nurse and 1 technologist). Six teams underwent hands-on training (HO) and 5 teams underwent lecture/computer-based training (CB) for contrast reaction management (CRM) and teamwork skills (TS). All similarly trained participants were tested in novel teams using a high-fidelity simulation scenario. Three CRM expert radiologists independently graded the CRM skills and three TS experts independently graded the TS skills tested. Objective scores were based on whether key actions were taken or not taken. Subjective scores were based on a 7-point Likert-like scale (strongly disagree to strongly agree). Objective and subjective scores were compared between training groups using the Mann-Whitney test. Spearman's correlation coefficient was used to compare objective and subjective scores.

**RESULTS**

The HO teams tended to score better than CB teams on the objective CRM (95.3±3.1 vs. 80.8±15.3 p=0.17) and subjective CRM scores (6.3±0.5 vs. 5.6±0.8 p=0.33). The HO and CB teams score more similarly on both objective TS (51.0±6.1 vs. 52.4±6.8 p=0.66) and subjective TS (3.7±0.4 vs. 4.1±0.9 p=0.25). There was good correlation between the objective and subjective TS scores (r=0.78, p=0.007). However, the overall objective score percentages were higher for CRM skills than TS skills for both the HO (p=0.03) and CB teams (p=0.06).

**CONCLUSION**

High-fidelity simulation based training may be better than lecture/computer-based training for teams of radiologists, technologists and nurses for contrast reaction management. However, a single session of high-fidelity simulation-based training or computer-based training appears to be similarly inadequate to master teamwork skills.

**CLINICAL RELEVANCE/APPLICATION**

High-fidelity simulation-based training may be better than computer-based training for teams of radiologists, technologist and nurses for contrast reaction management, but not for teamwork skills.

**Honored Educators**

Authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invest in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Puneet Bhargava, MD - 2015 Honored Educator
had comparable MCAT scores average aggregates of 32.8 and 32.0 respectively.
The experimental group performed statistically significantly better (P=0.035) with a 9.1% improvement. Both the class of 15 and 16
2016 scored an average 60.7% on the exam. 113 of 202 members of the control group, Class of 2015, scored an average of 55.6%.
following completion of their clinical anatomy course including the iPad driven anatomic radiology laboratory minicourse. The Class of
108 of 208 Class of 2016 second year clinical anatomy students completed the 20 multiple choice anatomy examination 12 months
interval following completion of their clinical anatomy course. First order test questions focused on anatomic concepts were
minicourse and thereby functioned as the control group. The test was then administered to the Class of 2016 at the same 12
their completion of clinical anatomy. The class of 2015 clinical anatomy lab did not include the iPad driven radiologic anatomy
examinations. A 20 question multiple choice examination was administered to the class of 2015 approximately 12 months following
the laboratory curriculum were utilized. Images shown during the laboratory sessions were later used on the 4 lab practical
OsiriX 3.5 (Pixmeo SARL) was used to project dicom images on the display. Projectional as well as cross sectional images specific to
Groups of 7-12 students of the Class of 2016 rotated through a 4-5 minute small group discussion in front of a 65-inch wall
mounted flat screen LCD display hooked up to an Apple TV (Apple, Inc). An iPad 3 (Apple, Inc.) equipped with iOS 5.1 and running
The faculty and residents of the radiology department of Tufts Medical Center participated in 23 of 27 gross anatomy sessions.
Pilot the portal with medical students transitioning from preclinical courses to clinical rotations, introducing these students to evidence-based decision making before they are exposed to unexplained variance in clinical ordering habits.

**METHOD AND MATERIALS**
An education portal was built on the American College of Radiology's Radiology Curriculum Management System (RCMS). RCMS and the CDS tool (ACR Select) were integrated via application programming interface. The cases simulate common clinical scenarios from a primary care practice setting, including questions regarding Choosing Wisely topics. Institutional review board approval was obtained for the pilot project. Learners navigated through the portal, receiving CDS feedback prior to and after selecting answers for the cases. Assessment was via a pre-test, post-test and survey questions.

**RESULTS**
On the survey, 85.29% of learners believe this portal with simulated CDS should be included in their medical school curriculum. The learners self-assessed their level of preparation to appropriately order imaging studies in front of a 65-inch wall mounted flat screen LCD display hooked up to an Apple TV (Apple, Inc). An iPad 3 (Apple, Inc.) equipped with iOS 5.1 and running OsiriX 3.5 (Pixmeo SARL) was used to project dicom images on the display. Projectional as well as cross sectional images specific to the laboratory curriculum were utilized. Images shown during the laboratory sessions were later used on the 4 lab practical examinations. A 20 question multiple choice examination was administered to the class of 2015 approximately 12 months following their completion of clinical anatomy. The class of 2015 clinical anatomy lab did not include the iPad driven radiologic anatomy minicourse and thereby functioned as the control group. The test was then administered to the Class of 2016 at the same 12 month interval following completion of their clinical anatomy course. First order test questions focused on anatomic concepts were utilized. No imaging was utilized on the exam. The study is IRB approved.

**CONCLUSION**
This novel approach has potential to address many needs in medical education, delivers value, and make a meaningful contribution to medical education. Timing of this project coincides with calls for physicians to embrace decision support. Using a readily available decision support software program, there is an opportunity to develop and implement standard key components of medical education curricula and assessment on the national level.

**CLINICAL RELEVANCE/APPLICATION**
This web-based product is scalable and could be used for future education projects such as graduate medical education, allied health education, quality improvement projects, and continuing medical education for practicing medical providers.

**METHOD AND MATERIALS**
The faculty and residents of the radiology department of Tufts Medical Center participated in 23 of 27 gross anatomy sessions. Groups of 7-12 students of the Class of 2016 rotated through a 4-5 minute small group discussion in front of a 65-inch wall mounted flat screen LCD display hooked up to an Apple TV (Apple, Inc). An iPad 3 (Apple, Inc.) equipped with iOS 5.1 and running OsiriX 3.5 (Pixmeo SARL) was used to project dicom images on the display. Projectional as well as cross sectional images specific to the laboratory curriculum were utilized. Images shown during the laboratory sessions were later used on the 4 lab practical examinations. A 20 question multiple choice examination was administered to the class of 2015 approximately 12 months following their completion of clinical anatomy. The class of 2015 clinical anatomy lab did not include the iPad driven radiologic anatomy minicourse and thereby functioned as the control group. The test was then administered to the Class of 2016 at the same 12 month interval following completion of their clinical anatomy course. First order test questions focused on anatomic concepts were utilized. No imaging was utilized on the exam. The study is IRB approved.

**RESULTS**
108 of 208 Class of 2016 second year clinical anatomy students completed the 20 multiple choice anatomy examination 12 months following completion of their clinical anatomy course including the iPad driven radiologic laboratory minicourse. The Class of 2016 scored an average 60.7% on the exam. 113 of 202 members of the control group, Class of 2015, scored an average of 55.6%. The experimental group performed statistically significantly better (P=0.035) with a 9.1% improvement. Both the class of 15 and 16 had comparable MCAT scores average aggregates of 32.8 and 32.0 respectively.

**PURPOSE**
Develop a case-based education portal simulating clinical decision support (CDS) at the point-of-order to highlight best practice in appropriate imaging utilization and patient safety. Pilot the portal with medical students transitioning from preclinical courses to clinical rotations, introducing these students to evidence-based decision making before they are exposed to unexplained variance in clinical ordering habits.

**METHOD AND MATERIALS**
An education portal was built on the American College of Radiology's Radiology Curriculum Management System (RCMS). RCMS and the CDS tool (ACR Select) were integrated via application programming interface. The cases simulate common clinical scenarios from a primary care practice setting, including questions regarding Choosing Wisely topics. Institutional review board approval was obtained for the pilot project. Learners navigated through the portal, receiving CDS feedback prior to and after selecting answers for the cases. Assessment was via a pre-test, post-test and survey questions.

**RESULTS**
On the survey, 85.29% of learners believe this portal with simulated CDS should be included in their medical school curriculum. The learners self-assessed their level of preparation to appropriately order imaging studies in front of a 65-inch wall mounted flat screen LCD display hooked up to an Apple TV (Apple, Inc). An iPad 3 (Apple, Inc.) equipped with iOS 5.1 and running OsiriX 3.5 (Pixmeo SARL) was used to project dicom images on the display. Projectional as well as cross sectional images specific to the laboratory curriculum were utilized. Images shown during the laboratory sessions were later used on the 4 lab practical examinations. A 20 question multiple choice examination was administered to the class of 2015 approximately 12 months following their completion of clinical anatomy. The class of 2015 clinical anatomy lab did not include the iPad driven radiologic anatomy minicourse and thereby functioned as the control group. The test was then administered to the Class of 2016 at the same 12 month interval following completion of their clinical anatomy course. First order test questions focused on anatomic concepts were utilized. No imaging was utilized on the exam. The study is IRB approved.

**CONCLUSION**
This novel approach has potential to address many needs in medical education, delivers value, and make a meaningful contribution to medical education. Timing of this project coincides with calls for physicians to embrace decision support. Using a readily available decision support software program, there is an opportunity to develop and implement standard key components of medical education curricula and assessment on the national level.

**CLINICAL RELEVANCE/APPLICATION**
This web-based product is scalable and could be used for future education projects such as graduate medical education, allied health education, quality improvement projects, and continuing medical education for practicing medical providers.

**METHOD AND MATERIALS**
The faculty and residents of the radiology department of Tufts Medical Center participated in 23 of 27 gross anatomy sessions. Groups of 7-12 students of the Class of 2016 rotated through a 4-5 minute small group discussion in front of a 65-inch wall mounted flat screen LCD display hooked up to an Apple TV (Apple, Inc). An iPad 3 (Apple, Inc.) equipped with iOS 5.1 and running OsiriX 3.5 (Pixmeo SARL) was used to project dicom images on the display. Projectional as well as cross sectional images specific to the laboratory curriculum were utilized. Images shown during the laboratory sessions were later used on the 4 lab practical examinations. A 20 question multiple choice examination was administered to the class of 2015 approximately 12 months following their completion of clinical anatomy. The class of 2015 clinical anatomy lab did not include the iPad driven radiologic anatomy minicourse and thereby functioned as the control group. The test was then administered to the Class of 2016 at the same 12 month interval following completion of their clinical anatomy course. First order test questions focused on anatomic concepts were utilized. No imaging was utilized on the exam. The study is IRB approved.

**RESULTS**
108 of 208 Class of 2016 second year clinical anatomy students completed the 20 multiple choice anatomy examination 12 months following completion of their clinical anatomy course including the iPad driven radiologic laboratory minicourse. The Class of 2016 scored an average 60.7% on the exam. 113 of 202 members of the control group, Class of 2015, scored an average of 55.6%. The experimental group performed statistically significantly better (P=0.035) with a 9.1% improvement. Both the class of 15 and 16 had comparable MCAT scores average aggregates of 32.8 and 32.0 respectively.
CONCLUSION
An iPad driven radiologic anatomy laboratory minicourse led by radiologists proved effective in improving student's 12 month retention of clinical anatomy knowledge.

CLINICAL RELEVANCE/APPLICATION
Small group anatomy instruction is effective at teaching anatomic concepts through imaging.

SSK10-05  Coming Out of the Dark: A Curriculum for Teaching and Evaluating Radiology Residents' Communications Skills through Simulation

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S102D

Participants
Carolynn M. Debenedectis, MD, Worcester, MA (Presenter) Nothing to Disclose
Jean-Marc Gauquet, MD, PhD, Worcester, MA (Abstract Co-Author) Nothing to Disclose
Joseph Makris, MD, Worcester, MA (Abstract Co-Author) Nothing to Disclose
Stephen D. Brown, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Max P. Rosen, MD, MPH, Worcester, MA (Abstract Co-Author) Stockholder, Everest Scientific Inc; Consultant, PAREXEL International Corporation; Stockholder, Cynvenio Biosystems, Inc; Medical Advisory Board, Cynvenio Biosystems, Inc

PURPOSE
The purpose of this project is to develop a curriculum to teach radiology residents communication skills through simulation. Communication skills are a core competency for which radiology residents must be evaluated. As Radiology has moved from "film" to PACS, opportunities for direct communication between Radiologists and referring clinicians have decreased. Additionally, radiologists increasingly must communicate effectively with patients. Simulation has been shown an effective tool, and we believe it can be used to teach and evaluate communication skills for radiology residents.

METHOD AND MATERIALS
Current first (N=5) and fourth year (N=3) radiology residents (PGY 2 and PGY 5) participated in 6 baseline communication scenarios with trained professional patient "actors". Scenarios included error and apology, delivering bad news, canceling examination/procedure, radiation risk counseling, giving results in pediatric imaging, and angry referring physician. Resident performance in the scenarios was evaluated by attending radiologists with prior communication skills training and the patient actors, using the Gap-Kalamazoo Communication Skills (GKCS) Assessment Form. All activities were videotaped at our interprofessional Center for Experiential Learning and Simulation (iCELS). Immediately following completion of all 6 scenarios, residents were debriefed, and defined teaching points were identified. Following a 2 week washout period and additional training, residents participated in a second similar simulation.

RESULTS
The average GKCS score for all the residents improved to 79% (range 66-86%) in part 2 compared to 74% (range 65-82%) in part 1. Fourth year residents performed better on both part 1 and 2 of the simulation when compared to first year residents. Average fourth year's score for part 1 was 77% vs. 72% for first year residents. Average fourth year's score for part 2 was 81% vs. 76% for first year residents.

CONCLUSION
Simulation is a promising method for teaching and evaluating residents' communication skills.

CLINICAL RELEVANCE/APPLICATION
Simulation can be used to teach and evaluate radiology residents' communication skills in compliance with the core competency requirement.

SSK10-06  Use of in-situ High-fidelity Severe Contrast Reaction Simulation Radiology Team Performance Testing to Identify Gaps in Knowledge for Teamwork Skills Based on TeamSTEPPS®

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S102D

Participants
Carolyn L. Wang, MD, Seattle, WA (Presenter) Nothing to Disclose
Sankar Chinnagounder, MD, Worcester, MA (Abstract Co-Author) Nothing to Disclose
Daniel S. Hippe, MS, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company
Ryan O'Malley, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Puneet Bhardava, MD, Shoreline, WA (Abstract Co-Author) Editor, Reed Elsevier
Sadaf F. Zaidi, MD, Spokane, WA (Abstract Co-Author) Nothing to Disclose
William H. Bush JR, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To perform in-situ hands-on high-fidelity simulation testing of teams of radiology residents, nurses and technologists with a severe contrast reaction scenario to identify gaps in knowledge on teamwork skills.

METHOD AND MATERIALS
Eleven nurses, 11 technologists and 11 PGY2 radiology residents were recruited for this IRB and HIPAA compliant study. Participants were arranged into teams of 3 (1 resident, 1 nurse and 1 technologist). All participants underwent TeamSTEPPS® training with an interactive lecture. Eleven teams underwent in-situ high-fidelity simulation scenario testing with a severe contrast reaction scenario with built in medical mistakes. Three TeamSTEPPS® expert trainers independently graded the teamwork skills (TS) tested and their grades were averaged. Grades (out of 100%) for each skill were computed by adding up grades for each sub-item and overall grades were computed by adding up grades for each skill. The sub-item grades were examined to determine on which skill sub-items participants generally performed particularly poorly to help refine the training program.
RESULTS
The overall TS grades were low (52±6%). The grades for each major skill were also low (40-59%) including SBAR (Situation Background, Assessment, Recommendation), closed loop communication, CUS (Concerned, Uncomfortable, Safety issue), huddle and leadership. For SBAR, the low grades were due to participants rarely using the specific word from the acronym and not offering recommendations. For closed-loop communication, participants rarely named an individual for a call out and frequently failed to close the loop. Only 2 of the 11 groups had an identifiable team leader on whom all graders agreed. The majority of huddles were not being performed in a timely fashion and the teams rarely attempted to create a shared mental model.

CONCLUSION
In-situ high-fidelity severe contrast reaction simulation testing of teams of radiology residents, nurses and technologists can be used to identify knowledge gaps in teamwork skills. This allows focused training to include improving methods of relaying patient information, identifying a situational leader, and proper closed loop communication.

CLINICAL RELEVANCE/APPLICATION
Patient safety requires effective teamwork skills. Training radiology teams (nurses, technologists and radiologists) should focus on teamwork skills and in-situ high-fidelity simulation testing can identify specific gaps.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Puneet Bhargava, MD - 2015 Honored Educator

SSK10-07  Teaching from Every Angle: Integrating 3D Anatomy with Interactive Case-based Radiology Playlists
Wednesday, Dec. 2 11:30AM - 11:40AM Location: S102D

Participants
Derek A. Smith, MBChB, Edinburgh, United Kingdom (Presenter) Nothing to Disclose
Jeremy B. Jones, MRCP, FRCR, Melbourne, Australia (Abstract Co-Author) Nothing to Disclose

PURPOSE
As clinical imaging becomes more accessible, radiologists have an ever-increasing opportunity to be actively engaged with medical student teaching. We sought to assess how this teaching can be aided by innovative approaches and new technologies.

METHOD AND MATERIALS
Case based tutorials were designed for medical students on their clinical orthopaedics placement. Normal anatomy was viewed and manipulated using a three-dimensional (3D) imaging 'Sectra Table'. Plain film and cross-sectional imaging was then displayed through the device to discuss common and important fractures and injuries. Groups of 6-10 students attended sessions run by a radiologist (consultant or clinical fellow). Post-session feedback was collected online with quantitative Likert scales and qualitative free-text comments.

RESULTS
Sessions were rated by 53 students (from January to March 2015) on a scale of 'poor' (1) to 'awesome' (5), for the following criteria: content (median score 4.6), relevance (4.6), style of presentation (4.8) and quality of display aids (4.9). Feedback praised the use of the imaging table relating 3D anatomy to clinical imaging ('brilliant aid, great technology'). The ability to view plain film and cross-sectional imaging and explore associated anatomical structures was highly valued. Having the opportunity to go through imaging on a case-by-case basis with a radiologist was appreciated and many requested more radiology teaching.

CONCLUSION
Using the interactive 3D surface is an exciting new model for student and teacher, and this was reflected by the high feedback scores and comments. It reinforces the importance of understanding underlying anatomy and highlights the value of the information gained from plain film. Interactive teaching with a radiologist proved popular and helps to introduce advanced imaging concepts at an appropriate level.

CLINICAL RELEVANCE/APPLICATION
Integrated anatomy and radiology teaching with an interactive case-based approach using novel 3D technology proved popular and engaged students while enhancing their clinical knowledge.

SSK10-08  Improving First-Year Resident Education in Musculoskeletal Imaging: Comparison of Workflow Using the Customary Chronologic Approach with the Novel Anatomy Based Approach
Wednesday, Dec. 2 11:40AM - 11:50AM Location: S102D

Participants
Leon Lenchik, MD, Winston-Salem, NC (Presenter) Nothing to Disclose
Robert D. Boutin, MD, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Jasjeet Bindra, MBBS, MD, Davis, CA (Abstract Co-Author) Nothing to Disclose
Bahram Kiani, MD, Winston Salem, NC (Abstract Co-Author) Nothing to Disclose
Cyrus Bateni, MD, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Scott D. Wuetzer, MD, MS, Winston-Salem, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE
Determine if organization of a PACS worklist by chronologic order versus anatomic order influences first-year radiology resident performance, resident satisfaction, or faculty satisfaction.
METHOD AND MATERIALS

In a prospective study conducted at two major academic institutions, first-year residents on their first musculoskeletal imaging rotation were randomly divided into two groups based on chronologic or anatomic sorting of their worklist. Residents in the chronologic group (CG) sorted their worklist based on the date of the study with the oldest studies interpreted first. Residents in the anatomy group (AG) sorted their worklist based on an anatomic region for the day (Day 1: Shoulder, humerus, elbow; Day 2: Forearm, wrist, hand; Day 3: Pelvis, hip; Day 4: Femur, knee, leg; Day 5: Ankle, foot). At the end of the 4-week rotation, residents took a 25-question, image-based examination and completed a satisfaction survey, which assessed experience, teaching, and workload on a scale of 1 to 5 (1 = poor; 5 = excellent). For each resident, the faculty completed a similar survey that assessed the experience, teaching, and workload. Resident and faculty surveys also included three open-ended questions to provide qualitative assessment of satisfaction. Data from the two institutions were pooled, and the CG and AG groups were compared.

RESULTS

There were 7 residents in the CG group and 9 in the AG group. The numbers of correct answers on the post-rotation examination were slightly higher in the AG group (14.8) than the CG group (14.1). Resident satisfaction scores of overall experience were higher in the AG group (4.7) than the CG group (4.0). Resident satisfaction scores relating to teaching were similar in the AG group (4.8) and CG group (4.9). Resident satisfaction scores relating to workload were similar in the AG group (3.9) and CG group (4.0). Faculty satisfaction scores were similar in the two groups. Qualitative assessment of resident and faculty satisfaction comments were overwhelmingly positive for both groups. The single negative comment was from one resident assigned to the CG group.

CONCLUSION

For first-year residents rotating on the musculoskeletal service, organizing the PACS worklist by anatomic region rather than by date improves learning and increases resident satisfaction.

CLINICAL RELEVANCE/APPLICATION

Novel approaches to managing resident workflow can improve their experience on the musculoskeletal service.

Participants

Laura M. Fayad, MD, Baltimore, MD (Presenter) Nothing to Disclose
Molecular Imaging (Staging and Therapy Control)

Wednesday, Dec. 2 10:30AM - 12:00PM Location: S504CD

AMAPRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants
Umar Mahmood, MD, PhD, Charlestown, MA (Moderator) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;
Suzanne E. Lapi, PhD, Saint Louis, MO (Moderator) Research Grant, ImaginAB, Inc

Sub-Events

SSK11-01 Noninvasive Monitoring of Early Antiangiogenic Therapy Response using RGD-conjugated Ultrasmall Superparamagnetic Iron Oxide Nanoparticles in an Orthotopic Human Nasopharyngeal Carcinoma Model

Wednesday, Dec. 2 10:30AM - 10:40AM Location: S504CD

Participants
Yanfen Cui, Shanghai, China (Presenter) Nothing to Disclose
Caiyuan Zhang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Huanhuan Liu, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Dengbin Wang, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
Molecular imaging is merging as a powerful tool for the noninvasive imaging of the biological processes. The purpose of this study was to validate a novel integrin αvβ3-targeted ultrasmall superparamagnetic iron oxide (USPIO) nanoparticles, Fe3O4@PAA-RGD, for its ability to detect tumor angiogenesis and assess the early response of an antiangiogenesis agent Avastin® in an orthotopic human nasopharyngeal carcinoma (NPC) model.

METHOD AND MATERIALS
The specific uptake of Fe3O4@PAA-RGD in HUVECs and CNE-2 Cells was evaluated using Prussian blue staining, transmission electron microscopy (TEM). The ability of Fe3O4@PAA-RGD to noninvasively assess αvβ3 integrin positive vessels in NPC tumor xenografts was evaluated with a 3.0T MR scanner. For the assessment of antiangiogenesis therapy, the mice bearing human NPC tumor xenografts were intraperitoneally injected with Avastin® (n=12) or normal saline (n=12) three times in a week at a dose of 200 µg/mouse. T2* mapping was performed baseline and after 2 and 7 days of treatment.

RESULTS
The specific uptake of the particles was mainly dependent on the interaction between RGD and integrin αvβ3 of HUVEC, which could be competitively inhibited by addition of unbound RGD. The tumor targeting of Fe3O4@PAA-RGD was observed in the orthotopic NPC model, which demonstrates accumulation of nanoparticles exclusively at the neovasculature but not within tumor cells. The vascular accumulation of Fe3O4@PAA-RGD caused significantly higher changes of the R2* value of tumors than observed for unlabelled USPIO. Bevacizumab treatment resulted in a significant reduction of the R2* values compared with the control group both at day2 and day7, confirmed by the immunohistochemistry of MVD after treatment.

CONCLUSION
This study demonstrates that RGD-coupled, PAA-coated USPIOs efficiently label integrin αvβ3expressed on endothelial cells. Furthermore, these molecular MR imaging probes are capable of noninvasive monitoring of the tumor response to bevacizumab therapy at early stages of treatment.

CLINICAL RELEVANCE/APPLICATION
RGD-coupled, PAA-coated USPIOs efficiently label integrin αvβ3expressed on endothelial cells. Furthermore, these molecular MR imaging probes are capable of noninvasive monitoring of the tumor response to bevacizumab therapy at early stages of treatment.

SSK11-02 Point of Care Assessment of Melanoma Tumor Signaling and Metastatic Burden from μNMR Analysis of Tumor Fine Needle Aspirates and Peripheral Blood

Wednesday, Dec. 2 10:40AM - 10:50AM Location: S504CD

Participants
Michael S. Gee, MD, PhD, Jamaica Plain, MA (Presenter) Nothing to Disclose
Arezou Ghazani, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Hakho Lee, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ralph Weissleder, MD, PhD, Boston, MA (Abstract Co-Author) Investor, T2 Biosystems, Inc

PURPOSE
To use μNMR technology for molecular profiling of tumor fine needle aspirates and peripheral blood of melanoma patients, in order to assess BRAF signaling compared with genetic reference and metastatic burden compared with imaging reference.

METHOD AND MATERIALS
μNMR in vitro assessment of expression of melanocyte (MelanA, HMB45) and MAP kinase signaling (pERK, pS6K) molecules was
Optical Molecular Imaging of Mesenchymal-Epithelial Transition Factor (c-Met) for Enhanced Detection and Characterization of Primary and Metastatic Hepatic Tumors

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S504CD

Awards
Trainee Research Prize - Resident

Participants
Shadi A. Esfahani, MD, MPH, Boston, MA (Presenter) Nothing to Disclose
Pedram Heidari, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Umar Mahmood, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;

Purpose
Primary liver cancer as well as metastatic liver disease, predominantly from colorectal cancer (CRC) are major causes of cancer death. The success of liver cancer therapy depends on accurate diagnosis at the time of biopsy and efficiency of cytoreductive surgery. c-Met is a proto-oncogene overexpressed in 74-90 % of hepatocellular carcinoma (HCC) and CRC. We assessed whether optical imaging of c-Met using a targeted fluorescence probe, can be used to delineate and characterize the liver tumors and be effectively employed for intraoperative interventions and personalized therapy.

Method and Materials
A modified cyanine 5-tagged peptide with high affinity to c-Met was used. Cell binding assay was performed by incubation of human HCC cells (HepG2,Huh-7), CRC cells (HT-29), and cMET-negative cells (LNCaP) with probe ± HGF. Fluorescence signal was correlated to c-Met expression level. Focal models of primary and metastatic liver cancer were generated by injection of HepG2, Huh-7, and HT-29 in hepatic subcapsular space of nude mice (n=24). Near infrared fluorescence (NIRF) imaging was performed over 8 h after probe injection. Uptake in liver and tumor, and tumor to background ratio (TBR) were calculated. Probe biodistribution was assessed by measuring NIRF signal in multiple organs. IHC evaluation of c-Met expression in human CRCs and HCCs was performed using tissue arrays.

Results
Incubation of cells with probe showed enhanced fluorescence signal in c-Met expressing cells compared to LNCaP, and strong correlation between signal and c-Met expression level (R2=0.99,p<0.0001). NIRF imaging showed high uptake in subcapsularly grown tumors and greater signal compared to the liver over 8 h; TBR reached a peak of 5.46±0.46 in Huh-7, 3.55±0.38 in HepG2 and 15.93±0.61 in HT-29, 4 h post-injection. IHC of tissue arrays confirmed c-Met overexpression in 86% of CRC and 84.9% of HCC cores.

Conclusion
High TBR achieved in our tumor models and overexpression of c-Met in a majority of human HCC and metastatic CRC tumors suggest that optical imaging of c-Met is a promising approach for accurate delineation and characterization of liver tumors. This is a translatable advancement for intraoperative image-guided interventions and personalized treatment.

Clinical Relevance/Application
c-MET receptor imaging helps in precise delineation and in-situ characterization of primary hepatic tumors and metastases of other cancers to the liver.
PURPOSE
To perform an intra-animal comparison between 3D ultrasound molecular imaging (USMI) using clinical grade vascular endothelial growth factor receptor 2 (VEGFR2)-targeted contrast microbubble (MBVEGFR2) and 3D dynamic contrast-enhanced (DCE)-US for assessing tumor angiogenesis and anti-angiogenic treatment effects in a murine model of human colon cancer.

METHOD AND MATERIALS
Subcutaneous human colon cancers were induced in 19 mice and randomized to either anti-angiogenic treatment (n=11; i.v. single dose of anti-angiogenic agent, bevacizumab at 10mg/kg) or vehicle treatment (n=8; saline). 3D US imaging was performed with a clinical system (IU22 xMATRIX; Philips) and a matrix array transducer (X6-1; 3.2MHz) using 2 techniques: 1) USMI was performed 4min after i.v. injection of 5×10⁷ MBVEGFR2; and 2) DCE-US was performed with destruction-replenishment approach by constantly infusing non-targeted microbubbles at 40µL/min. VEGFR2-targeted signal intensity (SI) was quantified from USMI and 2 perfusion parameters, relative blood volume (rBV) and flow (rBF) were calculated from DCE-US. VEGFR2 expression levels and the percent area of blood vessels (PABV) were assessed ex vivo using immunofluorescence (IF) and correlated with corresponding in vivo US parameters.

RESULTS
Both 3D US imaging techniques showed strong anti-angiogenic treatment effects. All 3 parameters including VEGFR2-targeted SI (58%, P=0.002), rBV (52%, P=0.002) and rBF (38%, P=0.02) significantly decreased following anti-angiogenic treatment compared to controls. IF showed significantly diminished VEGFR2 expression (P=0.03) and PABV (P=0.03) in treated tumors, while no significant change was observed in control tumors. SI was highly correlated with VEGFR2 expression (r=0.95, P=0.001), and rBV (r=0.71, P=0.08) and rBF (r=0.82, P=0.02) showed good correlation with PABV.

CONCLUSION
Both 3D USMI and 3D DCE-US provide complementary in vivo information on anti-angiogenic treatment effects and allow accurate quantification of tumor angiogenesis in human colon cancer xenografts compared to ex vivo reference gold standard techniques.

CLINICAL RELEVANCE/APPLICATION
3D imaging capabilities may further expand the future clinical role of both USMI and DCE-US in cancer imaging.

SSK11-05 Accurate Prediction of Nodal Status in Preoperative Patients with Thyroid Carcinoma Using Next-Gen Nanoparticle

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S504CD

Participants
Aofile Kilcoyne, MBChB, Boston, MA (Presenter) Nothing to Disclose
Roy Phitayakom, Boston, MA (Abstract Co-Author) Nothing to Disclose
Gilbert H. Daniels, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Sareh Parangi, Boston, MA (Abstract Co-Author) Nothing to Disclose
Gregory Randolph, Bosotn, MA (Abstract Co-Author) Nothing to Disclose
Mukesh G. Hansinghani, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The goal of the study is to test the ability to image lymph node metastases in thyroid cancer by a novel MRI imaging agent the ferromagnetic nanoparticle Ferumoxytrol (Feraheme; AMAG Pharmaceuticals, Lexington, MA), which has residual magnetic properties that are detectable by MRI. These carboxymethyl dextran-coated iron oxide ((FeO)₁ - n(Fe₂O₃)n) nanoparticles slowly extravasate and travel through the lymphatic system to lymph nodes. The particles are subsequently internalized into macrophages, presumably through macrophocytosis. Prior studies using this approach with other malignancies (such as prostate cancer) demonstrated abnormal nanoparticle accumulation patterns which are detectable by MRI. We prospectively enrolled 12 patients with confirmed metastatic thyroid carcinoma (3 medullary, 9 papillary) undergoing surgery and compared preoperative MRI appearance of lymph nodes to post-operative histopathologic analysis. The study group consisted of 5 male and 7 female patients, with an mean of 34 nodes resected (range from 1 - 135).

METHOD AND MATERIALS
This exploratory study was performed as a prospective, single-dose pilot study and was approved by the Institutional Review Board. All patients with known thyroid cancer who were scheduled for surgical resection were eligible for enrollment in this study. Exclusion criteria included: age < 18, history of iron overload or known allergy to parenteral iron.

RESULTS
We demonstrated 76.92% sensitivity and 95.74% specificity, 90.91% PPV (CI 70.84% to 98.88%) NPV 88.24% (76.13% to 95.56%) for the detection of central nodes. There was 82.76% sensitivity and 91.78% specificity, PPV 61.54% (CI 49.83% to 72.34%) NPV 97.1% (CI 94.73% to 98.6%) for the detection of peripheral nodes.

CONCLUSION
Lymph node metastases correlate with recurrent disease in patients with thyroid carcinoma. We currently have limited ability to image central lymph nodes prior to thyroidectomy in patients with thyroid carcinoma. This preliminary study suggests that MRI imaging following nanoparticle injection is a potentially worthwhile imaging modality. Additional studies are necessary comparing this with other established methods.

CLINICAL RELEVANCE/APPLICATION
Our study has demonstrated that nanoparticle-enhanced MRI is an accurate and safe method for pre-operatively detecting nodal metastases in patients with thyroid carcinoma.
To determine the possibility of using radiofrequency hyperthermia (RFH) to enhance therapeutic effect of herpes simplex virus thymidine kinase/ganciclovir (HSV-TK/GCV) on hepatocellular carcinoma (HCC).

**METHOD AND MATERIALS**

Human HCC cells (HepG2) were first transfected with lentivirus/luciferase. For both in-vitro confirmation and in-vivo validation, Luciferase-labeled HCC cells and HCC tumor xenografts on mice received different treatments: (i) combination therapy of intratumoral HSV-TK/GCV-mediated gene therapy plus MR imaging-heating-guideewire (MRHG)-mediated RFH; (ii) gene therapy only; (iii) RFH only; and (iv) phosphate-buffered saline (PBS) as control. Cell proliferation was quantified by MTS assay. Tumor size and signal changes were monitored by ultrasound imaging and optical imaging before and at days 7 and 14 after treatments, which were
correlated with subsequent histology.

**RESULTS**

In vitro experiments, MTS assay demonstrated the lowest cell proliferation in combination therapy group compared with those in three control groups (29±6% VS 56±9%, 93±4%, and 100±5%, p<0.05). Of in vivo experiments, ultrasound imaging showed smaller relative tumor volume in combination therapy group than those in three control groups (0.74±0.19 VS 1.79±0.24, 3.14±0.49 and 3.22±0.52, p<0.05). Optical imaging demonstrated significant decrease of bioluminescence signals of tumors in the combination therapy group, compared to those in three control groups (1.2±0.1 VS 1.9±0.2% VS 3.3±0.6% VS 3.5±0.4%, p<0.05)(Figure). These imaging findings were correlated well with histologic confirmation.

**CONCLUSION**

RF-hyperthermia can enhance HSV-TK/GCV-mediated gene therapy of hepatocellular cancer, which may open new avenues for efficient management of hepatocellular carcinoma using MR/RF hyperthermia-integrated interventional gene therapy.

**CLINICAL RELEVANCE/APPLICATION**

RF-hyperthermia can enhance HSV-TK/GCV-mediated gene therapy of hepatocellular cancer.
expression changes for the purpose of therapeutic guidance.

**METHOD AND MATERIALS**

64Cu-DOTA-cetuximab F(\(ab')\)2 and 64Cu-DOTA-HER3 F(\(ab')\)2 were prepared and probe affinity for their targets assessed. The TNBC cell lines MDMBA468 and HCC70 were treated with the AKT inhibitor GDC-0068 for one day at a range of concentrations. Following treatment, uptake of EGFR probe or HER3 probe was assessed, and results compared to protein expression changes of EGFR or HER3, respectively, as assessed by Western blot. MDMB468 mice were then treated with GDC-0068 or control for 2 days. After treatment, mice were imaged with either 64Cu-DOTA-EGFR F(\(ab')\)2 or 64Cu-DOTA-HER3 F(\(ab')\)2 to assess changes in EGFR or HER3 expression, respectively.

**RESULTS**

Treatment of the TNBC cell lines MDAMB468 and HCC70 with GDC-0068 resulted in increased EGFR Probe uptake of 6% and 88% respectively. Interrogation of the same cell lines with HER3 Probe demonstrated uptake changes of 74% and 102%. These findings correlate closely to changes in protein expression as assessed by Western blot. MDAMB468 mouse xenografts treated with control or AKT inhibitor for two days and then imaged demonstrate no significant change in SUVmean of EGFR PET Probe (0.48 vs. 0.53, \(p=0.11\)), however demonstrate a significant change in SUVmean of HER3 PET Probe (0.35 vs 0.73, \(p<0.01\)).

**CONCLUSION**

TNBC resistance to AKT inhibition can be mediated through increased RTK expression in a pattern that differs across cell lines and patient tumors. We demonstrate that the differential change in RTK expression can be noninvasively assessed, demonstrating in a model of TNBC that while imaged EGFR expression does not change, imaged HER3 expression increases by 108%. These noninvasively assessed differential changes in RTK expression may inform subsequent therapeutic choices.

**CLINICAL RELEVANCE/APPLICATION**

The pattern of RTK expression change induced by AKT inhibition is not known prior to treatment. RTK PET imaging may allow for noninvasive assessment of these changes to optimize therapeutic regimens.
SSK12-04  Imaging of Cervical Disc Degeneration in 3D Ultrashort Echo Time MR Imaging Comparing with Conventional T2 Weighted Spin Echo Sequences; An in Vivo Preliminary Study

PURPOSE
To evaluate the image findings of cervical disc degeneration in 3 dimensional ultrashort echo time MR imaging (3D UTE) according to disc degeneration in conventional T2 weighted spin echo sequences (T2 SE).

METHOD AND MATERIALS
A total of 315 discs of 63 patients (36 men and 27 women; mean age 53.62 years, age range - 19-85) were imaged with sagittal T2 SE (repetition time msec/time to echo msec, 2800/90) and sagittal 3D UTE (16.1/0.028, 4.4, echo-subtraction). In T2 SE, disc degenerations were evaluated from C2-3 to C6-7 using a grading system proposed by Pfirrmann et al. In 3D UTE, discs were classified as follows, according to the morphology of the cartilaginous endplate (CEP), and the signal intensity of the nucleus purposes (NP): type I (smooth thin CEP; low signal intensity of the NP), type II (mild irregular CEP; low signal intensity of the NP), type III (irregular and thickened CEP with or without high signal intensities in some portion of the NP), and type IV (an irregular and thickened CEP with high signal intensities in nearly all of the NP). Each type of disc in the UTE was compared with grades of disc degeneration in T2 SE and analyzed by a linear- by-linear association.

RESULTS
In mild degeneration (grade 2, n=127), type I discs (107/127, 84.3%) were most frequently seen but none of the type IV discs were found in 3D UTE. In cases of severe degenerations (grade 4, n= 11), type IV discs (6/11, 54.5%) were most frequently found but none of the type I discs were seen in 3D UTE. There was a statistically significant tendency between the types of disc in UTE and grades of disc degeneration in T2 SE.

CONCLUSION
The degenerative cervical discs showed thick irregular CEPs and increased prevalence of high signal intensity at the NP in 3D UTE.

CLINICAL RELEVANCE/APPLICATION
The change of cartilaginous endplates and increased amount of short T2 components in a nucleus pulposus according to degeneration in 3D UTE may help to understand and diagnosedisc degeneration.
PURPOSE
To evaluate correlation between T1ρ (T1p), T2 values and disc degeneration and morphologic changes in the lumbar intervertebral discs.

METHOD AND MATERIALS
Twenty-two subjects (M:F=8:14; mean age 55.5 years; range 26-84 years) with 109 lumbar intervertebral discs (from L1-2 to L5-S1) were examined at 3.0T MRI. Disc degeneration was evaluated using the 5-level Pfirrmann grading system and the disc morphology was categorized into five groups: normal, bulging, annular tear, protrusion, extrusion. For T1p and T2 quantification, regions of interest (ROIs) were drawn on the three mid-sagittal images at nucleus pulposus (NP), posterior annulus fibrosus (AF), and junction of the NP and posterior AF for each disc on T1p and T2 maps. Quantitative measurements for hemi-discs were made within the protruded or extruded portion. Statistical analysis was performed using Spearman rank correlation and partial correlation.

RESULTS
The Pfirrmann grades showed strong correlations with the T1p values at the NP (r=.800, p<.001), T2 values at the NP (r=-.792, p<.001), and T2 values at the junction (r=-.603, p<.001), T2 values at the NP (r=.578, p<.001), and T1p values at the NP (r=.509, p<.001). After correction for effects of patient age and disc level, there was strong to moderate correlation between the Pfirrmann grades and T1 p values at the NP (r=.750, p<.001 after correction of age effect and r=.697, p<.001 after correction of disc level effect).

CONCLUSION
T1p and T2 mapping, especially T1p values at the NP and T2 values at NP and junction, provided quantitative measurements of the progression of the intervertebral disc degeneration with strong correlations. T2 values at the junction proved good relationship in the assessment of the disc morphologic changes.

CLINICAL RELEVANCE/APPLICATION
T1p and T2 mapping provide quantitative measurements for disc degeneration and morphologic changes, which can be used as a synergistic modality for evaluation of lumbar degenerative disc disease.

PURPOSE
To evaluate diagnostic performance of spin echo based T2-weighted mDixon MR images and to compare with T1-weighted MR images for detection of vertebral metastasis.

METHOD AND MATERIALS
From April to September 2014, we found 124 patients who underwent whole spine MRIs with spin echo mDixon for the evaluation of vertebral metastases. We obtained conventional T1-weighted images, mDixon images including water and fat images of T2 mDixon, and contrast-enhanced water images of T1 mDixon. We found 23 bone metastases of 12 patients by inclusion criteria: 1) patients with a record of a bone metastasis diagnosis as the primary or secondary diagnosis and 2) Positron emission tomography-computed tomography (PET-CT) scan within one month. The lesion at same level on PET-CT scan was utilized as a reference. Two radiologists reviewed fat and water images of T2 mDixon and contrast enhanced water image of T1 mDixon in random order separately. We calculated sensitivities, specificities, accuracies, positive and negative predictive values, inter-observer agreements.

RESULTS
Of 23 metastatic lesions, the reviewer 1 detected 16 on T1-weighted images, 16 on water images, 15 on fat images of T2 mDixon, 20 on contrast enhanced water images of T1 mDixon. And the reviewer 2 detected 19, 18, 18 and 22, respectively. Contrast-enhanced water images of T1 mDixon showed higher sensitivity than other images (76.1% vs. 73.9% vs. 71.7% vs. 91.3%). Specificities, accuracies, positive and negative predictive values of three spin echo based mDixon images were similar values to conventional T1-weighted images (98.9% vs. 98.0% vs. 98.8% vs. 98.1%; 97.2% vs. 96.2% vs. 96.7% vs. 97.7%; 85.4% vs. 75.6% vs. 82.5% vs. 80.8%; 98.0% vs. 97.8% vs. 97.7% vs. 99.3%). The kappa values of inter-observer agreement were moderate degree (0.712, 0.679, 0.679 and 0.790, respectively).

CONCLUSION
The spin echo based T2-weighted mDixon MR images show good diagnostic performances in sensitivity, specificity, accuracy, positive and negative predictive values compared with T1-weighted MR images for detection of vertebral metastasis.

CLINICAL RELEVANCE/APPLICATION
Using spin echo based T2-weighted mDixon technique, we can obtain water and fat images with single scan, which have similar diagnostic performances to conventional T1-weighted images for the detection of vertebral metastases. And fat images of T2 mDixon can be used for detection of vertebral metastasis instead of T1-weighted images.
In conclusion, a better understanding of the CT manifestations of spinal lesions in SAPHO patients may support clinical diagnosis in

RESULTS
27 lesional foci were identified in the 13 patients on initial MR images. Extension of the erosions was seen in 20 foci (74%) and 3 new lesional foci appeared. During follow-up, 31 of the 75 (41%) initial erosions spread by degrees within a single vertebra to the adjacent vertebrae and to the vertebral corner of the adjacent vertebrae. Changes in SI of the vertebral body were seen in 21 of the 27 (78%) initial foci. In 8 (30%) of the 27 initial lesional foci, a soft tissue involvement at the anterior or lateral paraspinous region was noted. Thickness of this involvement progressed compared to initial examinations in 3 of the 27 foci (11%). A decrease in disk space height was observed on follow-up MRI in 10 of the 27 initial foci (37%) and was associated with high SI on T2-weighted images or gadolinium enhancement of the disk space in 3 (11%), further mimicking disk space infection. Bony bridges over the disk space increased in 3 lesional foci (11%) and appeared in 2 (7%) during follow-up.

CONCLUSION
During the course of the SAPHO syndrome, vertebral involvement spread by degrees within a single vertebra to the adjacent cortices as well as to the vertebral corner of the adjacent vertebrae.

CLINICAL RELEVANCE/APPLICATION
The gradual local spread of the vertebral disease process strongly suggests SAPHO syndrome in the appropriate clinical context.

Participants
Emilie A. Dodre, MD, Lille, France (Presenter) Nothing to Disclose
Caroline Parlier, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Gilles Havem, Paris, France (Abstract Co-Author) Nothing to Disclose
Jean-Denis Laredo, MD, Paris, France (Abstract Co-Author) Research Consultant, Cardinal Health, Inc; Research Consultant, Laurane Medical; Research Consultant, F. Hoffman-La Roche Ltd; Research Grant, SERVIER

METHOD AND MATERIALS
Between October 1992 and January 2012, 13 patients (10 women, 3 men; median age at first MR imaging: 33 years) with SAPHO syndrome involving the spine underwent 2 MR examinations of the spine after an interval of at least 3 months. Three musculoskeletal radiologists reviewed MR spinal images in consensus. Erosions of vertebral bodies defined lesional foci. Lesional foci separated by one or more normal vertebral corner were analyzed as distinct lesions. Cortical bone erosions, vertebral signal intensity (SI) alterations compared with normal vertebral body SI, soft-tissue involvement, intervertebral disk SI and disk height compared with the other disks and osseous bridges were evaluated.

RESULTS
27 lesional foci were identified in the 13 patients on initial MR images. Extension of the erosions was seen in 20 foci (74%) and 3 new lesional foci appeared. During follow-up, 31 of the 75 (41%) initial erosions spread by degrees within a single vertebra to the adjacent vertebrae and to the vertebral corner of the adjacent vertebrae. Changes in SI of the vertebral body were seen in 21 of the 27 (78%) initial foci. In 8 (30%) of the 27 initial lesional foci, a soft tissue involvement at the anterior or lateral paraspinous region was noted. Thickness of this involvement progressed compared to initial examinations in 3 of the 27 foci (11%). A decrease in disk space height was observed on follow-up MRI in 10 of the 27 initial foci (37%) and was associated with high SI on T2-weighted images or gadolinium enhancement of the disk space in 3 (11%), further mimicking disk space infection. Bony bridges over the disk space increased in 3 lesional foci (11%) and appeared in 2 (7%) during follow-up.

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CLINICAL RELEVANCE/APPLICATION
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Participants
Emilie A. Dodre, MD, Lille, France (Presenter) Nothing to Disclose
Caroline Parlier, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Gilles Havem, Paris, France (Abstract Co-Author) Nothing to Disclose
Jean-Denis Laredo, MD, Paris, France (Abstract Co-Author) Research Consultant, Cardinal Health, Inc; Research Consultant, Laurane Medical; Research Consultant, F. Hoffman-La Roche Ltd; Research Grant, SERVIER

METHOD AND MATERIALS
Between October 1992 and January 2012, 13 patients (10 women, 3 men; median age at first MR imaging: 33 years) with SAPHO syndrome involving the spine underwent 2 MR examinations of the spine after an interval of at least 3 months. Three musculoskeletal radiologists reviewed MR spinal images in consensus. Erosions of vertebral bodies defined lesional foci. Lesional foci separated by one or more normal vertebral corner were analyzed as distinct lesions. Cortical bone erosions, vertebral signal intensity (SI) alterations compared with normal vertebral body SI, soft-tissue involvement, intervertebral disk SI and disk height compared with the other disks and osseous bridges were evaluated.

RESULTS
27 lesional foci were identified in the 13 patients on initial MR images. Extension of the erosions was seen in 20 foci (74%) and 3 new lesional foci appeared. During follow-up, 31 of the 75 (41%) initial erosions spread by degrees within a single vertebra to the adjacent vertebrae and to the vertebral corner of the adjacent vertebrae. Changes in SI of the vertebral body were seen in 21 of the 27 (78%) initial foci. In 8 (30%) of the 27 initial lesional foci, a soft tissue involvement at the anterior or lateral paraspinous region was noted. Thickness of this involvement progressed compared to initial examinations in 3 of the 27 foci (11%). A decrease in disk space height was observed on follow-up MRI in 10 of the 27 initial foci (37%) and was associated with high SI on T2-weighted images or gadolinium enhancement of the disk space in 3 (11%), further mimicking disk space infection. Bony bridges over the disk space increased in 3 lesional foci (11%) and appeared in 2 (7%) during follow-up.

CONCLUSION
During the course of the SAPHO syndrome, vertebral involvement spread by degrees within a single vertebra to the adjacent cortices as well as to the vertebral corner of the adjacent vertebrae.

CLINICAL RELEVANCE/APPLICATION
The gradual local spread of the vertebral disease process strongly suggests SAPHO syndrome in the appropriate clinical context.
the absence of characteristic signs.

CLINICAL RELEVANCE/APPLICATION

A deep understanding of the CT manifestations of spinal lesions in SAPHO patients may support clinical diagnosis in the absence of cutaneous disorders and typical anterior chest wall involvement.

SSK12-09 Evaluation of T2-weighted WARP Sequences in Patients with Spinal Prosthesis

Wednesday, Dec. 2 11:50AM - 12:00PM Location: E353C

Participants
Shun Qi, Xi’an, China (Presenter) Nothing to Disclose
Ying Liu, MD, PhD, Xian, China (Abstract Co-Author) Nothing to Disclose
Panli Zuo, Beijing, China (Abstract Co-Author) Nothing to Disclose
Hong Yin, MD, PhD, Xi’an, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

MRI is an important modality for imaging the spine as it allows assessment of the spinal cord, adjacent soft tissues and osseous structures. In this study, we compared images quality and diagnostic sensitivity between WARP with standard TSE sequences in interbody fixation patients with titanium screws.

METHOD AND MATERIALS

30 patients (11 males and 19 females; age range, 35-72 years) who were clinically examined discomfort after interbody fixation surgery with titanium screws were scanned at a 1.5T MR scanner (MAGNETOM Aera, Siemens). The T2-weighted sagittal and axial images were acquired using a standard TSE sequence and a WARP TSE sequence implemented the SEMAC and VAT techniques as well as increased bandwidth for radiofrequency and readout pulses. SEMAC factor was 6 for all WARP imaging. The cumulative area of signal void was measured on the axial image, which was defined as the area without discernible anatomic information for both low and high-signal-intensity artifacts induced by the prosthesis (Fig. 1A). Length of spinal canal obscuration on the sagittal image was also measured (Fig. 1B).

RESULTS

On axial T2-weighted images, the area of signal void at the level of the prosthesis (mean ± standard deviation) was 10.4 cm² ± 4.5 for WARP and 26.6 cm² ± 10.2 for standard TSE images (Fig. 1C). On sagittal T2-weighted images, the length of spinal canal obscuration at the level of the prosthesis was 1.8 cm ± 0.3 for WARP and 5.4 cm ± 1.2 for standard TSE images (Fig. 1D). Visualizations of all periprosthetic anatomic structures were significantly better for WARP compared with standard imaging. Interobserver agreement for visualizations of anatomic structures was good for both WARP (k = 0.73) and standard (k = 0.71) imaging. The number of abnormal findings noted on WARP images (28 findings) was significantly higher than the number of findings detected on standard images (10 findings) with all abnormal imaging findings detected on standard images were also noted on WARP images.

CONCLUSION

MR images with WARP sequences significantly reduced metal-related artifacts and improved delineation of the prosthesis and periprosthetic region therefore increased the diagnostic sensitivity in patients with clinical abnormalities.

CLINICAL RELEVANCE/APPLICATION

WARP sequences significantly reduced metal-related artifacts.
Numerous neuroimaging studies have reported impaired white matter (WM) integrity in patients with major depressive disorder (MDD). However, due to inclusion of medicated patients, it is difficult to conclude whether the alterations observed in previous meta-analyses of diffusion tensor imaging studies were related to the disease itself. The present study was to provide a quantitative voxel-wise meta-analysis of WM alterations in medication-free MDD patients excluding interference from medication effects.

**METHOD AND MATERIALS**

A systematic search was conducted for the relevant studies. Anisotropic Effect Size version of Signed Differential Mapping (AES-SDM) was applied to analyse the WM alterations between medication-free MDD patients and healthy controls. Two subgroup analyses were separately conducted in medication wash-out patients and medication-naive patients. DTIquery software was used for fibre tracking.

**RESULTS**

15 primary studies comprising 434 MDD subjects (251 female; mean age 34 years) matched with 429 healthy controls (233 female; mean age 33 years) were included. Both the pooled meta-analysis and the subgroup meta-analysis in medication wash-out patients showed robustly fractional anisotropy (FA) reductions in the WM of the right cerebellum hemispheric lobule (CHL), the body of the corpus callosum (CC), and the bilateral superior longitudinal fasciculus III (SLF III), while FA reductions in the genu of the CC and the right anterior thalamic projections were only seen in medication-naive patients. Fibre tracking showed that the main tracts involved the right cerebellar tracts (CT), the body of the CC and the bilateral SLF III and arcuate network.

**CONCLUSION**

By excluding the confounding influences of medication status, the present study revealed the WM abnormalities in brain regions of MDD involved in cognition, memory function and emotional processing. These findings may contribute to a better understanding of the underlying neuropathology of MDD and be conducive to target selection for the non-drug therapy that the current era of psychosurgery utilizes as therapies for depression, such as electroconvulsive therapy, deep brain stimulation, and transcranial magnetic stimulation.

**CLINICAL RELEVANCE/APPLICATION**

By excluding the confounding influences of medication status, the disease-related brain regions of white matter abnormalities of MDD can be conducive to target selection for the non-drug therapy.
Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social interaction, communication, and stereotyped or repetitive behaviors. White matter (WM) abnormalities have long been suspected in ASD, but the available evidences have been inconsistent. We conducted the first multimodal meta-analysis of WM volume (WMV) and fractional anisotropy (FA) studies to elucidate the most robust WM abnormalities in ASD.

METHOD AND MATERIALS

PubMed, ISI Web of Science, PsycINFO, Cochrane Library, and EMBASE databases were searched between 1994 and 2014 for all voxel-wise studies comparing WMV or FA between patients with ASD and healthy control subjects (HCS). Manual searches were also conducted and authors were contacted soliciting additional data. Coordinates were extracted from clusters of significant WM and FA difference between ASD patients and HCS. Anisotropic effect size signed differential mapping (AES-SDM) was used to examine regions of WMV and FA alterations in ASD patients compared to HCS separately. Furthermore, peak WMV and FA data were combined using novel multimodal meta-analytic methods implemented in AES-SDM. Meta-regression methods were also used to explore potential effects of clinical profiles.

RESULTS

27 studies (providing 29 datasets: 20 WMV and 9 FA) were included comprising 544 adult and pediatric patients with ASD and 544 matched HCS. Patients with ASD showed widespread WM abnormalities including cerebellum, external capsule, cingulum and prefrontal WM, but findings were particularly robust in the crossing between the genu and anterior body of corpus callosum (CC), which showed both decreased WMV and decreased FA (Fig A-C). Meta-regression showed the age was negatively correlated with WMV in the left cerebellum while the percentage of male patients was negatively correlated with FA in the body of CC (Fig D and E).

CONCLUSION

This study gave a thorough profile for the WM abnormalities in ASD and provided evidence that inter-hemisphere was the most convergent circuitry affected in ASD. Meta-regression results perhaps revealed the structural underpinning of age and gender differences in epidemiological and clinical aspects of ASD.

CLINICAL RELEVANCE/APPLICATION

This study confirmed inter-hemisphere was the most convergent circuitry affected in ASD and suggested that structural underpinning of age and gender differences in epidemiological and clinical aspects of ASD.

SSK13-03  Disorganization of White Matter Microstructure in Attention-Deficit/Hyperactivity Disorder: A Tract-Based Spatial Meta-analysis

Participants
Lizhou Chen, Chengdu, China (Presenter) Nothing to Disclose
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Qi Liu, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Ming Zhou, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Yi Liao, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Qiong Gong, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Xiaoqi Huang, MD, Chengdu, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

White matter (WM) abnormalities have been conceived as important substrates of Attention-deficit/hyperactivity disorder (ADHD), but the available studies involving diffusion tensor imaging (DTI) with tract-based spatial statistics (TBSS) analysis yielded variable findings. We conducted the first tract-based spatial meta-analysis contrasting ADHD patients with healthy control subjects (HCS) to clarify the consistent changes of regional fractional anisotropy (FA) underpinning this disorder.

METHOD AND MATERIALS

Systematic and comprehensive searches of the PubMed, ISI Web of Science, PsycINFO, Medline, Cochrane Library, and EMBASE databases were performed for TBSS studies published between 1994 and 2014 together with 'in press' articles. The reference lists of identified articles and review articles were also manually scrutinized to obtain additional papers. Coordinates were extracted from clusters of significant FA difference between ADHD and HCS. Anisotropic effect size signed differential mapping (AES-SDM) was used to examine regions of FA alterations in ADHD patients relative to HCS. DTIquery software was applied to help locate the fascicles involved in each region. Besides, meta-regression methods were used to explore potential effects of clinical profiles.

RESULTS

A total of 9 TBSS studies (including 11 datasets) were enrolled, comprising 363 ADHD patients and 293 HCS. ADHD patients showed significant FA reductions in the right sagittal stratum and splenium of corpus callosum (CC) compared with HCS (Fig. A and C). Fibers passed through these clusters included the inferior fronto-occipital fasciculus, the inferior longitudinal fasciculus, and the splenium of CC (Fig. D). Sensitivity analysis and subgroups analyses further confirmed these findings. Meta-regression showed that the age was positively correlated with the FA in the splenium of CC (Fig. B).

CONCLUSION

Our findings confirmed the most convergent WM abnormalities in ADHD and suggested that the posterior brain networks of WM tracts may be affected in ADHD, with the potential of disconnection of the gray matter regions they connect. Furthermore, the disruption in splenium of CC may be a key target in the neurodevelopment of ADHD.

CLINICAL RELEVANCE/APPLICATION

Through meta-analysis using signed differential mapping (SDM), our study suggested that the disorganized white matter microstructure of posterior brain network may be a target underpinning ADHD pathophysiology.

SSK13-04  Altered Intranetwork and Internetwork Functional Connectivities in Type 2 Diabetes Mellitus with and
without Cognitive Impairment

Wednesday, Dec. 2 11:00AM - 11:10AM Location: N226

Participants
Shiqi Yang, Wuhan, China (Presenter) Nothing to Disclose
Yihao Yao, Wuhan, China (Abstract Co-Author) Nothing to Disclose
Yan Zhang, Wuhan, China (Abstract Co-Author) Nothing to Disclose
Wenzhen Zhu, MD, PhD, Wuhan, China (Abstract Co-Author) Nothing to Disclose
Yong Liu, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To analyze the alteration of intranetwork and internetwork functional connectivities using resting-state functional MRI (rsfMRI) with type 2 diabetes mellitus (T2DM) progression.

METHOD AND MATERIALS
Nineteen T2DM patients with normal cognition (DMCN), 19 T2DM patients with cognitive impairment (DMCI), 19 healthy controls (HC) were evaluated by 3 T MR scanner. Altered functional connectivities derived from 36 prior well defined brain regions of interest (ROIs) of 5 important resting-state network (RSN) systems [default mode network (DMN), dorsal attention network (DAN), control network (CON), salience network (SAL), sensorimotor network (SMN)] were investigated at 3 levels (integrity, network, connectivity pairs) by one-way ANOVA.

RESULTS
At integrity level, decreased connectivity strength of bilateral posterior cerebellum (pCBLM) were found across DMCN and DMCI (P < 0.05), right insula (rIns) only in DMCI. At network level, impaired intranetwork in DMN and CON were found in DMCI while not in DMCN (P < 0.05), and no impaired internetwork in the 5 RSNs was found among the 3 groups. At connectivity level, significant differences of fifty connectivity pairs were found among HC, DMCN, DMCI (P < 0.05), the top three altered connectivity pairs were left anterior prefrontal cortex versus left superior parietal (laPFC-lSP), right anterior cingulate cortex versus right ventral anterior cingulate cortex (rACC-rvACC), right insula versus right primary visual (rIns-rV1) (P < 0.005). Fuctional connectivity strength of specific brain architectures in T2DM at 3 levels were found associated with HbA1c, duration, MMSE and MoCA (P < 0.05).

CONCLUSION
These altered profiles of intranetwork and internetwork indicated intergroup differences and cognitive impairment of DMCI, might be the potential biomarkers applied to predict the progression, evaluate the impairment of cognition, understand the pathophysiology further for T2DM.

CLINICAL RELEVANCE/APPLICATION
These findings might be the potential biomarkers applied to predict T2DM progression, evaluate recognition impairment, and understand T2DM pathophysiology further.

SSK13-05

Prequit Right NAcc-VTA Functional Connectivity as a Marker of Smoking Cessation Outcomes

Participants
Zhujing Shen, Hangzhou, China (Presenter) Nothing to Disclose
Wei Qian, Hangzhou, China (Abstract Co-Author) Nothing to Disclose
Peiyu Huang, Hangzhou, China (Abstract Co-Author) Nothing to Disclose
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Minming Zhang, MD, PhD, Hangzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
Chronic smoking hijacks nicotine-dependent individuals’ reward circuit, causing structural and functional alteration. However, the relationship between reward circuit and smoking cessation outcomes remains unclear. In the present study, we analyze the association between resting-state functional connectivity (rsFC) in reward circuit and subsequent smoking cessation outcomes (point prevalence abstinence at 4 weeks).

METHOD AND MATERIALS
Functional magnetic resonance images from 53 smokers and 41 healthy controls were acquired using a 3.0T MRI scanner prior to quitting. After 12-week treatment, smokers were divided into relapers (n=30) and abstainers (n=23). We then analyzed ROI-wise rsFC within reward circuit by setting 11 seeds (including VTA, bilateral NAcc, amygdala, hippocampus, mediodorsal thalamus and rostral anterior cingulate cortex).

RESULTS
The rsFC between right NAcc and VTA, right NAcc and right amygdala were significantly different in the three groups (p=0.014; p=0.002). While only right NAcc-VTA coupling differentiated relapers from abstainers (higher in relapers than abstainers, p=0.026). In addition, the strength of interhemispheric connectivity between NAcc (r²=0.255, p=0.004) and hippocampus (r²=0.256, p=0.004) were positively correlated with nicotine dependence severity (FTND) in relapers.

CONCLUSION
These results suggest that right NAcc-amygdala coupling reflects smoking status, while enhanced right NAcc-VTA coupling, core projection implicated in rewarding, is a promising marker of relapse vulnerability. The findings also show that relapse-vulnerable smokers can be detected before quit attempts, which may optimize clinical intervention and improve smoking cessation outcomes.

CLINICAL RELEVANCE/APPLICATION
Our study brings light to the neural mechanisms underlying smoking cessation. Prequit neuroimage data can help to identify relapse risk, which leads to personalized clinical strategies.

**SSK13-06** Describing of Obsessive-compulsive Disorder in Seven Dimensions Using Multivariate Pattern Analysis Based on Gray Matter Anatomy

Wednesday, Dec. 2 11:20AM - 11:30AM Location: N226

Participants
Xinyu Hu, Chengdu, China (Presenter) Nothing to Disclose
Xin Yang, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Qi Liu, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Ming Zhou, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Lizhou Chen, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Fei Li, MD, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Yanchun Yang, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Qiyong Gong, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Xiaoqi Huang, MD, Chengdu, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Obsessive-compulsive disorder (OCD) is one of the most common disabling psychiatric disorders. Although previous magnetic resonance imaging (MRI) studies have already revealed abnormalities of cortical folding patterns (ie. cortical thickness, surface area) in OCD patients, how these abnormalities can be translated to clinical application is still a challenging task. Multivariate pattern analysis (MVPA) approach is a promising analytical technique which allows the classification of individual observations into distinct groups and bears the advantage of individualized judgement in the future. Thus, in current study, we aimed to apply one of the MVPA approach known as Support Vector Machine (SVM) to distinguish OCD patients from healthy control subjects (HCS) based on multidimensional surface features of gray matter anatomy.

**METHOD AND MATERIALS**

High-resolution T1-weighted volumetric 3D MR images were acquired for 33 drug-naive OCD patients and 33 matched HCS using a 3.0 T MRI system. Structural images were preprocessed with the FreeSurfer software to accurately and rapidly generate a set of seven morphometric parameters including volumetric and geometric features at each spatial location on the entire cortical surface (Fig A). Then all these parametric maps were used to discriminate OCD patients from HCS based on leave-one-out cross-validation approach with SVM using Probid software. We also drew a receiver operating characteristic (ROC) curve to help evaluate the performance of each parameter.

**RESULTS**

Classification accuracies, sensitivity and specificity for SVM classifier of combined left and right morphometric parameters are shown in Fig A. Among all parameters, the cortical thickness provided highest and above chance prediction accuracies for OCD patients (accuracy=75.76%, P<0.001) (Fig A and Fig B).

**CONCLUSION**

The current study illustrated that among all cortical features, cortical thickness showed the highest accuracy in classifying OCD patients from HCS, which indicated its potential diagnostic value in helping detecting OCD.

**CLINICAL RELEVANCE/APPLICATION**

The present study provides preliminary support for the suggestion that application of SVM to cortical thickness maps could be used to aid the identification of individuals with OCD in clinical practice.

**SSK13-07** Phase II Clinical Trial: Efficacy of Methylene Blue in Human Cognitive and fMRI Measures

Wednesday, Dec. 2 11:30AM - 11:40AM Location: N226

Participants
Pavel Rodriguez, MD, San Antonio, TX (Presenter) Nothing to Disclose
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Juan E. Gutierrez, MD, San Antonio, TX (Abstract Co-Author) Speakers Bureau, Bayer AG
Betty Hevi, San Antonio, TX (Abstract Co-Author) Nothing to Disclose
Jinqi Li, MD, San Antonio, TX (Abstract Co-Author) Nothing to Disclose
Jack L. Lancaster, PhD, San Antonio, TX (Abstract Co-Author) Nothing to Disclose
Francisco Gonzalez-Lima, PhD, Austin, TX (Abstract Co-Author) Nothing to Disclose
Timothy Duong, San Antonio, TX (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Methylene blue (MB) is a FDA grandfathered drug used in clinics for more than 100 years. MB acts in the mitochondria to sustain or enhance ATP energy production. MB has been shown efficacious in animal models of ischemic stroke, traumatic brain injury, and Alzheimer's disease (AD). A phase II clinical trial showed that daily oral MB (RemberTM) slowed the progression of AD compared to placebo. We have also found that low-dose MB increases brain glucose uptake, oxygen consumption, and evoked responses in the rat brain. Our goal was to use functional MRI (fMRI) to assess the efficacy of MB on cognitive and physiologic measures in the human brain.

**METHOD AND MATERIALS**

Double-blind, placebo-controlled, randomized clinical trial (NCT01836094) of 28 healthy young volunteers using delayed matching to sample (DMTS), psychomotor vigilance task (PVT), and visual-motor tasks (VMT) modeled using e-PRIME 2.0. Interventions: USP grade methylene blue (n=15) and placebo (n=13) administered orally at 280 mg once. All subject data were acquired in the same...
scanner (Siemens TIM Trio 3.0 Tesla; 32 channel head coil). fMRI and regression analysis were conducted using SPM 8.0 (UCL) and FSL (FMRIB). Correlation analysis was performed using MarsBar and SPSS 22 (IBM), and CBF analysis was conducted using the ASLtbx (UPenn).

RESULTS
Mean age was 29-30 years, 65% of subjects were female, and mean education was 17.5 years for both groups. No difference in cerebrovascular reactivity in both groups using CO₂ challenge. Paired t-test analysis demonstrated that MB increased fMRI BOLD activity in midbrain, cerebellum, medial pallidum, prefrontal, parietal and occipital cortex (cluster-wise pFWE<0.05) during the encoding and maintenance phases of the DMTS memory task. MB subjects had a 7% increase in the number of correct responses during the DMTS task (p<0.01). MB subjects also had a significant decrease in mean CBF in the posterior cingulate and inferior parietal cortex during the VMT (cluster-wise pFWE <0.05).

CONCLUSION
MB has a robust effect enhancing visuospatial working memory and its underlying encoding and maintenance neural networks. MB is also associated with greater suppression of the default mode network during the VMT.

CLINICAL RELEVANCE/APPLICATION
As the first fMRI neuroimaging study of MB in healthy humans, our objective was to understand the effect of MB on working memory, vigilance and task-evoked BOLD and cerebral blood flow (CBF).

SSK13-08  Bayesian Analysis of fMRI Data: Application in Autism

Participants
Parisa Mazaheri, MD, Baltimore, MD (Presenter) Nothing to Disclose
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Edward H. Herskovits, MD, PhD, Baltimore, MD (Abstract Co-Author) Consultant, BioClinica, Inc; Shareholder, RadDx, Inc;

METHOD AND MATERIALS
An in house developed resting state functional connectivity (rsFC) analysis environment is used to analyze rsfMR images. The analysis environment performs four tasks: image preprocessing, variable selection, Bayesian analysis, and model aggregation. After standard preprocessing and eliminating motion artifacts, the algorithm generates voxel-based rsFC maps for each atlas-based seed region. Investigators can use any structural or functional atlases of their choice. Next, by employing a Bayesian Network data-mining approach the rsFC maps and group membership variable C (e.g., TC vs. ASD) are used as inputs for pattern extraction. The outputs are group of voxels strongly predictive of group membership, presented as potential neuroimaging biomarkers of the clinical condition under analysis. In the last step, the algorithm aggregates all significant connectivity patterns across all seeds and performs the final classification. The algorithm was tested on 116 subjects (ASD=54; mean age 11.29 ± 2.66 years, 6 females) and (TC=62, mean age 12.16 ± 3.02 years, 14 females) from NYU publically available data set.

RESULTS
We used 90 AAL atlas structures as seed regions. 26 connectivity models, from 14 seeds, were found to be highly predictive of ASD with accuracies ranging from 78% to 71%. Six out of those 14 seeds were in frontal lobe. When used all connectivity models, we could classify subjects with 90.5% accuracy. Detected circuits were strongly associated with various indices of clinical severity and accurately reflected the known anatomic distribution of affected regions described in ASD.

CONCLUSION
Compared with conventional methods that focus on group differences, we identified differences in brain connectivity patterns at an individual level and accurately classified subjects in a highly heterogeneous condition such as ASD.

CLINICAL RELEVANCE/APPLICATION
Provides physicians with an automated connectivity analysis environment, and facilitates understanding and subsequently management of highly complex and socially important conditions such as ASD.

SSK13-09  Voxelwise Meta-Analysis of Resting-state Brain Activity Abnormalities in Patients with Major Depressive Disorder

Participants
Youjin Zhao, Chengdu, China (Presenter) Nothing to Disclose
Ming Y. Du, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Xinyu Hu, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Jing Jiang, Chengdu, China (Abstract Co-Author) Nothing to Disclose
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Graham J. Kemp, Liverpool, United Kingdom (Abstract Co-Author) Nothing to Disclose
Qiyong Gong, Chengdu, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
Resting-state brain activity abnormalities have long been suspected in major depressive disorder (MDD) but the available evidence has been inconsistent. Moreover, to our knowledge, there has been no meta-analysis utilized existent human neuroimaging literature to provide insights into the functional abnormalities in MDD at resting-state. To address this lack we conducted the first...
meta-analysis of low-frequency fluctuation (ALFF) and fractional ALFF (fALFF) studies in MDD to help clarify the resting-state functional abnormalities underpinning this condition.

METHOD AND MATERIALS

A systematic search was conducted for ALFF and fALFF studies in MDD. A voxel-wise meta-analysis using the anisotropic effect-size Signed Differential Mapping (AES-SDM) method was conducted on ALFF/fALFF studies. Meta-regression was used to explore the effects of demographics and clinical characteristics.

RESULTS

A total of 8 ALFF and 4 fALFF studies comprising 345 MDD subjects (142/203 male/female; mean age 34 years) matched with 329 healthy controls (149/180 male/female; mean age 33 years) met the inclusion criteria. The pooled meta-analysis of the ALFF and fALFF studies on MDD patients showed significantly increased brain activities in the bilateral anterior cingulate cortex (ACC) extending to medial frontal gyrus and the left insula, and decreased brain activities in the right superior temporal gyrus, the left middle occipital gyrus, the left cerebellum and the right lingual gyrus relative to healthy controls (see Fig.1A). Meta-regression analyses indicated that the illness duration and the symptom severity of MDD patients were positively associated with brain activity in the left anterior cingulated cortex (LACC) and right medial superior frontal gyrus, respectively (RMSFG) (see Fig. 1B).

CONCLUSION

Meta-analysis revealed a pattern of neural abnormalities in MDD, characterized by functional brain abnormalities in brain regions involved in cognition, emotional processing and self-referential processes. These findings may contribute to a better understanding of the underlying pathophysiology as well as better characterization of the functional neural correlates of depressive symptoms.

CLINICAL RELEVANCE/APPLICATION

This study revealed resting-state brain activity abnormalities in major depressive disorder patients and could provide biomarkers for diagnosis and treatment evaluation.
NSK14

Neuroradiology/Head and Neck (Head and Neck Tumors)

Wednesday, Dec. 2 10:30AM - 12:00PM Location: N229

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

PURPOSE

To evaluate the utility of dynamic contrast-enhanced MRI and diffusion weighted imaging (DWI) in the differentiation of nasopharyngeal carcinoma (NPC) and nasopharyngeal lymphoma (NPL).

METHOD AND MATERIALS

Forty-two patients with pathologically confirmed NPC and 27 patients with NPL were recruited and underwent conventional MRI and dynamic contrast-enhanced MRI. The MR signals, time signal-intensity curves (TIC) types, time to peak (TTP), enhancement peak (EP), maximum contrast enhancement ratio (MCER), mean apparent diffusion coefficient (ADC) value, and relative apparent diffusion coefficient (rADC) value of all the subjects were calculated and analyzed, thereafter, inter-group comparison was performed. The threshold values of ADC and rADC for differentiating NPC from NPL were determined using a receiver operating characteristic curve (ROC) analysis.

RESULTS

For NPC group, 32 cases (76.19%) demonstrated obvious heterogeneous enhancement. The mean TTP, EP, MCER and WR were (48.29±12.20)s, 1475.38±77.76, (136.89±24.41)% and 16.81±8.36, respectively. For NPL group, 24 cases (88.89%) demonstrated obvious homogeneous enhancement. The mean TTP, EP, MCER and WR were (63.21±14.29)s, 1161.82±64.04, (113.47±28.52)% and 7.39±6.21, respectively. The ADC value and rADC value were (842.34±94.66)×10-6 mm2·s-1 and 0.74±0.08 in NPC, whereas (652.15±83.47)×10-6 mm2·s-1 and 0.56±0.08 in NPL. The differences of TTP, EP, MCER, WR, ADC, rADC between NPC and NPL were statistically significant (P<0.05). The TTP of NPC was lower than that of NPL, whereas the opposite for the remaining parameters. The best differentiate threshold value of ADC and rADC were 736.5×10-6mm2·s-1, 634.0×10-6mm2·s-1, respectively. While the areas under the ROC curve (AUC), sensitivity, specificity and Youden index of ADC and rADC were 0.943, 0.909, 0.852, 0.761, and 0.951, 0.955, 0.892, 0.77, respectively. rADC value was slightly superior to ADC value in differentiating NPC from NPL.

CONCLUSION

DWI and Dynamic contrast-enhanced MRI are effective in differentiating NPC from NPL.

CLINICAL RELEVANCE/APPLICATION

Dynamic contrast-enhanced MRI and DWI can be applied in the differential diagnosis of NPC from NPL.
A total of 21 patients with suspected cervical CUP underwent a simultaneous 18F-FDG PET/MRI examination (Biograph mMR, Siemens). The scan protocol comprised: 1) T1 TSE, 2) T2 TSE, 3) DWI, 4) T1 fs post-contrast VIBE and 5) T1 fs TSE imaging after the application of 0.05 mmol kg/bw Gadoteric acid (Dotarem, Guerbet). The corresponding datasets (PET/MRI and MRI alone) were read separately by two radiologists for detection and identification of potential primary cancer lesions (2 point ordinal scale), lesion conspicuity as well as diagnostic confidence (3 point ordinal scale). All available data (histology, prior examinations, PET/MRI, follow-up examinations) served as standard of reference. Mean values were compared using Wilcoxon rank sum test.

RESULTS

Cervical primary cancer was present in 13 of 21 patients. 18F-FDG PET/MRI enabled correct identification of all 13 (100%), while MRI alone allowed for detection of 9/13 malignancies (69.4%). Lesion conspicuity and diagnostic confidence were rated significantly higher for 18F-FDG PET/MRI compared to MRI alone datasets (e.g. diagnostic confidence: PET/MRI:2.7±0.3; MRI alone 1.8±0.5; p<0.05).

CONCLUSION

PET/MRI was shown to be superior towards MRI alone for detection of cervical CUP, offering a significantly higher diagnostic confidence in the discrimination of malignant lesions.

CLINICAL RELEVANCE/APPLICATION

Based on the significantly improved detection of malignant lesions while maintaining equal acquisitions times to MRI alone, integrated PET/MRI can be considered a highly valuable tool for assessment of cervical CUP.

SSK14-03 Post-treatment Change versus Recurrence of Squamous Cell Carcinoma in the Head and Neck: Histogram Analysis of the Area under the Curves Ratio from Dynamic Contrast-enhanced T1-weighted Perfusion MRI

Wednesday, Dec. 2 10:50AM - 11:00AM Location: N229

Participants
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PURPOSE

To evaluate the predictive value of the histogram parameters of AUCR (initial and final area under the time signal-intensity curves ratio) derived from dynamic contrast-enhanced perfusion MR imaging (DCE MRI) for differentiation of tumor recurrence from post-treatment change of in patients with squamous cell carcinoma in the head and neck (HNSCC).

METHOD AND MATERIALS

Forty-six patients after definitive treatment for HNSCC with contrast-enhancing lesions at the primary sites on follow-up MRI were assessed using conventional and DCE MRI. We calculated and correlated the time signal-intensity curve parameters (initial and final area under the time signal-intensity curves, the maximum signal-intensity from time of arrival to time to peak (Emax), the time at Emax (Tmax), initial slope of signal-intensity increase) and the cumulative histogram parameters of AUCR (AUCR50, AUCR75, AUCR90 and AUCR95) with the final pathologic or clinical diagnosis. The best predictor for differentiation of tumor recurrence from post-treatment change was determined by receiver operating characteristic curve analyses. We assessed the added value of AUCR histogram parameters to inconclusive results of conventional MRI alone after blinded review of conventional MR images by a neuroradiologist.

RESULTS

46 patients were subsequently classified as having tumor recurrence (n=17) or post-treatment change (n=29). Tumor recurrence group showed significantly shorter Tmax and significantly higher AUCR50, AUCR75 and AUCR90 compared to those of post-treatment change group (P < 0.05). AUCR90 was the best predictor for tumor recurrence (Az = 0.77; 95% CI, 0.64-0.91) with the estimated cut-off of 1.02. When AUCR90 was added on inconclusive results of conventional MRI alone, 17.6 % of recurrent tumors were more detected without significant difference in the diagnostic specificity.

CONCLUSION

Tumor recurrence of HNSCC can be differentiated from post-treatment change by using the histogram parameters of AUCR. The added value of AUCR histogram analysis is 17.6 % of more detection of recurrent tumors without compromise of diagnostic specificity.

CLINICAL RELEVANCE/APPLICATION

Our study signifies that recurrent HNSCC can be differentiated from post-treatment change by using the histogram parameters of AUCR. The added value of AUCR90 on inconclusive results of conventional MRI alone is 17 % more detection of tumor recurrence without compromise of diagnostic specificity.

SSK14-04 Gaussian and non-Gaussian Diffusion MRI of the Head and Neck: The Effect of the Choice of B Values

Wednesday, Dec. 2 11:00AM - 11:10AM Location: N229

Participants
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SSK14-05 Differentiation of Malignant and Benign Solid Nodules of the Thyroid Gland on Unenhanced Computed Tomography

Wednesday, Dec. 2 11:10AM - 11:20AM Location: N229

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PURPOSE
Diffusion MRI has been widely used for the diagnosis and monitoring of head and neck lesions. Non-Gaussian diffusion parameters (e.g., mean diffusion, ADCo, and kurtosis, K) have the potential to provide important information on tissue microstructure beyond ADC. The aim of this study was to investigate the value of quantitative diffusion assessment in the diagnosis of head and neck lesions.

METHOD AND MATERIALS
This IRB approved prospective study included 46 (27 malignant/19 benign) patients suspected of head and neck tumors between June 2014 and February 2015. Head and neck MRI was performed using a 3-T system equipped with a dedicated 16-channel head and neck coil. A read-out segmented EPI (RS-EPI) sequence combined with GRAPPA parallel acquisition and 2D-navigator-based reacquisition was used with 9 b values of 0, 75, 150, 300, 600, 1000, 1400, 1800, 2200 sec/mm2. Parametric maps of Gaussian and non-Gaussian diffusion parameters (K, ADCo, and ADC) were generated by fitting the diffusion MRI signal using variable combinations of b values.

RESULTS
The performance (AUC) of ADC0-1400 (ADC derived from b values of 0 and 1400) (0.802) was higher than ADC0-600 or ADC0-1000 (0.753, 0.748) and ADC150-1400 (0.768). AUC of ADC0-1400 was significantly higher than that of ADC150-1000 (0.727, P<0.05). K or ADC0 (0.71, 0.685, using all b values) didn’t significantly change depending on the choice of b values, and gave the different information than ADC on their parametric maps.

CONCLUSION
The choice of b values could significantly affect the diagnostic performance of ADCs in head and neck lesions. Non-Gaussian diffusion parameters showed stable results regardless of the choice of b values, and their parametric maps have the potential to provide new information on tumor characteristics in addition to ADC.

CLINICAL RELEVANCE/APPLICATION
Non-Gaussian diffusion parameters beyond ADC give the stable results regardless of the choice of b values in head and neck lesions, easier to make comparison between facilities.

SSK14-05 Differentiation of Malignant and Benign Solid Nodules of the Thyroid Gland on Unenhanced Computed Tomography

Wednesday, Dec. 2 11:10AM - 11:20AM Location: N229

Participants
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PURPOSE
The natural iodine content of benign thyroid nodules may be higher than that of malignant nodules. The purpose of this study is to assess the value of unenhanced computed tomography (CT) in differentiation of malignant and benign solid nodules of the thyroid gland based on this hypothesis.

METHOD AND MATERIALS
80 patients with solid thyroid nodules, initially seen on ultrasonography have been examined by an identical protocol of unenhanced and contrast-enhanced CT, including 48 patients with pathologically-proven thyroid carcinoma and 32 patients with pathologically-proven nodular goiter. The attenuation value of the lesions on unenhanced CT has been measured. Statistical analysis has been done by the Student's t-test and the Chi-square test.

RESULTS
The attenuation value of malignant nodules on unenhanced CT has been 34±11 HU, while the attenuation value of benign nodules has been 56±21 HU. The difference has been statistically significant (p<0.001). When the cut-off value for diagnosis of malignancy is ≤50 HU, the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy for the diagnosis of malignancy have been 89.6%, 68.8%, 81.1%, 81.5%, and 81.3% respectively compared to 72.9%, 71.9%, 79.5%, 63.9%, and 72.5% at a cut-off value of ≤40 HU and 93.8%, 53.1%, 75.0%, 85.0%, and 77.5% at a cut-off value of ≤55 HU respectively.

CONCLUSION
Malignant thyroid nodules have a statistically-significant lower attenuation value than benign nodules on unenhanced CT. Attenuation value ≤50 HU has an accuracy of 81.5% for diagnosis of thyroid carcinoma.

CLINICAL RELEVANCE/APPLICATION
Unenhanced CT of the thyroid gland may be useful in differentiation of benign and malignant nodules of the thyroid and needs therefore to be included as part of the protocol of CT of the thyroid gland.
SSK14-06  Prospective Assessment of the Accuracy of Radiologic CT Staging of Extrinsic Tongue Muscle Involvement in Oral Cavity Cancer

Wednesday, Dec. 2 11:20AM - 11:30AM Location: N229

Participants
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PURPOSE
Pre-operative imaging plays an important role in staging advanced oral cavity cancer (OCC) treated with surgical resection followed by chemoradiation. Extrinsic tongue muscle invasion (ETMI) was added as a T4a classification in the 3rd edition of AJCC. The purpose of this prospective study was to examine the accuracy of preoperative contrast enhanced CT (CECT) and surgical assessment of ETMI using pathologic evaluation as the gold standard.

METHOD AND MATERIALS
This IRB approved prospective study recruited 34 consecutive patients with primary OCC between August 2014 and February 2015. Inclusion criteria were untreated primary OCC, available pre-operative CECT and surgical resection with pathological gross examination. Two neuroradiologists blindly reviewed the images for ETMI using the following scale: yes (Y), probably yes (PY), no (N), and probably no (PN). Three Head and Neck surgeons assessed for ETMI intra-operatively using the scale: Y, N or indeterminate. A single pathologist reviewed all gross examination notes for ETMI.

RESULTS
Twenty-five of the 34 patients met inclusion criteria. Six patients had pathologically proven ETMI. For statistical analysis, a radiologic score of yes/probably yes was scored as a yes and no/probably no as a no. Sensitivity (SN), specificity (SP), positive predictive value (PPV) and negative predictive value (NPV) for Radiologist 1 and 2 were: 83%, 84%, 62.5%, and 94%, and 100%, 84%, 92.5%, and 100%, respectively. Two intra-operative cases rated indeterminate by the surgeons were considered a no, leading to an overall intraoperative assessment SN, SP, PPV, and NPV of: 80%, 100%, 100%, 95%.

CONCLUSION
Although this preliminary study suggests that imaging findings on CECT may have a higher SN but lower SP than surgical observation, both radiographic and surgical determination of ETMI had equivocal cases. This highlights the importance of systematic assessment of the gross specimen to facilitate accurate pathologic ETMI to minimize unnecessary upstaging. Ongoing investigation with specific pathologic focus on ETMI would be needed to confirm the reproducibility of pathologic staging and follow up of clinical outcomes to determine the clinical significance.

CLINICAL RELEVANCE/APPLICATION
Radiographic ETMI should be verified with pathological findings and interdisciplinary communication between pathologists, surgeons, and radiologists to minimize unnecessary upstaging.

SSK14-07  Short-Term Effects of Concurrent Radiochemotherapy on Hypopharyngeal and Laryngeal Squamous Cell Carcinoma: Evaluated with Dual-Energy CT Quantitative Parameters

Wednesday, Dec. 2 11:30AM - 11:40AM Location: N229

Participants
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Meng Lin, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the value of dual-energy spectral computed tomography (CT) quantitative parameters in predicting short-term effects of concurrent radiochemotherapy on hypopharyngeal and laryngeal squamous cell carcinoma (SCC), and provide valuable evidence for early judging the response of the tumor to therapy in clinical practice.

METHOD AND MATERIALS
This study was approved by the ethics committee and all patients provided written informed consent. Spectral parameters of 34 patients with laryngeal and hypopharyngeal SCC who underwent dual-energy spectral CT (GE Discovery CT 750 HD) scan with spectral mode before therapy were analyzed retrospectively, all cases were proven by pathological findings. Spectral parameters contained IC-L (iodine concentration of lesion), WC-L (water concentration of lesion) and HU (slope of spectral HU curve), which were obtained by analyzing pretherapy CT scan datas with GSI Volume Viewer software in AW4.6 workstation. The following scans were taken at the 4th week after concurrent radiochemotherapy ended. By therapeutic effects, all patients were divided into treatment-sensitivity group (28 cases) and reatment-resistant group (6 cases). Parameters between two groups were compared, and the diagnosis experiment was evaluated.

RESULTS
Mean IC-L and HU in treatment-sensitivity group were 16.80±4.61 mg/cm³, 2.28±0.63 respectively, while the two parameters were 23.84±4.05 mg/cm³, 3.23±0.68 in the other group. IC-L and HU were significantly different between two groups (P<0.05).
However, WC-L was showing no significant difference (P>0.05). Receiver operating characteristic (ROC) analysis of IC-L, and λHU in prediction of treatment-sensitivity showed: AUC (the area under curve) of IC-L was 0.81, larger than the AUC of λHU (AUC=0.79). With IC-L≤18.43 mg/cm³ as diagnosis threshold in prediction of treatment-sensitivity, the sensitivity, specificity, positive predictive value, negative predictive and Youden's index value were 72.73%, 83.33%, 88.89%, 62.50%, 0.56 respectively.

CONCLUSION
IC-L could be helpful in the prediction short-term effects of concurrent radiochemotherapy on hypopharyngeal and laryngeal squamous cell carcinoma.

CLINICAL RELEVANCE/APPLICATION
Dual-energy spectral CT has a potential value in clinical treatment options of hypopharyngeal and laryngeal SCC.

SSK14-08 Role of Magnetic Resonance Imaging in Thyroid Nodules; Evaluation of the Magnetic Resonance Spectroscopy and Diffusion Weighted in Differentiating Benign from Malignant Thyroid Nodules

Participants
Pratiksha Yadav, Pune, India (Presenter) Nothing to Disclose

PURPOSE
To evaluate the diagnostic benefits of MRI in evaluation of thyroid lesionTo evaluate the role of DWI WITH ADC mappingTo evaluate the characteristic pattern of MR spectroscopy in various benign and malignant pathologies of thyroid

METHOD AND MATERIALS
This is prospective study carried out in 39 patients with already known thyroid nodules diagnosed on ultrasonography. All studies were done on 1.5 T Siemens Magnetom machine. Precontrast T1WI sagittal, axial, STIR, T2WI coronal and axial, post contrast fat saturated axial T1WI were taken. DWI with ADC mapping, single voxel MR spectroscopy were also done. Findings of MRI correlate with the final diagnosis on histopathological examination

RESULTS
Study was done on 39 cases. There were 19 cases of multinodular goiter, 5 cases of adenomas, 6 cases of thyroiditis and 9 cases of malignant lesion. The mean ADC value of the thyroid malignant lesion was significantly lower than the mean ADC value of thyroid benign lesions. High Choline peak was observed in the malignant lesions. Sensitivity of combined DW, ADC mapping and MRS show sensitivity of 98.9% sensitivity to detect the malignant lesion with specificity of 93.4%

CONCLUSION
Thyroid lesions routine imaging could not differentiate malignant lesion from benign lesion. Diffusion weighted imaging with ADC mapping and Magnetic resonance Spectroscopy are good noninvasive investigation to diagnose malignancy.

CLINICAL RELEVANCE/APPLICATION
MRI evaluation of thyroid lesions combined with DWI & MRS are a good noninvasive test to diagnose the malignant lesion. It is useful to see the extent of the tumor, involvement of the surrounding structures, retrosternal extension and lymph nodal involvement.

SSK14-09 Prediction Study on Energy Spectrum Parameters in Larynx and Hypopharyngeal Squamous Cell Carcinoma with Different Pathological Grades

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PURPOSE
To discuss the effect of energy spectrum parameters in sDECT (single-source dual-energy spectral CT) on evaluating larynx and hypopharyngeal squamous cell carcinoma (SCC) with different pathological grades.

METHOD AND MATERIALS
Retrospective analysis was carried out in 60 patients with confirmed pathological diagnosis of larynx and hypopharyngeal SCC from January to August in 2014. They were all scanned by sDECT (Discovery CT 750 HD) before treatment. After scanning, all data was analyzed with GSI Volume Viewer software of GE AW4.6 workstation. IC-L (iodine concentration of lesion), WC-L (water concentration of lesion), s-SHC (slope of spectral Hu curve), CT value in 70Kev monoergic image, IC-C (iodine concentration of carotid sinus), WC-C (water concentration of carotid sinus), sIC (standardized IC) and sWC (standardized WC). According to cell differentiation, all the patients were divided into low differentiated group and mid-high differentiated group. Parameters between two groups were compared, and the diagnosis experiment was evaluated.

RESULTS
Mean IC-L, s-SHC and sIC in low differentiated group were 15.61 mg/cm³±5.06mg/cm³, 2.07±0.77 and 15.61mg/cm³±5.06mg/cm³ respectively, while the three parameters were 20.29±7.40mg/cm³, 2.68±1.04 and 20.29±7.40mg/cm³ in the other group. All three parameters were significantly different between two groups (P<0.05). However, WC-L, CT value and sWC were showing no significant difference (P>0.05). ROC (receiver operating characteristic) analysis of IC-L, s-SHC, and sIC in prediction of low differentiated larynx and hypopharyngeal SCC showed: AUC (the area under curve) of sIC was 0.79, larger than the AUC of IC-L and s-SHC. AUC difference between s-SHC and sIC was significant (P<0.05), while it was not significant between IC-L and sIC (P>0.05). With sIC>5 as diagnosis threshold in prediction of low differentiated SCC, the sensitivity, specificity, positive predictive
value and negative predictive value were 84.21%, 75.61%, 61.5% and 91.2% respectively.

CONCLUSION
sIC could be helpful in the prediction of larynx and hypopharyngeal SCC with different pathological grades.

CLINICAL RELEVANCE/APPLICATION
sDECT maybe a potential method for judging the differentiation of pathological grade of Larynx and Hypopharyngeal SCC
**PURPOSE**

C-arm cone beam CT perfusion (CBCTP) has shown promise to generate relatively accurate perfusion parameters. However, high noise, inadequate temporal resolution and temporal sampling due to the inferior detector dynamic range and slow gantry rotation can limit this accuracy. In this study we address these problems using newly developed techniques.

**METHOD AND MATERIALS**

Seven canines underwent endovascular surgery with IACUC approval. Acute ischemic stroke was introduced in five of the subjects through large vessel occlusion, with the remaining two subjects serving as controls with no stroke imparted. CTP was performed 3.5 hours post-induction and immediately followed by a CBCTP acquisition with a Biplane system. CTP images were reconstructed using vendor's software, CBCTP images were reconstructed and post processed to reduce noise (using Prior Image Constrained Compressed Sensing (PICCS)) and to enhance temporal resolution and sampling (using the TEmporal REsolution and SAmping Recovery (TERESAR)). The CTP and CBCTP images were coregistered, reformatted into 5mm slices and processed with the same software to compute perfusion maps. Arterial input functions (AIF) were selected at the same region (basilar artery) for both datasets. The maps were then randomized and reviewed by two experienced interventional neuroradiologists. Image quality scores as well as the confidence of diagnostic decision were recorded.

**RESULTS**

The noise in the post-processed CBCTP images was greatly reduced and 0.5s temporal resolution and sampling was achieved. The AIF was well recovered compared to the CTP dataset. Image quality scores show no statistical difference between CTP and CBCTP maps, and the confidence evaluations indicate strong agreement between the two imaging modalities for making stroke diagnoses.

**CONCLUSION**

By improving contrast to noise ratio and enhancing both temporal resolution and sampling density for CBCTP scans, perfusion maps were generated that correlate well with conventional CTP acquisitions. With the ability to produce accurate perfusion maps with C-arm systems in interventional suites, we now have the possibility to perform CBCTP scans pre- and post-interventional treatment for rapid patient diagnosis without transferring the patient.

**CLINICAL RELEVANCE/APPLICATION**

The workflow of endovascular treatment for acute ischemic stroke patient can be further optimized using this technique, potentially delivering improved patient outcomes.
METHOD AND MATERIALS

Contrast agents were injected into hepatic artery of rabbits with implanted VX-2 hepatic tumors with a rate of 0.5 ml/second and 8 ml in total. Two CBCT scans were made before and after the injection. Two flat panel (Varian 4030CB and Perkin Elmer 1621) x-ray imaging systems oriented at right angle to each other were used to simultaneously acquire two sets of projection images over 360° at a rate of 7.5 frames/second during each scan. Following the scans, regular CBCT image sets were reconstructed from the projections and the pre-injection image set was subtracted from the post-injection image set to form a 3D contrast map. Each of the two orthogonal post-injection projection sets was then divided into 12 subsets, thus creating 12 orthogonal pairs of 30° limited angle projection sets which were then reconstructed to form 12 3D image sets corresponding to 12 consecutive phases over the scanning time. A maximum likelihood estimation iterative algorithm was applied for image reconstruction with the contrast map used as the constraint.

RESULTS

We have successfully reconstructed 4D images of contrast flow and used them to obtain time-density curves over various regions-of-interest (ROIs). We have demonstrated differences of flow patterns between implanted tumors and normal tissues with the time-density curves measured from the reconstructed 4D image data.

CONCLUSION

Dual-gantry image acquisition and constrained iterative reconstruction algorithm may help obtain multi-phasic CT images with a single post-injection scan allowing contrast flow to be dynamically imaged and quantified, which may help guide transcatheter arterial intervention procedures for liver tumors. This work was supported in part by research grants: CA104759 and CA124585, EB000117 from NIBIB, CA138502A1, and a subcontract from NIST-ATPs.

CLINICAL RELEVANCE/APPLICATION

Our method provides the capability of imaging contrast injection process in organs and the measured time-density curves may be of interest to differentiate malignant and benign tumors.

SSK15-03 Evaluation of H(L)ctr on CBCT with a Stationary Source

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S403B

Participants
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Background

The equilibrium dose Deq and rise to equilibrium H(L) are recognized as dose metrics that more fully capture the contributions of scattered radiation in multi-detector CT (MDCT). Deq and H(L) are not limited to MDCT, these metrics can be used to characterize cone beam CT (CBCT) systems as well.

Evaluation

Five sections from two TG200/ICRU polyethylene phantoms, with a total length of 1 m, were used as the scattering material. The phantom was centered at isocenter of an interventional system (Axiom Artis dTA, Siemens). A 0.6 cc thimble chamber with a real-time digitizer was centered within the middle section of the phantom. Because of symmetry at isocenter, rotation of the source was unnecessary. Serial integrated dose measurements were made with a series of 10 s exposures at collimation widths of 25-250 mm at 81 kV and 0 mm of Cu. A real-time dose profile, using the same technique factors, was obtained by translating the patient gantry at a constant speed of 14.7 cm/s. H(L)ctr was calculated from the dose profile. Additional acquisitions of the dose profile were performed at tube potentials of 50 kV; the maximum and minimum collimation; and 0.9 mm Cu beam filtration.

Discussion

Significant cone-angle effects at the wide collimation lengths require an offset, dependent on collimation width, for equivalence to the H(L)ctr determined using the real-time dose measurements. Because of the limited fan angle, the beam does not intercept the entire diameter of the phantom and so the radial dose behavior differs substantially in form from that typical of MDCT, particularly near the edge.

Conclusion

Though the radial dose distribution is altered near the edge due to the small beam angle, CBCT can still be characterized along the longitudinal axis. A series of measurements with known collimation widths can be used to determine H(L)ctr. While measurements performed with the real-time dosimeter can be obtained with a single exposure, a correction must be applied.

SSK15-04 Development of a Dedicated Cone-beam CT System for Imaging of Intracranial Hemorrhage

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S403B

Participants
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Prompt detection of intracranial hemorrhage (ICH) is essential to accurate diagnosis of traumatic brain injury (TBI) and stroke. This work reports development of a dedicated cone-beam CT (CBCT) system that overcomes conventional limitations to low-contrast imaging performance to provide reliable detection of acute ICH at the point of care.

**METHOD AND MATERIALS**

An imaging performance model for task-based detectability index provided the foundation for system design and optimization, including system geometry, imaging technique, and detector choice. Experimentation on a CBCT bench investigated the influence of three important factors on image quality and dose: (1) bowtie filters formed from Al and Ti with various degrees of beam flattening; (2) optional incorporation of an antiscatter grid with grid ratio ranging from 6:1 to 12:1; and (3) selection of detector readout mode (low-gain (LG), high-gain (HG), and dynamic gain (DG) readout). Performance was quantified in CBCT images of an anthropomorphic head phantom with simulated ICH inserts in terms of image uniformity, noise magnitude and correlation, CNR, and spatial resolution, and dose was measured using a Farmer chamber throughout a 16 cm CTDI phantom.

**RESULTS**

CBCT images of the head acquired using optimal system geometry (source-axis and source-detector distance 75 and 110 cm, respectively) and technique (90 kV, 0.625 mAs / projection) exhibited good visualization of low-contrast ICH inserts: LG readout yielded CNR = 5.5; HG readout provided a 15% increase in CNR (6.3) but suffered skin line artifacts and HU inaccuracy due to bare-beam saturation; DG readout yielded a 12% increase in CNR (6.2) and avoided saturation artifacts. Use of an Al bowtie filter in HG mode improved CNR by 23.4% (6.8), permitting lighter grids (or no grid) and reducing CTDIw by ~47% (10.1 mGy).

**CONCLUSION**

A dedicated CBCT system will permit detection of acute ICH and improve diagnosis and treatment of patients with brain injuries at the point of care in the ICU, urgent care, and mobile environments.

**CLINICAL RELEVANCE/APPLICATION**

A CBCT head scanner designed according to task-based performance optimization and physical experimentation exhibited image quality suitable to ICH detection. Further improvement will be gained by integration with model-based image reconstruction and artifact correction. The work supports development of a scanner prototype now underway for clinical studies.
Many imaging scenarios involve known devices in the field-of-view (e.g., intraoperative imaging of metal implants). Known component reconstruction (KCR), which integrates device shape and material information into the reconstruction, has demonstrated great potential to reduce metal artifacts and required x-ray exposures. However, accurate KCR requires spectral characterization of system and components (e.g., through pre-scans of devices in air - greatly reducing the practicality of KCR). In this work, we develop a calibration-free KCR that jointly estimates the patient volume and a spectral transfer function (STF) for homogeneous components from a single diagnostic scan.

RESULTS

STFs estimated using precalibration and the modified KCR were very similar and provided a good fit to air-scan data. In CBCT studies, FBP exhibited substantial metal artifacts due to beam hardening and photon starvation while KCR methods showed a strong capability for artifact reduction. The calibration-free KCR showed better performance, likely due to its ability to adapt to additional physical effects in the diagnostic scans (e.g. increased beam hardening due to surrounding tissues).

CONCLUSION

Calibration-free KCR has the capability to reduce artifacts through high-fidelity device models, outperforming FBP and a more cumbersome KCR method with precalibration. Improved image quality facilitates assessment of pedicle screw placement (including visualizations of possible complications near the device) as well as potential dose reductions.

CLINICAL RELEVANCE/APPLICATION

Metal artifacts are common in interventional imaging where implant knowledge is available. The proposed approach has potential widespread application in situations where visualization near implant boundaries is critical.

SSK15-07 High Quality Time-resolved C-arm Cone Beam CT Angiography Images for Large Vessel Occlusion Diagnosis

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S403B

Participants

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PURPOSE

With the demonstrated feasibility of measuring perfusion parameters, C-arm cone beam CT perfusion (CBCTP) scans performed directly in the interventional suite potentially enable faster patient triaging and improved patient outcomes. In this work, a method for creating time-resolved cone beam CT angiography (4D-CBCTA) images from the CBCTP acquisition and its potential benefits are discussed.

METHOD AND MATERIALS

Under IRB approval, 21 C-arm cone beam CT dynamic perfusion scans of 17 patients with acute ischemic strokes were acquired. For each multi-sweep CBCTP dataset, a 3D isotropic filtered back projection (FBP) image volume of each rotation was reconstructed and co-registered. All image volumes were post processed using Prior Image Constrained Compressed Sensing (PICCS) to reduce noise and TEmporal REsolution and SAmpling Recovery (TERESAR) to enhance temporal resolution and improve the temporal sampling density. The final image volumes were then imported into a research workstation enabling display of time-resolved volumetric renderings of a patient's cerebral vasculature. Two experienced interventional radiologists independently evaluated the image quality and diagnosed each case. Cronbach's alpha coefficients and ROC analysis were used to inter-examine agreement and diagnostic value of this novel image presentation.

RESULTS

Post processing greatly reduced the noise contained in each volume and a half-second temporal resolution was achieved. Observers agreed that image quality for large cerebral arteries was very good and ROC curves demonstrated excellent diagnostic value for detecting large vessel occlusions (AUC=0.987 and 1).
CONCLUSION
4D-CBCTA derived from CBCTP datasets provides high quality images that allow accurate diagnosis of large vessel occlusions. With the ability to acquire both CBCTP images and high quality 4D-CBCTA images from a single C-arm acquisition, it may greatly reduce the time needed to transfer acute ischemic stroke patient between CT/MR room and interventional room.

CLINICAL RELEVANCE/APPLICATION
This technique can reduce the time from arrival to endovascular treatment for stroke patients, achieving better patient outcomes.

SSK15-09 Ultra-High Resolution Quantitative Cone Beam CT of the Extremities with a CMOS X-ray Detector

Wednesday, Dec. 2 11:50AM - 12:00PM Location: S403B

Participants
Wojciech Zbijewski, PhD, Baltimore, MD (Presenter) Research Grant, Carestream Health, Inc
Qian Gao, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Joseph W. Stayman, PhD, Baltimore, MD (Abstract Co-Author) Research Grant, Elekta AB; Research Grant, Varian Medical Systems, Inc
John Yorkston, PhD, Rochester, NY (Abstract Co-Author) Employee, Carestream Health, Inc
Shadpour Demehr, MD, Baltimore, MD (Abstract Co-Author) Research support, General Electric Company; Researcher, Carestream Health, Inc; Consultant, Toshiba Corporation
Jeffrey H. Siewersden, PhD, Baltimore, MD (Abstract Co-Author) Research Grant, Siemens AG; Consultant, Siemens AG; Research Grant, Carestream Health, Inc; License agreement, Carestream Health, Inc; License agreement, Elekta AB;

PURPOSE
To investigate early detection of pathological alterations in trabecular bone due to accelerated treatment and improve prognosis in osteoporosis and osteoarthritis, but is currently challenged by a lack of high resolution imaging modality capable of resolving the trabecular structure (~100 µm) while simultaneously providing diagnostic soft-tissue contrast. We investigate the feasibility of ultra-high resolution in-vivo imaging of trabecular bone by implementation of a CMOS x-ray detector on a previously developed extremities cone-beam CT (CBCT).

METHOD AND MATERIALS
CMOS detectors offer lower electronic noise (~500 electrons/pixel), faster read-out (up to 30 frames/second for 30x30 cm field of view) and higher resolution than aSi flat panel detectors (FPDs) typically used in CBCT. Initial evaluation of CMOS-based extremities CBCT employed a Dalsa Xineos 1515 detector (99 µm pixels, 600 µm CsI scintillator) and a rotating anode x-ray source (0.3 mm focal spot). Magnification was 1.25 (matching that of extremities CBCT prototype). A contrast phantom, a resolution phantom with...
a 127 µm Tungsten wire for measurement of Point Spread Function (PSF), and a hand phantom (real skeleton in soft tissue-equivalent plastic) were imaged at 90 kVp, 0.1 - 0.5 mAs/frame and 720 projections (0.5º steps).

RESULTS
Reconstructions of the contrast phantom show satisfactory soft tissue discrimination with adipose-to-water contrast-to-noise ratio ranging from 2.6 at 0.1 mAs/frame to 5.1 at 0.5 mAs/frame. Full-width half maximum of the PSF was 0.26 mm, indicating high spatial resolution. Further improvement of resolution via optimization of CsI thickness is being investigated. Images of the hand phantom show excellent visualization of the cancellous bone, with clearly delineated trabecular architecture down to ~0.2 mm.

CONCLUSION
CMOS-based extremities CBCT provides high spatial resolution and diagnostic soft tissue contrast, establishing a novel platform for in-vivo imaging of bone microarchitecture. When combined with model-based reconstruction with advanced models of detector blur, the system is anticipated to reach ~100 µm detail size, opening applications in quantitative bone morphometrics for early detection of osteoporosis and osteoarthritis.

CLINICAL RELEVANCE/APPLICATION
Major improvement in spatial resolution of extremities CBCT is achieved with a CMOS detector, enabling in-vivo quantitative trabecular morphometry for early detection of osteoporosis and osteoarthritis.
**SSK16**

**Physics (Radiation Dose Measurement)**

Wednesday, Dec. 2 10:30AM - 12:00PM Location: S404AB

**A Computer Program to Assess Organ Doses for Pediatric and Adult Patients Undergoing CT Scans**

Participants
Mitchell M. Goodsitt, PhD, Ann Arbor, MI (Moderator) Research collaboration, General Electric Company

Sub-Events

**SSK16-01**

**A Computer Program to Assess Organ Doses for Pediatric and Adult Patients Undergoing CT Scans**

Participants
Choonsik Lee, PhD, Rockville, MD (Presenter) Nothing to Disclose
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Wesley E. Bolch, PhD, Gainesville, FL (Abstract Co-Author) Nothing to Disclose
Les R. Folio, DO, MPH, Bethesda, MD (Abstract Co-Author) Research agreement, Carestream Health, Inc

**PURPOSE**
To develop a computer program to assess organ doses for pediatric and adult patients undergoing computed tomography (CT) scans using a series of reference pediatric and adult computational human phantoms coupled with the Monte Carlo transport simulation of x-ray in CT scans.

**METHOD AND MATERIALS**
A comprehensive set of organ dose conversion coefficients, organ dose normalized to CTDIvol, were calculated using 10 pediatric phantoms, recently adopted by International Commission on Radiological Protection (ICRP) as international reference, and the ICRP reference adult phantoms (ICRP Publication 110). The simulated organ doses were experimentally validated by physical anthropomorphic phantoms. A graphical user interface was designed to obtain the user input of patient and scan parameters. The routines for Size Specific Dose Estimates (SSDE) and organ doses under tube current modulation scans (based on mAs data abstracted from DICOM headers) were also programmed. To evaluate the performance of the computer program, organ doses were calculated for 10 pediatric and adult sample patients, and compared with existing CT dosimetry tools.

**RESULTS**
A computer program with GUI was developed for users to input CT scan parameters and assess organ doses and other dose descriptors as output. The calculated organ doses matched the measured values within 15%. The organ doses calculated for the 10 sample patients using our program showed up to 200% discrepancies compared to the existing CT dose calculators (CTDosimetry and CT-Expo). Detailed analysis of the anatomy of phantoms revealed that realistic human phantoms are crucial to improving accuracy in CT organ dosimetry.

**CONCLUSION**
A user-friendly computer program for CT dose calculations was developed and validated. The program is based on the realistic ICRP reference phantoms and up-to-date red bone marrow dosimetry methods, and provides several convenient features compared to the existing tools.

**CLINICAL RELEVANCE/APPLICATION**
The computer program developed in this study is a convenient tool providing organ doses for CT patients based on the ICRP reference phantoms. The program will be useful for epidemiological studies of CT risk and patient dose monitoring.

**SSK16-02**

**Can Gaming Consoles Be Used to Improve X-Ray Imaging? A Feasibility Study**

Participants
Steven Don, MD, Saint Louis, MO (Presenter) Research Grant, Carestream Health, Inc;
Robert MacDougall, MSc, Cambridge, MA (Abstract Co-Author) Nothing to Disclose
William Clayton, St. Louis, MO (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To test the feasibility of using gaming console technology to improve the quality of X-ray projection imaging by automatically measuring body part thickness and mitigating the causes of repeat examinations.

**METHOD AND MATERIALS**
Proprietary software was developed for the Microsoft Kinect 1.0 for Windows using C#. Both the optical camera and infrared sensor outputs were recorded and tested with a mock-up wall stand. The software was designed to control radiation dose variation by measuring body-part thickness. It also was designed to reduce common reasons for repeating images including wrong body part, motion, positioning, and clipped anatomy.

**RESULTS**
The system recognized body part and left/right side of the body to reduce taking the wrong body part. Thickness measurements...
Making Proper Use of the ICRU/AAPM CT Dose Phantom: Recommendations and Limitations

This feasibility study indicates that technology can be adapted from mass-produced gaming consoles to control radiation dose and reduce repeat rates. This device can help the radiology community adhere to the ALARA principle.

CONCLUSION

This feasibility study shows that body-part thickness can be measured automatically and can aid in setting technique based on patient thickness without physical contact measurement (e.g., calipers). The system can reduce repeat rates by confirmation of the correct body part, and checking for motion, positioning, and collimation immediately before the radiograph.

CLINICAL RELEVANCE/APPLICATION

This feasibility study indicates that technology can be adapted from mass-produced gaming consoles to control radiation dose and reduce repeat rates. This device can help the radiology community adhere to the ALARA principle.

SSK16-03 Making Proper Use of the ICRU/AAPM CT Dose Phantom: Recommendations and Limitations

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S404AB

Participants
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Jeffrey H. Siewerdsen, PhD, Baltimore, MD (Abstract Co-Author) Research Grant, Siemens AG; Consultant, Siemens AG; Research Grant, Carestream Health, Inc; License agreement, Carestream Health, Inc; License agreement, Elekta AB; ;

Background

The ICRU/AAPM CT phantom was designed by AAPM Task Group 200 to implement the recommendations of TG111 for testing the radiation output of CT machines over all irradiation lengths L; it is not limited to the single point at 100 mm determined using current CTDI methodology. It can also be employed over several types of CT platforms; however, there are situations where the results have to be carefully interpreted in order to avoid improper cross-platform comparisons.

Evaluation

For determining the rise to equilibrium function h (L) up to its limiting value, a small radiation detector is placed at the radial distance of interest in the central plane of the phantom. Two methods can be used: 1) integrated exposure is recorded for scans of varying length L for multi-detector CT (MDCT) or for collimations of varying width L for fixed-table platforms, symmetric about the longitudinal center of the phantom; 2) a single scan through the entire phantom while recording the exposure rate, dx / dt. Monte Carlo calculations have shown good agreement with measurement. Modifications to both methods have been used for measurements on interventional C-arms with CT reconstruction capability, including machines limited to sub 360° rotations.

Discussion

Helical scans using a narrow collimation and low pitch provide the high sampling frequency essential for the implementation of method 2 on multi-detector CT (MDCT) machines. Method 1 with L as the collimation width is often a better choice for C-arm CT. Also, with C-arm CT, the beam angle will often not intercept the entire diameter of the phantom. Motion was tracked graphically over time and angiographic images were displayed with red indicating gross motion, yellow as slight motion, and green as no motion. Clipped anatomy was displayed with an overlay of the collimated light field. Positioning was confirmed with the optical camera. The display output included a stylized body part, optical visualization of the patient, thickness measurement, and motion over time displayed graphically as shown in the figure (shown: left hand centered over the center AEC, recent but no current motion, and 19 mm thick in the AP projection at the central ray).

Conclusion

The ICRU/AAPM phantom is a robust and flexible tool in determining h (L) with alternate measurement methods which show consistent results. For alternate platforms, there may be constraints not normally experienced in MDCT than need to be considered.

Improving Staff Radiation Protection during Computed Tomography Using a Simple Traffic Light System

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S404AB

Participants
Christina Heilmaier, MD, Zurich, Switzerland (Presenter) Nothing to Disclose
Niklaus Zuber, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Andre Liebing, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Dominik Weishaupt, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
When scanning emergency and intensive-care patients medical staff frequently needs to remain in the scanner room to supervise patients during computed tomography (CT) scans. Often there is high uncertainty concerning staff's best position from a radiation protection perspective. The purpose was to establish a simple system, which helps medical staff to find the optimal position with regard to their own radiation protection.

METHOD AND MATERIALS
To provide guidance for staff we performed dose measurements (µGy/s) on different positions near the CT table using a portable dose detector. Based on these dose values we placed stickers with a diameter of 30 cm on different positions of the floor according to the traffic light system (red = worst position; orange = intermediate position; green = best position). Thereafter, we asked staff to provide evaluation of the new system using a 5-point-scale (1 = not true, 3 = undetermined, 5 = true).

RESULTS
Dose measurements yielded lowest radiation exposure of staff on the lateral part of the CT chassis (mean dose rate, 0.2 µGy/s) and highest values near the CT table close to the gantry (mean dose rate, 20.2 µGy/s). Intermediate dose rates were measured at the opposite end of the gantry and approximately 1.5 meters away from the table (mean rate, 1.9 µGy/s). Survey of 36 staff members revealed that overall judgment of the traffic light system was very positive (mean rating, 4.8). The majority of respondents tried to follow the stickers during the CT scan (mean rating, 4.6) and felt safer since the sticker were placed on the floor (mean rating, 4.5). However, some mentioned that it sometimes was impossible to stand in the green sticker as patient monitoring was limited. Evaluation of knowledge concerning best own position showed that many staff members had considerably misjudged their previous radiation exposure (mean rating of 'I already knew before where best position was', 3.4), which was especially evident in those with only few work experience (1-2 years; mean rating, 1.8).

CONCLUSION
From a radiation protection perspective best position of staff members is on the lateral part of CT chassis, while it is worst to stand near the table close to the gantry. By implementing a traffic light system staff protection and reassurance can be improved.

CLINICAL RELEVANCE/APPLICATION
A traffic light system helps staff members to find the best position during a CT scan to receive lowest possible radiation dose.

Dose-splitting to Obtain Repeat Datasets of Varying Radiation Dose Levels without Repeat Acquisition: Methodology and Verification

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S404AB

Participants
Daniele Marin, MD, Cary, NC (Presenter) Nothing to Disclose
Juan Carlos Ramirez-Graldo, PhD, Malvern, PA (Abstract Co-Author) Employee, Siemens AG
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Ehsan Samei, PhD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Achille Mileto, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Alex Bibbey, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS
The ACR CT accreditation phantom (Gammex 464) was scanned using a third-generation dual-source MDCT platform (Somatom Definition FORCE). The scanner was equipped with a prototype research scan mode that allows user-defined partitioning of the radiation dose between the two x-ray tubes (A and B) by independently selecting the milliampere value of each tube when operating in the dual-source (DS) mode. All scans were performed using both single-source (SS) and DS acquisitions, at constant 120 kVp. For each DS acquisition, three radiation dose levels were reconstructed using the projection data of each radiation tube alone (A or B) or the two tubes combined (A + B). Six different dose levels were obtained for each acquisition mode, including (a) 200, 150, 100, 75, 50, and 25 mAs for SS and (b) 200 mAs (A = 150; B = 50 mAs) and 100 mAs (A = 75; B = 25 mAs) for DS acquisitions. Objective assessment of image quality was performed and compared between the SS and DS acquisitions. Analysis included evaluation of first order image quality metrics (noise, contrast, and CNR) as well as a more comprehensive detectability index, which accounts for the impact of noise, noise power spectrum (NPS), contrast, contrast-dependent task transfer function (TTF), task definition, and eye filter. Radiation dose data were also collected (CTDIvol, DLP).

RESULTS
For equal radiation dose levels, there was no significant difference between SS and DS acquisitions for measured image quality metrics, including noise (average difference, 1.4%; range, 0.2-3.2%), contrast (7.3%; 0.8-12.4%), and CNR (7.4%; 2.0-12.6). Differences between SS and DS were even smaller for the detectability index (0.7%; 0.1-2.3%). NPS and TTF curves for SS and DS acquisitions showed nearly perfect overlap for all radiation dose levels.

CONCLUSION
DS single-energy MDCT platform can precisely and accurately reconstruct datasets at different radiation dose levels from the projection data acquired of each radiation tube by itself or in combination with the second radiation tube.

CLINICAL RELEVANCE/APPLICATION
A reliable strategy to simultaneously obtain three dose levels from a single, dose-neutral, MDCT acquisition can overcome the
practical and ethical challenge of obtaining multiple dose levels from the same patient.

**SSK16-06**

**RIS-integrated Dose Monitoring System: First Optimization Results for a Breast Screening Program on a Large Dataset of FFDM and DBT Exams**

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S404AB

Participants
Andrea Nitrosi, PhD, Reggio Emilia, Italy (Presenter) Nothing to Disclose
Marco Bertolinti, Reggio Emilia, Italy (Abstract Co-Author) Nothing to Disclose
Cinzia Campani, Reggio Emilia, Italy (Abstract Co-Author) Nothing to Disclose
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Lorenzo Ghiddi, Reggio Emilia, Italy (Abstract Co-Author) Nothing to Disclose
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Valentina Iotti, MD, Reggio Emilia, Italy (Abstract Co-Author) Nothing to Disclose
Rita Vaconadio, Reggio Emilia, Italy (Abstract Co-Author) Nothing to Disclose
Mauro Iori, Reggio Emilia, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To show how a RIS-integrated dose monitoring systems can reduce variability of acquisition settings optimizing dose-image quality ratio in a population based breast screening program (BSP).

**METHOD AND MATERIALS**

Our Diagnostic Imaging Department (DID) adopted a RIS-PACS integrateddose monitoring system. For mammography, the average glandular dose (AGD), compression level, breast thickness and glandularity, as well as the selected automatic exposure control (AOP) mode (for FFDM one among three with increasing dose levels labelled as "dose", "standard" and "contrast", for DBT a single dose level called "tomo" are available) are registered for each projection. The DID BSP monitors about 55,000 examinations/year from eleven mammography units equally configured. To date we collected data from more than 500,000 mammographic exposures and more than 15,000 DBT ones. AGD dependency on the compression force and the selected AOP has been verified. The compression force (at least 100N) and the FFDM AOP selection ("dose" mode) were standardized among the radiographers.

**RESULTS**

After standardization FFDM AGD variability decreased from 60% to 28% and the overall median AGD decreased from 1.38 to 1.22 mGy. For FFDM AOP dose, standard and contrast the median AGD (mGy) [25th percentile, 75th percentile] were respectively 1.18 [1.06, 1.37], 1.51 [1.35, 1.77], 1.85 [1.72, 2.05] while for DBT AOP tomo were 1.61 [1.44, 1.85]. The breast compressed thickness median both for FFDM and DBT was 53 mm, while the median glandularity calculated by the mammographic unit were respectively 40% and 20%.

**CONCLUSION**

It has been verified that AGD is highly dependent on the AOP mode selected for FFDM and on the compression force both for FFDM and DBT. The glandularity evaluation is quite different between FFDM and DBT. This element probably impacts on AGD calculations.

**CLINICAL RELEVANCE/APPLICATION**

The iterative application of monitoring processes and integration with information systems like RIS for the qualification of image quality-dose ratio, may improve clinical quality performance in diagnostic imaging.

**SSK16-07**

**Effects on Radiation Exposure and Image Quality of Abdominal CT with Attenuation-based Automatic Kilovoltage Selection**

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S404AB

Participants
ShuTing Wang, Shenyang, China (Abstract Co-Author) Nothing to Disclose
Ke Ren, MD, ShenYang, China (Abstract Co-Author) Nothing to Disclose
Long Cui, MD, PhD, Shenyang, China (Presenter) Nothing to Disclose

**PURPOSE**

To compare the radiation dose and image quality between standard-dose CT and a low-dose CT obtained with the combined use of an attenuation-based automatic kilovoltage (kV) selection tool (kV Assist) and adaptive statistical iterative reconstruction (ASiR) for abdominal CT examination of adults with small or medium body size.

**METHOD AND MATERIALS**

Sixty consecutive patients with body mass index (BMI) below 26kg/m2 underwent abdominal contrast-enhanced CT (GE Discovery CT750 HD). Patients were divided into two groups, Automated adaption of both tube potential and tube current in group A (n=30) and with fixed 120 kV in group B(n=30).Data of two groups were reprocessed with 50% and 30%ASiR, respectively. Although the noise was slightly higher in group A (13.60±1.74 vs. 12.27±1.73 HU in arterial phase while 13.92±2.11vs. 12.66±2.35 HU in portal venous phase; p<0.05), the SNRs and CNRs were similar to or even higher than that of standard 120-kV protocol. No significant differences of various tissues were calculated. The subjective image quality was assessed by two blinded and independent observers with a 5-point scale (1=non diagnostic; 5=excellent).

**RESULTS**

After standardization FFDM AGD variability decreased from 60% to 28% and the overall median AGD decreased from 1.38 to 1.22 mGy. For FFDM AOP dose, standard and contrast the median AGD (mGy) [25th percentile, 75th percentile] were respectively 1.18 [1.06, 1.37], 1.51 [1.35, 1.77], 1.85 [1.72, 2.05] while for DBT AOP tomo were 1.61 [1.44, 1.85]. The breast compressed thickness median both for FFDM and DBT was 53 mm, while the median glandularity calculated by the mammographic unit were respectively 40% and 20%.
Does Body Mass Index (BMI) Outperform Body Weight as a Surrogate Parameter for Size Specific Dose Estimates (SSDE) in Adult Patients?

Wednesday, Dec. 2 11:40AM - 11:50AM Location: S404AB

Participants
Johannes Boos, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Rotem S. Lanzman, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Christoph Schleich, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Patric Kroepil, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Christoph K. Thomas, MD, Duesseldorf, Germany (Presenter) Speaker, Siemens AG

PURPOSE
Body weight has been proposed as a comprehensive alternative to surrogate size specific dose estimates (SSDE). The aim of this study was to assess the value of the body mass index (BMI) in comparison to body weight as a surrogate parameter for SSDE in abdominal and chest CT of adult patients.

METHOD AND MATERIALS
211 patients (83 female, 128 male, mean age 61.6±14.0 years) undergoing CT examinations of the chest (n=105) or abdomen (n=106) were included in this retrospective study. Weight and size of the patient at the time of the examinations were used to calculate the BMI (weight/size²). Effective diameter (Deff) was assessed performing diameter measurements in the axial midvolume CT-slice. Correlation between BMI, weight and effective diameter was calculated. SSDE were calculated based on Deff, weight and BMI.

RESULTS
Mean size, weight and BMI were 172.7±10.0cm, 80.2±19.9kg and 26.8±5.6kg/cm², respectively. Mean lateral diameter, a.p. diameter and Deff were 35.9±4.9, 28.9±4.4 and 30.4±4.4, respectively. There was a significant correlation between BMI and Deff (r=0.82) as well as weight and Deff (r=0.82) (p<0.05 respectively). SSDE calculation based on BMI matched SSDE based on Deff (7.3±2.7mGy vs 7.3±2.7mGy), while SSDE calculation based on body weight led to a difference of 7% (7.8±4.4mGy, p>0.05). BMI showed a better correlation with Deff than body weight for abdominal CT (r=0.87 vs 0.84) while correlation was inferior for chest CT (r=0.76 vs 0.82).

CONCLUSION
SSDE based on BMI do not differ significantly from SSDE based on diameter measurements in thoracoabdominal CT and can be used to simplify the SSDE method. Furthermore, BMI is superior to body weight as a surrogate parameter for SSDE in abdominal CT of adult patients.

CLINICAL RELEVANCE/APPLICATION
BMI can be used as a surrogate for SSDE. Thereby, BMI can lead to relevant simplification of the SSDE method, especially in large scale register analysis.

Body Mass Index Based GSI Assist in Abdominal CT: Investigation of Radiation Dose and Image Noise

Wednesday, Dec. 2 11:50AM - 12:00PM Location: S404AB

Participants
Chai Y. Ru III, MD, Zhengzhou, China (Presenter) Nothing to Disclose
Jianbo Gao, MD, Zhengzhou, China (Abstract Co-Author) Nothing to Disclose
Peijie Lv, MMed, Zhengzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the radiation dose and image noise of spectral CT imaging with gemstone spectral imaging(GSI) assist in abdominal CT based on the body mass index(BMI) compared with conventional CT scan

METHOD AND MATERIALS
This study received institutional review board approval, and all participants provided written informed consent. 68 patients underwent CT plain scan with the conventional mode of 120 kVp and enhanced CT with spectral imaging mode in arterial phase (AP) and venous phase(VP). The optimal spectral imaging parameters were automatically selected with GSI assist on. 65 keV monochromatic images in venous phase were reconstructed and compared with plain CT images. All patients were divided into four groups according to BMI(group A,n=12;BMI <18.5 kg/m²; group B,n=28;BMI 18.5~23.9 kg/m²; group C,n=19;BMI 24~28.9 kg/m²; group D,n=9;BMI ≥29 kg/m²). Image noise of liver, muscle and abdominal subcutaneous fat was measured, and volume CT dose index(CTDIvol) and effective dose(ED) were recorded among the four groups. Difference of radiation dose and image noise between the two scanning modes in each group were compared using paired t-test.

RESULTS
Between the conventional mode and spectral CT with GSI assist mode for all patients, the CTDIvol and ED showed no significant differences ($P=0.071, 0.059$), while the image noise of liver, muscle and fat had significant differences (all $P<0.001$). In group A, the CTDIvol, ED and image noise of liver, muscle and fat for GSI assist mode were lower than conventional mode (all $P<0.001$). The CTDIvol and ED had no significant difference between the two scanning mode in group B ($P=0.058, 0.077$) and group C ($P=0.073, 0.059$), but higher for the GSI assist mode in group D (both $P<0.001$). Image noise of liver, muscle and fat in group B, C and D for GSI assist mode were all lower than conventional CT mode (all $P<0.001$) except for the image noise of fat in group D ($P=0.055$).

**CONCLUSION**

GSI assist scanning mode can reduce radiation dose in patients with BMI under 18.5 kg/m² without sacrificing image quality and can reduce image noise in patients with BMI range between 24 kg/m² and 28.9 kg/m² in equivalent radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

Within a certain BMI range, GSI assist scan mode can reduce radiation dose or image noise, and is recommended clinical application for its easy operation.
SSK17

**ISP: Radiation Oncology (Outcomes/Quality of Life I)**

**Wednesday, Dec. 2 10:30AM - 12:00PM Location: S104A**

**Participants**

Martin Colman, MD, Houston, TX (Moderator) Nothing to Disclose
James S. Welsh, MD, MS, Batavia, IL (Moderator) Nothing to Disclose

**Sub-Events**

**SSK17-01 Radiation Oncology Keynote Speaker: Perspectives in Breast Cancer**

**Wednesday, Dec. 2 10:30AM - 10:40AM Location: S104A**

**Participants**

Anna Shapiro, MD, Syracuse, NY (Presenter) Nothing to Disclose

**SSK17-02 An Institutional Review of Radiation Doses from Radiological Imaging Procedures in Image-guided Radiotherapy of Cancers**

**Wednesday, Dec. 2 10:40AM - 10:50AM Location: S104A**

**Participants**

Li Zhou, PhD, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Yibao Zhang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Jun Deng, PhD, New Haven, CT (Presenter) Nothing to Disclose

**PURPOSE**

To systematically compare radiation doses to organs-at-risk (OARs) between planning CTs and image-guided procedures during image-guided radiotherapy (IGRT) of cancers.

**METHOD AND MATERIALS**

With IRB approval, 4832 cancer patients who underwent IGRT at our institution between Sep. 2009 and Apr. 2014 were included in this retrospective study. Their gender, age, circumference were collected as well as all the radiological imaging procedures performed, including computed tomography (CT), kilo-voltage portal imaging (KVPI), megavoltage portal imaging (MVPI) and kilo-voltage cone-beam computed tomography (kVCBCT). Correlations between patient’s size and organ dose were first established via Monte Carlo dose calculations in patient anatomy, and then used for patient-specific organ dose estimation. The imaging doses to brain, lungs and red bone marrow (RBM) were analyzed.

**RESULTS**

A total of 142017 imaging procedures were performed on 4832 patients, 5113 of which were CT scans. Regardless of age, average CT doses to brain, lungs and RBM were 0.5, 0.6, 0.6 cGy for males, and 0.5, 0.6, 0.6 cGy for females, accounting for 1.6%, 3.5%, 2.0%, 1.6%, 4.0% and 3.3% of combined dose, respectively. Peaking at 45 cGy, KVPI contributed largest doses to brain, about 47 times of CT doses. In lungs and RBM, average KVPI dose remained higher for most children but decreased below 14 cGy in adults. Unlike KVPI, average MVPI doses to OARs were less than 10 cGy, peaking at 16 cGy in RBM for eldest males. kVCBCT doses were generally 0-8 cGy except for males of 51 years and older who received largest number of scans in pelvis.

**CONCLUSION**

While CT scans deposited a small portion of radiation doses to cancer patients, image-guided procedures employed in IGRT can contribute up to 50 cGy of cumulative imaging doses to brain, 30 cGy to lungs and 40 cGy to RBM in pediatric patients. This study indicated a pressing need for personalized imaging protocol to maximize clinical benefits of imaging procedures while reducing imaging doses and associated cancer risks.

**CLINICAL RELEVANCE/APPLICATION**

This study reveals a strong need for personalized imaging protocol to maximize clinical benefits of imaging procedures while reducing imaging doses and associated cancer risks.

**SSK17-03 Impact of Single Day Multidisciplinary Clinics on the Lead Time from Diagnosis to Initiation of Treatment in Head and Neck Cancers**

**Wednesday, Dec. 2 10:50AM - 11:00AM Location: S104A**

**Participants**

Raju Vaddepally, Oak Brook, IL (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): We evaluated the impact of single day multidisciplinary clinics (MDC) on the lead time from diagnosis to treatment in head and neck cancers compared with matching patients prior to the implementation of MDC. We also wanted to investigate the relationship of demographic factors to the lead time.Materials/Methods: We retrospectively analyzed clinical and demographic variables of 310 patient’s records collected from head and neck cancer tumor registry at St. Joseph Mercy Hospital, Ann Arbor, from 2007 to 2013. We had 170 cases with in the MDC period compared to 140 prior to the MDC. Results: We excluded 60 cases from our analysis because of missing data; no date of biopsy (N=5), no documentation of first treatment date (N=42).
and tumor resected on the same day of biopsy (N=22). This left 129 cases (76%) in the MDC period and 112 cases (80%) in the Pre-MDC period. Mean age was 63 in both the groups. Frequencies of other demographic factors include males (76% vs 79%), Caucasians (91% vs 88%), married (66% vs 62%) and insurance as Medicare (57% vs 50%), median distance from clinic (22 miles vs 17), in the MDC vs Pre-MDC groups respectively. Most of the cancers were squamous cell carcinomas (88% vs 83%), however, we had more stage 4 disease in MDC (56%) when compared to the Pre-MDC group (41%). To compare the two groups, after adjusting for demographic variables and an interaction between stage and site, we fit a generalized linear regression model. There was no difference in the median number of days from biopsy to definitive treatment between the two groups, (35 MDC vs 33.5 in Pre-MDC, p = 0.14. The average number of days from biopsy to definitive treatment was 1.13 times longer, for the MDC group (95% CI: 0.96 to 1.32). Marital status was the only variable statistically significantly related to lead time (p = 0.04). Time to definitive treatment was 0.83 (95% CI: 0.70 to 0.99) times shorter, on average for married vs unmarried patients in both the groups. Post hoc analysis was also done to investigate the association between MDC and time to first radiation dose, where radiation was the first treatment. There were only 78 cases that met these criteria, Pre-MDC (N=37) and MDC (N=41). The negative binomial regression model showed no association of MDC with time to first radiation treatment (median time in days was, 40 in pre-MDC vs 38 in MDC). Time to radiation treatment was 0.91 (95% CI: 0.74 to 1.00) times shorter in the MDC when compared to the pre-MDC group. Conclusion: There was no significant difference in lead time with single day MDC compared to patients Pre-MDC in head & neck cancer patients. However, patients in the MDC group had more advanced cancer, which could reflect more complex work-up and management, resulting in longer lead time. Interestingly, marital status was associated with decrease in lead time in married compared to unmarried patients, in both the groups.

SSK17-05  A Review of Studies Using Self-reported Measures of Sexual Function among Female Cancer Patients Treated with Radiation Therapy, 2008-2014

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S104A

Participants
Anuja Jhingran, MD, Houston, TX (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): A systematic review was conducted to identify and characterize self-reported sexual function (SF) measures administered to women who had received radiation therapy (RT) for cancer. Materials/Methods: Using 2009 PRISMA guidelines, we searched electronic bibliographic databases for quantitative studies published January 2008-September 2014 that used a self-reported measure of SF, or a quality of life (QOL) measure that contained at least one item pertaining to SF. Of these studies, we selected articles that reported the percentage of females who had received any form of RT. Results: Of 1,487 articles initially identified, 83 met inclusion criteria. The studies originated in 28 different countries with 23% from the U.S.A. Most studies focused on women treated for breast, gynecologic, or colorectal cancer, with the percent of women having received RT ranging from 7% to 100%. Only 19 articles (23%) provided information about radiation dose, number of fractions, field, or type of RT equipment. SF was assessed with 27 unique self-reported measure, the most common being the EORTC QLQ modules (considered as one measure), the Female Sexual Function Inventory, and the Sexual Function Vaginal Changes Questionnaire. Of the 32 studies designed to compare SF by treatment modality, one-third found no statistically significant difference between RT and other modalities, and 28% found worse SF associated with RT. Only 4 studies reported on interventions to improve SF. Conclusion: The paucity of RT information in the reviewed articles, and the large number of measures used to assess SF limit comparative analysis. Needed are intervention studies with common metrics, preferably dedicated SF measures developed with cancer patients treated with RT. This systematic review will assist radiation oncologists select SF measures and encourage assessment of this quality of life domain in patient care.

SSK17-06  The Impact of Weight Loss on Set-up Accuracy with Patients Receiving Head and Neck Cancer Radiation Therapy

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S104A

Participants
Sayed Y. Zia, MA, MD, New York, NY (Presenter) Nothing to Disclose
Awais Mirza, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Umut Ozbek, New York, NY (Abstract Co-Author) Nothing to Disclose
Ren-Dih Sheu, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Vishal Gupta, MD, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Richard L. Bakst, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Patients receiving radiation therapy for head and neck cancers often experience severe weight loss and in some cases require re-planning. The purpose of this study was to evaluate whether we can determine at what point patients daily shifts vary greatly in relation to their specific weight loss to ensure the safe delivery of radiation therapy to our patients. Materials/Methods: 99 consecutive patients with head and neck cancers were treated with radiation therapy (+/- chemotherapy) at our institution. Patient and disease characteristics: median age 59 (41-94), 14% female, 86% male, 3% Stage 0, 10% Stage I, 12% Stage II, 15% Stage III, 60% Stage IV. Weight loss was measured and recorded during weekly on treatment visits. KV imaging was performed daily to ensure setup accuracy. All shifts were recorded on a daily basis to include AP, LR, and SI shift. Spearman correlation coefficients were used in statistical analysis. Results: The mean weight loss during treatment in our cohort was 13.6kgs (+2.4kgs to - 24.9kgs). Stage of disease was found to correlate with percent weight loss (p=0.040). Mean weight loss was found to increase with advanced stage disease (Table 1), MEAN WEIGHT LOSS, Stage MEAN Weight Loss(%)01.814.261.6.8116.281.75In regards to treatment, there was no statistical correlation between treatment being adjuvant or definitive with regards to percentage weight change (p=0.56). The largest PA (posterior-anterior) shift (p=.309), SI (superior-inferior) shift (p=.517), LR (left-right) shift (p=.303) compared to the largest shift (p=.247) were trended against weight loss and found not to be statistically significant. Conclusion: Our study demonstrates that despite weight loss of head and neck cancer patients, there was no significant correlation with setup inaccuracy. Increasing stage was found to be predictive of an increase in percent weight change. This study suggests that most patients undergoing head and neck radiation therapy will have a reliable set-up when properly immobilized despite significant weight loss. Further, this study highlights the importance of daily KV imaging and close monitoring of patients weight in head and neck cancer patients.

SSK17-07  Technology Meets Quality for Physician Collaboration in Oncology Peer Review

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S104A

Participants
Richard L. Bakst, MD, New York, NY (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Patients receiving radiation therapy for head and neck cancers often experience severe weight loss and in some cases require re-planning. The purpose of this study was to evaluate whether we can determine at what point patients daily shifts vary greatly in relation to their specific weight loss to ensure the safe delivery of radiation therapy to our patients. Materials/Methods: 99 consecutive patients with head and neck cancers were treated with radiation therapy (+/- chemotherapy) at our institution. Patient and disease characteristics: median age 59 (41-94), 14% female, 86% male, 3% Stage 0, 10% Stage I, 12% Stage II, 15% Stage III, 60% Stage IV. Weight loss was measured and recorded during weekly on treatment visits. KV imaging was performed daily to ensure setup accuracy. All shifts were recorded on a daily basis to include AP, LR, and SI shift. Spearman correlation coefficients were used in statistical analysis. Results: The mean weight loss during treatment in our cohort was 13.6kgs (+2.4kgs to - 24.9kgs). Stage of disease was found to correlate with percent weight loss (p=0.040). Mean weight loss was found to increase with advanced stage disease (Table 1), MEAN WEIGHT LOSS, Stage MEAN Weight Loss(%)01.814.261.6.8116.281.75In regards to treatment, there was no statistical correlation between treatment being adjuvant or definitive with regards to percentage weight change (p=0.56). The largest PA (posterior-anterior) shift (p=.309), SI (superior-inferior) shift (p=.517), LR (left-right) shift (p=.303) compared to the largest shift (p=.247) were trended against weight loss and found not to be statistically significant. Conclusion: Our study demonstrates that despite weight loss of head and neck cancer patients, there was no significant correlation with setup inaccuracy. Increasing stage was found to be predictive of an increase in percent weight change. This study suggests that most patients undergoing head and neck radiation therapy will have a reliable set-up when properly immobilized despite significant weight loss. Further, this study highlights the importance of daily KV imaging and close monitoring of patients weight in head and neck cancer patients.
The role of adjuvant radiation therapy (ART) after lymph node dissection (LND) in pts with Stage III melanoma is controversial.

**PURPOSE**

Evan J. Wuthrick, MD, Columbus, OH (Sara Erinn Priyanka)

Participants
Dawn Henrich, San Jose, CA (Presenter) Employee, ICAD, Inc; Stockholder, ICAD, Inc
Ajay Bhatnagar, MD, Pittsburgh, PA (Abstract Co-Author) Consultant, ICAD, Inc
Bridge Krueger, San Jose, CA (Abstract Co-Author) Employee, ICAD, Inc
Kamal Gogineni, San Jose, CA (Abstract Co-Author) Employee, ICAD, Inc

**ABSTRACT**

Purpose/Objective(s): Surface electronic brachytherapy is becoming recognized for treatment of non-melanoma skin cancer (NMSC). Radiation Oncologists providing these treatments may not have peer-to-peer collaboration available. This abstract will demonstrate feasibility in performing peer review within multiple non-affiliated organizations using a cloud-based platform to increase quality and safety.

Materials/Methods: The oncology system stores patient specific clinical and dosimetric data for electronic brachytherapy and was utilized for multi-fraction treatment across several facilities. A total of 37,000 consecutive treatments were captured over a period of 2.5 years. The oncology platform is used to facilitate workflow management and documentation in a process structured environment. Mandatory fields throughout the care path allow consistent data to maximize comprehensive peer reviews. The cloud-based infrastructure permitted quick access to pertinent chart details across multiple non-affiliated locations to streamline the peer review method. Evaluation elements specific to surface electronic brachytherapy were determined at onset. These included a variety of specifications regarding clinical presentation, diagnosis including pathology, informed consent, radiation prescription including dose fractionation scheme, treatment delivery parameters and presence of appropriate clinical documentation. An independent Radiation Oncologist was chosen to review 2 patient charts per month at each location during the validation process between July-December 2014. Results: Peer Review of 69 unique NMSC lesions was completed in 65 patients with a mean age of 78 years (Range 56-96). Pathologic history presented with Basal Cell, Squamous Cell, Carcinoma in Situ, and Basosquamous in anatomic locations throughout the face, trunk, and scalp (63%, 31%, and 6%, respectively). The peer reviewed patients were supervised by 22 Radiation Oncologists located across 11 unique locations. A dose prescription was present in 100% of patient charts which varied between 500cGy, 400cGy, and 450cGy per fraction (84%, 13%, and 3% respectively). These were prescribed at depths of 2, 3, and 4 mm with 55% most commonly prescribed at 2 mm. Additional data fields such as lesion size, cone size, and cutout type assisted in determining appropriateness of treatment parameters. Appropriateness of care was satisfactory in all patient charts evaluated. Conclusion: A cloud-based management platform enables a single Radiation Oncologist to remotely complete peer reviews effectively across multiple non-affiliated locations. The concept of utilizing data systems to complete peer review for surface electronic brachytherapy is feasible and should be introduced in the broader oncology community for data capture and predictive analytics to improve patient care.

**SSK17-08 Proton Radiation Therapy for Incurable Head and Neck Disease by the Palliative QUAD Shot Regimen**

Participants
Stanley Gutiontov, MD, Chicago, IL (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): To report our institutional experience of palliative proton radiotherapy (RT) for cancers in the head and neck with the QUAD SHOT regimen.

Materials/Methods: Seventeen patients completed at least 1 cycle of palliative RT to the head and neck with proton therapy for incurable primary or metastatic disease based on the RTOG 85-02 QUAD SHOT regimen (370 cGy twice daily over 2 consecutive days at 2 to 3 week intervals up to a total dose of 4400 cGy) between July 2013 and January 2015 at our center; two were lost to follow-up. In the remaining fifteen patients, we defined palliation as relief of the presenting symptom(s) or tumor response by clinical exam or imaging. Overall survival (OS) was estimated by the Kaplan-Meier (KM) method. The Spearman rho test was used to examine the correlation between various clinical factors and palliative response. Toxicity was scored using the NCI CTCAE v4.0. Results: Median patient age was 70 years (range 54 to 89). 66% were male and 34% were female. The most common histology was squamous cell carcinoma (66%), followed by adenocarcinoma of the lung metastatic to the head and neck (13%), non-anaplastic thyroid carcinoma (7%), mucosal melanoma (7%), and adenocarcinoma (7%). Primary or recurrent AJCC stage was I (7%), II (13%), III (6%), IV (67%), and unknown (13%). The stage I patient also had metastatic SCLC. Five patients (33%) had a history of surgical resection at the primary disease site, eleven patients (73%) had previously received systemic chemotherapy, and ten patients (66%) had received significant prior RT at the palliative site (median dose 66 Gy; range, 21 to 75 Gy). Three patients had received two prior courses of RT to the site. KPS was >70 in all patients. The most common presenting symptoms were visual changes (16%), dysphagia/odynophagia (16%), pain (12%), and/or epistaxis (12%). Seven patients (47%) completed three QUAD SHOT cycles, and six patients (40%) received systemic therapy, typically targeted agents, concurrently. Palliative response was observed in 73% of patients. Median OS was 4.17 months (range, 0.57-17.0). No Grade 3 or higher acute toxicities were observed. One patient, who had received two prior courses of RT to the site, developed a Grade 2 dermatitis. The most common toxicity was Grade 1 fatigue (27%). By the log-rank test, palliative response (p=0.018) was associated with improved OS. Using bivariate analysis, palliative response was correlated with increasing number of QUAD SHOT cycles (p=0.017) but not with KPS, histology, or concurrent chemotherapy. Conclusion: Delivery of the QUAD SHOT regimen by proton radiotherapy for patients with loco-regionally advanced or metastatic disease in the head and neck provides excellent rates of palliative response with no Grade 3 or higher acute toxicity. The minimal toxicity profile in these heavily pre-irradiated patients is encouraging and warrants further study.

**SSK17-09 Patterns of Local and Distant Recurrence Based on MAP Kinase Pathway Mutations in Patients with Stage III Melanoma Treated with Lymph Node Dissection and Adjuvant Radiation Therapy**

Participants
Priyanka Chabani, BA,MS, Columbus, OH (Presenter) Nothing to Disclose
Steve Walston, DO, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Erik W. Krueger, MD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Sara Peters, MD,PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Terence M. Williams, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Evans J. Wuthrick, MD, Columbus, OH (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The role of adjuvant radiation therapy (ART) after lymph node dissection (LND) in pts with Stage III melanoma is controversial.
Recently, different sub-groups of melanoma have emerged based on the presence of BRAF and NRAS driver mutations in the MAP Kinase pathway. We sought to determine clinical outcomes after LND and ART on the basis of BRAF, NRAS, and MAPK-wild-type (wt) status.

**METHOD AND MATERIALS**

We reviewed the records of patients (pts) treated with LND followed by ART at our institution from 2006 to mid-2014. 65 pts met our study criteria. We collected information on demographic, pathologic, and treatment-related variables from medical records. We tested melanoma tissue samples from all pts for BRAF/NRAS mutations using PCR-based genetic assays. Loco-regional and distant recurrences were assessed using follow-up imaging and exam findings. We examined the association of variables collected with clinical outcomes using Kaplan and Meier methods and Cox proportional hazards models.

**RESULTS**

Of the 65 pts, 42 (65%) were male and the median age was 57 yrs (range 22 - 87). 19 pts (29%) received LND and ART to the head and neck, 28 (43%) to the axilla, and 18 (28%) to the groin. Pts received external beam RT with the majority receiving 30 Gy/5 fractions (61%) or 48 Gy/20 fractions (26%). 32 pts (49%) were BRAF-positive, 33 pts (51%) were BRAF-negative. Of the 33 BRAF-negative pts, 15 pts (23%) had NRAS mutations, 18 pts (28%) were MAPK-wt. Median follow up time was 1.6 years (0.2-7.8). Presence of BRAF mutation was significantly associated with local-regional recurrence (HR: 4.3; 95% CI 0.9-20.0; p = 0.06). At 2-yr follow-up, 33% of BRAF+ pts failed loco-regionally, compared to 7% of BRAF- pts. There were a total of 11 loco-regional failures. Presence of BRAF mutation was not significantly associated with distant failure (aHR: 0.75; 95% CI 0.4-1.4; p = 0.34). At 2-yr follow-up, 54% of BRAF+ pts had distant failure, compared to 65% of BRAF- pts. There were a total of 37 distant failures.

**CONCLUSION**

BRAF-positive pts had significantly increased rates of loco-regional failure but similar rates of distant failure compared to BRAF-negative pts after LND and ART for Stage III Melanoma.

**CLINICAL RELEVANCE/APPLICATION**

BRAF-positive pts may derive less loco-regional control than BRAF-negative pts from ART after LND for Stage III melanoma; adjuvant immunotherapy or targeted therapy may be better options for these pts.
**SSK18**

**Vascular/Interventional (Advances in Hepatic Tumor Ablation)**

**Wednesday, Dec. 2 10:30AM - 12:00PM Location: N227**

**GI**

**IR**

**MR**

**AMA PRA Category 1 Credits™: 1.50**

**ARRT Category A+ Credits: 1.50**

**FDA**

Discussions may include off-label uses.

**Participants**

Nael E. Saad, MBCh, Saint Louis, MO (Moderator) Research Consultant, Veran Medical Technologies, Inc; Proctor, Sirtex Medical Ltd.

Charles Y. Kim, MD, Durham, NC (Moderator) Research Grant, Galil Medical Ltd; Consultant, Kimberly-Clark Corporation; Consultant, Cryolife, Inc

**Sub-Events**

**SSK18-01 Long-Term Therapeutic Outcomes of Radiofrequency Ablation For Subcapsular versus Non-Subcapsular Hepatocellular Carcinoma**

**Wednesday, Dec. 2 10:30AM - 10:40AM Location: N227**

**Participants**

Tae Wook Kang, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Hyo Keun Lim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Mimi Kim, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

**PURPOSE**

Recent clinical guidelines for management of hepatocellular carcinoma (HCC) have not recommended the radiofrequency (RF) ablation for subcapsular tumor due to a higher risk of incomplete ablation or major complications. However, these guidelines were mainly based on retrospective studies with insufficient sample size and follow-up. We retrospectively compared the long-term therapeutic outcomes of RF ablation for HCC in a subcapsular versus non-subcapsular location using propensity score matching.

**METHOD AND MATERIALS**

508 patients (396 men, 112 women; age range, 30-80 years) with a single HCC (<5 cm) were treated with ultrasonography-guided percutaneous RF ablation as a first-line treatment. We divided the patients into two groups, subcapsular (n = 227) or non-subcapsular group (n = 281). We evaluated the association of subcapsular location and the long-term therapeutic outcomes of RF ablation including local tumor progression (LTP) and overall survival (OS) using the matched data and assessed the major complication rate in overall data.

**RESULTS**

After matching, there were 163 matched pairs of patients in both groups. In the matched groups, the 3- and 5-years cumulative LTP rates were estimated as 18.8% and 20.9%, respectively, for the subcapsular group, and 13.2% and 16.0% for the non-subcapsular group. The corresponding OS rates were 90.7% and 83.2% in the subcapsular group, and 91.4% and 79.1% in the non-subcapsular group, respectively. The hazard rates for LTP (HR [hazard ratio] = 1.37, P = 0.244) and OS (HR = 0.86, P = 0.604) were not significantly different between two matched groups. In addition, there was no significant difference in both groups in terms of major complications rates (P > 0.05).

**CONCLUSION**

The difference in long-term therapeutic outcomes of RF ablation for HCC was not significant between the subcapsular and non-subcapsular groups.

**CLINICAL RELEVANCE/APPLICATION**

The consideration of overall technical difficulty of RF ablation for HCC under various clinical settings is more reasonable than the dichotomous view of recommendation for RF ablation judged by anatomical location including subcapsular HCCs.

**SSK18-02 Ablation Margin Size and Not Modality Predicts Local Tumor Progression after Ablation of Colorectal Liver Metastases: A Case-control Study of RF and Microwave Ablation**

**Wednesday, Dec. 2 10:40AM - 10:50AM Location: N227**

**Participants**

Waleed Shady, MBCh, New York, NY (Presenter) Nothing to Disclose

Joseph P. Erinjeri, MD, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

Karen T. Brown, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

Anne M. Covey, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

Stephen B. Solomon, MD, New York, NY (Abstract Co-Author) Research Grant, General Electric Company

Constantinos T. Sofocleous, MD, PhD, New York, NY (Abstract Co-Author) Consultant, Sirtex Medical Ltd

Christina L. Zenobi, New York, NY (Abstract Co-Author) Nothing to Disclose

Mithat Gonen, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

Nancy Kemeny, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare the local tumor progression rates of colorectal liver metastases ablated percutaneously using either microwave (MW) or radiofrequency (RF).
METHOD AND MATERIALS

We performed an IRB-approved retrospective review of a prospectively created HIPAA-compliant ablation database. We included patients with CLM ablated using RF between November 2009 and December 2012. These were matched to a group of patients with CLM ablated using MW between November 2009 and July 2014. Patients were excluded if the percutaneous ablation was used to treat a local recurrence of a previous ablation. The ablation margin was measured on the 1st portal venous phase CT obtained post-ablation (4-8 weeks), and classified as either ≤5 mm or >5 mm. Patients/tumors were excluded if the ablation margin could not be measured due to either: (a) lack of a CT scan at baseline or at 4-8 weeks post-ablation, or (b) fused ablation defects. Clinical characteristics were compared between both groups. Kaplan-Meier methodology was used to calculate LTP-free survival. Stratified log-rank tests were used to analyze predictors of LTP.

RESULTS

The study enrolled 53 patients with 77 tumors ablated with RF in 64 sessions, and 36 patients with 43 tumors ablated with MW in 39 sessions. No differences existed between both groups in baseline clinical characteristics or mean tumor size (1.9 cm MW versus 1.9 cm RF) (P=0.9). The LTP-free survival rate at 2 years was 67% in the RF group and 71% in the MW group (P=0.9). The percentage of ablation margins >5 mm achieved with RF was 58% (45/77) and 42% with MW (18/43) (P=0.08). An ablation margin ≤5 mm was a predictor of LTP in both the RF group (P<0.001) and the MW group (P=0.005). The median LTP-free survival in tumors with a margin ≤5 mm was longer in the MW group than in the RF group (21 months versus 8 months), approaching statistical significance (P=0.09). The LTP rate for tumor with an ablation margin >5 mm was 4% in the RF group (2/45) and 6% (1/18) in the MW group (P=0.3). Minor complications rate for MW and RF were 26% (10/39) versus 13% (8/64) (P=0.09), and major complications rates were 15% (6/39) versus 13% (8/64) (P=0.7).

CONCLUSION

Local control after ablation of CLM is dependent on an adequate ablation margin and not the modality used.

CLINICAL RELEVANCE/APPLICATION

Sufficient ablation margins remain the most important factor to achieve prolonged LPFS regardless of thermal energy.

SSK18-03 Role of Microwave Ablation (MWA) Therapy of Liver Metastases from Colorectal Carcinoma Post systemic Chemotherapy: Tumor Control and Survival Rates

Wednesday, Dec. 2 10:50AM - 11:00AM Location: N227

Participants

Nour-Eldin A. Nour-Eldin, MD,PhD, Frankfurt Am Main, Germany (Presenter) Nothing to Disclose
Mohammed A. Alsubhi, BMBS, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Nagy N. Naguib, MD, MSc, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Martin Beeres, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Lehnt, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

to evaluate the safety, efficiency, effectiveness, and overall outcome in patients treated with microwave thermal ablation of colorectal metastases post systemic chemotherapy.

METHOD AND MATERIALS

An institutional review board-approval was obtained with informed consent of all patients. Retrospective analysis of prospective intention to treat study was performed from January 2008 to January 2013, and included 92 patients (mean age 56 years SD: 2.6) with 132 liver metastases measuring 0.7-5.0cm, who were treated with microwave ablation (MWA). Local tumor control, complications, and long-term survival were analyzed.

RESULTS

The mean follow-up period was 32.5 months. Complete ablation was achieved in 117 of 132 (88.6%) nodules. Seventeen of the 117 (14.5%) successfully treated nodules developed local recurrence. Univariate analysis showed that tumor size of < 3 cm is a significant risk factor (P = 0.04). Multivariate analysis showed that number of cycles of chemotherapy (FOLFOX) was a significant prognostic factor for overall recurrence (P=0.03), whereas disease-free interval was the significant prognostic factor for distant recurrence (P=0.03). Major complications occurred in 1.1% of patients. No procedure-related mortalities were observed. The 1, 2, 3, and 5-year overall survival rates after the initial ablation were 82, 61.2, 51.2, and 38.3%, respectively. The main cause of death was systemic tumor progression in 65.3% of the patients.

CONCLUSION

MWA is a safe and effective treatment option for patients with liver metastases from Colorectal Carcinoma post systemic chemotherapy.

CLINICAL RELEVANCE/APPLICATION

MWA could be safely used as a part of the therapeutic armamentarium in the management of patients with hepatic colorectal metastasis post systemic chemotherapy.

SSK18-04 Local Response Assessment after Percutaneous CT-guided IRE of Hepatic Malignancies: How Useful is Diffusion-weighted MRI (DWI)?

Wednesday, Dec. 2 11:00AM - 11:10AM Location: N227

Participants

Alexandra Barabasch, MD, Aachen, Germany (Presenter) Nothing to Disclose
Philipp Heil, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Martina Dietelmaier, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Nils A. Kraemer, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Assessment of response to hepatic IRE using standard MR-sequences is difficult due to complex signal intensity (SI) changes of the ablation zones that occur during follow-up. DWI offers a high sensitivity for detection of liver metastases. Therefore, aim of this study was to evaluate if DWI is useful to help distinguish normal post-therapeutic SI changes after IRE from local recurrence.

RESULTS
Within the first two days after IRE, ADCmin-values decreased significantly compared to pre-treatment ADCmin in 26 of 37 patients. Thereafter, ADCmin values increased continuously in all of these patients and, within 1-3 months after IRE, were back to normal, i.e. reached the level of the ADCmin values of normal liver parenchyma. In 8/37 patients, this normalization of ADCmin-values was not observed, but instead, exhibited a further decrease of ADCmin at follow up (6 weeks - 12 months) that were then lower than the baseline ADCmin of the tumor before IRE treatment. At the time when the ADC-min decrease was found, remaining hepatic MRI pulse sequences, including visual analysis of DWI, were not suspicious of local recurrence. Only at later follow-up MRI, presence of local tumor recurrence was confirmed in 7 out of these 8 cases.

CONCLUSION
These initial results suggest that quantitation of ADCmin is useful to identify local recurrences after hepatic IRE, because changes of ADCmin (specifically, a new decrease of ADCmin after post-treatment ADC normalization) precede visually perceptible SI changes.

CLINICAL RELEVANCE/APPLICATION
DWI, with ADC-min quantitation, may allow early diagnosis of local tumor recurrence after IRE.

SSK18-05 MR Imaging Findings after Hepatic Irreversible Electroporation (IRE) - How to Depict Local Recurrence

Participants
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PURPOSE
We systematically followed patients after percutaneous IRE for primary or secondary liver malignancies according to a standardized follow-up MRI protocol. Our aim was to describe the normal changes of MR signal pattern over time that can be expected after IRE; this knowledge is important in order to allow the sensitive detection of signal intensity (SI) changes that are not within normal limits, i.e. likely represent local recurrence.

METHOD AND MATERIALS
27 patients (mean age 62y) with 37 malignant liver tumors (4 HCC, 33 metastases) underwent CT-guided percutaneous IRE. Pre-and post-interventional hepatic MRI (T2w TSE, dynamic CE T1w GE, T1w GE in late phase) with DWI (b=800) was performed before treatment, within 2 hours after IRE, at 24 hours after IRE, and at 1, 2, 4, 6, 8, 12 weeks after IRE, and every 3 months thereafter. MR-images were systematically analyzed by two readers in consent. The ablation volume was carefully manually rendered on each b=800 DW image of the ablation zone to create a volume of interest. Minimal ADC-values (ADCmin) were measured in the target lesion before treatment and in the ablation volume after treatment.

RESULTS
Even after successful IRE, in 23/37 (62%) cases, the ablated tumor was still visible, with unchanged SI and internal architecture as before IRE, for 1-8 weeks after IRE in 8/23 cases, for 3-9 months in 12/23 cases, and for more than 12 months in 3/23 cases. The ablation zone itself appeared as an intermediately hyperintense area on T2w images until 1 week after IRE in all cases. Thereafter, the ablation zone inverted its SI and appeared on T2w images immediately hypointense in the center, with a hyperintense rim, the latter exhibited strong contrast enhancement in 34/37 cases. This appearance persisted for 1-4 weeks in 17/34 cases, for 6-8 weeks in 10/34 and for 3-6 months in 7/34 cases. The ablation zones showed a steady decrease in size and disappeared completely in 21/37 cases (within 3 months in 16 cases). Local recurrences were observed in 7/37 (19%) cases and were visible as intermediately hyperintense masses on the edge of the intermediately low SI ablation zone on T2w images.

CONCLUSION
IRE induces complex signal intensity changes that vary over time. In the majority of cases, the treated target lesions were visible within the ablation zone over a longer period of time. This makes diagnoses of local recurrence difficult.

CLINICAL RELEVANCE/APPLICATION
Knowledge of the typical MR-imaging appearance of the IRE ablation zone and its changes over time is important to avoid diagnostic errors in the follow up of patients after IRE.
PROCEEDINGS OF THE COMMISSION ON MEDICAL PHYSICS AND BIOPHYSICS
Wednesday, Dec. 2 11:20AM - 11:30AM Location: N227

Participants
Johanna M. van Breugel, MSc, Utrecht, Netherlands (Presenter) Nothing to Disclose
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METHOD AND MATERIALS
Five pigs were placed on a Philips Sonalleve MR-HIFU system (1.5T, Philips Healthcare). PSA was induced using propofol (4.5-6mg/kg/h) and remifentanil (4.8-5.8μg/kg/h). Volumetric sonications were performed under PSA (4x4x10mm3, 450W acoustic power, 15-25s). MRI and acoustic energy delivery were respiratory gated with a pencil beam navigator. Then, GA was induced using midazolam (1mg/kg/h), nimbox (0.09mg/kg/h), and sufentanil (11.3μg/kg/h). Mechanical ventilation was set to 13/min and the ablation protocol was repeated. For both protocols the nonperfused volumes (NPVs) were measured and the duty cycles (DC) of the therapeutic sonications were compared. PSA was induced in two patients prior to HIFU treatment using propofol (1.4 and 1.6 mg/kg/h) and remifentanil (2.5 and 0.3 μg/kg/h). Vital functions were monitored.

RESULTS
Under GA a median DC of 64.0% (IQR 62-67, n=42) was achieved and of 79.5% (IQR 73-85, n=42) under PSA. The mean NPV per sonication was 0.09ml during GA and 0.16ml during PSA. Breathing frequency (BF) under PSA varied between 9-15 breaths/min. Vital functions remained stable. During both patient treatments under PSA the BF could be depressed to values as low as 5/min while the ETCO2 level stayed <6.5%, and blood pressure and heart rate values remained normal.

CONCLUSION
The animal experiments confirmed the feasibility of volumetric HIFU ablations using respiratory gating under PSA. The results were comparable or superior to those achieved under GA. The subsequent PSA procedures on human patients evidenced the similarity in respiratory depression of the PSA protocol while vital functions and patient safety were not impaired. Future work anticipates translation of these findings in a clinical liver ablation study.

CLINICAL RELEVANCE/APPLICATION
Magnetic Resonance-guided High Intensity Focused Ultrasound (MR-HIFU) ablation in the liver is complicated by the continuous target movement due to respiration. Respiratory gating represents a simple and robust solution, which usually requires general anesthesia (GA) to obtain a long resting phase. From a patient's perspective however, procedural sedation and analgesia (PSA) has advantages over GA: a lower risk of complications and shorter recovery.

SSK18-08 Preclinical Evaluation of an MR-Compatible Microwave Ablation System and Comparison with a Standard Microwave Ablation System in an ex Vivo Bovine Liver Model

Participants
Rudiger Hoffmann, Tubingen, Germany (Presenter) Nothing to Disclose
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Frank Eibofner, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose
Jakob Weiss, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolaou, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group
Speakers Bureau, Bayer AG
Stephan Clasen, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Philippe L. Pereira, MD, Heilbronn, Germany (Abstract Co-Author) Research Consultant, Terumo Corporation; Speaker, AngioDynamics, Inc; Speaker, BSD Medical Corporation; Speaker, Terumo Corporation; Speaker, Celona BioSciences, Inc; Speaker, Medtronic, Inc; Speaker, BTG International Ltd; Speaker, Biocompatibles International plc; Advisory Board, Siemens AG; Advisory Board, Terumo Corporation; Advisory Board, Bayer AG; Advisory Board, BTG International Ltd; Advisory Board, Medtronic, Inc; Support, Bracco Group; Support, Pharma Cept GmbH; Support, Terumo Corporation; Support, Siemens AG; Support, Novartis AG; Support, GlaxoSmithKline plc; Consultant, Celona BioSciences, Inc; Research Grant, Biocompatibles International plc; Research Grant, Siemens AG; Research Grant, Terumo Corporation; Research Grant, BTG International Ltd; Hans-Jorg Rempp, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS
Overall, 52 ablation procedures were performed in an ex vivo bovine liver phantom, with various non-perfusion cooled microwave ablation devices and varying ablation durations, using the following settings: [A] 16G standard antenna, 2cm active tip, 2.4m cable; [B] MR-compatible 16G-antenna, 2cm active tip, 2.4m cable; [C] MR-compatible 16G-antenna, 2cm active tip, extended 6m cable; [D] MR-compatible 16G-antenna, 4cm active tip, extended 6m cable. Ablation durations were 3min, 5min and 10min for settings [A]-[C], performing an additional 15min ablation for setting [D]. Settings [A]-[C] were compared regarding the size of the ablation, i.e., short axis diameter (SA), Volume (V), as well as the generator energy output (E), with analysis of variance and Tukey post
RESULTS

No statistically significant differences were found between [A], [B] and [C] regarding SA and V (10min; [A]: SA=25.8±2.4mm, V=17.8±4.4cm³; [B]: SA=25.3±1.9mm, V=16.6±3.0 cm³; [C]: SA=25.0±2.0mm, V=17.8±2.7 cm³); however, the highest generator energy output was measured for setting [C] ([A]: 9.9±0.5kJ, [B]: 10.1±0.5kJ, [C]: 13.1±0.3kJ, p<0.001). SA, V and E were significantly larger with setting [D] than [C] with 10min ablations ([D]: SA=34.0±2.9mm, V=39.4±7.5 cm³, E=16.7±0.8kJ) without significant difference in sphericity index ([C]: SA/LA=0.46±0.02, [D]: SA/LA=0.52±0.04, p=0.08). Largest ablation zone was achieved with setting [D] after 15 min ablation time (SA=41±1.4mm, V=60.9±5.2cm³, SA/LA=0.59±0.01).

CONCLUSION

The MR-compatible microwave antenna and a standard, comparable, non-MR-compatible microwave ablation device create similar ablation zones. Use of an extension cable for generator positioning outside the MR scanner room is possible without loss of ablation performance.

CLINICAL RELEVANCE/APPLICATION

The tested MR-compatible system can be used without loss of ablation performance compared to the standard system.

PURPOSE

To evaluate the efficacy and safety of computed tomography (CT) guided microwave ablation of tumors in hepatic dome.

METHOD AND MATERIALS

An Interventional Radiology database was used to retrospectively identify patients who underwent CT-guided percutaneous microwave ablation for liver tumors located in the hepatic dome between June 2011 and December 2014. Creation of artificial ascites was attempted as an adjunctive maneuver to displace the liver away from the right hemidiaphragm to minimize the potential risks of phrenic nerve injury, pneumothorax or peritoneal burn. Treatment response was assessed by either contrast material enhanced CT or magnetic resonance imaging (MRI) at 1, 3, 6, 9, 12 months and every 3 months thereafter. Primary clinical success was defined as absence residual tumor on one month post-ablation CT or magnetic resonance imaging. Secondary clinical success defined as no residual lesion after repeat microwave ablation.

RESULTS

Between June 2011 and December 2014, 46 patients (M: F = 31:15, mean age = 64.4 years, (range = 25-89 years) underwent CT-guided percutaneous microwave ablation for 48 tumors in the hepatic dome. Creation of artificial ascites with 0.9% normal saline solution (0.9% NS) as an adjunctive maneuver to displace the dome from the right hemidiaphragm was performed in 34/48 (70%) of ablations with mean volume of 1237.5 ml of fluid (range=300-3000 ml). Primary success was achieved in 41/48 (85%). Four tumors required retreatment to achieve complete necrosis for a secondary success rate of 94%. There were no major complications. Two patients experienced small, asymptomatic pneumothoraces that were aspirated at the time of the procedure and did not result in thoracostomy or unexpected hospitalization.

CONCLUSION

Computed tomography guided microwave ablation of hepatic dome lesions is associated with high success rate and low complication rate. Creation of artificial ascites may have a protective effect on minimizing the risk of thermal injury to the diaphragm and/or risk of significant pneumothorax.

CLINICAL RELEVANCE/APPLICATION

Computed tomography guided microwave ablation of hepatic dome lesions is associated with high success and low complication rates.
PURPOSE
1. Determine number/characteristics of breast cancers found in women undergoing imaging evaluation for focal breast pain.
2. Determine the optimal imaging evaluation of focal breast pain.

METHOD AND MATERIALS
We performed a chart review of 4720 women who underwent imaging evaluation of focal breast pain from 2001-2013. Women ages 18 and over with breast pain isolated to a single focus, quadrant, or two separate foci were included. Exclusion criteria were concurrent symptoms (palpable lump, nipple discharge/retraction); recent trauma; breast surgery in the last 6 months; lactation; and personal history of breast cancer. 944 patients met criteria. We recorded the type of imaging work-up, whether there was a corresponding finding at the site of pain, type of finding described, BI-RADS™ assessment, whether biopsy was performed, and pathologic outcomes. Subsequent imaging/clinical follow up was recorded.

RESULTS
Patients ranged in age from 18-90 (mean 47). Imaging evaluation consisted of sonogram (US) alone in 286 women, mammogram (MG) alone in 231 women, and both US/MG in 427 women. Mammographic parenchymal densities were 7% extremely; 41% heterogeneously; 43% scattered; 9% fatty. 111 women had an imaging finding at the site of pain, 99 of which were benign. 12 biopsies of corresponding findings were performed: 9 were benign (1 papilloma, 3 fibroadenomas, 5 other); 3 were malignant (1 invasive lobular, 1 invasive ductal, 1 ductal carcinoma in situ). The malignancies were diagnosed in three women, ages 56, 57, and 61. Two women had a family history of breast cancer. All three malignancies were seen on MG; 2 had an US correlate. At initial evaluation, 4 breast cancers were diagnosed remote from the site of pain. Follow up evaluation demonstrated subsequent breast cancers at the site of pain in 6 women, ranging from 1-10 years after initial presentation.

CONCLUSION
A corresponding imaging finding is seen in 11% of patients with focal breast pain. Neither breast density nor age correlates with focal breast pain. Focal breast pain rarely signifies malignancy (3/944 patients). No cancers were detected in women younger than 56; all cancers were visible on mammogram.

CLINICAL RELEVANCE/APPLICATION
Focal breast pain is common, but is rarely associated with malignancy (0.3% in our study). Optimal workup of focal pain may be guided by patient's age; targeted ultrasound may not be necessary if the mammogram is negative.
2 blinded breast radiologists using the BI-RADS lexicon, with only index lesion and patient age identified. Assessments were recorded and compared to the original prospective interpretation.

RESULTS
82 studies prospectively assessed as BI-RADS 3 were available for blinded review, including 43 cases (8 malignancies) and 39 controls. The first reader assessed 18/82 (22.0%) as BI-RADS 0, 13 cases, 5 controls; 35/82 (42.7%) as BI-RADS 2, 11 cases, 24 controls; 7/82 (8.5%) BI-RADS 3, 4 cases, 3 controls; 22/82 BI-RADS 4, 15 cases, 7 controls. The second reader assessed 8/82 (9.8%) as BI-RADS 0, 4 cases, 4 controls; 27 (32.9%) BI-RADS 2, 11 cases, 16 controls; 33 (40.2%) BI-RADS 3, 19 cases, 14 controls; 14 (17.0%) BI-RADS 4, 9 cases, 5 controls. The two readers had the same BI-RADS assessment on 34/82 (41.5%) exams. Of the 8 cancers, the first reader assessed 2 as BI-RADS 0, 1 as BI-RADS 2, 1 as BI-RADS 3, and 4 as BI-RADS 4; the second reader assessed 2 as BI-RADS 2, 4 as BI-RADS 3, and 2 as BI-RADS 4. Reasons for BI-RADS 0 assessment included incomplete mammographic views, lack of ultrasound for masses or asymmetries, and failure to include the lesion on follow up imaging. On blinded review, reasons for BI-RADS 4 assessment included suspicious morphology or documented instability.

CONCLUSION
Many BI-RADS 3 lesions were judged to have had incomplete diagnostic evaluation on blinded review. Lesions assigned to the BI-RADS 3 category are, by definition, challenging to evaluate. There is a large amount of inter-observer variability in assessment of these challenging mammographic lesions.

CLINICAL RELEVANCE/APPLICATION
Internal practice audits of upgraded and non-upgraded BI-RADS 3 lesions may improve consistency in interpretation as much inter-observer variability exists in assessment of lesions as probably benign.

HONORED EDUCATORS
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Catherine S. Giess, MD - 2015 Honored Educator
Robyn L. Birdwell, MD - 2015 Honored Educator

SSM01-03 Patient Preferences and Understanding of the Breast Imager's Role in Performing and Communicating Biopsy Results

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E451A

As the health care model transforms to a value-based system, radiologists may potentially add value by communicating biopsy results directly to patients. However, limited data is available in this area. Our purpose was to evaluate from whom patients want to hear results after image-guided breast biopsy procedures.

METHOD AND MATERIALS
An anonymous survey was offered to patients undergoing any image-guided breast biopsy before meeting the breast radiologist (BR) and after the procedure from March 16, 2015 - March 27, 2015 using SurveyMonkey, as part of a preliminary analysis. At our academic institution, the procedure team includes a technologist, radiology resident or breast imaging fellow, nurse practitioner, and attending BR.

RESULTS
27/41(66%) patients responded. 18/41(64%) thought the BR was a physician, 7/41(25%) a technologist, and 2/41(7%) were unsure. 27(100%) felt that the BR was an essential part of the breast care team. For normal results, before and after the procedure respectively, 14(52%) and 16(60%) wanted to hear from the ordering provider, 6(22%) and 5(19%) from the performing BR, 0(0%) and 1(4%) from anyone in breast imaging, and 7(26%) and 5(19%) from whoever would give results the soonest. (p=NS). For abnormal results, before and after the procedure respectively, 17(62%) and 22(82%) wanted to hear from the ordering provider, 6(22%) and 0(0%) from the performing BR, 0(0%) and 1(4%) from anyone in breast imaging, and 4(15%) and 4(15%) from whoever would give results the soonest (p<0.05).

CONCLUSION
Although patients perceive the BR to be an essential part of their care, most prefer to hear results from their ordering provider, especially if abnormal. Many patients did not know the BR was a physician, suggesting the need for better communication and further patient education.

CLINICAL RELEVANCE/APPLICATION
Although a BR may add value by giving biopsy results; patients prefer to hear from the ordering provider. Further study is needed to understand patient preferences and understanding of the BR role.
SSM01-04  Proteomics at Work: Can a Protein-based Blood Assay Help Detect Breast Cancer in Women Aged 25-75 with BI-RADS 3 or 4 Imaging Findings?

Wednesday, Dec. 2 3:30PM - 3:40PM Location: E451A

Participants
Ana P. Lourenco, MD, Providence, RI (Presenter) Nothing to Disclose
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Christa Corn, MD, Scottsdale, AZ (Abstract Co-Author) Employee, Provista Diagnostics, Inc
Michael Silver, MS, Scottsdale, AZ (Abstract Co-Author) Employee, Provista Diagnostics, Inc
Rao Mulpuri, Scottsdale, AZ (Abstract Co-Author) Employee, Provista Diagnostics, Inc
Kasey Benson, PhD, Scottsdale, AZ (Abstract Co-Author) Employee, Provista Diagnostics, Inc
Elias Letsios, Scottsdale, AZ (Abstract Co-Author) Employee, Provista Diagnostics, Inc

PURPOSE
To determine if a blood assay can improve breast cancer detection in patients ages 25-75 with BI-RADS 3 or 4 imaging findings.

METHOD AND MATERIALS
This IRB approved, HIPAA compliant prospective multi-center study enrolled patients aged 25-75 with BI-RADS 3 or 4 imaging findings. Informed consent was obtained. Eligible patients included women ages 25 - 75 with BI-RADS 3 or 4 imaging, no history of cancer and no prior breast biopsy in the last six months. Patients not undergoing biopsy had imaging follow-up at 6 months. Multiple algorithms for the detection of cancer were developed in the training set. These were validated and the data from the training was combined to perform a full prospective/retrospective analysis to optimize model sensitivity and specificity.

RESULTS
508 patients were enrolled and randomized; 300 in the training set and 208 in the validation set. Serum protein biomarkers (SPBs) and tumor associated autoantibodies (TAAbs) identified in prior proteomic screens were measured prior to biopsy. Pathology results were recorded for all patients undergoing biopsy, and imaging results were recorded for all patients undergoing 6 month follow-up imaging. Individual biomarker concentrations and patient data were evaluated using logistic regression models developed from prior studies. The most robust of these models utilized 5 SPBs together with 13 TAAbs to generate an initial sensitivity of 82.2%, specificity of 82.5%, PPV of 28.4% with a NPV of 97.5%. This model also produced an AUC of 0.8485 in a ROC analysis. 6-month follow-up is ongoing, and some patients presumed benign may be diagnosed with invasive cancer and/or DCIS at follow-up. Of the 508 BI-RADS 3 or 4 patients, 344 were biopsied resulting in the diagnosis of 51 malignancies (14.8%). By comparison, the protein based blood assay identified 148 patients to be biopsied and identified 42 malignancies (28.4%).

CONCLUSION
This multi-center study suggests that blood assays combining SPBs and TAAbs can differentiate benign from malignant breast disease in women aged 25-75 with BI-RADS 3 or 4 imaging findings with high sensitivity and negative predictive value.

CLINICAL RELEVANCE/APPLICATION
Blood assays that could distinguish benign from malignant breast disease may help decrease the number of benign breast biopsies performed, thus decreasing healthcare costs and patient morbidity.

SSM01-05  Focal Breast Pain: Does Breast Density Affect the Need for Ultrasound?

Wednesday, Dec. 2 3:40PM - 3:50PM Location: E451A

Participants
Michael W. Cho, MD, MPH, Durham, NC (Presenter) Nothing to Disclose
Lars J. Grimm, MD, Durham, NC (Abstract Co-Author) Advisory Board, Medscape, LLC;
Karen S. Johnson, MD, Durham, NC (Abstract Co-Author) Research Consultant, Siemens AG

PURPOSE
To evaluate the utility of ultrasound in women with focal breast pain who are categorized as low breast density (predominantly fatty and scattered fibroglandular) on digital mammography.

METHOD AND MATERIALS
This study retrospectively reviewed 2176 cases of breast pain imaged between 12/6/06 and 3/15/13. Of these, 248 met inclusion criteria for primary focal breast pain: women (mean age 53 years) with focal, non-axillary, non-radiating pain isolated to one quadrant. Women who were pregnant or lactating or who had associated symptoms of palpable lump, skin changes, history of trauma or infection were excluded. Digital mammogram and directed ultrasound were performed at initial presentation. Breast density, mammogram, ultrasound, biopsy findings (when applicable), and follow up imaging results (mean: 3.8 years, range: 2.0-8.1 years) were recorded.

RESULTS
Fourteen percent (35/248) of lesions were only detected by ultrasound and had no correlate on digital mammography. Lesions detected only by ultrasound (ultrasound-only lesions) occurred in women categorized in the following breast density categories on digital mammography: 0% predominantly fatty, 22% (5/23) scattered fibroglandular, 44% (10/23) heterogeneously dense, and 35% (8/23) extremely dense. Ultrasound-only lesions prompted four biopsies, which all resulted in benign histology. Additionally, 2% (4/248) of cases reported incidental ultrasound-only lesions, triggering either additional (benign) biopsies or a two year course of imaging follow up. At two-year follow-up, one patient developed breast cancer in the same quadrant as the site of primary focal pain, where no findings were initially detected by either digital mammography or ultrasonography. This occurred in a woman with heterogeneously dense breast tissue. No subsequent cases of breast cancer occurred in women with low breast density.

CONCLUSION
No cancers would have been missed by excluding directed ultrasound in the evaluation of focal breast pain in low breast density
women with a negative digital mammogram.

**CLINICAL RELEVANCE/APPLICATION**

Digital mammography alone without directed ultrasound appears to be a reasonable approach in evaluating primary focal breast pain in women whose breast density is categorized as either scattered fibroglandular or predominantly fatty.

**SSM01-06 Is Ultrasound Effective in the Detection of Breast Cancer in Patients Presenting with Breast Pain?**

Wednesday, Dec. 2 3:50PM - 4:00PM Location: E451A

Participants
Andrea X. Gallo, MD, Toronto, ON (Presenter) Nothing to Disclose
Monali Warade, MD, MBBS, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Franklin Goldberg, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Derek Muradali, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The purpose of this study is to determine if the routine use of ultrasound is appropriate for cancer detection in patients presenting with breast pain.

**METHOD AND MATERIALS**

All consecutive patients presenting to our department with a sole complaint of breast pain, who underwent a breast ultrasound, over a 4 year period, were included in this IRB-approved retrospective study. Patients with a history of breast cancer or palpable lumps were excluded. Breast ultrasounds were performed by technologists with 7-12 years experience and reviewed by one of two fellowship trained radiologists with 20 -25 years experience. All follow up imaging and pathology reports were reviewed.

**RESULTS**

422 patients were entered into the study (mean age 45 years). After the initial ultrasound, 368/422 patients were classified as BI-RADS 1 or 2, 40/422 as BI-RADS 3, 5/422 as BI-RADS 0 and 9/422 as BI-RADS 4. Follow up imaging tests included 5 mammograms, 236 ultrasounds and 5 MRI's over a 56 month period. At total of 26 image guided biopsies (20 core biopsies, 7 fine needle aspiration biopsies) and 1 surgical biopsy were performed for final diagnosis. All cases were classified as benign as a final diagnosis. There were no cases of invasive or non-invasive breast cancer.

**CONCLUSION**

Our data suggests that the prevalence of breast cancer in patients presenting with breast pain as a sole complaint is low. Breast ultrasound also resulted in a substantial number of unnecessary follow up imaging tests, potentially resulting in more harm than benefit in this patient population.

**CLINICAL RELEVANCE/APPLICATION**

The use of breast ultrasound to detect breast cancer in patients with breast pain as the sole presenting symptom may result in more harm than benefit, as the prevalence of breast cancer in this population is low.
SSM02
Breast Imaging (Ultrasound Advanced Applications)
Wednesday, Dec. 2 3:00PM - 4:00PM Location: E451B

Participants
Sughra Raza, MD, Boston, MA (Moderator) Nothing to Disclose
Catherine S. Giess, MD, Wellesley, MA (Moderator) Nothing to Disclose

Sub-Events
SSM02-01 The Utility of Ultrasound Superb Microvascular Imaging for Evaluation of Vascularity in Solid Breast Masses: Comparison with Color and Power Doppler Imaging-Interobserver Variability and Diagnostic Performance

Participants
Ah Young Park, MD, Ansan, Korea, Republic Of (Presenter) Nothing to Disclose
Bo Kyong Seo, MD, PhD, Ansan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ok Hee Woo, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Kyoonsoon Jung, Anyang, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Seon Jeong Oh, MD, Ansan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the utility of ultrasound Superb Microvascular Imaging (SMI) for evaluation of solid breast masses by comparing with conventional Doppler imaging.

METHOD AND MATERIALS
A total of 191 solid breast masses in consecutive 169 patients were prospectively evaluated with color Doppler (CDI), power Doppler (PDI) and SMI before core needle biopsy between February 2014 and March 2015. Three breast radiologists analyzed number, distribution (peripheral, central, or both), and morphology (dot, linear, branching or tortuous/penetrating) of vessels within the masses, and assessed BI-RADS categories on gray-scale images and all vascular images of each mass. These features were correlated with pathological results. We evaluated interobserver variability in imaging analyses with intraclass correlation and compared diagnostic performance between gray-scale imaging only and combined use of gray-scale and each vascular imaging, CDI, PDI, and SMI for discrimination between benign and malignant masses with receiver operating characteristic (ROC) curve analysis. In addition, we used Kruskal-Wallis test to determine whether three vascular imaging techniques had significant difference.

RESULTS
Pathological diagnoses revealed 92 cancers and 99 benign lesions. Interobserver variability was excellent in assessment of BI-RADS categories and analyses of vascular images (range of intraclass correlation coefficients, 0.86-0.98). SMI showed more number of vessels and more frequent central or both distribution and branching or tortuous/penetrating morphology than CDI and PDI (P<.0001). In the diagnostic performance, the area under the ROC curve (AUC) was the best in combined use of gray-scale and SMI (AUC=0.815) when compared with other modalities (AUC=0.774 for gray-scale only, 0.789 for combined use of gray-scale and CDI, and 0.791 for combined use of gray-scale and PDI) and this was statistically significant (P<.0001).

CONCLUSION
SMI is superior to CDI or PDI in the demonstration and characterization of vascularity in solid breast masses. The combined use of gray-scale and SMI can improve the diagnostic performance for the differentiation of benign and malignant breast masses.

CLINICAL RELEVANCE/APPLICATION
SMI is a recommendable technique for evaluation of tumor vascularity in the breast and could be a supportive tool for the differentiation between benign and malignant breast masses.

SSM02-02 Shear Wave Elastography Assessed with Maximum Visual Color Stiffness in Breast Lesions: The Role as a Complementary Study on B-mode US

Participants
Shin Ho Kook, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Seon Hyeong Choi, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yoon Jung Choi, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jung Eun Lee, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Inyoung Youn, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the diagnostic performance of shear-wave elastography (SWE) with maximum visual color elasticity assessment in addition to B-mode US and the value as a complementary study on B-mode US in breast lesions.
METHOD AND MATERIALS

From Jan 2011 to Dec 2013, 1621 lesions (1293 benign, 328 malignant) of 1561 patients (mean age, 50.5) who underwent B-mode US and SWE before biopsy were included. The size and BI-RADS final assessment of B-mode US features of each lesion were recorded. Color SWE was retrospectively assessed with maximum color stiffness, using the color scale. Two cut-off values as blue (<40kPs, group 1) or blue to green (<80kPs, group 2) were used as benign reference points to differentiate from malignant lesions. Diagnostic performance (sensitivity, specificity, PPV, NPV and diagnostic accuracy) of each B-mode US, color SWE, and combination of two modalities were statistically evaluated. And they were also evaluated according to the lesion size (<1cm, 1-2 cm, 2-3cm, 3cm <).

RESULTS

SWE with maximum visual color elasticity assessment showed improvement of 1.3 and 0.9% in specificity and 8.5 and 5.1% in PPV by adding color SWE on B-mode US in group 1 and 2 (p<0.001), without improvement of overall diagnostic accuracy. The sensitivity, specificity, PPV, NPV and diagnostic accuracy are as follows: 75.5%, 95.9%, 84.5%, 93% and 91.3% for B-mode only, and 38.3%, 97.2%, 93%, 61.9% and 68.2% in group 1, 52.8%, 96.8%, 90%, 79.7% and 81.7% in group 2 for combination of B-mode and color SWE respectively. Combination of B-Mode US and SWE results, according to the lesion size showed improvement of 1.1-1.8% in specificity and 5.1-17.8% in PPV in group 1 and 2. There was statistical significance in the lesions less than 2 cm in group 1 and 2 (p<0.001).

CONCLUSION

SWE with maximum visual color elasticity assessment added to B-mode US revealed improvement of specificity and PPV (P<0.001), without improvement of overall diagnostic accuracy. And it could be helpful as a complementary study to reduce the false positive diagnosis with confidence before making the decision of biopsy.

CLINICAL RELEVANCE/APPLICATION

B-mode US shows high sensitivity and relatively low specificity, SWE can decrease false positive by adding on B-mode US as a complementary tool with higher specificity and PPV than B-mode US.

SSM02-03 Downclassification of Suspicious Breast Masses Using Opto-Acoustic Imaging

Participants

Erin I. Neuschler, MD, Chicago, IL (Presenter) Nothing to Disclose
A. Thomas Stavros, MD, San Antonio, TX (Abstract Co-Author) Advisor, Devicor Medical Products, Inc; Advisor, General Electric Company; Advisor, SonoCine, Inc; Owner, Iconopedia, LLC; Medical Director, Seno Medical Instruments, Inc;
Philip T. Lavin, PhD, Framingham, MA (Abstract Co-Author) Research Consultant, Seno Medical Instruments, Inc
Michael J. Ulissey, MD, Auburn, WA (Abstract Co-Author) Consultant, Seno Medical Instruments, Inc; Stockholder, Tractus Company Limited

PURPOSE

Diagnostic specificity remains disappointingly low for methodologies optimized to achieve near 100% sensitivity. Seno Medical’s opto-acoustic (OA) imaging fuses real time co-registered, interleaved laser optic and ultrasound imaging showing dual functional findings (hemoglobin de-oxygenation) and morphology (angiogenesis) for breast masses using a hand-held probe. A 100 subject pilot study, conducted as part of a larger pivotal study, was evaluated for the potential ability of OA to downgrade BI-RADS (BR) scores in benign masses, specifically whether masses originally scored BR 4a or 4b could be downgraded to either BR 3 or 2 and if masses coded BR 3 could be downgraded to 2.

METHOD AND MATERIALS

7 independent readers (IRs) and the expert radiologist (ER) trainer blindly assessed all 102 masses from the 100 pilot study cases using only OA without any knowledge of clinical data or outcome. There were 75 biopsied masses (39 benign, 36 malignant). Gray-scale ultrasound images were taken with the OA device immediately prior to the OA exam. Later, the IRs assigned a BR score to these images, the internal ultrasound control (IUC). IRs were trained by the ER to identify and score three OA internal features and two OA external features for all masses. They were then immediately offered the results of two nomograms (that were calculated from their OA feature scores) to help predict the Probability of Malignancy (POM). A 2% or less POM was used as the threshold to define a mass that could be downgraded to BR 3. A 0% POM was used to downgrade a mass to BR 2.

RESULTS

Using OA, the IRs were able to downgrade site-CDU classified BR 3 masses to BR 2 in 33% of cases, BR 4a masses to BR 2 or 3 in 53% of cases, and BR 4b masses to BR 2 or 2 in 33% of cases. Using OA, the IRs downgraded IUC-classified BR 3 masses to BR 2 in 43% of cases, BR 4a to either BR 3 or 2 in 43% of cases, and BR 4b masses to either BR 3 or 2 in 13% of cases. OA (IRs) had 97.6% sensitivity and 44.4% specificity.

CONCLUSION

Benign masses classified as BR 3, 4a and 4b could be potentially downgraded to BR 3 or 2 by using OA with the aid of nomograms. The multi-center 2097 subject pivotal study will allow for confirmation.

CLINICAL RELEVANCE/APPLICATION

Downgrading BR 3, 4a and 4b masses without missing cancers is an unmet need. If verified, these findings could prevent not only biopsies but multiple follow-up ultrasound exams over 2 years.

SSM02-04 Prediction of Invasive Breast Cancer Using Shear-wave Elastography in Patients with Biopsy-confirmed Ductal Carcinoma in Situ

Participants

Jae Seok Bae, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
PURPOSE
To investigate whether lesion stiffness measured by shear-wave elastography (SWE) could predict histologic upgrade of ductal carcinoma in situ (DCIS) confirmed by ultrasound (US)-guided core needle biopsy (CNB).

METHOD AND MATERIALS
This retrospective study was conducted with institutional review board approval, and informed consent was waived. From January 2012 to February 2015, database search revealed 120 biopsy-confirmed DCIS in patients (mean age 52.4 ± 9.8) who underwent B-mode US and SWE prior to surgery. Clinicopathologic results, B-mode findings, size on US, mean and maximum elasticity values on SWE were recorded. Three radiologists independently analyzed qualitative color scores on SWE images using 5 point scale. To identify the preoperative factors associated with upgrade to invasive cancer, B-mode US findings, SWE information, and clinical variables were analyzed using univariate and multivariate logistic regression analysis. Qualitative color scores assessed by individual radiologists were analyzed to identify correlation with clinicopathologic variables, lesion size, and findings on B-mode US using multiple linear regression analysis. Interobserver agreements among radiologists on qualitative color score were assessed using multi-rater kappa statistic.

RESULTS
The overall upgrade rate was 41.7% (50 of 120). Mean, maximum stiffness values, qualitative color scores, and lesion size showed significant differences in upgrade and non-upgrade groups. Multivariate logistic regression analysis revealed mean (P=0.012), maximum stiffness (P=0.039), and lesion size (P<0.001) were significantly correlated with histologic upgrade. In reader study, color scores were correlated with the histologic upgrade, mammographic density, and B-mode category in all three radiologists (P value <0.04). The overall interobserver agreement for elasticity score was excellent (κ= 0.814 - 0.887).

CONCLUSION
Breast lesion stiffness measured by SWE could be helpful to predict the upgrade to invasive cancer in US-guided biopsy proven DCIS patients.

CLINICAL RELEVANCE/APPLICATION
For patients with DCIS confirmed by US-guided CNB, stiffness values on SWE can lead patient to undergo a proper one-step operation when surgical excision is performed.

SSM02-05 Is Contrast Enhanced Ultrasound as Good or Better than MRI in Evaluation of Breast Cancer Patients Receiving Neoadjuvant Chemotherapy?

Wednesday, Dec. 2 3:40PM - 3:50PM Location: E451B

Participants
Sandy C. Lee, MD, Los Angeles, CA (Presenter) Nothing to Disclose
Edward G. Grant, MD, Los Angeles, CA (Abstract Co-Author) Research Grant, General Electric Company ; Medical Advisory Board, Nuance Communications, Inc
Pulin A. Sheth, MD, Santa Monica, CA (Abstract Co-Author) Nothing to Disclose
Bhushan Desai, MBBS, MS, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Steven Cen, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Darryl Hwang, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Mary W. Yamashita, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Linda Hovanessian-Larsen, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose of this pilot study is to evaluate the performance of Contrast Enhanced Ultrasound (CEUS) versus Contrast Enhanced MRI (CE-MRI) in monitoring treatment response in breast cancer (BC) patients receiving preoperative neoadjuvant chemotherapy (NAC) by comparing tumor visibility and size.

METHOD AND MATERIALS
We prospectively studied 18 women diagnosed with invasive BC and receiving NAC, who had CEUS and CE-MRI as part of their preoperative imaging to detect tumor response. Each woman had three CEUS scans and at least two CE-MRI scans: (1) baseline prior to initiating NAC, (2) 3 weeks after initiation of NAC, and (3) after completion of NAC prior to surgery. The breast imager interpreting the CEUS or the CE-MRI was blinded to results of the other study. The presence of a lesion, tumor size, percent necrosis, and peak intensity were recorded. Results of the two techniques were compared to each other and to the gold standard histopathology obtained at surgery. Spearman correlation and intraclass correlation with absolute agreement were used to evaluate the findings.

RESULTS
All 18 women have biopsy proven invasive ductal carcinoma. The mean size of enhancing tumor at baseline on CEUS is 3.4 cm (range 1.5-6.9 cm) and on CE-MRI is 4.3 cm (range 2.5-7.7 cm). The results demonstrate a strong correlation in tumor size between CEUS and CE-MRI r=0.87 (p<0.01). Intraclass correlation also shows good absolute agreement, icc=0.78 (p<0.01). When comparing percent tumor necrosis between CEUS vs. CE-MRI, there is 80% agreement (95% CI of 40%, 98%). Comparable quantitative parameters, namely "peak intensity (tumor - normal)" for CEUS and "peak enhancement at one minute" for CE-MRI, demonstrate correlation with r=0.46 (p=0.05). Trends suggest that CEUS has a better degree of correlation and agreement than CE-MRI with tumor size at surgical pathology.

CONCLUSION
CEUS is comparable to CE-MRI in evaluating treatment response of breast cancer in patients receiving NAC. In our pilot series, CEUS was found to be a valuable imaging modality for determining the tumor size, percent necrosis, and peak intensity, and is
comparable to the results of CE-MRI.

**CLINICAL RELEVANCE/APPLICATION**

Further investigation with a larger cohort may prove that CEUS can be a better, more cost effective method than CE-MRI in monitoring treatment response in breast cancer patients receiving NAC.

**SSM02-06  Impact of Real-time MRI Navigated Ultrasound in Preoperative Breast Cancer Patients**

Wednesday, Dec. 2 3:50PM - 4:00PM Location: E451B

Participants

Ah Young Park, MD, Ansan, Korea, Republic Of (Presenter) Nothing to Disclose
Bo Kyong Seo, MD, PhD, Ansan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ok Hee Woo, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jaehyung Cha, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate the utility of real-time MRI navigated ultrasound (US) for second-look examination in preoperative breast cancer patients.

**METHOD AND MATERIALS**

Between October 2013 and February 2015, 55 consecutive breast cancer patients who underwent second-look US examination with real-time MRI navigated US to identify MRI-detected lesions on preoperative evaluation were enrolled. Of a total of 67 breast lesions, 41 lesions were detected on conventional US, 23 were additionally detected on MRI navigated US, and the remaining two were not found. The detection rates of conventional US and MRI navigated US were compared with McNemar test. We evaluated clinical data (age and change of surgical plan), and US findings (background echotexture, distance from nipple, and mass characteristics) and MRI findings (size, depth, type, characteristics, and kinetics of lesions) based on the BI-RADS lexicon. We compared these features between two groups with student T test, chi-square, or Fisher's exact test; 41 lesions detected with both conventional US and MRI navigated US (Group 1) and 23 lesions detected with only MRI navigated US (Group 2).

**RESULTS**

The detection rates of conventional US and MRI navigated US were statistically different, 61.2% (41/67) vs 95.5% (65/67) (P<.0001). Heterogeneous background echotexture (69.6% [16/23] vs 34.1% [14/41], P=.012), isoechoic masses on US (65.2% [15/23] vs 7.3% [3/41], P<.0001), and deep location on MRI (26.1% [6/23] vs 14.6% [6/41], P=.041) were more common in Group 2. The proportion of change in surgical plan was higher in Group 2 although there was less statistical significance (43.5% [10/23] vs 22.0% [9/41], P=.071). In 10 patients with change of surgical plan in Group 2, four underwent mastectomy due to multicentric cancers and six underwent additional excision due to concurrent high-risk lesions.

**CONCLUSION**


**CLINICAL RELEVANCE/APPLICATION**

Real-time MRI navigated US is useful to identify breast lesions on second-look US examination for MRI-detected additional lesions in breast cancer patients, which can affect treatment plan.
PURPOSE

In-stent restenosis is one of the most important limitations of coronary angioplasty (PCI). Accurate assessment of coronary stents after PCI using non-invasive CT imaging remains challenging despite new stent materials and improvements in CT technology. New model-based iterative reconstruction (IR) filters have been shown to significantly improve the assessment of native coronary vessels. In our study we systemically evaluated the influence of IR on visualization of coronary stent lumen.

METHOD AND MATERIALS

Ten coronary stents of various materials placed in plastic tubes filled with contrast agent (345 HU) were scanned with a 256-slice CT (iCT, Philips). Images were reconstructed (0.67mm slice thickness, 0.35mm increment) with standard filtered back projection, hybrid IR (iDose L4) and two different model-based IR settings (Cardiac Routine (CR) & Cardiac Sharp (CS)) at 3 strength levels (IMR, Philips). Each stent and reconstruction was assessed using established parameters: image noise (standard deviation (SD) in a standardized ROI), in-stent attenuation (mean attenuation difference between stented and non-stented lumen of the contrast agent-filled tube) and image sharpness (calculated maximum slope of signal intensity profiles across the stents).

RESULTS

Image noise was significantly lower in IMR data, being lowest at higher iteration levels (FBP 25.4/iDose 18.8/IMRCR1 9.6/IMRCR2 6.1/IMRCR3 3.4/IMRCS1 12.9/IMRCS2 8.6/IMRCS3 4.7 HU; p < .01). Differences in attenuation across the stents were significantly smaller in IMR data when applying the CR setting which showed the best depiction of the in-stent attenuation (FBP 372.8/iDose 353.9/IMRCR1 90.1/IMRCR2 110.8/IMRCR3 112.6 HU; p < .01). IMR CS however suppressed stent-blooming artifacts excessively with in parts severely reduced densities in stented tube lumina which might be explained by limitations of spatial resolution. Maximum image sharpness was significantly higher in IMR data (FBP 387.2/iDose 386.8/IMRCR1 656.2/IMRCR2 661.8/IMRCR3 647.0/IMRCS1 845.3/IMRCS2 862.8/IMRCS3 879.7 HU/pixel; p < .01).

CONCLUSION

Well-established objective CT image-quality assessment parameters of coronary stents are significantly improved by using model-based IR when the adequate setting is applied.

CLINICAL RELEVANCE/APPLICATION

Non-invasive evaluation of coronary stents is an important and challenging task. Model-based IR has the potential of significantly improving coronary-stent assessment.

SSM03-02 Assessment of Iterative Metal Artifact Reduction (IMAR) in Cardiac CT for Patients with Pacemakers and Implantable Defibrillators

Participants
Juan Montoya, Rochester, MN (Presenter) Nothing to Disclose
Shuai Leng, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Ahmed Halaweish, PhD, Rochester, MN (Abstract Co-Author) Employee, Siemens AG
Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG
Eric E. Williamson, MD, Rochester, MN (Abstract Co-Author) Research Grant, General Electric Company

PURPOSE

Metal artifacts from pacemaker leads and implantable cardioverter defibrillators (ICD) can significantly obscure relevant anatomy in
cardiac CT. This study aimed to apply iterative metal artifact reduction (iMAR) to Cardiac CT for improved visualization of lead tips and surrounding anatomy in patients with pacemakers and ICDs.

**METHOD AND MATERIALS**

CT raw data were retrospectively collected for patients that underwent clinically indicated gated CT of the heart using a dual-source CT scanner (Somatom Definition and Definition Flash, Siemens Healthcare) and had a pacemaker or ICD. Images were reconstructed using routine weighted-filtered back projection (WFBP) and a research prototype of cardiac iMAR using an offline reconstruction workstation. A cardiac radiologist evaluated WFBP and iMAR images side-by-side, blinded to the reconstruction method. Another investigator determined post hoc which image was WFBP and iMAR so that the following grading scale was applied to the iMAR images: 1=obviously worse, degrades diagnosis confidence, 2=slightly worse, does not affect diagnosis confidence, 3=equivalent, 4=slightly better, does not affect diagnosis confidence, 5=obviously better, improves diagnosis confidence. For objective metal artifact evaluation, the length of severe artifacts from each lead were measured in multiple axial images. Wilcoxon signed rank test was used to compare the radiologist evaluation as well as the difference in the length of metal artifacts.

**RESULTS**

16 patients (13 pacemakers, 3 ICDs) had a total of 31 leads. Mean reader grade was 4.5 for iMAR (P-value<0.001) indicating significant improvement of image quality and diagnostic confidence. The average reduction in the length of severe metal artifacts caused by the leads was 4.5 mm using iMAR compared to WFBP (p-value < 0.0001). Better metal artifact reduction was achieved in right ventricle leads, which we suspect is due to increased motion in the right atrium. Two iMAR cases created artifacts in anatomical regions different than lead tips.

**CONCLUSION**

The use of iMAR for cardiac CT in patients with pacemakers or ICDs can improve the visualization of anatomical structures close to the leads, resulting in improved diagnostic confidence.

**CLINICAL RELEVANCE/APPLICATION**

The use of iMAR in cardiac CT could improve the visualization of critical anatomy by significantly reducing artifacts from metal devices, leading to improved diagnostic confidence.

**SSM03-03  Cardiac Keynote Speaker: Congenital Heart Disease**

Wednesday, Dec. 2 3:20PM - 3:40PM Location: S502AB

Participants
Albert De Roos, MD, Leiden, Netherlands (Presenter) Nothing to Disclose

**SSM03-05  Pulmonary Insufficiency Assessment by Cardiac Magnetic Resonance: Regurgitation Fraction or Absolute Value of Reverse Volume?**

Wednesday, Dec. 2 3:40PM - 3:50PM Location: S502AB

Participants
Francesco Secchi, MD, Milano, Italy (Presenter) Nothing to Disclose
Marcello Petriti, Milano, Italy (Abstract Co-Author) Nothing to Disclose
Paola Maria Cannao, MD, San Donato Milanese, Italy (Abstract Co-Author) Nothing to Disclose
Elda Chiara Resta, Milano, Italy (Abstract Co-Author) Nothing to Disclose
Massimo Chessa, San Donato Milanese, Italy (Abstract Co-Author) Nothing to Disclose
Francesco Sandanelli, MD, San Donato Milanese, Italy (Abstract Co-Author) Speakers Bureau, Bracco Group Research Grant, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific
Mario Carminati, MD, San Donato Milanese, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare the use pulmonary regurgitation fraction (PRF) or absolute value of pulmonary reverse volume (PRV) in the evaluation of pulmonary insufficiency with cardiac magnetic resonance (CMR).

**METHOD AND MATERIALS**

We retrospectively studied 44 patients (mean age 23±11 mean value±standard deviation, 17 females and 27 males) with pulmonary/conduit insufficiency due to various congenital heart diseases who underwent CMR (1.5 T) before and after surgical valve implantation (14 patients) or percutaneous Melody valve implantation (30 patients). We performed short axis ECG triggered cine true-FISP (fast imaging with steady state precession) and phase contrast sequences. A reader with four-year of experience in CMR segmented endocardial contours of right ventricle (RV) to obtain end diastolic volume index (EDVI), stroke volume index (SVI) and analyzed the flow. We obtained both PRF (%), retrograde flow divided by anterograde) and PRV (ml/m2) and we correlated them with RVEDVI, SVI and differences (Δ) of RVEDVI before and after procedures. Spearman test was used.

**RESULTS**

Overall PRF (%), PRV (ml/m2), RVEDVI (ml/m2) and SVI (ml) were 23±25, 0.29±0.22, 99±43 and 45±16 respectively. RVEDVI was significantly correlated with PRF (r=0.480; P=.001) and PRV (r=0.549; P<0.001). RSVI was significantly correlated with PRF (r=0.605; P<0.001) and PRV (r=0.701; P<0.001). ∆RVEDVI was significantly correlated with PRF (r=0.427; P=.004) and PRV (r=0.489; P=.001).

**CONCLUSION**

PRV is stronger correlated with RVEDVI, RSVI and ∆RVEDVI than PRF.

**CLINICAL RELEVANCE/APPLICATION**

Pulmonary reverse volume is a stronger indicator of RV dysfunction than regurgitation fraction.
PURPOSE
Aortic coarctation is a narrowing of the aorta in the region of the transition between the aortic arch and the descending aorta where the fetal ductus arteriosus had joined. The AHA Guidelines recommended therapy for patients with a systolic coarctation pressure gradient of more than 20 mmHg. We have implemented a solution for the non-invasive assessment of aortic diameters and pressure gradients based on an MRI protocol combining a whole heart or angiographic MRI with a 4D PC MRI.

METHOD AND MATERIALS
The EXTENTO software prototype works with a 3D whole heart covering the aortic arch or MR angiography of the aorta for the extraction of the anatomical information and geometrical measurements. This is fused with a 4D PCMRI sequence for the assessment of the corresponding hemodynamics. The workflow consists of an interactive segmentation followed by the exploration of diameters as well as the centerline pressure difference curve for an interactively selected vessel region. Furthermore, pressure maps are visualized in 3D. The provided application has been applied to 5 datasets of patients scheduled for stenting therapy of aortic coarctation (age 11-44). All data were acquired with a Philips Achieva 1.5T scanner. Whole heart volumes were acquired with a resolution of 1.42x1.42x2mm³, 4D PC MRI had a velocity encoding between 3 and 4 m/s, a spatial resolution of 1.41x1.41x2.3mm³, and a temporal resolution of 40ms.

RESULTS
Data processing was possible in all cases and took 10 to 15 minutes. Systolic pressure gradients along the selected centerline sections were between 15 and 22mmHg and clearly visible in the calculated parameter maps.

CONCLUSION
The presented results suggest that the proposed MR imaging protocol and image processing solution could be suitable for the non-invasive assessment of stenoses in clinical practice.

CLINICAL RELEVANCE/APPLICATION
Aortic coarctation occurs in about 7% of all congenital heart defects. The high afterload induced by the stenosis can lead to ventricular dysfunction and thus a major therapy goal is to remove the pressure gradient. Pressure catheters are the standard diagnostic tool for the assessment of intravascular pressures. The suggested imaging and analysis aims at enabling the non-invasive measurement of relevant anatomic and hemodynamic information.
PURPOSE

A four-dimensional noise reduction (4DNR) method applied to datasets having short interval times (≤ 50 ms), referred to as legato, has been reported using phantom analysis to significantly reduce noise without changing the CT numbers or spatial resolution. Coronary CT angiography (CCTA) usually acquires datasets that include "padding" phases centered on the end-diastole. However, the additional information provided by additional phases has largely been ignored. Legato can be applied to such datasets to reduce image noise in CCTA. The present study conducts quantitative image quality analysis using retrospective clinical cases to examine the hypothesis that post-processing with legato reduces noise in CCTA images.

METHOD AND MATERIALS

The records of 25 consecutive patients (mean 63 [range 15-80] years old, 7 female) who had undergone routine CCTA using a retrospective ECG-gated helical scan (120 kVp, reference tube current-time product as 390 mAs) with a 128-detector row dual-source CT, were retrospectively reviewed. The three datasets for the end-diastolic phase were reconstructed with iterative reconstruction, and were post-processed including the implementation of legato. Image datasets for the center phase obtained from the collected and computed datasets are referred to as non-legato and legato images. Objective image quality was measured for various regions of interest, and subjective image quality was evaluated with a five-point Likert scale. The difference in image quality between non-legato and legato images was assessed by the Welch test and the Cochran-Armitage test.

RESULTS

Using legato, contrast-to-noise ratio and signal-to-noise ratio were significantly improved from 13.6 ± 2.8 to 22.9 ± 4.6, and 19.6 ± 4.1 to 29.7 ± 7.1 for the aortic root, and 17.7 ± 3.6 to 29.6 ± 5.5, and 14.2 ± 3.5 to 23.0 ± 6.6 for the mean of the proximal coronary arteries (P < 0.001 for each). Further, the subjective image score was also significantly improved using legato (median 4 to 5, P = 0.028).

CONCLUSION

Our proposed post-processing 4DNR method with short internal time reduced 40% of the image noise in clinical CCTA, and significantly improved image quality.

CLINICAL RELEVANCE/APPLICATION

Using the "padding" data, image quality of coronary CT angiography could be significantly improved using the post-processing 4DNR method.
Gui-Xiang Zhang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To assess the effect of IBR technique in correcting banding artifact of CCTA in 64-slice CT.

**METHOD AND MATERIALS**

Coronary CTA was performed on 70 patients with diagnosed or suspected coronary artery disease, using a 64-row CT scanner (GE Discovery CT750 HD). Image quality between standard reconstruction (group standard) and IBR reconstruction (group IBR) was compared by 2 experienced readers on GE AW4.6 workstation, using a 5-point scale, according to a standard 15-segment model by American Heart Association.

**RESULTS**

Mean heart rate range 43-132 bpm, 71 ± 13.29 bpm, there were 163 segments with 220 motion artifacts, IBR construction corrected 73.6% (162/220) of the artifacts. Stepladder as the most artifact, 97.27% of which were recovered after IBR reconstruction, and the majority artifacts of split-level, disconnection, density gradient were recovered well. Significant higher image quality was observed in IBR group than standard group (3.97 ± 0.93 vs 4.11 ± 0.92, p < 0.001). The interpretability was increased after IBR reconstruction at level of segment and artery with no statistically difference between two groups.

**CONCLUSION**

IBR technique is helpful in correcting banding artifact in CCTA of 64-slice CT.

**CLINICAL RELEVANCE/APPLICATION**

IBR technique provides a convenient and effective method to correct banding artifact, especially for ladder artifact, which is helpful in improving image quality and diagnostic accuracy of coronary CTA.

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Mathias Meyer, Mannheim, Germany (Presenter) Speaker, Siemens AG; Speaker, Bracco Group

**PURPOSE**

Coronary CT angiography (CCTA) is a reliable examination with a strong ability to rule out coronary artery disease. However, the radiation exposure from a CCTA examination was relatively high, in the last decade multiple technical improvements resulted in a decrease in radiation exposure. The high-pitch spiral scan mode allows for further reduction in radiation dose. However, as the scan is made in a single heart beat, a low heart rate has always been a necessity. With the introduction of the 3rd generation dual source CT (DSCT) the time needed for the acquisition has been reduced, allowing for acquisition in patients with higher heart rates. In this study we investigate the effect of heart rate on image quality when using the high-pitch spiral mode comparing the 2nd and 3rd generation DSCT.

**METHOD AND MATERIALS**

We retrospectively investigated the first 50 patients scanned with the 2nd and 3rd generation DSCT at our institution. The heart rate during acquisition was recorded. Tube voltage and current were selected semi-automatic. The table movement speed increased from 458 mm/sec to 737 mm/sec with the 3rd generation DSCT. Subjective image quality was measured by two independent observers using a five-point Likert score.

**RESULTS**

The mean heart rate was 56.4 ± 6.0 for the 2nd and 59.0 ± 7.4 for the 3rd generation DSCT (p = 0.045). Subjective image quality was better for the 3rd generation DSCT with a mean Likert score of 4.2 ± 0.8 vs 3.0 ± 0.7 (p = <0.0001). The decrease in image quality due to higher heart rates started at a later point for the 3rd generation compared to the 2nd generation DSCT (figure 1). The radiation dose for high-pitch spiral mode is already low, with a lower radiation dose of 0.6 ± 0.3 mSv for the 3rd generation DSCT compared with 1.2 ± 0.5 mSv for the 2nd generation DSCT (p < 0.0001).

**CONCLUSION**

Higher heart rates increase the change of a lower quality CCTA. When comparing the 3rd and 2nd generation DSCT the 3rd generation allows for a utilization of the high-pitch spiral mode at higher heart rates, increasing the population suitable for high-pitch spiral scan mode.

**CLINICAL RELEVANCE/APPLICATION**

With the applicability of the high-pitch spiral mode with higher heart rates the clinical usage can be further increased. Decreasing radiation exposure without concerns for image quality.
PURPOSE
To evaluate radiation dose and number of inconclusive coronary segments at coronary CT angiography (cCTA) using retrospective electrocardiographic (ECG) gating at 100/70kV.

METHOD AND MATERIALS
With IRB approval, 154 patients (median age 54 years; 98 men) with high or irregular heart rate prospectively underwent retrospectively ECG-gated cCTA on a third generation dual-source CT (DSCT) system at 70kV (n=103) or on a second generation DSCT system at 100kV (n=51). Images were reconstructed in best diastolic phase (BDP), best systolic phase (BSP), and in all phases (AP) at 10% intervals across the R-R cycle. Objective and subjective image quality were evaluated as well as the presence of motion artifacts with the three different reconstruction approaches. Comparisons between the groups were analyzed with two-way ANOVA or Wilcoxon-Rank-Sum Test depending on the distribution of the data.

RESULTS
Mean heart rate was 93 ± 16 beats per minute. The mean effective radiation dose was 4.5 mSv for 70kV compared to 8.4 for 100kV (p<0.05). At BDP reconstruction, 110 patients showed motion artifacts in one or more coronary segments (in total, 246 segments). At BSP reconstruction, the number of patients with motion artifacts decreased to 57 (147 segments). In contrast, if images were reconstructed with the AP approach, all vessels and coronary segments were evaluable with both cCTA protocols.

CONCLUSION
Retrospectively ECG-gated cCTA at 70kV results in 52% decreased radiation dose. This is especially important as the AP algorithm allows evaluating all coronary segments for stenosis, in contrast to best BDP or BSP phase alone. Furthermore, retrospectively ECG-gated cCTA allows for the evaluation of left ventricular function as a potentially useful diagnostic and prognostic adjunct.

CLINICAL RELEVANCE/APPLICATION
Retrospectively-ECG-gated coronary CTA at 70 kV without ECG-controlled tube current modulation strengthens the robustness of cCTA by significantly reducing the number of non-diagnostic coronary segments while radiation dose can be reduced.
**SSM05**

**Chest (Vascular/ Radiation Dose Reduction)**

Wednesday, Dec. 2 3:00PM - 4:00PM Location: S404CD

**Participants**

Edith M. Marom, MD, Ramat Gan, Israel (Moderator) Nothing to Disclose

Brett W. Carter, MD, Houston, TX (Moderator) Author, Reed Elsevier; Consultant, St. Jude Medical, Inc.

**Sub-Events**

SSM05-01 Dual Energy Pulmonary CT Angiography with a 3rd Generation Dual Source CT System Using 5.4g of Iodine in Comparison to a Second Generation DSCT Scan with 32g of Iodine: A Feasibility Study

**Awards**

Trainee Research Prize - Resident

**SSM05-02 Clinical Severity of Chronic Thromboembolic Pulmonary Hypertension: Assessment on Lung Perfused Blood Volume Images Acquired by Dual Energy CT**

**Participants**

Hidenobu Takagi, MD, Sendai, Japan (Presenter) Nothing to Disclose

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Kei Takase, MD, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose

### PURPOSE

To compare objective and subjective image quality between a dual-energy (DE) CT pulmonary angiography (CTPA) protocol using a 5.4g of iodine load versus standard CTPA protocols using a 32g iodine load.

### METHOD AND MATERIALS

This prospective IRB-approved study included 150 in-patients/emergency patients with suspected pulmonary embolism (78 male; mean age 65±17 years). Fifty patients who were examined on a 3rd generation dual-source CT (DSCT) with a newly optimized DE CTPA protocol had chronic renal insufficiency (estimated glomerular filtration rate <60ml/min/1.73m²) and thus received a low contrast media injection of 5.4g iodine. Each of these fifty patients were either examined with a standard CTPA protocol or a standard DE CTPA receiving an iodine load of 32g. For the DE CTPA virtual monochromatic spectral (VMS) datasets at 40-100keV were reconstructed. The optimal mean photon energy was determined, and subjective and objective image quality were evaluated and compared between these datasets. Comparisons between the groups were analyzed with two-way ANOVA or Wilcoxon-Rank-Sum Test depending on the distribution of the data.

### RESULTS

For the main pulmonary arteries the 50keV and for the peripheral pulmonary arteries the 40keV dataset provided the highest contrast-to-noise-ratio (CNR) for both DE CTPA protocols, with significantly higher CNR values for the standard DE CTPA protocol (p<0.05). These 40/50keV VMS datasets resulted in significantly higher CNRs if compared to the standard CTPA protocol for both the main and peripheral pulmonary arteries, again for both DE CTPA protocols (p<0.05). Subjective image quality did not significantly differ for both DE CTPA protocols when compared to the standard CTPA protocol (p>0.05).

### CONCLUSION

DE CTPA utilizing image reconstruction at 40/50keV allows for a significant reduction in iodine load while improving vascular signal intensity and maintaining CNR which is especially important in patients with chronic renal insufficiency.

### CLINICAL RELEVANCE/APPLICATION

Dual-energy CTPA allows for reducing the contrast media amount by 83%, while maintaining diagnostic image quality. This is of particular importance in patients with chronic renal insufficiency.
This Institutional Review Board-approved retrospective study included 39 consecutive patients with CTEPH (10 men, 29 women). LPBV was imaged with a second-generation dual-source CT scanner. Two radiologists independently scored the degree of perfusion defects in each lung segment according to the following criteria: score 0, no defect; score 1, defect less than half of a segment; score 2, defect in more than half of a segment. In case of disagreement, final consensus was reached by mutual discussion. The LPBV defect score was defined as the sum of the scores of 18 lung segments. Pulmonary artery pressure (PAP), right ventricular pressure (RVP), pulmonary vascular resistance (PVR), cardiac output (CO) and cardiac index (CI) were recorded by right heart catheterization (RHC). Brain natriuretic peptide (BNP) and 6 minutes walk distance (6MWd) were also recorded. Interobserver agreement was calculated by weighted Cohen’s kappa. Correlations between LPBV defect score and RHC-parameters, BNP and 6MWd were evaluated by Spearman’s rho correlation coefficients. P < 0.05 was considered statistically significant.

RESULTS
Interobserver agreement for scoring perfusion defects on each segment was good (κ = 0.79, 95% confidence interval, 0.75, 0.83). All patients showed abnormal lung perfusion in bilateral lungs with the median LPBV defect score of 16 (range, 5–23). Positive correlation of LPBV defect score was found with mean PAP (ρ = 0.50, P < 0.01), systolic PAP (ρ = 0.55, P < 0.001), diastolic PAP (ρ = 0.42, P < 0.01), PVR (ρ = 0.57, P < 0.001), RVP (ρ = 0.50, P < 0.01) and BNP (ρ = 0.42, P < 0.01), a tendency of negative correlation with 6MWd (ρ = -0.35, P = 0.08). No significant correlation was found with CO (ρ = -0.22, P = 0.18) or CI (ρ = -0.26, P = 0.11).

CONCLUSION
The LPBV defect score is significantly correlated with RHC- and clinical parameters, and may become a useful tool to estimate the severity of CTEPH.

CLINICAL RELEVANCE/APPLICATION
LPBV by dual-energy CT is useful for not only detecting abnormal findings of lung perfusion, but also for estimating the clinical severity in patients with CTEPH.

SSM05-03 Correlation between Pulmonary Emboli Characteristics and Perfusion Abnormalities in Material Decomposition Images of Dual Energy CT (DECT)
Wednesday, Dec. 2 3:20PM - 3:30PM Location: S404CD

Participants
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Amita Sharma, MBBS, Boston, MA (Abstract Co-Author) Nothing to Disclose
Efren J. Flores, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Jo-Anne O. Shepard, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
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Subba R. Digumarthy, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Shaunagh McDermott, FFR(RCSI), Boston, MA (Abstract Co-Author) Nothing to Disclose
Azadeh Tabari, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess relationship between iodine distribution abnormalities in pulmonary blood volume (PBV) images and type of pulmonary embol (occlusive versus non-occlusive) in virtual monochromatic DECT images.

METHOD AND MATERIALS
Our study included 57 patients (mean age 59±15 years, M:F 25:32, mean weight 77±19 kg) who had pulmonary embolism on chest CT. All CT exams were performed on single or dual source MDCT scanners capable of DECT. Virtual monochromatic (40–60keV), and PBV images were used for assessment. Images evaluated for enhancement in pulmonary arteries, the location of filling defects and their characteristics (occlusive vs non-occlusive). Pulmonary abnormalities were evaluated synchronously on virtual monochromatic and PBV images for location, shape, size, enhancement, and likely diagnosis. The presence of right heart strain (RHS) and diameter of pulmonary trunk were recorded. The CTDI vol, DLP were recorded. Data were analyzed using ANOVA and student’s t-test.

RESULTS
Mean CTDI vol was 8±2 mGy (range: 5–16). Mean pulmonary trunk diameter was 26±5 mm (15–44). Optimal/excellent enhancement in subsegmental pulmonary arteries was seen in 89% of cases. RHS was predicted in 40% of cases (23/57). Occlusive PEs (OPEs, present in 47/57 patients) was seen most commonly at segmental level (53%). Discordant pulmonary infarctions (characterized by PBV defects larger than size of radiographic opacity on lung window) were seen in 30% of cases, and were most often associated with segmental OPEs (28% of OPEs cases). Mismatched defects (defects seen on PBV without abnormality on lung window) were seen in 14% of cases, and were always associated with segmental OPEs (17% of total OPEs). Size-concordant infarctions and defects (size of PBV abnormality equal to radiographic abnormalities) were seen in 21% and 15% of OPEs cases, respectively. In total, 66% of total OPEs were associated with infarction or defects. Infarcts or PBV defects were noticed in 70% of expected RHS cases.

CONCLUSION
Presence of pulmonary infarction or perfusion defect on pulmonary blood volume images is a good predictor for presence of occlusive lobar or segmental pulmonary embolism as well as right heart strain.

CLINICAL RELEVANCE/APPLICATION
Presence of occlusive pulmonary emboli requires interpretation of PBV images to rule out any perfusion defects.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at:
SSM05-04  Do We Really Need Bolus Tracking for Chest CT Angiography?: Assessment of Fixed Delay Prolonged Bolus (FDPB) Contrast Injection Protocol, for Optimal Vascular Enhancement

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S404CD

Participants
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Shaunagh McDermott, FFR(RCSI), Boston, MA (Abstract Co-Author) Nothing to Disclose
Efren J. Flores, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Jo-Anne O. Shepard, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Mannudeep K. Kalra, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Subba R. Digumarthy, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To assess the feasibility of fixed delay prolonged bolus(FDPB) contrast injection during routine chest CT for evaluation of mediastinal and pulmonary vessels as compared to CT pulmonary angiography(CTPA) done with triggered bolus tracking(BT) techniques.

METHOD AND MATERIALS

Of the 100 patients included in our study, 50 patients underwent routine chest CT with FDPB(M:F 29:21, mean age 59±18 years, mean weight 77±15kg) and 50 weight-matched patients had CTPA using BT(4 cc/second, 370 mg%, 80ml), M:F 23:27, mean age 57±17 years, mean weight 77±15 kg. Patients weighing more than 90 kg and who got contrast injection via central venous catheter were excluded. The FDP injection involved administration of 25ml of contrast (370 mg%) at rate of 1ml/second followed by 55ml contrast at rate of 2.2ml/second with scanning at 57 second fixed delay. All CT scans were performed on (128-slice Siemens Definition Edge MDCT) using automatic kV selection technique(Care kV). All exams were assessed subjectively for vascular abnormalities (in pulmonary arteries, aorta, and heart), and artifacts. HU values in main pulmonary arteries and aorta, CTDI vol and DLP were recorded. Data were analyzed using student’s t-test.

RESULTS

Mean CTDI vol was 5±1.3 mGy for FDPB. Mean HU for FDPB in main pulmonary artery and ascending aorta were 311±79 and 305±49, respectively, with corresponding values of 371±110 and 219±88 for CTPA-BT. Optimal/excellent contrast enhancement at segmental level was seen in 92% of cases for FDPB compared to 86% for CTPA-BT examinations(p<0.9). The inability to rule out central pulmonary emboli was noticed in 3% of cases for FDPB and CTPA-BT. FDPB resulted in significantly superior enhancement in heart and thoracic aorta in all patients compared to CTPA-BT. Contrast streak artifacts were also substantially lower on FDPB than on CTPA-BT(p<0.001). For FDPB, 5% of cases revealed incidental pulmonary emboli compared to 9% of cases for CTPA-BT at segmental level.

CONCLUSION

Fixed delay prolonged contrast injection protocol can provide optimal contrast enhancement in pulmonary arteries, heart, and aorta compared to the bolus tracking technique. The prolonged injection results in substantially less artifacts.

CLINICAL RELEVANCE/APPLICATION

Fixed delay bolus of chest CT has the potential to be as the only chest contrast enhanced CT protocol for the evaluation of vascular and non-vascular chest abnormalities.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Subba R. Digumarthy, MD - 2013 Honored Educator
To estimate the ability to detect indeterminate pulmonary nodules ≥ 5 mm (IPNs) at varying dose levels using standard filtered back projection (FBP) and iterative reconstruction (sinogram-affirmed iterative reconstruction; SAFIRE) using a two-stage study design.

**METHOD AND MATERIALS**

In stage 1, CT projection data from 44 chest CT exams performed using automatic exposure control [70 Quality ref. mAs (QRM)] were collected. IPNs were identified by two thoracic radiologists who did not participate in the reader study. Using a validated noise insertion tool to simulate reduced doses, 10 datasets were reconstructed for each patient (FBP and SAFIRE at 5 dose levels each (2.5, 5, 10, 30, and 70 QRM)): 440 total cases). In each reading session, 3 thoracic radiologists randomly evaluated each patient’s data once using thin 1 mm axial and MIP images. Using a dedicated computer workstation, readers tightly circumscribed all IPNs, gave a confidence score (0 - 100), and graded image quality. A successful interpretation was defined as ≥ 2 readers localizing all “essential” IPNs (or no non-lesion localizations in negative cases), where an essential IPN was identified by the reference standard and ≥ 2 readers at 70 QRM FBP. Sample size calculations (p0=0.8, p1=0.9, alpha=0.05 (one sided)) determined ≥ 37 cases to pass through stage 1. JAFROC analysis was also performed on a per-lesion basis using a non-inferiority limit of -0.1.

**RESULTS**

Dose levels of ≥ 5 QRM (or 2.5 QRM using SAFIRE) met stage 1 criteria for correct interpretation. Using non-inferiority criteria, the JAFROC figure of merit was also non-inferior for all configurations except for 2.5 QRM FBP. At 5 QRM, pooled sensitivities and specificities were nearly identical between FBP and SAFIRE (FBP: 87% [95% CI: 70-95%] and 88% [74-95%], SAFIRE: 86% [69-94%] and 91% [75-97%]; respectively). Diagnostic image quality was greater for SAFIRE images at 10 – 70 QRM (p<0.05).

**CONCLUSION**

CT images reconstructed at dose levels corresponding to 5 - 30 QRM (and at 2.5 QRM when using SAFIRE) performed similar to 70 QRM FBP in this pilot study for detection of IPNs. Further study is needed to confirm this large potential for dose reduction.

**CLINICAL RELEVANCE/APPLICATION**

Whether or not iterative reconstruction is used, the radiation dose for screening or surveillance chest CT can be substantially lowered without compromising observer performance.

**SSM05-06 The Usefulness of a Dictionary Learning Post-processing Technique for Improving Image Quality of Low-Dose Chest CT**

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S404CD

Participants
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Kakuya Kitagawa, MD, PhD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Shuichi Murashima, MD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Hajime Sakuma, MD, Tsu, Japan (Abstract Co-Author) Departmental Research Grant, Siemens AG; Departmental Research Grant, Koninklijke Philips NV; Departmental Research Grant, Bayer AG; Departmental Research Grant, Guerbet SA; Departmental Research Grant, DAIICHI SANKYO Group; Departmental Research Grant, FUJIFILM Holdings Corporation; Departmental Research Grant, Nihon Medi-Physics Co, Ltd

**PURPOSE**

Low-dose CT is widely used for lung cancer screening. In low-dose conditions, however, CT images are prone to have increased noise and low-contrast detectability. Recently, our group developed a super-resolution (SR) technique based on a dictionary for enhancing image quality in MR angiography. The purpose of this study was to improve the image quality of low-dose CT by expanding the concept of the SR technique.

**METHOD AND MATERIALS**

Chest CT was acquired with 64-slice CT (Discovery CT750HD) by using a standard current of 200-300mA and a reduced current of 20mA in 12 patients who were referred for chest CT. We developed an image improvement method that consists of (1) generation of a dictionary representing the relationship between standard- and low-dose patches adopted from standard- and low-dose CT datasets, and (2) construction of high quality image from low-dose CT dataset by embedding optimal patches selected from the dictionary. For each patient, standard- and low-dose CT datasets in the remaining 11 patients were used to generate the dictionary. This procedure was repeated for all 12 patients. Image noise was evaluated as the standard deviation of CT intensity in the descending aorta. Qualitative assessment of image quality was performed for the mediastinum and lung by using a 5-point scale (5=excellent, 1=very poor) by two observers. In addition, image quality of abnormal lung structures (nodules or consolidation) were also assessed on a 5-point scale as well.

**RESULTS**

Image noise on low-dose CT was significantly reduced by using the dictionary learning method (20.4±7.9HU vs 48.5±13.7HU, p<0.0005). For image quality of the lung and mediastinum, low-dose CT generated by the dictionary learning method was rated significantly better than original low-dose CT (lung, score 2.8±0.6 vs 1.9±0.7, p=0.0039; mediastinum, score 2.9±0.8 vs 2.3±0.8, p=0.0078). Image quality of abnormal lung structures was also significantly improved by using the new technique (score 3.4±0.6 vs 2.7±0.6, p=0.0273).

**CONCLUSION**

The dictionary learning post-processing method can provide significantly improved image quality and reduced image noise on low-dose chest CT.

**CLINICAL RELEVANCE/APPLICATION**

Substantial improvement of image quality can be achieved by using the dictionary learning-based method on low-dose chest CT, leading to more accurate interpretation, while minimizing radiation dose.
Does FDG PET/CT Have Value in Detecting Recurrence of Esophageal Carcinoma?

Participants
Jonathan D. Dodd, MD, Dublin 4, Ireland (Moderator) Nothing to Disclose
Kyung S. Lee, MD, PhD, Seoul, Korea, Republic Of (Moderator) Nothing to Disclose

Sub-Events

PURPOSE
The purpose of this study was to determine the utility of FDG-PET/CT in detecting recurrent disease in patients with esophageal cancer after surgical resection.

METHOD AND MATERIALS
Subjects in this retrospective study were 125 consecutive esophageal cancer patients who were surgically treated between 3/31/2003 and 4/30/2012 and had routine follow up FDG PET/CT examinations. The number and sites of FDG avid lesions were retrospectively analyzed and were correlated with histological assessment and/or continued progression by imaging.

RESULTS
Of the 125 patients who met the inclusion criteria, 50 patients were confirmed to have recurrence in 62 sites, 53-1097 days postsurgery (median: 416 days). Recurrence was detected in 57% and 20% of patients within the first 12 and 24 months respectively after surgery. Forty-one patients (66%) had recurrence in distant organs (most commonly liver [20, 48%]), 16 (26%) lymph node metastases and 5 (8%) had recurrence at the anastomotic site. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of FDG-PET/CT for diagnosing recurrence at the anastomosis is 83%, 32%, 16%, 98% and 75%, for lymph nodes metastasis was 100%, 90%, 61%, 100%, and 92%. For metastases to distant organs was 100%, 96%, 93%, 96%, and 97%.

CONCLUSION
FDG PET/CT is accurate in detecting recurrence in patients after resection of esophageal cancer when recurrence is to metastatic lymph nodes or distant organs but has very low specificity and positive predictive value in the evaluation of anastomotic recurrence.

CLINICAL RELEVANCE/APPLICATION
This study clarifies the role of FDG-PET/CT in detecting recurrence in patients with esophageal cancer.

Low Attenuation of the Thyroid Gland on Noncontrast Chest CT is Predictive of Hypothyroidism

PURPOSE
To determine whether the mean computed tomography (CT) attenuation value of the thyroid gland can be used to predict hypothyroidism.

METHOD AND MATERIALS
A search of the electronic medical record was performed to identify patients with a diagnosis of hypothyroidism who received a
A search of the electronic medical record was performed to identify patients with a diagnosis of hypothyroidism who received a noncontrast chest CT scan. Consecutive patients without known thyroid gland dysfunction and with normal thyroid function tests who received a noncontrast chest CT scan were selected as a euthyroid control group. The mean CT attenuation value of the thyroid gland in Hounsfield units (HU) was determined for each patient using the standard workstation region-of-interest measurement tool.

RESULTS

210 patients (69% female; 31% male; mean age 66 years) with medically established hypothyroidism and 50 euthyroid patients (72% female; 28% male; mean age 65 years) were available for analysis. Mean CT attenuation values of ≤50 HU and ≤70 HU were highly predictive of hypothyroidism (specificity 100% [95% CI: 92-100%; P=0.01] and 98% [95% CI: 89-100%; P=0.001], respectively). The sensitivity of a mean CT attenuation value of ≤100 HU for detecting hypothyroidism was 74% [95% CI: 71-77%; P=0.006]. Overall, lower mean CT attenuation values predicted a higher relative risk for hypothyroidism.

CONCLUSION

Low mean CT attenuation (≤70 HU) of the thyroid gland on noncontrast chest CT is highly predictive of hypothyroidism.

CLINICAL RELEVANCE/APPLICATION

Hypothyroidism is an established treatable risk factor for cardiovascular disease. Many cases of hypothyroidism are subclinical. Hypothyroidism can be detected with high specificity on screening and diagnostic noncontrast chest CT scans, which can be used to augment the comprehensive cardiovascular risk assessment afforded by this examination.

SSM06-03 Generalized Mucositis-related Bronchiolitis in the Setting of Allogeneic Stem Cell Transplantation: A Potential Mimic of Lower Respiratory Tract Infection

Wednesday, Dec. 2 3:20PM - 3:30PM Location: S406B

Participants

Christopher Kloth, Tuebingen, Germany (Presenter) Nothing to Disclose
Ulrich Grosse, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
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Sergios Gatidis, MD, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose
Wolfgang Bethge, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolau, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG
Marius Horger, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To describe a little known therapy-related small airway phenomenon presumably caused by mucosal irritation in patients undergoing allogeneic stem cell transplantation (allo-SCT).

METHOD AND MATERIALS

Retrospective database search at our institution identified 739 hematological patients who underwent chemotherapy+allo-SCT between September 2004 and March 2014. After excluding infectious pulmonary complications, 75 patients (female=24; male=51; median age=47y) with signs of generalized bronchiolitis (GB) on chest-HRCT were identified. CT was performed proximate to chemotherapy-onset; 92% had follow-up-CT (mean, 1.9weeks). The presence of centrilobular nodules/bronchial wall thickening(BWT)/tree-in-bud(distributed diffuse vs. focal)/ground-glass-opacity(GGO)/airspace opacification/luminal impactions/air-trapping was correlated with occurrence and duration of oral mucositis and therapy characteristics. Intensity of tree-in-bud and centrilobular nodules was graded absent(grade=0), moderate(grade=1) and marked(grade=2).

RESULTS

Overall incidence of GB among allo-SCT-patients was 10.7%. GB was diagnosed at the time point of transplantation with a mean duration of CT-findings of 4 weeks(±2.7). Tree-in-bud (17%[grade 2] and 83%[grade 1]) and BWT was present in 100%. Centrilobular nodules were found in 45.5% of patients (20% [grade 2], 24% [grade 1] and 56% [none]) being always diffusely distributed. Air-trapping/mosaic pattern were found in 13% and 16%, respectively. Resolution of GB was spontaneous. GB and its severity correlated with the temporal course and grade of oral mucositis; frequency and degree was not significantly influenced by the chemotherapy regimen. The incidence of GB in HRCT was statistically significant higher in patients with oral mucositis (p=0.035).

CONCLUSION

GB is frequent during chemotherapy for allo-SCT and is characterized by even distribution of tree-in-bud/ BWT/centrilobular nodules, mild clinical symptoms and spontaneous resolution.

CLINICAL RELEVANCE/APPLICATION

Severe pulmonary complications occur in patients undergoing allo-SCT. Treatment strategy depends primarily on differentiation between infectious and non-infectious genesis. In the setting of respiratory symptoms lower respiratory tract infection must be suspected. However, knowledge of potential mimics is essential for accurate patient management. At this point, mucosal barrier injury (mucositis) represents a potential differential diagnosis.

SSM06-04 Dual-input Perfusion of Lung Lesions with 320-detector-row CT: Its Reproducibility, Value in differentiating Malignant from Benign Lesions and Correlation with Lesion Micro-vessel Density

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S406B

Participants

Hui Liu, Shanghai, China (Presenter) Nothing to Disclose
Jiang Lin, MD, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Jimei Yao, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Xuliang Lu, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PREVIEW

To compare dual-input CT perfusion with 320-detector-row CT (64/64) and single-input CT perfusion with 64 detector row CT (64/4) in the assessment of malignant and benign lung lesions.

METHOD AND MATERIALS

A search of the electronic medical record was performed to identify patients with a diagnosis of hypothyroidism who received a noncontrast chest CT scan. Consecutive patients without known thyroid gland dysfunction and with normal thyroid function tests who received a noncontrast chest CT scan were selected as a euthyroid control group. The mean CT attenuation value of the thyroid gland in Hounsfield units (HU) was determined for each patient using the standard workstation region-of-interest measurement tool.
PUNRCE
To investigate the reproducibility of dual-input CT perfusion (DI-CTP) of lung lesions with 320-detector-row CT, its value in differentiation of malignant and benign lesions and the correlation between CTP parameters and micro-vessel density (MVD).

METHOD AND MATERIALS
116 patients with various lung lesions confirmed by pathology underwent DI-CTP. There were 95 malignant and 21 benign lesions. The pulmonary trunk and the descending aorta were selected as input arteries for measuring contributions from pulmonary and bronchial circulation to the lesions. Pulmonary flow (PF), bronchial flow (BF), and perfusion index (PI) were calculated by two independent radiologists. Intraclass correlation coefficient (ICC) and Bland-Altman statistics were used to evaluate intra- and inter-observer agreement. 94 lesions had immunohistochemical staining with CD34. DI-CTP parameters were compared between malignant and benign lesions. Correlation between DI-CTP and MVD was studied.

RESULTS
Both intra- and inter-observer agreements were good to excellent (ICC>0.90). PF and PI of benign lesions were higher than those of malignant lesions. BF of malignant lesions was higher than that of benign lesions. Statistically significant differences of BF, PF and PI were found between malignant and benign lesions (P<0.05) with the area under the PI ROC curve being 0.936, the largest of the three perfusion parameters. There was statistically significant difference in MVD between benign and malignant lesions (P<0.05). BF, PF and TPF values were positively correlated with MVD (P<0.05).

CONCLUSION
DI-CTP is reproducible and reflects the angiogenesis of lung lesions. It can provide additional information for differential diagnosis of malignant from benign lung lesions.

CLINICAL RELEVANCE/APPLICATION
DI-CTP is reproducible and reflects the angiogenesis of lung lesions. It can provide additional information for differential diagnosis of malignant from benign lung lesions.

SSM06-05 The Effectiveness of Digital Tomosynthesis for the Nodule Detection in Danger Zone vs Non-Danger Zone: Phantom Study

Wednesday, Dec. 2 3:40PM - 3:50PM Location: S406B

Participants
Eun Young Kim, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Joo Sung Sun, MD, Suwon-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Taehee Kim, MD, PhD, Suwon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Seon Young Park, MD, Suwon-si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Kyung Joo Park, MD, Suwon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the effectiveness of digital tomosynthesis (DT) with dual-energy subtraction radiography (DES) and chest radiography (CXR) for detecting simulated pulmonary nodules (SPN) according to the nodule size and location.

METHOD AND MATERIALS
Four different sizes (5, 8, 10 and 12mm in a diameter) of SPNs (1~4 nodules/1 exam) were inserted into 8 different area of lung phantom classified as danger or non-danger zone (Fig 1). Three modalities of DT, DES, and CXR were all performed at the same time for every 96 examinations. Additional 96 examinations 3 modalities without nodule (normal control) were performed. Finally, a total of 192 examinations were prepared for each set of modality. Three sets of image data were randomly arranged and three observers independently reviewed all images in a random order. Three observers were asked to identify nodule and score confidence with 4 scales. Also asked to measure largest diameter of each nodule and record interpretation time. The jackknife alternative free-response receiver operating characteristic (JAFROC) was used to analyze overall diagnostic performance for each modality.

RESULTS
FROC analyses revealed significantly better performance (P <0.05) of DT than CXR and DES for the detection of pulmonary nodules. The observer-averaged figure of merit (FOM) was 0.78, 0.77 and 0.95 for CXR, DES, and DT, respectively. The TPF increased with an increase in size of the nodules. The mean interpretation time for DT (mean±SD, 53 ± 19 s) was higher (P<0.05; Wilcoxon test) than for CXR (28 ± 12 s) and DES (30 ± 11 s).

CONCLUSION
The DT significantly improved the diagnostic performance to detect pulmonary nodules than CXR and DES, especially nodules located in danger zone that easily obscured by superimposed vascular structure and bone structure.

CLINICAL RELEVANCE/APPLICATION
DT seems to be a superior modality for work up of pulmonary nodule with higher image quality and boosts its ability for nodule located in danger zone that easily obscured by superimposed bone and vascular structure on CXR and DES.

SSM06-06 Lung Nodule Classification using Learnt Texture Features on a Single Patient Population

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S406B

Participants
Lyndsey C. Pickup, MEng, DPhil, Oxford, United Kingdom (Presenter) Employee, Mirada Medical Ltd
Aamibika Talwar, MA, MBCHIR, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
Shameema Stalin, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
To validate the use of texture features and a machine learning approach to generate a "probability-of-malignancy" score for lung nodules.

Method and Materials

A database with 705 distinct pulmonary nodules (PNs) was created with contrast CTs from 139 patients in a selected geographical region. All patients with reported PNs from Jan-Apr 2013 were included; those with unavailable scans or malignancy status (by histology or 2-year stable follow-up) were excluded. The dataset contained 328 benign nodules, 7 primary cancers, and 370 metastases. 522 image texture features in 2D/3D were extracted from each PN and its borders (contoured using Mirada XD, Mirada Medical Ltd). These included Haralick, Gabor and Laws features, fractal dimensions, plus combinations and difference features, with dimensionality reduction using principal component analysis. A greedy algorithm selected maximally discriminative features one by one, and mapped feature responses to malignancy probabilities using a Support Vector Regressor (LibSVM). For robust analysis, the dataset was partitioned into distinct thirds: one for training, one for cross-validation (setting SVR parameters, using a simplex method), and one for testing (reporting AUC). For each feature set, 100 different splits were evaluated, with the mean AUC on each split being compared. A leave-one-out validation result was also computed, for ease of comparison to other work. The work was repeated on a dataset excluding patients undergoing chemotherapy at the time of the scan, leaving 160 malignant and 230 benign nodules.

Results

A mean AUC of 0.872 (std 0.020) was obtained by the feature set selected. The best single feature was the standard deviation of a Gabor filter response on the nodule boundary, and the peak mean AUC overall was obtained with 40 features. The leave-one-out AUC was 0.905, and this increase is to be expected because leave-one-out is less robust to overfitting than the three-fold approach. For the chemo-free population, the AUC was 0.942.

Conclusion

This texture feature model is successful at discriminating malignant and benign nodules over a large selection of nodules drawn from a single patient population. Future work should include more primary cancers.

Clinical Relevance/Application

Differentiating malignant and benign pulmonary nodules is a common clinical problem in which software may help support clinical decisions and guide patient management.
SSM07

Emergency Radiology (Neurologic Emergencies)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: S403B

Participants
Clint W. Sliker, MD, Ellicott City, MD (Moderator) Nothing to Disclose
Savvas Nicolaou, MD, Vancouver, BC (Moderator) Institutional research agreement, Siemens AG

Sub-Events

SSM07-01 Utility of Repeat Head CT in Mild Traumatic Brain Injury (mTBI) Patients Presenting with Small Isolated Falcine or Tentorial Subdural Hematoma (SDH)

Wednesday, Dec. 2 3:00PM - 3:10PM Location: S403B

Participants
Kavi K. Devulapalli, MD, MPH, San Francisco, CA (Presenter) Nothing to Disclose
Alisa D. Gean, MD, San Francisco, CA (Abstract Co-Author) Medical Advisory Board, Samsung Electronics Co Ltd Speakers Bureau, Educational Symposium International Stockholder, Global Indemnity plc Spouse, Employee, Global Indemnity plc
Jared A. Narvid, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Esther L. Yuh, MD, PhD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Blhaya Rehani, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Michael C. Huang, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
David McCoy, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Alina Uzelac, MD, Mill Valley, CA (Abstract Co-Author) Nothing to Disclose
Jason F. Talbott, MD, PhD, San Francisco, CA (Abstract Co-Author) Data Safety Monitoring Board, StemCells, Inc

PURPOSE
In cases of mTBI with acute intracranial hemorrhage, serial head CT (hCT) scans to evaluate stability are routinely performed, even in cases of isolated small hematomas which are not easily accessible for surgical decompression. This practice has not been validated, and repeat exams frequently necessitate increased emergency room stay times, ICU monitoring, and additional exposure to ionizing radiation. The goal of this study is to evaluate clinical and imaging features of isolated falcine and tentorial SDH at presentation and short term follow-up.

METHOD AND MATERIALS
A retrospective analysis of all patients presenting to our Level 1 trauma center from January 2013 through March 2015 undergoing initial and short-term follow-up hCT with initial findings positive for isolated SDH along the falx and/or tentorium was performed.

Patients with penetrating trauma, other sites of intracranial hemorrhage, brain contusion, or depressed skull fractures were excluded.

Clinical information including gender, age and history of anticoagulation was obtained through review of electronic medical records.

RESULTS
90 patients met inclusion criteria (55 males; 35 females; average age 57.8 years). 63% of SDHs were falcine, 32% tentorial and 5% mixed. On average, isolated falcotentorial SDHs were small (mean thickness = 2.7mm; range 2-8mm), without significant mass effect, and decreased in size on follow-up hCT with an average follow-up time of 8.4 hours. Increase in SDH size was seen in 3 patients (3%) with average increase in SDH thickness of 3.3-mm. No new intracranial hemorrhages were seen on follow-up hCT. 2 of 3 patients with increase in SDH were anti-coagulated (average INR = 3.8) and the remaining patient had a depressed platelet count. In total, nine patients (10%) were anti-coagulated at presentation with mean INR=3.2 (range 2.1-4.9).

CONCLUSION
Isolated falcine and tentorial SDHs in mild TBI are small and rarely increase in size on short term follow-up hCT. Present data suggest repeat hCT in mTBI patients with isolated falcine or tentorial SDH who are not anti-coagulated is unnecessary for assessing stability of hemorrhage. In anti-coagulated patients and patients with low platelet counts, follow-up imaging is advisable.

CLINICAL RELEVANCE/APPLICATION
Isolated parafalcine and paratentorial SDH are common findings after trauma and often necessitate repeat imaging. This project may help guide clinical decision making with regards to repeat imaging.

SSM07-02 Traumatic Midline Subarachnoid Hemorrhages on Initial Computed Tomography as Markers of Severe Diffuse Axonal Injury

Wednesday, Dec. 2 3:10PM - 3:20PM Location: S403B

Participants
Daddy Mata Mbemba, MD, PhD, Sendai, Japan (Presenter) Nothing to Disclose
Shunji Mugikura, MD, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Atsuhiko Nakagawa, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Takaki Murata, MD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Yasuko Tatewaki, MD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose

Awards
Trainee Research Prize - Fellow
The presence of intraventricular hemorrhage (IVH) on initial CT (iCT) has been recently reported to predict diffuse axonal injury (DAI) located in the corpus callosum or brain stem (severe DAI) on subsequent MRI. We aimed to test the hypothesis that midline (interhemispheric and perimesencephalic) subarachnoid hemorrhages (SAH) commonly associated with IVH on iCT could have a similar clinical value in predicting severe DAI.

METHOD AND MATERIALS
Consecutive 270 head trauma patients who underwent iCT within 24 hours and MRI within 30 days were included. First, as potential CT predictors of DAI, we used the following 6 CT items included in Marshall or Rotterdam CT scores: status of basal cistern, status of midline shift, epidural hematoma, IVH, SAH, and volume of hemorrhagic mass. Next, SAH were searched at cerebral cortices, sylvian fissures, sylvian vallecula, cerebellar folia, interhemispheric fissure, and perimesencephalic cisterns and a 7-grade (0 to 6, 0 means no SAH) SAH severity score based on these locations was assigned to each patient. Based on MRI results, patients were divided in two groups of DAI positive and DAI negative, and were assigned a following DAI staging reported to be prognostic in functional outcome, stage 3 being the worst: stage 0: no DAI, 1: DAI in the lobar white matter or cerebellum, 2: DAI in the corpus callosum with or without stage 1 lesions, and 3: DAI in the brain stem with or without stages 1 or 2 lesions.

RESULTS
77 (28.5%) of 270 patients had DAI. Of the 6 CT items, IVH and SAH were independently associated with DAI (both P<0.05). Of the locations, the interhemispheric and perimesencephalic SAH were the independent predictors of DAI (both P<0.05). SAH score and DAI staging showed significant positive correlation (P<0.0001). SAH score in DAI stage 3 or stage 2 was significantly higher than that of DAI stage 0 (both, P <0.0001). No statistical significant difference was noted in SAH score between DAI stages 0 and 1. The presence of midline SAH on iCT had sensitivity of 60.7%, specificity of 81.8%, PPV of 43.6% and NPV of 90% in predicting severe DAI.

CONCLUSION
Midline SAH on iCT are makers of DAI, specifically severe DAI. Using them as markers could greatly reduce unnecessary MRI in head trauma patients.

CLINICAL RELEVANCE/APPLICATION
Knowing that midline SAH on iCT has the same value as IVH in predicting severe DAI assists clinician to properly select head trauma patients who should undergo subsequent MRI.

SSM07-03 Delayed Intracranial Hemorrhage (ICH) in Patients Receiving Anti-coagulant or Prescription Anti-platelet (ACAP) Medication after Mild Blunt Trauma: Is Repeat hCT Necessary?

Wednesday, Dec. 2 3:20PM - 3:30PM Location: S403B

Participants
Kavi K. Devulapalli, MD, MPH, San Francisco, CA (Presenter) Nothing to Disclose
Alina Uzelac, MD, Mill Valley, CA (Abstract Co-Author) Nothing to Disclose
Esther L. Yuh, MD, PhD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
David McCoy, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Alisa D. Gean, MD, San Francisco, CA (Abstract Co-Author) Medical Advisory Board, Samsung Electronics Co Ltd Speakers Bureau, Educational Symposium International Stockholder, Global Indemnity plc Spouse,Employee, Global Indemnity plc Michael C. Huang, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Jason F. Talbott, MD, PhD, San Francisco, CA (Abstract Co-Author) Data Safety Monitoring Board, StemCells, Inc

PURPOSE
Current literature is conflicted with respect to the risk of delayed intracranial hemorrhage (ICH) in patients undergoing ACAP medication after blunt head trauma. Short interval follow-up hCT after an initially negative hCT is routine practice at many institutions. Given the rise in patients on ACAP therapy, we sought to formally evaluate our institution's 6-hour repeat hCT protocol in this population who present with an initially negative hCT after blunt trauma.

METHOD AND MATERIALS
A retrospective query of our radiologic database was performed to identify all consecutive non-contrast hCT studies performed between January 2013 and November 2014 using search terms for generic and commercial names of ten common anticoagulation and prescription anti-platelet medications in addition to the general terms "anticoagulant," "antiocoagulation" and "blood thinner." Studies were further screened on the basis of a prior CT within 24 hours, which was performed because of trauma and negative for intracranial traumatic pathology. Patients with indications for follow-up imaging other than ACAP use were excluded.

RESULTS
A total of 216 patients met inclusion criteria with only 2/216 (0.9%) developing delayed ICH. Both patients with delayed ICH were found to have trace volume subarachnoid hemorrhage in the ambient cistern, however without associated neurologic deficit or new symptoms. Both of these patients were receiving Coumadin antiocoagulation with average INR of 2.5 at the time of admission and were subsequently treated to reverse their antiocoagulation and discharged after short ICU observation without adverse event.

CONCLUSION
In our study, the incidence of delayed intracranial hemorrhage in patients receiving ACAP therapy was very small (<1%). The rare cases with delayed ICH were clinically silent. Present data build upon previous literature and lend further evidence that a short-interval follow-up CT among patients receiving ACAP therapy with an initially negative hCT after trauma may be unnecessary.
CLINICAL RELEVANCE/APPLICATION

Head CT is commonly performed after blunt trauma. Results from this study may help to guide clinical decision making regarding imaging in a subset of patients taking anti-coagulant or prescription anti-platelet medication.

SSM07-04 High-pitch Paranasal Sinus CT in Drunken Emergency Room Patients after Assault - Initial Results on Image Quality and Dose with Third-generation Dual-source CT

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S403B

Participants
Claudia Freillesen, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Patricia Dewes, MD, Frankfurt, Germany (Presenter) Nothing to Disclose
Boris Schulz, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Jan-Erik Scholtz, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Josef Matthias Kerl, MD, Frankfurt, Germany (Abstract Co-Author) Research Consultant, Siemens AG Speakers Bureau, Siemens AG
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Ralf W. Bauer, MD, Frankfurt, Germany (Abstract Co-Author) Research Consultant, Siemens AG Speakers Bureau, Siemens AG

PURPOSE
Image quality benefits from high-pitch scanning in agitated patients by freezing patient motion. We compared image quality and exposure parameters in patients with suspected maxillofacial fractures on second- and third-generation dual-source CT (DSCT)

METHOD AND MATERIALS
4 groups with 30 patients each were compared according CTDIvol, DLP, acquisition time and subjective image quality. The first group was examined on a second-generation DSCT (Flash, Siemens) with fixed 120 kV/50 mAs, pitch 3.0. The other three groups were examined on a third-generation DSCT (Force, Siemens): group 1 with fixed 120 kV/50 mAs and pitch 2.2; group 3 and 4 with fixed 120kV and automated exposure control (AEC) with 50 ref.mAs and pitch factors of 2.2 and 3.0, respectively. Images in groups 2-4 were reconstructed with iterative reconstruction (ADMIRE), in group 1 with FBP

RESULTS
Median CTDIvol (2.76 vs. 2.66 vs. 0.66 vs. 0.69 mGy) and DLP (58 vs. 41 vs. 13 vs. 14 mGycm) were significant lower in group 3 and 4 scanned on the third-generation DSCT with AEC (-76%/-75% and -75%/74%; p < 0.0001) without significant difference among each other. Subjective image quality was rated best in group 2 followed by group 3, both with a pitch factor of 2.2 (average scores: 1.87/1.70 vs. 1.40/1.30 vs. 1.63/1.50 vs. 2.43/2.27). Due to strong high-pitch artefacts the subjective image quality of group 4 was inferior to all other groups. Median acquisition time was significantly faster using third-generation DSCT (450 ms vs. 300 ms vs. 380 ms vs. 270 ms; p < 0.05).

CONCLUSION
Third-generation DSCT yields faster acquisition times and substantial radiation dose reduction using AEC. A pitch of 2.2 should be preferred since high-pitch artefacts are reduced. Although AEC was used, subjective image quality remains stable and reliable with iterative reconstruction

CLINICAL RELEVANCE/APPLICATION
Faster CT examination of agitated patients with suspected maxillofacial trauma with reduced radiation exposure and reliable image quality.

SSM07-06 Dual Energy in Noncontrast Head CT: Differentiation of Calcification from Acute Hemorrhage

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S403B

Participants
Christopher A. Potter, MD, Boston, MA (Presenter) Nothing to Disclose
Andrew Primak, PhD, Malvern, PA (Abstract Co-Author) Employee, Siemens AG
Aaron D. Sodickson, MD, PhD, Wayland, MA (Abstract Co-Author) Research Grant, Siemens AG; Consultant, Bracco Group

PURPOSE
To evaluate whether a novel DECT postprocessing application that separates calcification from hemorrhage can reliably differentiate these materials in non-contrast head CT foci in an indeterminate Hounsfield Unit (HU) range.

METHOD AND MATERIALS
DECT acquisitions of noncontrast head CTs were performed in the Emergency Department on a 128x2 slice dual-energy scanner (Siemens FLASH, Forchheim Germany). All scans containing foci of intracranial calcification or hemorrhage of 50-85 HU were included. Foci were designated as calcium or hemorrhage based on typical morphology or confirmatory imaging. DECT acquisitions used tube voltages 100/Sn140 kVp and tube current modulation (CareDose4D) using reference mAs 300/300. Source images from each tube were reconstructed as 0.75 x 0.5 mm slices and used for postprocessing on thin-client server (Syngo via, version VA30). The Brain Hemorrhage 3-material decomposition application designed to differentiate iodine from hemorrhage was modified by changing the iodine dual energy ratio to the calcium ratio of 1.44. Dual energy regions of interest (ROI) were placed to measure HU and standard deviation (std) in the mixed high/low kVp image, and the corresponding virtual non-calcium (VNca) and calcium-map (Ca) images. CTDIvol and DLP values were recorded.

RESULTS
10 foci each of calcification and hemorrhage were analyzed. Foci could not be differentiated based on mixed-image HUs (unpaired t-test p=0.24), with mean +/- std (range) of 63 +/- 7 (55-73) HU for hemorrhage and 68 +/- 12 (52-84) HU for calcification. VNca and Ca images demonstrated excellent separation of hemorrhagic from calcified foci (both p<0.0001). Calculated HU due to calcium content was 4 +/- 10 (-7-26) HU in hemorrhages and 48 +/- 15 (28-72) in calcific foci. VNca content was 58 +/- 12 (44-80) HU in hemorrhages and 20 +/- 7 (10-28) in calcific foci. A VNca threshold value of greater than 35 HU correctly attributed all hemorrhage and calcium cases. X-ray tube output mean +/- std (range) values were CTDIvol 48 +/- 4 (40-54) mGy and DLP 842
CONCLUSION
DECT can reliably differentiate intracranial calcification from hemorrhage in a proof-of-principle cohort of indeterminate HU value foci where densities typically overlap.

CLINICAL RELEVANCE/APPLICATION
DECT shows promise in differentiating foci of hemorrhage from calcification in ranges where HU values overlap, which may be beneficial when HU values alone are not definitive.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Aaron D. Sodickson, MD, PhD - 2014 Honored Educator
SSM08

Gastrointestinal (Loco-regional Therapy Liver Imaging)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E353A

AMI PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Debra A. Gervais, MD, Chestnut Hill, MA (Moderator) Nothing to Disclose
Steven S. Raman, MD, Santa Monica, CA (Moderator) Nothing to Disclose

Sub-Events

SSM08-01 Irreversible Electroporation in Patients with Hepatocellular Carcinoma: Immediate Versus Delayed Findings on MR Imaging

Wednesday, Dec. 2 3:00PM - 3:10PM Location: E353A

Participants
Guy E. Johnson, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Matthew J. Kogut, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
James Q. Park, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Raymond S. Yeung, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Daniel S. Hippe, MS, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company
Siddharth A. Padia, MD, Seattle, WA (Presenter) Nothing to Disclose

PURPOSE
Irreversible electroporation (IRE) is a non-thermal technique used to ablate soft tissue tumors. Our study assessed MR imaging appearance after IRE for the treatment of hepatocellular carcinoma (HCC).

METHOD AND MATERIALS
In this institutional review board-approved retrospective study with waiver of informed consent, twenty patients with HCC were treated with IRE over a 2.5 year period. Median patient age was 62, and 75% of patients had Child-Pugh A cirrhosis. Median tumor diameter was 2.0 cm (range 1.0-3.3 cm). Contrast-enhanced multiphase MR was performed on post-procedure day 1, 30, and every 90 days thereafter. Ablation zone sizes and signal intensities were compared between each time point for both T1- and T2-weighted images. Trends in MR signal intensity and tumor dimensions over time were quantified using generalized linear models.

RESULTS
MR appearance of a treated tumor includes a zone of peripheral enhancement with centripetal filling on delayed post-contrast images. Compared to post-procedure day one, there is a decrease in enhancing ablation zone size of 28.9% (mean) every 90 days. There is a trend towards decreasing signal intensity of the peripheral ablation zone over time on both T1- and T2-weighted images. Trends in MR signal intensity and tumor dimensions over time were quantified using generalized linear models.

CONCLUSION
IRE of HCC results in a large region of enhancement on immediate post-procedure MR, which involutes on follow-up imaging. This is associated with decreasing signal intensity of the peripheral ablation zone over time. This phenomenon may represent resolution of the reversible penumbra.

CLINICAL RELEVANCE/APPLICATION
1. Understanding of the standard MR imaging appearance after IRE can help guide future therapy and assess prognosis with respect to tumor response. 2. The large area of enhancement seen after IRE may represent regions of reversible electroporation, which may be used to optimize treatment protocols or target localized drug delivery in future studies.

SSM08-02 Local Hepatic Tumor Control in Patients with HCC Undergoing Transarterial Lipiodol Embolisation Followed by Microwave Ablation

Wednesday, Dec. 2 3:10PM - 3:20PM Location: E353A

Participants
Roland M. Seidel, MD, Homburg, Germany (Presenter) Nothing to Disclose
Alexander Massmann, MD, Homburg/Saar, Germany (Abstract Co-Author) Nothing to Disclose
Peter Fries, MD, Homburg, Germany (Abstract Co-Author) Nothing to Disclose
Guenther K. Schneider, MD, PhD, Homburg, Germany (Abstract Co-Author) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group;
Ame Buecker, MD, Homburg, Germany (Abstract Co-Author) Consultant, Medtronic, Inc Speaker, Medtronic, Inc Co-founder, Aachen Resonance GmbH Research Grant, Siemens AG

PURPOSE
To investigate local tumor control in patients with HCC undergoing lipiodol embolization and subsequent microwave ablation.

METHOD AND MATERIALS
25 patients with 35 HCC (mean size 23mm, SD 9mm) underwent superselective transarterial embolization with lipiodol. Subsequently
percutaneous CT guided microwave ablation of the tumors was performed using a 2,45 GHz generator (power output 80 to 120W) with cooled tip probes (Acculis, Angiodynamics, USA). All patients were investigated before therapy by unenhanced and dynamic contrast enhanced MR or CT; follow up was performed within 1, 3, 6 and more months after treatment. Treatment was rated as successful in case of a complete rim of necrosis surrounding the lesion and no further tumor growth. Patient data were evaluated retrospectively on a PACS workstation by two readers in consensus.

RESULTS
In 24 of 25 (96%) patients a complete ablation was diagnosed on the early follow up imaging. The patient rated with incomplete ablation presented tumor progression on follow up imaging. 1 patient initially rated as complete ablation presented lesion progression and underwent chemoembolization with no residual tumor up to 510 d after microwave ablation. Overall complete ablation rate per patient was 92% (23 of 25 patients) and 94% per lesion (33 of 35 lesions).

CONCLUSION
Microwave ablation in combination with lipiodol embolization for patients with HCC is a valuable therapeutic procedure for smaller hepatic tumors. Especially the targeting and embolizing potential of the retained lipiodol is likely to contribute to a more reliable tumor access and ablation effect.

CLINICAL RELEVANCE/APPLICATION
The treatment of smaller local HCC tumors becomes more and more an issue in the bridging to transplant situation and therefore minimal invasive percutaneous ablation techniques become attractive, since local tumor control is in the range of surgical treatments. This study demonstrates a reliable minimal invasive targeting and embolization technique in combination with microwave ablation for the enhancement of local tumor control.

SSM08-03 Analysis of a Series of Microwave Ablated Native HCCs: Which Parameters do Affect Outcome after Treatment?

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E353A

Participants
Valentina Battaglia JR, MD, Pisa, Italy (Presenter) Nothing to Disclose
Salvatore Mazzeo, MD, Pisa, Italy (Abstract Co-Author) Nothing to Disclose
Carla Cappelli, MD, PhD, Pisa, Italy (Abstract Co-Author) Nothing to Disclose
Rosa Cervelli, Pisa, Italy (Abstract Co-Author) Nothing to Disclose
Piercarlo Rossi, MD, Pisa, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Bartolozzi, MD, Pisa, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the efficacy at 1 month after treatment of ultrasound-guided percutaneous microwave ablation (MWA) of series of native HCCs.

METHOD AND MATERIALS
From January 2013 to February 2015, 221 patients with a single HCC lesion were candidate for ultrasound-guided percutaneous MWA. Of them, 113 were excluded because of patients’ habits or limited US visibility of the lesion (42 and 71 patients respectively). Finally, our study included 108 patients who were treated with MWA for a single hepatic lesion. All lesions were classified on the basis of dimensions, location and venous vessel contiguity. A cooled shaft antenna of 16 or 14 Gauge was percutaneously inserted into the tumor under ultrasound guidance. Microwave emitting power and time of treatment were tailored to tumor size (ranging from 35 to 50W). Lesions were classified on the basis of dimensions (1.5cm to 2cm: 31/108; 2.1 to 3cm: 54/108; 3.1 to 4cm: 23/108), of location: centrohepatic, subcapsular, close to gallbladder, para-hilar and para-caval. Moreover, lesions were divided into subdiaphragmatic (23: yes; 86: no) and on the basis of proximity (<5mm) to vascular structures (59: yes; 54: no). In all cases, a CT evaluation performed 1 month after procedure was done. Tumor response after treatment was evaluated by means of mRECIST. Statistical analysis was performed by means of Chi-square test and bivariate correlation.

RESULTS
All neoplasm were ablated in a single session and no major complication occurred. At CT evaluation, 84 lesions showed a Complete Response, 23 Partial response and 1 lesion Stable Disease. Statistical analysis showed no significant relationship between complete response and tumor size, time of ablation or power applied. At bivariate analysis, tumor location and subdiaphragmatic position did correlate (p<0.0001) with lesions’response to treatment, independently from dimensions and technical parameters of power emission.

CONCLUSION
In our series, tumor size did not appear to impact complete ablation rates, whereas lesion localization represents the most important factor influencing tumor response.

CLINICAL RELEVANCE/APPLICATION
Lesions’characteristics might lead to formulate a grading on the basis of whom to predict tumor response after treatment.

SSM08-04 Local Treatment for Colorectal Cancer Liver Metastases, Comparison of Radiofrequency Ablation and Surgical Metastasectomy

Wednesday, Dec. 2 3:30PM - 3:40PM Location: E353A

Participants
Naik Vietti Violi, Lausanne, Switzerland (Presenter) Nothing to Disclose
Alban L. Denys, MD, Lausanne, Switzerland (Abstract Co-Author) Nothing to Disclose
Pierre E. Bize, MD, Lausanne, Switzerland (Abstract Co-Author) Nothing to Disclose
Rafael Duran, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Nicolas Demartines, MD, Lausanne, Switzerland (Abstract Co-Author) Nothing to Disclose
Nermin Halkic, Lausanne, Switzerland (Abstract Co-Author) Nothing to Disclose
Diagnostic Performance of DECT in the Assessment of Treated Zone Following Percutaneous Ablation in Renal Cell Cancer: Image Quality and Radiation Dose Considerations

Wednesday, Dec. 2 3:40PM - 3:50PM Location: E353A

Participants
Diana Murcia, MD, Boston, MA (Presenter) Nothing to Disclose
Andrea Prochowski Jamurri, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Manuel Patino, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ronald S. Arellano, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Dushyant V. Sahani, MD, Boston, MA (Abstract Co-Author) Research Grant, General Electric Company; Research Consultant, Allena Pharmaceuticals, Inc.
Avinash R. Kambadakone, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the diagnostic performance of DECT in the evaluation of treated zone following percutaneous ablation of renal cell cancer (RCC) with assessment of value of iodine images (MD-I), image quality and radiation dose considerations.

METHOD AND MATERIALS
In this retrospective study, 26 patients (17 M, 9 F, mean age 69 years) with RCC treated with percutaneous ablation were included. The patients underwent contrast enhanced nephrographic phase dual energy CT scan with a single-source dual energy CT (750HD GE Healthcare, Milwaukee WI) as part of post ablation surveillance. In this cohort, 13 patients had single energy unenhanced scans. All the patients in this cohort had renal mass protocol single energy CT (SECT) at different time-points. Post processed subtraction, material density iodine (MD-I) and virtual unenhanced images were generated. Two blinded radiologists reviewed the SECT and DECT images in two separate sessions for ablation zone margin, presence of residual/recurrent tumor, image quality and presence of artifacts with a 5 point confidence score. The CTDI and DLP were recorded and compared between DECT series and SECT series.

RESULTS
A total of 28 RCC underwent percutaneous ablation. DECT with MD-I iodine images demonstrated higher specificity for detection of abnormal enhancement in the ablation zone suggesting residual tumor/recurrence compared to SECT (30% vs 91%). The image quality score for DECT (with MD-I) was higher compared to standard SECT images (5 vs 4.1 of SECT with p<0.05) with higher number of artifacts recorded in the subtraction images generated from standard non-contrast and contrast enhanced CT images (25% of cases). A single phase DECT had significant radiation dose reduction in comparison to dual phase SECT scans (736.11±231.6 mGy-cm vs 1596.5±450.2 mGy-cm; p<0.001) and the radiation dose considerations of nephrographic phase DECT and SECT were comparable (736.11±231.6 mGy-cm vs 609.5±169.1 mGy-cm; p=0.179).

CONCLUSION
DECT with iodine specific images improves diagnostic performance in the evaluation of ablation zone in RCC as compared to standard SECT images with significant reduction of radiation dose due to exclusion of non-contrast phase.

CLINICAL RELEVANCE/APPLICATION
Post ablation surveillance of treated zone in patients with RCC can present diagnostic challenges with the need for non-contrast...
SSM08-06 CT and MR Imaging Features to Predict Residual or Recurrent Hepatocellular Carcinoma after Transarterial or Percutaneous Treatment

Wednesday, Dec 2 3:50PM - 4:00PM Location: E353A

Participants
Eric C. Ehman, MD, San Francisco, CA (Presenter) Nothing to Disclose
Sarah Umetsu, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Nicholas Fidelman, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Linda Ferrell, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Benjamin M. Yeh, MD, San Francisco, CA (Abstract Co-Author) Research Grant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextarst, Inc
Judy Yee, MD, San Francisco, CA (Abstract Co-Author) Research Grant, EchoPixel, Inc
Thomas A. Hope, MD, San Francisco, CA (Abstract Co-Author) Advisory Committee, Guerbet SA; Research Grant, General Electric Company

PURPOSE
To determine which CT and MR features are most predictive of viable hepatocellular carcinoma (HCC) following percutaneous or transarterial treatment.

METHOD AND MATERIALS
Pathology reports for liver explants from 12/2012-7/2014 with CT or MR imaging performed within 90 days of transplant (45±28 days) were reviewed. Patients with a history of hepatocellular carcinoma and preoperative treatment including transarterial chemoembolization (TACE) or percutaneous ablation (radiofrequency, microwave, cryo, ethanol) were included. Each lesion was reviewed on the most recent pre-transplant imaging study and size, location and enhancement features recorded. Pathology slides were reviewed and the size of viable tumor nodule recorded (if present).

RESULTS
91 patients with 135 treated lesions were included. 88(65%) lesions were imaged with CT and 47(35%) with MR, including 89(66%) post-TACE, 24(18%) post-ablation, and 22(16%) post both TACE and ablation. At explant, 69(51%) of lesions showed viable tumor. 11/42(26%) of viable lesions at CT and 15/27(56%) at MR demonstrated nodular arterial enhancement (p=0.02). Washout was seen in 13/42(31%) of viable HCCs at CT and in 6/27(22%) at MR (p>0.05). Capsule appearance was seen in 2/42(5%) of viable lesions at CT and in 1/27(4%) at MR (p>0.05). Using each criteria to diagnose a study positive for recurrence, sensitivity and specificity were 38% and 92% for nodular enhancement, 28% and 94% for washout and 4% and 100% for capsule. Using any of the three criteria, overall sensitivity and specificity were 45% and 91%. Detection rate for nodular recurrence was 33% for lesions <1cm, 55% for lesions 1-2cm and 71% for lesions >2cm. Lesion detection by size was similar at CT and MR.

CONCLUSION
No single imaging finding was sensitive for viable HCC following treatment. Nodular arterial enhancement was the most frequently seen, and seen significantly more at MR than at CT. Washout was less frequently seen and seen equally at MR and CT. Capsule was rarely seen but when present always predicted recurrence. There is limited detection of lesions <1cm both at MR and CT and only marginal detection between 1-2cm.

CLINICAL RELEVANCE/APPLICATION
Post-treatment imaging is difficult to interpret and imaging features predictive of recurrent or residual disease are not well understood. Accurate diagnosis of viable tumor at post-treatment imaging is important to guide future therapy such as repeat TACE or ablation.
**Purpose**
This study was designed to quantify the degree of fluctuation in esophageal dimensions during continuous swallowing on Magnetic Resonance (MR) Imaging.

**Method and Materials**
30 healthy volunteers (25 males and 5 females, age range: 15-45 years) were chosen for the study. MR examination was done using a 1.5 tesla magnet. Initially, the esophagus was imaged in the resting state (Resting MR). Then, the volunteer was asked to drink water continuously and another set of MR images were obtained (Swallowing MR). The thoracic esophagus was divided into three segments (upper, middle and lower) based on anatomical landmarks. Diameter and the wall thickness of the esophagus were measured in each segment and the cross sectional area (CSA) was calculated.

**Results**
The esophageal CSA increased by twofold on swallowing MR scans as compared to the resting scans [Median(interquartile range) increase in CSA in upper segment - 117.3%(61-162.2), in middle segment - 87.7%(54.3-162.9) and in the lower segment - 122.1%(78.9 - 188.1)]. The anteroposterior and transverse diameters of the thoracic esophagus increased by about 60% as compared to the resting MR scans. The mean wall thickness of the thoracic esophagus was reduced by about 25% on swallowing MR as compared to resting scan.

**Conclusion**
Our study helps to define normal changes in esophageal dimensions during continuous swallowing. The lower third of the thoracic esophagus appears to be the most distensible segment.

**Clinical Relevance/Application**
Swallowing MRI has been proposed as an experimental investigative modality for motility disorders of the esophagus and knowledge of the fluctuation in esophageal dimensions during swallowing might be of clinical utility.
findings.

RESULTS

There were 32 well-to-moderately differentiated and 35 poorly differentiated squamous carcinoma verified by pathology. IC values of the well-to-moderately differentiated squamous carcinoma in both the arterial phase (AP) (2.66±1.07mg/ml) and venous phase (VP) (2.12±0.94mg/ml) were lower than that of the poorly differentiated squamous carcinoma (2.85±1.25mg/ml and 2.57±1.06mg/ml, respectively). The NIC value of the well-to-moderately differentiated squamous carcinoma was also lower than that of the poorly differentiated squamous carcinoma: 0.12±0.05 vs. 0.13±0.06 in AP and 0.42±0.13 vs. 0.61±0.18 in VP, respectively. Statistical differences of IC and NIC were found between the two groups in VP (both p<0.05) but not in AP (p>0.05).

CONCLUSION

There are correlation between the iodine concentration and normalized iodine concentration of esophageal cancers and their histological differentiation stages. IC and NIC parameters obtained in spectral CT for the esophageal cancer in the venous phase can be used as new indexes to differentiate esophageal cancer stages.

CLINICAL RELEVANCE/APPLICATION

Parameters such as normalized iodine concentration in esophageal cancer determined in spectral CT may be used to differentiate esophageal cancer stages.

SSM09-04 The Use of 3T Multiparametric MRI in the Staging of Esophageal Cancer (EC)

Wednesday, Dec. 2 3:30PM - 3:40PM Location: E353B

Participants

Daniela A. Cenzi, MD, Verona, Italy (Presenter) Nothing to Disclose
Lisa Zantedeschi, MD, Verona, Italy (Abstract Co-Author) Nothing to Disclose
Lucia Camera, Verona, Italy (Abstract Co-Author) Nothing to Disclose
Giacomo Schenal, Verona, Italy (Abstract Co-Author) Nothing to Disclose
Massimiliano Motton, MD, Verona, Italy (Abstract Co-Author) Nothing to Disclose
Stefania Montemezzi, MD, Verona, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate diagnostic feasability of MP-MRI for the preoperative staging of EC and to assess its efficacy in discrimination between
responders and non-responders in those who underwent neoadjuvant treatment (NT).

**METHOD AND MATERIALS**

Between 2011 and January 2015, 36 patients with biopsy-proven EC underwent 3T MRI with the same approach: T2 weighted images, DWI and DCE sequences, with cardiac and respiratory gating. According to local invasion (T1-2 vs T3-4) and nodal involvement (N- vs N+), we identified 11 patients with organ confined lesion who underwent surgery: MR-staging results were compared with histopathological findings directly. 25 patients were addressed to NT and restaging MRI after treatment was compared to histological findings after surgery. Sensitivity (SE), specificity (SP), positive (PPV) and negative (NPV) predictive value and accuracy were calculated for the both groups. For NT group, changes in ACD and changes in DCE time intensity curve at MRI before and after treatment were calculated. 2 readers independently determined: pre-NT and post-NT ADC, percentage changes in ADC (%ADC), DCE time intensity curves and interobserver variability.

**RESULTS**

Surgery group: for T staging, SE was 98 %, SP 78 %, accuracy 90%; for N staging SE was 67 %, SP 60 %, accuracy 64%. NT group after NT: for T staging SE was 80 %, SP 85 %, PPV 67%, NPV 92%, accuracy 89% and 76%, 78%, 50%, 91% and 91% respectively for N staging. Responders showed lower pre-NT ADC (1.30 vs 1.80Å~10-3mm2/s; P=0.002) and higher post-NT ADC (2.50 vs 1.64Å~10-3mm2/s; P=0.001) than non-responders and ADC increased in responders (%ADC, 90.28 versus 11 %, respectively). A slight difference was observed in DCE curves but without a significant difference (p>0.05). Interobserver reproducibility was good both for surgery (k 0.68) and post-NT (k 0.86).

**CONCLUSION**

MR can correctly stage organ-confined lesions according to the high specificity (for the T stage) and to rightly assess pathological nodal involvement (for the N stage) thanks to the good SE. The ADC can be used to assess esophageal tumour response to NT treatment as a reliable expression of tumour regression.

**CLINICAL RELEVANCE/APPLICATION**

Preoperative staging in esophageal cancer is critical in order to prompt a surgical (T1-T2 stages without nodal involvement) or neoadjuvant therapy (T3-T4 stages with nodal involvement).

**SSM09-05 Textural Analysis of Baseline 18F-FDG PET for Predicting Treatment Response and Prognosis in Patients with Locally Advanced Esophageal Cancer**

Wednesday, Dec. 2 3:40PM - 3:50PM Location: E353B

Participants
Xiaorong Sun, Jinan, China (Presenter) Nothing to Disclose
Lu Sun, Jinan, China (Abstract Co-Author) Nothing to Disclose
Ligang Xing, Jinan, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Textural features on baseline 18F-FDG PET have shown the potential role in predicting treatment response in mixed stage esophageal cancer. This study is aim to investigate the value of this new technique for locally advanced esophageal squamous cell cancer (ESCC) receiving chemoradiotherapy.

**METHOD AND MATERIALS**

Under a waiver from IRB, 48 patients with newly diagnosed locally advanced ESCC who treated with concurrent chemoradiotherapy were retrospectively reviewed. Thirty-nine patients with early stage ESCC were included as control. All patients underwent pretreatment whole-body 18F-FDG PET/CT. Fifty-four texture indices describing global, local, and regional features were measured in addition to 5 conventional indices as standardized uptake values (SUVs, including maximum, peak, and mean SUV), metabolic volume (MV), and total lesion glycolysis (TLG). Patients were classified as responders (R, complete or partial response) and non-responders (NR, stable or progressive disease) according to RECIST1.1. Progression-free survival (PFS) and overall survival (OS) were recorded. The prognostic significance of parameters was examined using receiver-operating-characteristic curves, Kaplan-Meier analysis, and Cox regression analysis.

**RESULTS**

Both intratumor heterogeneity and mean/peak intensity of FDG uptake were significantly higher in locally advanced ESCC than those in early stage. Thirty-four texture indices, MV, and TLG showed the ability to differentiate R from NR. Nine texture indices showed higher sensitivity (76.7%-86.7%) and specificity (77.8%-94.4%) than MV (76.7% and 83.3%) and TLG (73.3% and 83.3%). Ten texture indices and MV were hazard factors of PFS and OS. Large-zone emphasis, one of the regional texture indices, was the only independent predictor of survival, with hazard ratio of 4.22 (95%CI:1.83~9.72) for PFS and 3.90 (1.74~8.79) for OS. None of the SUVs could predict treatment response and survival.

**CONCLUSION**

FDG PET texture indices provide better predictive information than conventional parameters for locally advanced ESCC.

**CLINICAL RELEVANCE/APPLICATION**

The clinical application of FDG PET texture analysis could be an important step in personalized treatment of esophageal cancer.

**SSM09-06 CT Signs Can Predict Treatment Response and Long-Term Survival: A Study in Locally Advanced Esophageal Cancer with Preoperative Chemotherapy**

Wednesday, Dec. 2 3:50PM - 4:00PM Location: E353B

Participants
Xiao-Yan Zhang, Beijing, China (Presenter) Nothing to Disclose
Xiaoting Li, Beijing, China (Abstract Co-Author) Nothing to Disclose
Zhilong Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Accurate prediction of treatment response and prognosis before surgery will allow prompt therapy adjustment. This study proposed to evaluate the efficacy of CT signs on treatment response and survival for advanced esophageal squamous cell carcinoma patients with preoperative chemotherapy.

METHOD AND MATERIALS

This study retrospectively enrolled 135 consecutive patients with preoperative chemotherapy from September 2005 to December 2011. Logistic regression model was conducted to evaluate the association between pathological response and CT signs. Overall survival (OS) and disease-free survival (DFS) were estimated using Kaplan-Meier method and Cox proportional hazards model was constructed to determine associations between CT signs after neoadjuvant chemotherapy and survival outcomes.

RESULTS

The logistic regression showed the total LN number (> 6) at baseline and the CT value change rate (≤ 17%) were significant for poor response; OR were 5.07 (95% CI, 1.86 to 13.81, P = 0.002) and 2.35 (95% CI, 1.05 to 5.23, P = 0.037), respectively. In Cox analyses, preoperative tumor thickness (> 10 mm), total LN number (>6), and short diameter of the largest LN (> 10 mm) were significant for OS, HR were 2.33 (95% CI, 1.36 to 4, P = 0.002), 1.88 (95% CI, 1.12 to 3.17, P = 0.017) and 1.87 (95% CI, 1.07 to 3.28, P = 0.028), respectively; whereas only the short diameter of the largest LN was significant for DFS, HR was 2.36 (95% CI, 1.23 to 4.54, P = 0.01).

CONCLUSION

CT signs can predict therapeutic efficacy and survival outcomes and provide an opportunity to offer additional treatment options before surgery.

CLINICAL RELEVANCE/APPLICATION

This study provided the first evidence that CT signs can predict survival outcomes and therapeutic efficacy of patients with esophageal cancer who received preoperative chemotherapy. Therefore, it is of great clinical significance to perform CT examinations before and after neo-adjuvant therapies in esophageal cancer patients. The CT images interpreted before surgery could provide important information about survival and response, which would improve individualized treatment programs.
**Purpose**

Pancreatic cysts detection has increased due to the widespread use of advanced cross-sectional imaging. Pancreatic cysts represent a wide spectrum of lesions varying from those with extremely low malignant potential, to those associated with cancer. Mucin-producing cysts have a malignant potential, whereas serous cysts are generally benign. An overlap between imaging features can be misleading, and in the indeterminate cases additional evaluations such as follow up, FNA and/or surgery are required. The aim of this study was to evaluate the feasibility and the reproducibility of diffusion-weighted imaging (DWI) in characterizing pancreatic cysts when standard imaging is not diagnostic.

**Method and Materials**

Forty-four pancreatic cysts (43 patients; 27 females; 16 males; mean age 47 years) underwent histological or cyst fluid analysis after MRI including DWI were retrospectively analyzed. Three blinded readers independently evaluated signal intensity (SI) and ADC. Intra-observer and inter-observer agreement were calculated. Fisher’s exact test and Welch’s t test were used to compare SI and ADC values respectively, to pathological results. Diagnostic accuracy of thresholds ADC was assessed by ROC analysis. A p value of less than 0.05 was considered statistically significant.

**Results**

The mean ADC value of the mucin-producing cysts was $3.26 \times 10^{-3} \text{ mm}^2/\text{sec}$, $3.27 \times 10^{-3} \text{ mm}^2/\text{sec}$ and $3.35 \times 10^{-3} \text{ mm}^2/\text{sec}$ for the three readers, respectively. The mean ADC value of the serous cysts was $2.86 \times 10^{-3} \text{ mm}^2/\text{sec}$, $2.85 \times 10^{-3} \text{ mm}^2/\text{sec}$ and $2.85 \times 10^{-3} \text{ mm}^2/\text{sec}$ for the three readers, respectively. Difference in ADC values between the two cyst groups was 12.4%, 12.9% and 14.8% for the three readers, respectively ($p<0.001$). Intra-observer and inter-observer agreement were excellent. ROC analysis showed an area under the curve of 0.82 (CI, 0.69-0.94), 0.81 (CI, 0.67-0.94) and 0.85 (CI, 0.69-0.95) for the three readers, respectively. A threshold ADC of $3 \times 10^{-3} \text{ mm}^2/\text{sec}$ resulted in correct identification of cysts in 77-81% of cases, with sensitivity and specificity ranging between 84-88% and 66-72%, respectively.

**Conclusion**

DWI may be a helpful tool in distinguishing between mucin-producing and serous pancreatic cysts.

**Clinical Relevance/Application**

ADC values may be used to differentiate between mucin-producing and serous cysts of the pancreas and could potentially reduce unnecessary invasive approaches to diagnosis or the need for follow up studies.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/
Among 95 patients with 150 cysts, 12 patients with 16 cysts underwent operations. Out of 134 cysts in 83 non-surgical patients, the preliminary radiologic diagnosis with the pathologic results was compared. Furthermore, for surgical patients, we compared the change after the conclusion of follow-up period. For patients who underwent an operation, the cysts' radiologic features with those of the patients who did not undergo an operation. For surgical patients, we compared the ductal communication, p-duct dilatation, calcification and presumptive radiologic diagnosis of each cyst. We then recorded the size of the cysts, the maximum diameter, the maximal diameter, the cyst visualization at ultrasound, and the cyst visualization at MRI. We retrospectively selected 95 patients with 150 cysts from our hospital database. Selection criteria included patients with pancreatic surgery during the follow-up period. Two radiologists reviewed the initial CT and recorded size, location, shape, and AP abdominal diameter. The vast majority of PCL can be visualized at follow up with transabdominal ultrasound. Frequency of detection varies strongly with lesion size, location, patient weight and abdominal diameter.

RESULTS

252 PCL were evaluated in 57 patients (39 females, 18 males, mean age 67 yrs (range, 39-86 yrs)). Mean maximum cyst diameter was 8.5 mm (range, 2-92 mm). PCL were identified at ultrasound in 100% (5/5) of cysts ≥3 cm; 92% (12/13) of cysts ≥2 and <3 cm; 78% (43/55) of cysts ≥1 and <2 cm; 35% (27/78) of cysts ≥5mm and <1 cm; and 16% (16/101) of cysts <5 mm. Measured maximum diameter at US differed from maximum diameter at MRI by a mean 0.7 mm (range, -6 to +16 mm); cysts were under measured by US in 46% and over measured in 31% of maximum diameter measurements, respectively. US identified 47% (14/30) of cysts located in uncinate process, 53% (27/51) in head; 83% (10/12) in neck, 52% (35/67) in body, and 18% (17/93) in tail. There were statistically significant correlations between PCL visualization at US and maximum cyst size (p<0.001), patient weight (p=0.012), and AP abdominal diameter (p=0.0059); no significant correlation (p=0.43) between thickness of subcutaneous abdominal fat and cyst visualization at ultrasound was identified.

CONCLUSION

The vast majority of PCL can be visualized at follow up with transabdominal ultrasound. Frequency of detection varies strongly with lesion size, location, patient weight and abdominal diameter.

CLINICAL RELEVANCE/APPLICATION

Many pancreatic cystic lesions known to exist from prior imaging can be visualized and accurately measured at follow up with transabdominal ultrasound. Body habitus and cyst size and location correlate with success of ultrasound.

SSM10-05  Fate of Small Pancreatic Cysts (<3cm) after Long-term Follow-up: Analysis of Significant Radiologic Characteristics and Proposal of Follow-up Strategy

Wednesday, Dec. 2 2:30PM - 3:40PM Location: E353C

Participants

Heera Yoon, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Dong Ho Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Su Joa Ahn, Seoul , Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jeong Hee Yoon, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Joon Koo Han, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To describe the natural history of small, incidental pancreatic cysts after long-term follow-up, with an emphasis on identifying indicators of indolent lesions.

METHOD AND MATERIALS

We retrospectively selected 95 patients with 150 cysts from our hospital database. Selection criteria included patients with pancreatic cysts <3cm in CT from 2003-2004, followed with CT or MR for greater than 5 years (mean 117.1±19.6 months), or received pancreatic surgery during the follow-up period. Two radiologists reviewed the initial CT and recorded size, location, shape, ductal communication, p-duct dilatation, calcification and presumptive radiologic diagnosis of each cyst. We then recorded the size change after the conclusion of follow-up period. For patients who underwent an operation, we compared the cysts' radiologic features with those of the patients who did not undergo an operation. Furthermore, for surgical patients, we compared the preliminary radiologic diagnosis with the pathologic results.

RESULTS

Among 20 patients with 150 cysts, 17 patients with 16 cysts underwent operations. Out of 134 cysts in 83 non-surgical patients, two radiologists reviewed the initial CT and recorded size, location, shape, ductal communication, p-duct dilatation, calcification and presumptive radiologic diagnosis of each cyst. We then recorded the size change after the conclusion of follow-up period. For patients who underwent an operation, we compared the cysts' radiologic features with those of the patients who did not undergo an operation. Furthermore, for surgical patients, we compared the preliminary radiologic diagnosis with the pathologic results.
Among 95 patients with 150 cysts, 12 patients with 16 cysts underwent operations. Out of 154 cysts in 83 non-surgical patients, 49 (36.6%) cysts didn’t change in size, while 57 (42.5%) increased, and 27 (20.9%) decreased or vanished. Among increased 57 cysts, only 5 were larger than 3cm at the end of the follow-up period. The initial size of the cyst was significantly larger in the surgical group compared to the nonsurgical group (17.2±7.3mm vs 11.3±5.5 mm, p<0.000). Reasons for surgery included malignancy (4/95, 4.21%), borderline IPMN (6/95, 6.31%) with 5 moderate and 1 low grade, and SCN with increasing size (2/95, 2.11%). Pleomorphic and clubbed shape were significant features for borderline and malignant cysts. No cysts<15 mm and without p-duct change showed a significant change in size in 3 years.

CONCLUSION

The incidence of malignancy was 4.21% in our group. However, the majority of small cysts remained less than 3cm after long-term follow-up. The initial size of cysts as well as the shape are important features for predicting the progress and potential for malignant transformation. Patients with initial cysts<15mm, without P-duct change, and non-pleomorphic or clubbed shape may be assessed at long-term intervals without significant risk of malignancy.

CLINICAL RELEVANCE/APPLICATION

It is a feasible strategy to extend follow-up interval for cysts<15mm, without P-duct change, non-pleomorphic or clubbed shape, which could lead to reduce medical expenditure.

SSM10-06  The Diagnostic Performance of Transabdominal Ultrasonography for Incidental Pancreatic Cysts: Focus on the Effect of Prior Images, Size, and Location

Participants
Ju Hyun Jeon, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Jung Hoon Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ijin Joo, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Joon Koo Han, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To assess diagnostic performance of transabdominal ultrasonography (TAUS) for incidental pancreatic cysts with a focus on the effect of prior images, size, and location.

METHOD AND MATERIALS

1064 pancreatic cysts which were radiologically confirmed by contrast enhanced CT (n=795), MRI (n=21), CT and MRI (n=202), or endoscopic ultrasonography (EUS, n=46), were included in 938 patients who underwent TAUS. TAUS finding was analyzed based on the formal reports. One radiologist also retrospectively reviewed TAUS, CT, MR, and EUS images to determine the size, location, and detection rate of the pancreatic cyst before and after CT, MRI, or EUS. For statistical analysis, independent samples T-test and Chi-square test were applied.

RESULTS

Among 1064 pancreatic cysts, 107 cysts underwent TAUS both before and after CT, MRI, or EUS and 477 cysts underwent TAUS after prior study. 480 cysts underwent TAUS both before and after CT, MRI, or EUS. Overall 940 pancreatic cysts (88.3%) were delineated on TAUS. The detection rate of pancreatic cyst on TAUS before CT, MRI, or EUS was 49.2% (289/587), and the detection rate of pancreatic cyst on TAUS after CT, MRI, or EUS was 86.7% (830/957). In a group of patients who underwent TAUS both before and after CT, MRI, or EUS, the detection rate of pancreatic cyst on TAUS was increased after CT, MRI, or EUS (before: 40.0%, after: 85.2%, p=0.0001). The size of detected cysts (mean±SD, 15.5±9.2 mm) was larger than undetected cysts (mean±SD, 11.8±7.5 mm, p<0.0001) with significant difference. Undetected cysts on US were almost smaller than 2cm. The detection rate of TAUS before CT, MRI, and EUS in neck, body, head, tail, and uncinated process was 60.7%, 55.7%, 54.6%, 37.9%, and 27.5%. The detection rate of TAUS after CT, MRI, and EUS in neck, head, body, uncinated process, and tail was 95.6%, 91.4%, 91%, 87.6%, and 67.8%.

CONCLUSION

Transabdominal US is useful for detection of pancreatic cyst. The detection rate of TAUS was improved after CT, MRI, and EUS regardless the location.

CLINICAL RELEVANCE/APPLICATION

Transabdominal US is useful image modality for incidental pancreatic cysts; especially follow up after CT, MRI, and EUS.
### SSM11-02 The Effect of IV Contrast on Renal Function in Patients on Metformin

**Participants**
- Cody W. McHargue, BA, San Francisco, CA (Presenter)
- Arti D. Shah, MD, San Francisco, CA (Abstract Co-Author)
- Judy Yee, MD, Clayton, CA (Abstract Co-Author)
- Priyanka Jha, MBBS, Sacramento, CA (Abstract Co-Author)
- Isabel Allen, San Francisco, CA (Abstract Co-Author)
- Donald Chau, BA, San Francisco, CA (Abstract Co-Author)
- Robert Rushakoff, MD, San Francisco, CA (Abstract Co-Author)

**Method and Materials**
We conducted a retrospective cohort study of 130 adult outpatients at the San Francisco Veterans Affairs Medical Center to determine if there was a change in renal function in diabetic patients on metformin who underwent computed tomography (CT) scans with IV contrast between 2007-2014. Patients were excluded if immediately hospitalized after the CT scan. The generalized estimating equations method was used to determine whether IV contrast and pre-contrast creatinine (Cr) or estimated glomerular filtration rate (eGFR) were associated with a change in Cr or eGFR. Covariates included: age, gender, BMI, diabetes (DM) duration and HbA1c.

**Results**
In our cohort, mean age was 67±10 years, 119 (91%) were male, 71 (55%) were Caucasian, and 63 (49%) were higher risk (pre-contrast eGFR <60 ml/min/1.73m²). Mean DM duration was 6.5±6.0 years and mean HbA1c was 7.1±1.3%. Mean pre- and post-contrast Cr were 1.13±0.25 mg/dL and 1.09±0.26 mg/dL; p=0.02 (overall t-test). Mean pre- and post-contrast eGFR were 72±24 ml/min/1.73m² and 75±26 ml/min/1.73m²; p=0.006 (overall t-test). In fully-adjusted models, there was a significant decrease in Cr post-contrast: β-coefficient -0.24 (95% confidence interval [CI] -0.35 to -0.12), p<0.001. There was no significant change in eGFR post-contrast: β-coefficient -0.06 (95% CI -0.16 to 0.03), p=0.19. A subgroup analysis of patients with pre-contrast eGFR <60 ml/min/1.73m² showed similar results.

**Conclusion**
There is no evidence of deterioration in renal function in outpatients on metformin who receive IV contrast, even in a cohort with a large proportion of higher risk patients. Therefore, our results suggest that the current practice of holding metformin after IV contrast should be re-evaluated.

**Clinical Relevance/Application**
The practice of holding metformin and checking Cr two days after IV contrast should be re-evaluated as there was no evidence to suggest a decline in renal function in a cohort with high risk patients.
Research support, Sequent Medical, Inc Research support, Benvenue Medical, Inc Consultant, General Electric Company Consultant, Medtronic, Inc Consultant, Johnson & Johnson

**PURPOSE**

To determine whether patients with a solitary kidney are at higher risk for contrast-induced acute kidney injury (AKI) than matched control bilateral kidney patients.

**METHOD AND MATERIALS**

This retrospective study was HIPAA compliant and approved by our Institutional Review Board. Adult patients with bilateral kidneys or a solitary kidney from unilateral nephrectomy who received a contrast-enhanced computerized tomography (CT) scan at our institution from January 2004 to August 2013 were identified. The effects of contrast exposure on the rate of AKI (defined as a rise in maximal observed serum creatinine (SCr) of either 1) > 0.5 mg/dL or 2) > 0.3 mg/dL or 50% over baseline within 24-72 hours of exposure), and 30-day post-scan emergent dialysis and death were determined following propensity score-based 1:3 matching of solitary and control bilateral kidney patients.

**RESULTS**

Propensity score matching yielded a cohort of 247 solitary kidney patients and 691 bilateral kidney patients. The rate of AKI was similar between the solitary and bilateral kidney groups [SCr > 0.5 mg/dL AKI definition odds ratio (OR) = 1.11 (95% confidence interval (CI) 0.65 - 1.86); p = 0.70; SCr > 0.3 mg/dL or 50% AKI definition OR = 0.96 (95% CI 0.41 - 2.07), p = 0.99]. The rate of emergent dialysis was rare and also similar between cohorts (OR = 1.87 (0.16-16.4), p=.61). Though the rate of mortality was higher in the solitary kidney group (OR = 1.70 (1.06-2.71), p=.0202), chart review found that no death was attributable to AKI.

**CONCLUSION**

This study did not detect any significant differences in the rate of AKI, dialysis, or death attributable to contrast-enhanced CT in patients with solitary versus bilateral kidneys.

**CLINICAL RELEVANCE/APPLICATION**

Contrast-enhanced CT protocols can be guided by image optimization, rather than contrast-induced nephropathy risk in solitary kidney patients.

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**SSM11-05 Feasibility and Image Quality of Reduced Dose CT Intravenous Pyelogram Using Model-Based Iterative Reconstruction in Patients with Hematuria**

**Participants**

Caterina Colantoni, MD, Milan, Italy (Presenter) Nothing to Disclose
Antonio Esposito, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Anna Palmisano, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Excretory MR urography is a useful complementary technique in many MR imaging studies of the abdomen to assess kidney excretion and the urinary collecting system. However, after the injection of a standard dose gadolinium-based contrast media, frequently, the collecting system is unassessable for T2* effect due to very high concentration of Gd in the urine. Aim of the present study was to compare the enhancement of the urinary collecting system after the injection of a single standard dose of Gd-based contrast media known for different renal excretion rates: Gadobutrol, Gadobenate dimeglumine, and Gd-EOB-DTPA.

**METHOD AND MATERIALS**

In 60 patients (pts) with normal creatinine clearance and without urinary tract dilatation, mean signal intensities (pixel values) of the renal pelvis and of the paravertebral muscles for the calculation of renal pelvis/skeletal muscle ratio, were evaluated on 3D fast T1-weighted gradient-echo sequences with fat suppression obtained during excretory phase after intravenous injection of 0.1 mmol/kg contrast media: 20pts were studied with Gadobutrol, 20pts with Gadobenate dimeglumine, and 20pts with Gd-EOB-DTPA, respectively. Urinary collecting system was considered assessable/not-assessable according to the presence of T2* effect.

**RESULTS**

The mean signal intensities of renal pelvis were 1954±1368.5 (pixel values) for Gadobutrol, 2488±843.8 for Gadobenate dimeglumine, and 3609±1025.3 for Gd-EOB-DTPA, respectively. The mean signal intensity ratio of Gadobutrol and that of Gadobenate dimeglumine (p>0.05); significant differences were found between the mean signal intensity ratio of Gadobutrol and that of Gadobenate dimeglumine (p<0.005), and that of Gadobenate dimeglumine and of Gd-EOB-DTPA (p<0.001). Urinary collecting system was considered not-assessable in 8/20pts for Gadobutrol, in 1/20pt for Gadobenate dimeglumine, and in 0/20pts for Gd-EOB-DTPA.

**CONCLUSION**

The urinary collecting system was considered assessable in all pts studied after injection of a standard dose of Gd-EOB-DTPA, and this could be due to the low urine excretion rate.

**CLINICAL RELEVANCE/APPLICATION**

The use of Gd-EOB-DTPA in the excretory MR urography can improve the assessability of the excretory system, with no evidence of T2* shortening effects.

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**SSM11-04 New Insights in the MRI Excretory Phase: The Use of Gd-EOB-DTPA for the Evaluation of the Excretory System**

**Wednesday, Dec. 2 3:30PM - 3:40PM Location: E352**

Participants

Caterina Colantoni, MD, Milan, Italy (Presenter) Nothing to Disclose
Antonio Esposito, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Anna Palmisano, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
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**PURPOSE**

To new insights in the MRI excretory phase: the use of Gd-EOB-DTPA for the evaluation of the excretory system.
but there were no notable differences in CNRs between group A and B (P>0.05). Mean CTDIvol, SSDE and ED in excretory phase in CNRs in most segments were higher in group B than group C (P=0.001~0.062) and similar between group A and C (P=0.024~0.896), in group A and B (both P<0.001) than that of group C, but there was no significant difference between group A and B (P=0.934). There were no significant differences in mean attenuations of all urinary segments among 3 groups (P>0.05). Image noise was much less examinations were considered to be of acceptable image quality and inter-observer agreement was good (K=0.717, P<0.001). There

RESULTS

Both patient groups were not significantly different (26.8 +/- 7.8 kg/m² versus 27.5 +/- 4.8 kg/m²) in regards to BMI. Radiation dose was reduced by an average of 49% (p<0.01) on RD CT IVP (CTDI vol = 7.7 +/- 2.8 mGy) compared to SD CT IVP (CTDI vol = 15.1 +/- 4.8 mGy) on post-contrast imaging. Overall dose reduction averaged 36% with non-contrast and contrast-enhanced imaging (RD CT IVP CTDIvol = 15.31 +/- 2.8 mGy versus SD CT IVP CTDI vol = 23.91 +/- 5.3 mGy). Overall image quality impression of the collecting system, artifacts, and image sharpness were not significantly different between groups (P>0.05) between RD CT IVP and SD CT IVP. Subjective image noise was significantly lower (p<0.01) in RD CT IVP, which was also reflected by a quantitative reduction of image noise by an average of 44% (p<0.01) on non-contrast imaging and 37% (p<0.01) on post-contrast imaging.

CONCLUSION

RD CT IVP is feasible and allows for a substantial dose reduction compared to SD CT IVP protocol without compromising image quality.

CLINICAL RELEVANCE/APPLICATION

Introduction of iterative reconstruction algorithms which can be implemented with routine clinical CT IVP protocols to reduce radiation exposure while yielding diagnostic quality images.
group A and B were significantly lower than those of group C (P<0.05). Iodine dosage was reduced by 18.2% in group A than group B and C.

CONCLUSION

Given subjective and objective image quality, CTU at 100 kVp with 80% ASiR resulted in reduction of radiation dose, and 0.9mL/kg CM (320mgI/ml) iodine dosage was workable.

CLINICAL RELEVANCE/APPLICATION

High radiation exposure and Contrast-Induced Nephropathy for CTU have drawn much attention and anxiety, 100kVp with 80% ASiR and 0.9mL/kg CM may offer a means of resolution.
Sub-Events

SSM12-02 Using Modality Log Files to Guide MR Protocol Optimization and Improve Departmental Efficiency

Participants
Martin L. Gunn, MBChB, Seattle, WA (Presenter) Research support, Koninklijke Philips NV; Spouse, Consultant, Wolters Kluwer NV; Medical Advisor, TransformativeMed, Inc;
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Norman J. Beauchamp Jr, MD, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV

PURPOSE
Imaging equipment log files contain detailed data about workflow and equipment utilization that is unavailable on RIS and PACS sources. The purpose of this study was to investigate the use of log files to identify areas of waste based on scanner time, variability and number of sequences, and measure the impact of a departmental MR efficiency process.

METHOD AND MATERIALS
Log files (MRLFs) were extracted from 4 MR scanners from 07/2013 to 02/2015 and were parsed to extract several parameters (e.g. protocol, sequences, exam duration, idle time, table movement). Using RIS data and MRLFs, we identified protocols with the greatest volume, duration and variation. Using MRLFs, we monitored system utilization of liver mass (MRLiv) and abdo/pelvis survey (MRAP) protocols pre and post protocol optimization. Optimization included assigning MRLiv patients with cirrhosis undergoing HCC screening to a new abbreviated protocol (MRLivCirr), and sequence reduction and optimization (MRAP). Statistical comparisons included a 2 tailed T-test and F-test.

RESULTS
Mean monthly MRLiv patient volume (+/- s.d.) was 55 ± 16 before and 20 ± 1 after optimization. The remaining 38 +/- 18 patients/month were for HCC screening and were assigned to the new MRLivCirr protocol. Mean monthly MRAP exams before was 20.6 ± 7.3 and after was 17.6 ± 2.3. Exam duration (table time ± s.d.) for MRLiv patients was 30.9 ± 9.3 min before and 31.4 ± 11.7 min after (p=0.7). However, for patients in the new MRLivCirr protocol group, mean time reduced by 7.2 min/exam to 23.7 ± 7.9 min(p<0.001). Duration for patients undertaking MRAP reduced from 52.9 ±16.6 min to 43.1± 15.6 min, saving 9.8 min/exam (p<0.001). At an estimated rate of $650/hr, potential yearly savings could reach $36k for cirrhosis screening, and $22k for MRAP patients. The predictability of the exam length was improved with the s.d. of the MRLivCirr group (7.9 min) lower than the MRLiv group (11.7 min); F-Test, p<0.02.

CONCLUSION
MRLFs can be used to identify opportunities for equipment utilization improvement and measure the impact with accuracy. During our process we were able measure exact time savings and decreased variability per patient.

CLINICAL RELEVANCE/APPLICATION
Log files provide a way to measure modality utilization during image acquisition that are unavailable from RIS and PACS sources. They can be used to evaluate operational improvements in the department, potentially saving cost, and improving patient satisfaction.
Implementing a Collaborative Approach to Imaging Utilization Management at a Provider-Owned Managed Services Organization

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S102D

Participants
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Craig Reich, MD, Oakland, CA (Abstract Co-Author) Nothing to Disclose
Jeffrey D. Robinson, MD, MBA, Seattle, WA (Abstract Co-Author) Consultant, HealthHelp, LLC; President, Clear Review, Inc;
David B. Larson, MD, MBA, Los Altos, CA (Abstract Co-Author) Intellectual property license agreement, Bayer AG; Potential royalties, Bayer AG
Richard Sankary, MD, Oakland, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE
While effective at controlling utilization, radiology benefit managers (RBMs) are disliked because they require ordering physicians to demonstrate medical necessity to an imaging gatekeeper who is not part of the community in which care occurs. Provider-owned health plans often utilize RBMs because their non-radiologist Medical Directors (MDs) are not imaging specialists. The purpose of our study was to demonstrate that radiologists can train local MDs to be effective stewards of imaging using collaborative techniques and produce results on par with RBMs but with fewer denials.

METHOD AND MATERIALS
A provider-owned Managed Services Organization (MSO) underwent an imaging utilization management (UM) process redesign. Prior to 2015, only PET/CTs and MRI exams ordered by primary care physicians were reviewed. After 1/1/15, all requests for CT, MRI, PET/CT, nuclear cardiology, and echocardiography were reviewed using Milliman Care Guidelines. The UM MD staff attended a day-long workshop led by two radiologists expert in collaborative imaging stewardship. The peer-to-peer process was rescripted to emphasize the risks of imaging (e.g. radiation) and suggesting alternative management plans (e.g. alternative imaging modalities) when appropriate. To assess the efficacy of the intervention, the MSO pre-authorization database was queried for the intervention period (Q1 2015) and a seasonally-matched baseline period (Q1 2014). The data elements extracted are shown in Figure 1. Impact rate was defined as the percentage of cases modified, withdrawn, or denied.

RESULTS
There was a significant increase in impact rate (0.4% vs. 4.6%, p=0.005) during the intervention period versus the control period. The number of requests modified or withdrawn by the ordering physician increased significantly (0.4% vs. 3.8%, p=0.01), while the number of requests denied by MDs was not significantly different (0.0% vs. 0.6%, p=0.51). Overall, the number of studies authorized per 1,000 patients declined significantly after the intervention (96.8 vs. 89.0, p=0.006).

CONCLUSION
Local MDs trained by radiologists can be effective stewards of imaging by using collaborative techniques that significantly reduce unnecessary imaging utilization without significantly increasing the use of denials.

CLINICAL RELEVANCE/APPLICATION
Radiologists can create significant value for health systems by training local MDs to be effective stewards of imaging UM using collaborative techniques.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/
SSM12-05  Has Use of Prostate Biopsy and Transrectal Ultrasound Declined as Concerns Mount about Overdiagnosis of Prostate Cancer?

Wednesday, Dec. 2 3:40PM - 3:50PM Location: S102D

Participants
David C. Levin, MD, Philadelphia, PA (Presenter) Consultant, HealthHelp, LLC; Board of Directors, Outpatient Imaging Affiliates, LLC
Laurence Parker, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Ethan J. Halpern, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Vijay M. Rao, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE
In recent years there has been considerable debate about the issue of overdiagnosing prostate cancer (PCa). Since it is often an indolent disease and the potential harms from diagnosis and treatment are considerable, some have advocated a more conservative approach to conducting screening and diagnostic procedures. For example, the U.S. Preventive Services Task Force has issued a grade D recommendation against PSA-based screening. Our purpose was to study trends in the use of prostate biopsy (PB) and transrectal ultrasound (TRUS) over a recent 13-year period.

METHOD AND MATERIALS
The nationwide Medicare Part B Physician/Supplier Procedure Summary Master Files for 2001 through 2013 were used. They cover all Medicare fee-for-service beneficiaries (17.2 million males in 2013). CPT codes for PB and TRUS were selected and trends in procedure volume were evaluated. Utilization rates per 1000 males were calculated. Medicare specialty codes were used to identify the specialty of the physicians performing the procedures.

RESULTS
PB volume peaked in 2002, when a total of 292,045 were performed in Medicare patients. A generally downward trend then followed in subsequent years, reaching 165,382 in 2013 (-43%). The rate of PBs per 1000 male Medicare beneficiaries was 17.4 in 2002, decreasing to 9.6 in 2013. In that last year, urologists performed 87% of the biopsies, while radiologists performed 0.6%. Most of the rest were done in independent diagnostic testing facilities, in which the provider specialty could not be determined. TRUS volume peaked in 2006 at 318,518, then declined in subsequent years to 214,980 in 2013 (-33%). In that last year, urologists performed 90% of TRUSs, while radiologists performed 4%. The remaining 6% were performed by physicians in various other specialties.

CONCLUSION
The use of both PB and TRUS has declined substantially in recent years. This appears to reflect a more conservative approach to screening for PCa, which in turn has resulted from the extensive debate about the risks, costs, and benefits of identifying and treating the disease.

CLINICAL RELEVANCE/APPLICATION
Physicians are now performing fewer procedures relating to prostate cancer diagnosis.

SSM12-06  Calmative Training of MR Imaging Support Staff Improving Study Completion Rates and Patient Show-Up Rates

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S102D

Participants
Alexander M. Norbash, MD, Boston, MA (Presenter) Co-founder, Boston Imaging Core Laboratories, LLC;
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Gheorghe Doros, Boston, MA (Abstract Co-Author) Nothing to Disclose
Nina A. Mayr, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The throughput efficiency of high cost imaging services such as Magnetic Resonance Imaging (MRI) has major impact to the financial status of the imaging service, particularly given decreasing overall diminishing healthcare margins. We evaluated whether a simple and inexpensive calmative training to the imaging staff team as a cost-effective way to improve the throughput and impact the financial bottom line.

METHOD AND MATERIALS
A total of 97,712 patient visits from 3 tertiary academic medical centers participated, including 49,733 visits during one-year period prior to the calmative training and 47,979 one-year after training. The center's MRI teams received calmative skill training with advanced communication and calmative techniques through onsite proctoring, and additional education using case-based simulations with scenarios requiring calmative interventions and utilizing electronic educational tools. The study's incompletion rate and patient no-show rate during-year intervals before and after training were compared using two-sided chi-square tests for proportions at a 0.05 significance level.

RESULTS
Despite variations in the patient population at the different sites with differing baseline no-show rates (ranged 5-19.4%) and study incompletion rates (ranged 0.8-6.9%) prior to training, the combined patients data showed significant (p<0.0001) improvement of patient throughput with calmative training. Based upon the one-year data intervals compared before and after training, no-show rates decreased from 11.2% to 8.7% and incompletion rates decreased from 2.3 to 1.4% for all show-up patients. Additionally, increasingly lengthy and complex studies such as cardiac, whole body, or combined imaging studies were performed without an increase in no-show or incompletion rates following calmative training.
CONCLUSION
The results suggest that calmative training of the imaging support staff can significantly improve the no-show and incompletion rates of the MRI service, thereby improving the throughput and utilization of high-value and expensive imaging modalities such as MRI which happens to have offputting physical features including noise and a constrained bore.

CLINICAL RELEVANCE/APPLICATION
Calmative training of supportive staff can significantly improve the no-show and incompletion rates of the MRI service, improving throughput and resource use without added capital budget investment.
Informatics (Clinical Workflow, Displays and Mobile Devices)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: S403A

SSM13-01 Novel Use of Redmine Issue Tracking Software as a Radiology Workflow Management Tool

Participants
Vamsi R. Narra, MD, FRCR, Saint Louis, MO (Moderator) Consultant, Biomedical Systems; Rasu B. Shrestha, MD, MBA, Pittsburgh, PA (Moderator) Advisory Board, General Electric Company; Medical Advisory Board, Nuance Communications, Inc; Editorial Advisory Board, Anderson Publishing, Ltd; Advisory Board, KLAS Enterprises LLC; Advisory Board, Peer60; Board, Omnyx, LLC; Board, Health Fidelity, Inc

Sub-Events

Background
While the most basic radiology workflow entails a single viewing of a study by a radiologist and the rendering of a report, often a more complex process is required. A finding may need to be followed up or reviewed with a colleague; an improperly acquired study may necessitate a conversation with the technologist and patient recall for further imaging; a radiology resident may need to be alerted about a missed finding. We noted that these workflows are similar to those encountered in other industries and that a number of generic software packages exist to facilitate such tasks. We hypothesized that Redmine (http://redmine.org), a widely used free, open-source issue tracking application primarily used for software development, could be successfully adapted to handle these workflows within a large academic radiology department.

Evaluation
In 2014, we installed Redmine on a server running behind the department’s firewall, ensuring data security and HIPAA compliance. Small modifications to the Redmine source code and PACS configuration files enable bidirectional communication between PACS and Redmine. The radiologist runs the browser-based client alongside PACS and creates an ‘issue’ in Redmine for a given study. With the installation of one of many existing Redmine plugins, key images may be attached from PACS. A user may be assigned to the issue, indicating responsibility for seeing it to completion. Multiple users may be added as ‘watchers’, receiving auto-generated emails when the record is updated (e.g., with pathology results or surgical findings). Existing records are viewed in a searchable database, allowing users to manage due dates and priorities and mark issues as resolved.

Discussion
Since launching, over 800 studies have been followed within our department using Redmine, enabling a broad range of issues to be tracked to completion. The application functions as an efficient, crowd-sourced teaching file and quality assurance system.

Conclusion
Workflows encountered in radiology are similar to those found in other industries. Our adaptation of Redmine demonstrates that tools designed for these other industries may be easily adapted for a clinical radiology practice.

SSM13-02 Hooking based Gesture-controlled Interface for Operating Rooms and Reading Rooms without Modification of Source Codes

Participants
Ben J. Park, BS, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Taekjin Jang, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Namkug Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Stockholder, Coreline Soft, Inc
Sang Min Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sang Young Oh, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jong-Woo Choi, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Background
Recent technological advances in gesture based user interface have brought in numerous innovative ideas in viewing medical images. However, despite new attempts constantly being made to replace keyboards and mice, it is hard to find applications used in clinical practice. Physicians required interfaces that maintain aseptic conditions and seamlessly control medical images. Therefore, we developed and applied a message hooking program that maps a gesture to specific functions without any modification of the source codes of frequently used programs.

Evaluation
The program was set up in two different settings with a Leap Motion™ device for gesture detection. First, we installed this hooking program in the operating room. The aim was to accurately and safely browse images of a rhinoplasty and genioplasty patient from three different programs: CT images from a PACS viewer, volume rendered images from a 3D PACS viewer and patient photos from a basic image viewer. All three programs were seamlessly controlled by gestures and motions solely by the physician. Second, the
program was set up in the reading room to measure the performance compared to traditional input devices. Since contactless interfaces were not required in reading rooms, our goal was to use this program as a secondary device that provide several dominant features. We scanned through 96 images of a dynamic biliary CT study by gestures and compared the results with those of a mouse. Gesture based inputs significantly shortened time required to scan through images, 13.99±1.06 to 8.57±0.65sec (p<0.001).

Discussion
The most important feature of the program was providing a contactless interface to control medical images from multiple programs without modification of source codes. The program can be used solely with the sensor device or together with other input devices. Either way the program provided unparalleled user experience and increased performance in clinical setting.

Conclusion
We developed a message hooking program that detect gestures to control programs and applied it to operating and reading rooms. This program provided surgeons a new way to safely browse images during surgery and increased reading performances for radiologists.

SSM13-04  The First High-resolution Mobile Virtual-reality Devices Are Here, Could They Become the Next Step in Mobile Diagnostic Imaging and Enable a New Dimension in Radiology?

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S403A

Participants
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Soifa Tsolaki, Athens, Greece (Abstract Co-Author) Nothing to Disclose
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Maria G. Skilakaki, MD, Athens, Greece (Abstract Co-Author) Nothing to Disclose
Ploutarhos A Pipieropoulos, MD, PhD, Athens, Greece (Abstract Co-Author) Nothing to Disclose

Purpose
The primary purpose of our research was to obtain one of the first high-resolution mobile virtual-reality (VR) prototypes and see if we could enable VR visualization of dicom images, without compromising stability or image quality, so that this mobile system could then be used for diagnostic imaging. Our secondary purpose was to verify that remote diagnosis of complete CT examinations performed elsewhere, using our mobile VR system, was feasible.
METHOD AND MATERIALS

The mobile VR system weighs only 0.3 kg, it is powered by a high-tech smartphone, with an ultra-high density 550ppi display. Using the system is like being in front of a 175 inch mega screen, while enabling visualization at 360 degrees. Once the dicom images are downloaded to the system via 4G/LTE, the user wears the device and can scroll through the images, viewing up to 56 at any time, while being on the move. Even if our VR system can visualize any dicom image, we chose to test the device using CT images, because it’s a modality vastly used by emergency departments and requires the visualization of multiple images, taking advantage of the virtual 175 inch display. Once the VR system was ready, 271 exams were reviewed by a Consultant Radiologist in the hospital. The CT exams were reviewed remotely using VR by another Consultant Radiologist in another area, with no contact to the first examining doctor. The two doctors’ independent double blinded reports were compared using standardized reporting systems to assess imaging quality of the VR system in comparison to the hospital’s workstation.

RESULTS

In 1318/1355 (97.27%) results complete interobserver agreement was observed. The few 37/1355 (2.73%) contradicting results were limited to evaluations which also often present discrepancies between different examiners on the same monitor.

CONCLUSION

In most of the evaluated parameters, good interobserver agreement showed that the use of our VR system did not affect image quality and therefore did not alter the diagnosis. This technique can be used for remote diagnosis, avoiding the limitations of the relatively small displays of normal mobile devices. Therefore, remote diagnosis of complete CT examinations performed elsewhere using a mobile VR setting is feasible and useful.

CLINICAL RELEVANCE/APPLICATION

Remote diagnosis of CT examinations from a mobile VR device, that provides the equivalent of standing in front of a 175 inch display with a 360 degree view.

SSM13-06  Image Sharing Using Ubiquitous Patient Storage Services as an Alternative to Image Enabled PHR’s

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S403A

Participants
Elliot L. Siegel, MD, Severna Park, MD (Abstract Co-Author) Research Grant, General Electric Company; Speakers Bureau, Siemens AG; Board of Directors, Carestream Health, Inc; Research Grant, XYBIX Systems, Inc; Research Grant, Steelcase, Inc; Research Grant, Anthro Corp; Research Grant, RedRick Technologies Inc; Research Grant, Evolved Technologies Corporation; Research Grant, Barco nv; Research Grant, Intel Corporation; Research Grant, Dell Inc; Research Grant, Herman Miller, Inc; Research Grant, Virtual Radiology; Research Grant, Anatomical Travelogue, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, Toshiba Corporation; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Bayer AG; Research, TeraRecon, Inc; Medical Advisory Board, Bracco Group; Researcher, Bracco Group; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Researcher, Microsoft Corporation Mohamed Shoura, PhD, Newton, MA (Abstract Co-Author) Employee, Paxeramed Corp Mohammed I. Quraishi, MD, Louisville, KY (Presenter) Nothing to Disclose

Background

Our initial experience with the RSNA’s Image Sharing initiative has been positive with patients reporting a high level of satisfaction with ready access to their own images and reports in the cloud after selecting a commercial image enabled personal health record. However this has required a workflow in which patients who almost never already have an image enabled PHR are required to sign up for one of these PHR providers, create a password, and learn how to interact with the specific PHR system portal. Patients are or will eventually be required to sign up for a paid service for storage and access to these sites. The purpose of our pilot study is to investigate an alternative approach in which a patient’s existing cloud storage service can be utilized to store patient images.

Evaluation

A pilot study was performed utilizing a commercial PACS with interfaces to ubiquitously utilized storage available from providers such as Google Drive®, One drive®, DropBox® and others that offer both free and paid storage options to users. Alternatively, users are given the option not to utilize the cloud but to have images "pushed" to the local storage in their smart phones. Images from these various patient directed storage options can be viewed on a single viewer which has interfaces to the commercial email and storage providers. Survey data will be collected to determine the relative efficacy of this alternative standards based approach with regard to patient satisfaction. Relative patient preference for local (smartphone) or cloud storage will also be assessed.

Discussion

Initial experience with the pilot study has been that the approach has the advantages of the current RSNA image sharing approach including elimination of CD’s, ready access of images and reports to patients and clinicians without the relative challenges and costs associated with an image enabled PHR provider.

Conclusion

Initial experience with a system that empowers patients to utilize their own existing storage providers for archival and review of images including opting out of cloud storage to store images on their smart phones has been encouraging. Survey results from patients and providers are expected to provide additional insights.
PURPOSE
Renal allograft dysfunction early after kidney transplantation (ktx) is frequent, and may be caused by ischemia reperfusion injury or acute rejection. The purpose was to investigate renal allograft pathology in a mouse model of allogenic and isogenic ktx by perfusion imaging with arterial spin labelling (ASL) and diffusion weighted imaging (DWI) in correlation to histology.

METHOD AND MATERIALS
Allograft rejection was induced by allogenic ktx of C57Bl/6 (B6)-kidneys to Balb/c-mice in n=14 animals, isogenic ktx (B6-kindeys to B6-mice) was performed in n=18 mice. Cold and warm ischemia times were 60 and 30 min, respectively, in both groups. Healthy B6-mice served as controls. MRI was performed 1 and 6 days after ktx using a 7T-scanner. Flow alternating inversion recovery (FAIR) ASL and DWI sequences (7 b-values) were acquired, and maps of renal perfusion and apparent diffusion coefficient (ADC) were calculated. Renal histology was assessed for rejection and the severity of tubular injury and cell infiltration.

RESULTS
Following allogenic ktx animals developed a T-cell-mediated rejection, whereas isogenic mice had mild tubular injury but no rejection. Renal perfusion at d1 was reduced after allogenic (262±43 ml/(min*100g)) and isogenic ktx (335±41 ml/(min*100g)) compared to normal B6-mice (483±23 ml/(min*100g), p<0.001). After allogenic ktx, renal perfusion further decreased until d6 and was lower than in the isogenic group (80±13 vs 260±33 ml/(min*100ml), p<0.001). In contrast, ADC was unchanged after isogenic ktx compared to normal B6-mice. In the allogenic group with acute rejection ADC was reduced compared to the isogenic group at d1 (1.24±0.11 vs 1.61±0.03*10⁻³mm²/s, p<0.001) and d6 (1.09±0.04 vs 1.55±0.07*10⁻³mm²/s, p<0.001). Higher tubular injury and inflammation scores and higher percentage of infiltrating T-cells significantly correlated with ADC reduction at d1 and d6 and perfusion impairment at d6.

CONCLUSION
Renal allograft rejection is associated with progressive perfusion impairment and ADC reduction representing inflammation and cell infiltration. Isogenic ktx with prolonged cold ischemia time leads to moderate perfusion impairment without ADC reduction. MRI parameters correlate with histology.

CLINICAL RELEVANCE/APPLICATION
Functional MRI with ASL and DWI allows differentiation of renal graft pathology after transplantation. Parameters correlate with histology and may improve non-invasive diagnosis in ktx patients.
GagCEST analysis of morphologically non-degenerative IVDs (Pfirrmann score 1 and 2) in T2w images demonstrated significantly

CONCLUSION

in NP (p = 0.204; CI [-0.504 % - 2.170 %]). No significant difference of MTRasym values was found in degenerative IVDs between patients and controls comparing the differences of the means. Pooled non-degenerative IVDs (Pfirrmann 1 and 2) had significantly lower gagCEST effects (MTRasym values in %) in patients and controls, IVDs were classified according to the Pfirrmann score.

METHOD AND MATERIALS

14 whole body 18F-FDG-PET/MR examinations were performed in 12 patients with IRF. T1 and T2 sequences were used for anatomical localization of FDG uptake and identification of morphological changes associated with IRF. Contrast-enhanced-MRA was performed to judge changes of the vessel lumen. IRF tissue volume was calculated on MRI in cm3. FDG-uptake was assessed visually (using a 4-point scale) and quantitatively (maximal standardized uptake value [SUV max], target to background ratio [TBR]). Correlations between PET/MR findings (SUV max, TBR, visual score, IRF volume) and DAS (disease activity score), combining typical clinical symptoms for IRF, CRP/ESR/IL-6 levels and results of previous examinations by ultrasound, CT and MRI, were analyzed. Intended therapeutic management was documented before and after availability of PET/MR findings.

RESULTS

DAS classified 7 cases as having active disease and 7 as inactive. In contrast, PET/MR revealed active IRF in 10/14 cases and changed disease status according to DAS in 5 cases (36%), more specifically in 4 cases from inactive to active disease and active to inactive disease in 1 case. There was no association between DAS and the various PET/MR findings (p > 0.05). PET/MR showed vessel changes suggestive for active LVV in 3 cases. In addition, PET/MR imaging results had impact on therapeutic management in 6/14 cases (43%), in particular by starting or avoiding immunosuppressive therapy.

CONCLUSION

Whole body 18F-FDG-PET/MR may be considered as a useful approach for aiding in the management of patients with IRF.

CLINICAL RELEVANCE/APPLICATION

In IRF there is still a lack of reliable parameters to objectively assess the degree of inflammation and to guide therapy decisions. Imaging by whole body 18F-FDG PET/MR might help as a new approach.

SSM14-03 Glycosaminoglycan Chemical Exchange Saturation Transfer of Lumbar Intervertebral Discs in Patients with Spondyloarthritis

Wednesday, Dec. 2 3:20PM - 3:30PM Location: SS04CD

Awards

Molecular Imaging Travel Award

Participants

Christoph Schleisch, Dusseldorf, Germany (Presenter) Nothing to Disclose
Anja Lutz, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Joel Aissa, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Seerin, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Ruben Sengewein, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Benedikt Ostendorf, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Benjamin Schmitt, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Falk R. Miese, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To assess glycosaminoglycan (GAG) content of lumbar intervertebral discs (IVD) in patients with spondyloarthritis (Spa) using glycosaminoglycan chemical exchange saturation transfer (gageCET).

METHOD AND MATERIALS

Ninety lumbar intervertebral discs of nine patients with SpA and nine age-matched healthy controls (eight patients with ankylosing spondylitis; one patient with spondylitis related to inflammatory bowel disease; mean age: 44.1 ± 14.0 years; range: 27 - 72 years) were examined at a 3T MRI scanner in this prospective study. The MRI protocol included standard morphological, sagittal T2 weighted (T2w) images to assess Pfirrmann score of the five lumbar IVDs (L1 to S1) and biochemical imaging with gagCEST to calculate a region-of-interest analysis of nucleus pulposus (NP) and annulus fibrosus (AF). Prior to statistical testing of gagCEST effects (MTRasym values in %) in patients and controls, IVDs were classified according to the Pfirrmann score.

RESULTS

Significantly lower gagCEST values of NP and AF were found in Spa patients compared with healthy volunteers (NP: 1.41 % ± 0.41 %, p = 0.001; 95%-confidence interval, CI [0.600% - 2.226 %]; AF: 1.19 % ± 0.32 %, p < 0.001; CI [0.560 % - 1.822 %]) by comparing the differences of the means. Pooled non-degenerative IVDs (Pfirrmann 1 and 2) had significantly lower gagCEST effects in patients suffering from SpA compared with healthy controls in NP (p < 0.001; CI [1.176 % - 2.337 %]) and AF (p < 0.001; CI [0.858 % - 1.779 %]). No significant difference of MTRasym values was found in degenerative IVDs between patients and controls in NP (p = 0.204; CI [-0.504 % - 2.170 %]).

CONCLUSION

GagCEST analysis of morphologically non-degenerative IVDs (Pfirrmann score 1 and 2) in T2w images demonstrated significantly
lower GAG values in patients with spondyloarthritis in NP and AF possibly representing a depletion of GAG in spondyloarthritids in the absence of morphologic degeneration.

CLINICAL RELEVANCE/APPLICATION
GagCEST may be a powerful tool to access IVD composition in spondyloarthritids and to investigate therapy effects on GAG content in advanced studies.

SSM14-04  Preliminary Experience with 3T Time of Flight Simultaneous Cardiac PET/MRI in the Evaluation of Cardiac Sarcoidosis

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S504CD

Awards
Trainee Research Prize - Fellow

Participants
Kate Hanneman, MD, Toronto, ON (Presenter) Nothing to Disclose
Andrei Iagaru, MD, Stanford, CA (Abstract Co-Author) Research Grant, General Electric Company; Research Grant, Bayer AG
Henry Guo, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Amr Barkhdadi, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Mehran Jamali, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Dawn Holley, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Robert J. Herfkens, MD, Stanford, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The aim of this study is to investigate the utility of simultaneous time of flight (TOF) cardiac PET/MRI in the evaluation of cardiac sarcoidosis.

METHOD AND MATERIALS
Six consecutive patients (50% male, 53.3±12.3 years) were prospectively recruited over a 3-month period for parallel assessment of suspected cardiac sarcoidosis by standard clinical evaluation and simultaneous PET/MRI. Five healthy volunteers were initially scanned for protocol optimization. Patients first underwent standard cardiac PET/CT (Discovery 600 or 690, GE Healthcare) after administration of 9.7±0.4 mCi of 18F FDG. This was followed by a cardiac PET/MRI using a simultaneous scanner with TOF and 3T (Signa, GE Healthcare). Participants were prepared with 8-hour dietary instructions in order to suppress physiologic myocardial glucose uptake. Cardiac MRI sequences included breath-hold, ECG-triggered cine SSFP, T2-weighted, T1-mapping (pre- and post-contrast), and delayed myocardial enhanced (DME). Three experienced readers performed image analysis using an independent workstation with dedicated post-processing software.

RESULTS
PET/CT was acquired with a delay of 95.8±26.6 min, while PET/MRI had a delay of 195.5±35.6 min from 18F FDG injection. Total scan time for PET/MRI was significantly longer than for PET/CT (75.8±17.7 vs. 36.6±6.3 min, p=0.016). PET from PET/CT was positive for cardiac sarcoidosis in 50% of patients, while PET from PET/MRI was positive for cardiac sarcoidosis in 100% of patients. LV measurements by MRI were: EDV (159.3±33.5mL), ESV (87.6±50.0mL), LVEF (47.3±19.7%), pre-contrast T1 (1455.9±25.6ms), post-contrast T1 (307.0±63.6ms) and extra-cellular volume (ECV) (38.5%). DME and T2 hyper-intensity were identified in 67% and 33% of patients, respectively. There was a significant difference in effective radiation dose (ED) between PET/CT and PET/MRI (p=0.007). ED from the CT component of the PET/CT exam alone was 4.6±1.4mSv.

CONCLUSION
Simultaneous cardiac PET/MRI is feasible achieving diagnostic image quality with the added benefit of radiation dose reduction in comparison to PET/CT.

CLINICAL RELEVANCE/APPLICATION
Simultaneous cardiac PET/MRI is feasible, and provides additional information over PET/CT, potentially reducing the number of exams for patients.

SSM14-05  Role of FDG PET/CT for the Detection of Renal Infections in Cases of Pyrexia of Unknown Origin

Wednesday, Dec. 2 3:40PM - 3:50PM Location: S504CD

Participants
Sikandar M. Shaikh, DM,MRD, Hyderabad, India (Presenter) Nothing to Disclose
Hrishikesh Aurangabadkar, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Madhur K. Srivastava SR, MBBS, Chennai, India (Abstract Co-Author) Nothing to Disclose

PURPOSE
Patients with pyrexia of unknown origin were evaluated by FDG PET/CT for the detection of renal infections.

METHOD AND MATERIALS
26 patients underwent FDG PET/CT for the detection of infection foci involving the kidneys. Positive FDG PET/CT findings and pathological correlation served as the main outcome measures.

RESULTS
Of the 26 study patients, 18 (70.2%) had positive FDG PET/CT findings and a total of 24 major infection foci were identified. Five patients (24.6%) had at least two infection foci on FDG PET/CT scans. Two (53.8%) of the 3 patients with primary renal infections had concurrent multiple foci. seven patients (26.9%) had their treatments modified by FDG PET/CT results. Multivariate logistic regression analysis demonstrated that leucocyte count at diagnosis along with correlation with positive FDG PET/CT results. seven patients (26.0%) landed in hemodialysis during their hospital stay, and 6 of them had positive FDG PET/CT findings (P = 0.014). Positive FDG PET/CT results were an independent predictor of mortality (hazard ratio [HR]=3.896, 95% CI=1.039-14.613, P =
CONCLUSION

Our results suggest that FDG PET/CT is clinically useful for detecting occult infection foci in renal infections. In this population, positive FDG PET/CT findings may lead to a significant change in clinical management and independently predict mortality.

CLINICAL RELEVANCE/APPLICATION

PET-CT IS HIGHLY SENSITIVE IN EVALUATING THE RENAL INFECTION IN CONTEXT OF PYREXIA OF UNKNOWN ORIGIN.

SSM14-06 Image Monitoring of Impaired Phagocytic Activity of Kupffer Cells and Liver Oxygen Saturation in a Mouse Cholangitis Model Using Sonazoid-Enhanced US and Photoacoustic Image

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S504CD

Participants
Jung Hoon Kim, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Seo-Youn Choi, MD, Bucheon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyo Won Eun, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Seunghyun Lee, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Joon Koo Han, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate serial change of impaired phagocytic activity of Kupffer cells and liver Oxygen Saturation (sO2) in a mouse cholangitis model using sonazoid enhanced US (SEUS) and photoacoustic image (PI)

METHOD AND MATERIALS

Mouse cholangitis models were created by ligation of common bile duct (n=20, G1), left intrahepatic bile duct (n=19, G2-left and G2-right) and compared with control (n=14, G3). SEUS and PI were performed at 1, 2, and 4 weeks. PA images were collected at 750 and 850 nm and parametric maps of sO2 were generated. Serial change of echogenicity on the Kupffer phase and liver sO2 were measured in each groups. Serial changes in each group were analyzed using one way ANOVA with Bonferroni's method. Kupffer cell fraction using CD68 immunohistochemistry stain was also compared with SEUS.

RESULTS

Serial change of sonazoid enhancement enhancement showed decreased in G1 (15.1 + 8.6 x 10^-5) and G2-left (9.3+7.9 x 10^-5) than G2-right (248.8+253.3 x 10^-5) and control (153.7+34.7 x 10^-5). However, Kupffer cell fraction showed increased in G1 (36.1+7.1%) and G2-left (26.8+5.1%) than G2-right (16.6+5.6%) and control (12.3+3.3%), suggesting impaired phagocytic activity of Kupffer cells. Liver sO2 showed decreased in G1 (24.0+8.0%) and G2-left (22.7+8.4%) than G2-right (39.1+12.0%) and control (41.7+8.1%).

CONCLUSION

SEUS and PI are useful for monitoring of serial change of impaired phagocytic activity of Kupffer cells and liver sO2 in a mouse cholangitis model.

CLINICAL RELEVANCE/APPLICATION

SEUS and PI are feasible to assess the serial change of phagocytic activity of Kupffer cells and liver sO2 in a mouse cholangitis model.
**SSM15**

**ISP: Musculoskeletal (MRI Around Metal: Technique and Clinical Application)**

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E450A

- **AMA PRA Category 1 Credit™:** 1.00
- **ARRT Category A+ Credit:** 1.00
- **FDA**

**Participants**

Hollis G. Potter, MD, New York, NY (Moderator) Research support, General Electric Company

Siegfried Trattnig, MD, Vienna, Austria (Moderator) Nothing to Disclose

**Sub-Events**

SSM15-01  **Musculoskeletal Keynote Speaker: MR Imaging Around Metal-Technique and Clinical Implementation**

Wednesday, Dec. 2 3:00PM - 3:20PM Location: E450A

**Participants**

Hollis G. Potter, MD, New York, NY (Presenter) Research support, General Electric Company

SSM15-03  **Particle Induced Synovitis on MRI and Correlation with Polyethylene Surface Damage at Retrieval Analysis**

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E450A

**Awards**

**Trainee Research Prize - Fellow**

**Participants**

Angela E. Li, MBBS, MMed, New York, NY (Presenter) Nothing to Disclose

Christine C. Johnson, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

Darryl B. Sneag, MD, Chestnut Hill, MA (Abstract Co-Author) Nothing to Disclose

Chelsea N. Koch, BS, New York, NY (Abstract Co-Author) Nothing to Disclose

Kara Fields, New York, NY (Abstract Co-Author) Nothing to Disclose

Timothy M. Wright, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

Theodore T. Miller, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

Douglas E. Padgett, MD, New York, NY (Abstract Co-Author) Consultant, Stryker Corporation;

Hollis G. Potter, MD, New York, NY (Abstract Co-Author) Research support, General Electric Company

**PURPOSE**

To determine if a correlation exists between degree of polyethylene surface damage in total knee arthroplasty (TKA) tibial components and the severity of synovitis, osteolysis, and capsular thickness on MRI.

**METHOD AND MATERIALS**

With IRB approval, 62 patients who had an MRI within 1 year prior to revision arthroplasty were consecutively selected from our hospital registry of retrieved TKA implants. The MR images were retrospectively graded for particle induced synovitis based on the percentage of bulky hypertrophied synovium filling the joint. Capsular thickness and volume of osteolytic lesions were calculated. The articular surfaces of the retrieved tibial inserts were visually inspected, blinded to the MR appearances, and subjectively assigned damage scores by two independent observers using an established grading system. Inserts were graded for: deformation, embedded debris, scratching, burnishing, delamination, pitting, and abrasion. The MRI scores and measurements were compared to the articular surface damage scores using the Spearman correlation coefficient.

**RESULTS**

A positive correlation was found between the MRI grade of particle induced synovitis and the damage score (rs=0.423, p<0.01, or rs=0.450, p<0.01 when the synovitis grade was corrected for the degree of capsular distention). The volume of osteolytic lesions correlated with the damage score (rs=0.335, p<0.01). Capsular thickness did not correlate with damage scores (rs=-0.097, p=0.5). The synovitis grade strongly correlated with the volume of osteolytic lesions (rs=0.579, p<0.01). The length of implantation of the TKA correlated with both the synovitis grade and damage score (rs=0.396, p<0.01 and rs=0.487, p<0.01, respectively). The mean length of implantation was 6.7 years (range 1-30, SD 6.1 years).

**CONCLUSION**

Polyethylene surface damage in TKA correlates with the severity of particle-induced synovitis and volume of osteolytic lesions on MRI.

**CLINICAL RELEVANCE/APPLICATION**

The association between MRI findings and retrieval analysis of polyethylene damage suggests a link between wear debris and subsequent synovial reactions around failed TKAs.

SSM15-04  **Metal Artifact Reduction (MAR) on a Sliding Gantry CT-scanner: Evaluation of a MAR Algorithm Based on Two Compartment Physical Modelling in Patients with Hip Implants**

Wednesday, Dec. 2 3:30PM - 3:40PM Location: E450A

**Participants**
The aim of this study was to evaluate the impact of a novel metal artifact reduction (MAR) algorithm on image quality compared to standard filtered back projection (FBP) on a CT scanner with sliding gantry in patients with metallic hip implants.

RESULTS

OAS values were 153.2±48.3 HU for M34; 261.0±48.3 HU for M33; 328.7±228.7 HU for M32; 393.2±225.9 HU for M31; 446.8±224.2 HU for M30 and 528.9±227.7 HU for FBP. OAS values were significantly lower for M32-34 compared to FBP (p<0.05). Subjective image quality was 2.04±0.2 for FBP, 2.34±0.8 for M30, 2.6±0.5 for M31, 3.0±0.6 for M32, 3.5±0.6 for M33 and 3.8±0.4 for M34 (p<0.05 for M31-M34 vs. FBP, respectively). Increasing strength of the MAR level resulted in new artifacts in up to 16%.

CONCLUSION

The MAR algorithm leads to a significant reduction in artifacts from metallic hip implants. The highest MAR-level allows for the maximal artifact reduction but may also induce new artifacts.

CLINICAL RELEVANCE/APPLICATION

High levels of a MAR algorithm lead to a significant improvement of image quality in patients with hip implants.

SSM15-06 Usefullness of Slice Encoding Metal Artifact Correction (SEMAC) for Reducing Metal Artifacts after Total Knee Arthroplasty

Wednesday, Dec. 2 3:40PM - 3:50PM Location: E450A

Participants

Rajeev Mannem, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Suryanarayanan Kaushik, PhD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Scott J. Erickson, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Mark D. Hohenwalter, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Kevin M. Koch, PhD, Waukesha, WI (Abstract Co-Author) Nothing to Disclose

PURPOSE

Metal-induced susceptibility artifacts in MRI can be greatly reduced using Three-Dimensional Multi-Spectral Imaging methods (3D-MSI). A variety of previous studies have demonstrated preliminary clinical utility of 3D-MSI (i.e. "MAVRIC SL" and "SEMAC/Advanced WARP") in assessing complications near metal implants. Here, we present preliminary analysis of 3D-MSI utility in contrast-enhanced (CE) MRI at a field strength of 1.5T. Susceptibility-artifacts near metal implants introduce unique challenges to CE MRI. In particular, the hyperintense 'pileup' artifacts that are present in conventional fast/turbo spin-echo sequences often confound assessment of CE near metal implants. Use of T1w 3D-MSI for CE MRI reduces the footprint of these hyperintensity artifacts.

METHOD AND MATERIALS

MAVRIC SL 3D-MSI was implemented using modified pulse-sequencing software that allowed for shorter TR periods than the commercially available sequence. 3D-MSI images were acquired pre- and post contrast in at least one scan plane for each case. In addition conventional 2D-FSE images were acquired for each case for qualitative comparison of artifact reduction. Imaging data was acquired on a variety of implants including total hip-replacements, spinal fusion hardware, fixation screws, and support rods. All subjects were consented into a research study approved by the local ethics committee.

RESULTS

CE T1-weighted 3D-MSI at 1.5T enables uptake assessment in the immediate vicinity of metallic instrumentation. For assessments of painful total hip replacements CE aided in tissue differentiation in cases of adverse local tissue reaction. Contrast-enhanced 3D-MSI enabled improved assessments of early tumor recurrence. Assessment of failed back surgery syndrome also showed potential benefit from CE 3D-MSI, where contrast uptake in the immediate vicinity of pedicle screws was consistently observed. In addition, assessment epidural fibrosis and infection in the immediate vicinity of spinal hardware was enabled using contrast-enhanced 3D-MSI.

CONCLUSION

New 3D-MSI metal artifact reduction techniques can be used effectively to assess contrast uptake in the immediate vicinity of metallic hardware.

CLINICAL RELEVANCE/APPLICATION

These methods allow the freedom to assess common pathological conditions as if the hardware were absent and encourages future studies characterizing disease processes due to the hardware itself.

SSM15-06 Usefullness of Slice Encoding Metal Artifact Correction (SEMAC) for Reducing Metal Artifacts after Total Knee Arthroplasty
PURPOSE
To compare metal artifact reduction after total knee arthroplasty in MRI at 1.5 T using novel MRI sequence strategies.

METHOD AND MATERIALS
Two sequences were compared for the imaging of metal implants after total knee arthroplasty on a 1.5 T MR system: a slice encoding sequence for metal artifact correction (SEMAC) and a standard TSE sequence. 15 patients with titanium implants were evaluated. Degree of artifact reduction was assessed quantitatively and qualitatively by both, artifact measurements and a blinded read. The images were ranked by the following parameters: artifact size, distortion, and the ability to differentiate bone marrow, cortex and soft tissue. The images were also evaluated in respect of the visibility of crucial and collateral ligaments and the patellar tendon. The Insall-Salvati-Index was measured as well. The SEMAC technique was compared directly to the TSE standard sequence.

RESULTS
In comparison to standard sequences artifact size was 59% less utilizing SEMAC. In terms of bone marrow, bone cortex and soft tissue visualization SEMAC was ranked superior to the corresponding standard sequence. Distortion was less with SEMAC. For the evaluation of blur, the standard images were ranked superior to the corresponding SEMAC sequence. In terms of overall image quality, SEMAC was ranked superior to the standard sequence. For all terms of clinical relevance SEMAC was ranked superior to the corresponding standard sequence.

CONCLUSION
SEMAC effectively reduces artifacts caused by metallic implants after total knee arthroplasty relative to standard imaging.

CLINICAL RELEVANCE/APPLICATION
SEMAC sequences allow for better visualisation of crucial anatomic structures after total knee arthroplasty thus improving evaluation of postoperative result and detection of postoperative complications.
**SSM16**

**Nuclear Medicine (Cardiovascular Imaging)**

Wednesday, Dec. 2 3:00PM - 4:00PM Location: SS05AB

**SSM16-01** Anthropometric-based Radiopharmaceutical Dosing to Reduce Radiation in SPECT MPI: Initial Experience

**Participants**

- Charles M. Intenzo, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose
- Andrew C. Homb, MD, Louisville, KY (*Moderator*) Nothing to Disclose

**Purpose**

Myocardial perfusion imaging (MPI) using gated single photon emission computed tomography (SPECT) is a well-established approach to detect coronary artery disease and risk-stratify patients. For a typical 1-day rest/stress SPECT protocol, standard administered activities of Tc-99m sestamibi are 10 mCi (rest)/30 mCi (stress), resulting in a patient radiation dose of ~12 mSv.

The American Society of Nuclear Cardiology recommended decreasing radiation exposure to < 9 mSv in 50% of patients by 2014. To comply with this recommendation, we employed a new anthropometric-based dosage regimen.

**Method and Materials**

We investigated the relationship between administered Tc-99m sestamibi activity, patient size, and image quality. Patients undergoing SPECT MPI were recruited over two consecutive weeks; measures of weight (kg), height (m), and chest circumference (cm) were recorded. Body Mass Index (BMI) was calculated (kg/m²). Image quality was evaluated by a board-certified nuclear radiologist and a nuclear cardiologist.

**Results**

Thirty-one patients underwent 1-day rest/stress SPECT MPI. A convenient BMI-based 1-day rest/stress dosing regimen was developed through analyses of administered activity, patient size, and image quality. Administered activities were 6 mCi/18 mCi for BMI < 25 kg/m², 7 mCi/21 mCi for BMI 25-30 kg/m², 8 mCi/24 mCi for BMI 30-35 kg/m², and 10 mCi/30 mCi for BMI > 35 kg/m². The patient radiation doses were 7.26 mSv, 8.47 mSv, 9.68 mSv and 12.10 mSv, respectively. Image quality met clinical diagnostic requirements. Scan time remained the same. With the proposed dosing regimen, radiation exposures in ~ 60% of 31 patients were < 9 mSv.

**Conclusion**

Using “older” gamma camera technology anthropometric-based dosing of Tc-99m sestamibi significantly reduces radiation exposure while maintaining diagnostic image quality.

**Clinical Relevance/Application**

BMI-adjusted dosing of Tc-99m sestamibi for rest/stress SPECT MPI can significantly reduce patient radiation dose while maintaining image quality.

**SSM16-02** Effect of Inflammatory Cardiac Sarcoidosis on Myocardial Blood Flow Assessed by PET/CT

**Participants**

- Matthew J. Kruse, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
- Thomas H. Schindler, MD, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose

**Purpose**

Inflammatory cardiac sarcoidosis, as evidenced by FDG PET/CT imaging, confers an increased risk for sudden cardiac death and onset of heart failure. Dysfunction of the coronary circulation may represent a mechanistic link between inflammatory sarcoidosis activity and adverse outcomes. In this respect, we aimed to investigate effects of inflammatory cardiac sarcoidosis on coronary circulatory function.

**Method and Materials**

Individuals were 13 patients with biopsy-proven or clinical/imaging evidence of cardiac sarcoidosis undergoing baseline and follow-up cardiac PET/CT studies (31 total studies). Quantitative myocardial blood flow (MBF) was determined at rest and during pharmacologic vasodilation with N-13 ammonia or Rb-82 PET/CT, with calculation of myocardial flow reserve (MFR). Following a sarcoid diet protocol, FDG PET/CT was additionally performed to determine the presence of abnormal FDG uptake in the heart.
Myocardial segmentation was performed using the 17-segment model. Maximum SUV and metabolic volume above previously published SUV thresholds was calculated.

RESULTS
Myocardial segments with abnormal FDG activity (n=122) demonstrated decreased MBF during vasodilation (1.96 +/- 0.86 ml/g/min vs. 2.13 +/- 0.84 ml/g/min; p=0.045, Mann-Whitney Test) and decreased MFR (2.40 +/- 0.81 vs. 2.75 +/- 1.05; p=0.002). Resting MBF was not significantly different (0.82 ml/g/min vs. 0.79 ml/g/min; p=0.305). Myocardial segments that developed abnormal FDG activity on follow-up study (n=47) demonstrated a greater decrease in MFR compared with segments that remained FDG-negative (n=200) (p=0.003). Segments that normalized on follow-up study (n=31) demonstrated decreased resting MBF compared with segments that remained FDG-positive (n=28) (p=0.013). Global MFR was not significantly correlated with maximum SUV, metabolic volumes, or clinical factors. BMI was weakly inversely correlated with both resting (Pearson r=-0.364, p=0.044) and vasodilation (r=-0.485, p=0.007) global MBF.

CONCLUSION
Myocardial segments involved with active sarcoidosis as evidenced by abnormal FDG activity demonstrate decreased vasodilatation MBF and MFR, indicative of regional microvascular dysfunction that may reflect a basis for increased cardiovascular risk.

CLINICAL RELEVANCE/APPLICATION
Further studies are needed to determine if microvascular dysfunction detected by PET/CT perfusion quantitation may predict the risk of poor outcomes in cardiac sarcoidosis.
METHOD AND MATERIALS

Dynamic myocardial perfusion imaging (MPI) starting with 30-s bolus of Tc-99m perfusion agents was performed during adenosine stress and at-rest using a CZT camera (DNM 530c). The interval between two imaging was 3 hours and a 30-s pre-scan count was subtracted from the dynamic data at-rest. We generated 200 3-D volumes integrating 3-s time frames in the course of 600-s. Routine summed MPI were also acquired thereafter. The software allows the automatic edge detection of volume of interest for the blood pool in the left ventricle and the myocardium. Global time activity curves were fitted to a 2-compartment kinetic model (2-com), a Patlak plot analysis (PPA), and a dose uptake ratio of MPI (DUR) with input function. K1 and K2 were calculated for the stress and rest images. MFR index was calculated as follows: MFR index=K1 stress/K1 at-rest. The validation study included 45 consecutive pts who underwent CZT SPECT and coronary angiography within 2 weeks. (25 males, 68±11 y).

RESULTS

There were 17 pts with multi-vessel CAD while 28 had 0 or 1-vessel CAD. In the multi-vessel group, global MFR estimated by 2-com was 1.12±0.16 (Figure), which was significantly lower than 1.35±0.15 for pts with 0 or 1-vessel CAD (p<0.0001). The area under the curve (AUC) by receiver operating characteristic (ROC) analysis was 0.85, 0.73, and 0.65 for 2-com, PPA, and DUR, respectively. Using a cut-off value of 1.3, the sensitivity was 94% and specificity was 64% for diagnosing multi-vessel CAD. Moreover, multivariate analysis reveals that the global MFR by 2-com was an independent predictor of multi-vessel CAD among 11 clinical and MPI variables (chi-square: 5.46, p=0.02).

CONCLUSION

We developed and validated a novel software for calculating MFR from dynamic kinetic analysis using a CZT SPECT. It improves the detectability of multi-vessel CAD which causes globally decreased MFR and adds incremental diagnostic value to the standard MPI.

CLINICAL RELEVANCE/APPLICATION

Dynamic myocardial perfusion imaging with the 2-compartment analysis using the CZT SPECT enables us to estimate myocardial flow reserve and may improve the detectability of multi-vessel CAD.

SSM16-05 Physiologic Correlates of Rb-82 PET/CT Left Ventricular Mass: Volume Ratios

Wednesday, Dec. 2 3:40PM - 3:50PM Location: S505AB

Participants

Kenneth Nichols, PhD, New Hyde Park, NY (Presenter) Royalties, Syntermed, Inc; Andrew Van Tosh, MD, Roslyn, NY (Abstract Co-Author) Consultant, Pfizer Inc; Consultant, Bracco Group; Consultant, Cardinal Health, Inc; Consultant, Icahn Institute for Reproductive Medicine, NY

Nathaniel Reichek, MD, Roslyn, NY (Abstract Co-Author) Nothing to Disclose

Christopher J. Palestro, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

MRI and echocardiography investigators have found that computing the ratio of left ventricular (LV) mass:volume, indexed to a pt's body size, is a useful means of characterizing ventricular remodeling, including aiding in predicting the likelihood of adverse cardiac events. We sought to identify the pathophysiologic mechanisms leading to abnormal M/Vi by examining whether LV myocardial blood flow (MBF) measured by Rb-82 PET/CT is also abnormal for pts with low Mi/Vi.

METHOD AND MATERIALS

We performed a retrospective investigation of data acquired for 194 pts who underwent rest/stress Rb-82 PET/CT imaging for suspected cardiac disease. LV mass indexed to body size (Mi) = 100 • resting mass/(a • height^0.54 • weight^0.61), where a = 6.82 for women, 8.25 for men. LV end-diastolic volume indexed to body (Vi) = 100 • resting end-diastolic volume/(b • height^1.25 • weight^0.43), where b = 10.0 for women, 10.5 for men. For pts with Mi/Vi < 1.0, those

RESULTS

55 pts had Mi/Vi < 1.0 (mean 0.86±0.08) and 139 pts had Mi/Vi ≥ 1.0 (mean 1.32±0.22). Compared to pts with Mi/Vi ≥ 1.0, those with Mi/Vi < 1.0 had abnormally low rest values of EF (45±16% versus 60±15%, p<0.0001) and low MBF (0.58±0.25 versus 0.96±0.59 ml/g/min, p < 0.0001) and abnormally high CVR (182±471 versus 131±80 mm Hg/ml/g/min, p = 0.0001). Differences were even more pronounced at stress, with abnormally low values of EF (45±17% versus 65±14%, p<0.0001) and low MBF (1.06±0.61 versus 1.89 ± 0.96ml/g/min, p < 0.0001) and abnormally high CVR (107±49 versus 64±42 mm Hg/ml/g/min, p = 0.0001). For pts with Mi/Vi < 1.0, rest and stress MBF and EF were significantly lower, and CVR significantly higher, than published normal limits for these parameters.

CONCLUSION

Our results suggest that a finding of an abnormally low indexed mass-to-volume ratio in an individual is consistent with impaired myocardial blood flow, which hampers EF response to stress.

CLINICAL RELEVANCE/APPLICATION

A finding of low indexed mass-to-volume ratio should be followed up by more specific procedures such as coronary arteriography to assess more completely arterial status.

SSM16-06 F-18 FLT PET/CT Imaging for Diagnosis of Cardiac Sarcoidosis

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S505AB

Participants

Christopher J. Palestro, MD, New Hyde Park, NY (Presenter) Royalties, Syntermed, Inc; Consultant, Icahn Institute for Reproductive Medicine, NY

Nathaniel Reichek, MD, Roslyn, NY (Abstract Co-Author) Consultant, Pfizer Inc; Consultant, Bracco Group; Consultant, Cardinal Health, Inc; Consultant, Icahn Institute for Reproductive Medicine, NY

Van Tosh, MD, Roslyn, NY (Abstract Co-Author) Consultant, Icahn Institute for Reproductive Medicine, NY

Nichols, PhD, New Hyde Park, NY (Abstract Co-Author) Consultant, Pfizer Inc; Consultant, Bracco Group; Consultant, Cardinal Health, Inc; Consultant, Icahn Institute for Reproductive Medicine, NY

Reichek, MD, Roslyn, NY (Abstract Co-Author) Nothing to Disclose

Presenters

Christopher J. Palestro, MD, New Hyde Park, NY

Nathaniel Reichek, MD, Roslyn, NY

Van Tosh, MD, Roslyn, NY

Nichols, PhD, New Hyde Park, NY

Reichek, MD, Roslyn, NY
PURPOSE

2-deoxy-2-F-18 fluoro-D-glucose (FDG) positron emission tomography (PET) has been proposed to play a role in the diagnosis of cardiac sarcoidosis. However, assessing inflammatory lesions in cardiac sarcoidosis using FDG can be challenging because the FDG accumulates in normal myocardium. In contrast to FDG, 3'-deoxy-3'-F-18 fluorothymidine (FLT) uptake in normal myocardium is low. The purpose of this study was to investigate the feasibility of FLT PET/CT for the detection of cardiac sarcoidosis.

METHOD AND MATERIALS

Sixteen FLT PET/CT studies in 12 patients suspected of having cardiac sarcoidosis were performed. Six studies were performed before therapy and 10 studies were performed after immunosuppressive therapy. Fifty min after an intravenous injection of FLT, a 10-min emission scan of the heart was obtained. CT data for attenuation correction was obtained. Myocardial FLT uptake in cardiac sarcoidosis was defined as a "focal" or "focal on diffuse" pattern. In case of abnormal uptake, the maximal standardized uptake value (SUV) of lesions was measured. In case of no abnormal uptake, the mean SUV of myocardium was measured.

RESULTS

Five of 6 FLT studies before therapy showed a focal pattern of FLT uptake. Four of 10 FLT studies after therapy showed a focal pattern of FLT uptake. The mean (±SD) SUV after therapy (1.68±0.59) was significantly lower than that before therapy (3.02±0.90) (p<0.02).

CONCLUSION

These preliminary results indicate that FLT PET/CT might be a potentially useful tracer in the detection and therapy monitoring of cardiac sarcoidosis.

CLINICAL RELEVANCE/APPLICATION

FLT PET/CT might be a potentially useful tracer in the detection and therapy monitoring of cardiac sarcoidosis.
**SSM17**

**Neuroradiology (Neurointerventional Radiology)**

Wednesday, Dec. 2 3:00PM - 4:00PM Location: N227

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00
FDA
Discussions may include off-label uses.

**Participants**

Colin P. Derdeyn, MD, Saint Louis, MO (Moderator) Consultant, Terumo Corporation; Consultant, Penumbra, Inc; Consultant, Silk Road Medical; Stock options, Pulse Therapeutics, Inc;

Albert J. Yoo, MD, Newton, MA (Moderator) Research Grant, Penumbra, Inc; Research Grant, Terumo Corporation; Research Consultant, Medtronic, Inc;

**Sub-Events**

SSM17-01  **Recurrences May Occur More than Ten Years after Endovascular Treatment of Intracranial Aneurysms: A Prospective Cohort Study, a Systematic Review and Meta-Analysis**

Wednesday, Dec. 2 3:00PM - 3:10PM Location: N227

**Participants**

Olivier Naggara, MD, Paris, France (Presenter) Nothing to Disclose
Augustin Lecler, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Jean Raymond, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Christine Rodriguez, Paris, France (Abstract Co-Author) Nothing to Disclose
Denis Trystram, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Wagih Ben Hassen, Paris, France (Abstract Co-Author) Nothing to Disclose
Jean-Francois Meder, MD, PhD, Paris, France (Abstract Co-Author) Nothing to Disclose
Catherine Oppenheim, MD, PhD, Paris, France (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Our aim was to assess the 10-year efficacy of endovascular treatment (EVT) of intracranial aneurysm (IA) in terms of recurrence, assessed on long-term MR angiography (LT-MRA), and bleeding and de novo aneurysm formation. We also aimed to identify potential risk factors of aneurysm recurrence, including IA occlusion on 3-to 5-year MRA (MT-MRA), through a prospective study and a systematic review of the literature.

**METHOD AND MATERIALS**

We prospectively performed clinical examination and 3T MRA 10-years after EVT of IA in a single institution. Individual informed consent was obtained. In addition, the literature was searched using PubMed, EMBASE, and Cochrane databases to identify studies reporting bleeding and/or aneurysm recurrence rate in patients followed beyond 10-years after EVT. Univariate and multivariate subgroup analyses were performed to identify risk factors (MT-MRA results, aneurysm characteristics, retreatment within 5 years).

**RESULTS**

In the prospective study, among 129 aneurysms followed >10 years, 16 (12.4%) demonstrated sac recanalization between MT- and LT-MRA. Neck remnant on MT-MRA (Relative risk [RR]: 4.16, 99%Confident interval [99%CI]: 2.12-8.14) and retreatment within five years (RR: 4.67, 99% CI: 1.55-14.03) were risk factors for late recurrence. In the systematic review (15 cohorts, 2773 patients, 2902 aneurysms), bleeding rate, recurrent aneurysm, and de novo lesion were, respectively 0.7% (99%CI, 0.2-2.7%, I2: 0%, 694 aneurysmes), 11.4% (99%CI, 7.0-18.0%, I2: 21.6%), and 4.1% (99%CI, 1.7-9.4%, I2: 54.1%). Incomplete initial treatment (RR: 7.08, 99%CI, 1.24-40.37, I2: 82.6%) and aneurysm size > 10 mm (RR: 4.37, 99%CI, 1.83-10.44, I2: 0%) were risk factors for late recurrence.

**CONCLUSION**

EVT of IA is effective in preventing long-term bleeding, but may be followed by recurrences in a significant proportion of cases, a finding that may justify following selected patients for ≥10 years, i.e. in patients with Raymond grade 2 classification on 3- to 5-year MRA or when aneurysm >10 mm.

**CLINICAL RELEVANCE/APPLICATION**

Long-term (> 10 years) MRA follow-up may be needed in patients with aneurysms larger than 10 mm, or in the case of grade 2 aneurysms at the end of standard midterm follow-up. De novo aneurysms may occur between 5 and 10 years after treatment in one in 25 patients.

SSM17-02  **Does Recurrence Effect the Clinical Outcome after Endovascular Coiling of Ruptured Intracranial Aneurysms? - A Ten Year Retrospective Study**

Wednesday, Dec. 2 3:10PM - 3:20PM Location: N227

**Participants**

Robert K. Moreland, MD, Ottawa, ON (Presenter) Nothing to Disclose
Marlise P. dos Santos MSc, MD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Rafael Glikstein, Ottawa, ON (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To identify the factors associated with clinical outcome of coiling of ruptured intracranial aneurysms (RIA).
METHOD AND MATERIALS

Retrospective review of all patients with RIA treated with endovascular coil embolization at a active single centre between 2002-2013. Cases of flow-related (AVM, DAVF related) aneurysms, flow-diversion and parent artery occlusion were excluded. We identified patient, periprocedural, procedural and aneurysm characteristics associated with pre-discharge and long-term clinical outcome (modified Rankin Scale (mRS) 0-2 [favorable] versus 3-6 [unfavorable]). We used univariate Cox Proportional Hazards Model followed by multivariate regression analysis of covariates to identify risk factors associated with poor clinical outcome.

RESULTS

A total of 305 RIA in 302 patients (mean age of 55.3 years) met criteria, including 216(70.8%) females. The mean follow-up was 34.2 months. Preoperatively, 176 cases had a mRS of 0-2, and 129 had a mRS of 3-5. Complete/near-complete occlusion was achieved in 245(81.3%) of the RIA, and body residual in 60(19.7%). At discharge 11 patients (3.61%) had a clinically worse mRS, 59 (19.34%) improved, and 231 (77.05%) were unchanged. Our periprocedural mortality (≤30 days) was 13.8%(42). Perioperative complications occurred in 18.4% of the cases. Postprocedure vasospasm occurred in 44.9% of the cases. Target maximum aneurysm size(<=7,>7) and aneurysm width (<=7,>7) had a significant effect on end clinical outcomes, while neck size(<=4,>4) and dome/neck ratio (<=2,>2) did not. Recurrence occurred 109 times (35.73%) after coiling, of which 40 (36.70%) underwent retreatment; the recoiling did not impact the clinical outcome. Mean time until retreatment was 15.7 months. Recurrence post discharge was not associated with a worsening of clinical disability (HR 1.417 CI 95% 0.722-2.779). There were four rebleeds occurring on average 30.5 months post procedure.

CONCLUSION

In our practice from 2002-2013 the safety of coil embolization RIA was comparable to the available literature. Recurrence and baseline occlusion status did not influence clinical outcomes. The maximum aneurysm size and width impacted long term clinical results, while the neck size and dome/neck ratio did not.

CLINICAL RELEVANCE/APPLICATION

Reoccurrence post ruptured aneurysm repair with endovascular coiling does not significantly impact end patient clinical outcome.

SSM17-03 Single Center Cerebral Aneurysm Treatment with FRED and PED Flow Diverters; Initial Experience, Techniques and Comparative Outcomes

Wednesday, Dec. 2 3:20PM - 3:30PM Location: N227

Participants
Soheil Sabet, MD, Istanbul, Turkey (Presenter) Nothing to Disclose
Nurten Andac, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Hacer Bal, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Feyyaz Baltacioglu, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Gazanfer Ekinci, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose

PURPOSE

This retrospective study of the initial institutional experience provides insight into technical challenges, clinical and radiographic outcomes, and complication rates during deployment and after the use of FRED (FRED™, TUSTIN, CA.- MicroVention, Inc.) and PED (PED™, ev3; Plymouth, Minnesota) flow-diverting stents for cerebral aneurysms.

METHOD AND MATERIALS

Informed consent was obtained from all patients. We implanted 91 flow diversion devices, including 51 PED and 46 FRED with or without adjunctive intraaneurysmal embolization for treatment of a total of 95 aneurysms between February 2012-April 2015 in our institution (Forty FRED devices to treat 46 aneurysms in 35 cases and 51 Pipeline devices to treat 49 aneurysms in 36 cases.). All patients underwent an-platelet therapy. Angiographic follow-up examinations were carried out in 50 patients (Thirty of PED and 20 of FRED cases.). Median clinical follow up period was 1.33 year (1.81 year in PED and 0.85 year in FRED group).

RESULTS

The flow diverter was successfully deployed in 87 of 91 stents (95.6%). The complete or near-complete occlusion rate was 70% in PED and 95% in FRED cases who had angiographic follow ups. Postprocedural aneurysm hemorrhage and consequent subarachnoid bleeding occurred in 1 patients from PED group due to stent migration. Total mortality rate during study period was 0%. We experienced failure of PED expansion in two patients whereas only one early deployment of stent within normal segment of ICA occurred in FRED group. We also encountered acute stent thrombosis within one hour of FRED deployment in one case. The stent was recanalized by deployment of a Solitaire AB (eV3™, Irvine, CA, USA) stent and intraarterial Tirofiban infusion. During angiographic follow ups 1 case of each group showed evidence of asymptomatic in-stent stenosis.

CONCLUSION

Flow-diverting stents play an important role in the treatment of intracranial aneurysms. Considering our experience, easier delivery and implantation, retrievability owing to its different design and higher aneurysmal occlusion rate in FRED makes it more advantageous in treatment of cerebral aneurysms when compared with PED. The relative efficacy and morbidity of these treatment methods must be considered in the context of available alternate interventions.

CLINICAL RELEVANCE/APPLICATION

FRED flow diverter may be more advantageous in treatment of cerebral aneurysms when compared with PED.
The aim of this study was to determine the predictive value of three different dynamic CT angiography (dynCTA) parameters - occlusion length, collateralization extent, and time delay to maximum enhancement - for latest generation stent-retriever thrombectomy recanalization outcome in patients with acute ischemic stroke.

**METHOD AND MATERIALS**

In this IRB-approved study, subjects were selected from an initial cohort of 2059 consecutive patients who had undergone multiparametric CT including whole-brain CT perfusion (WB-CTP). We included all patients with (a) a complete occlusion of the M1-segment of the MCA or the carotid T and (b) subsequent intraarterial stent-retriever thrombectomy. dynCTA was reconstructed from WB-CTP raw datasets. Technical outcome of thrombectomy was scored using the modified Thrombolysis in Cerebral Infarction (mTICI) scale. Logistic regression analyses were performed to determine independent predictors of a favorable outcome (mTICI=3).

**RESULTS**

A total of 69 patients (mean age 68±14yrs, 46% male) were included for statistical analysis. mTICI scores after recanalization were as follows: mTICI=0: 5 patients, mTICI=1: 3 patients, mTICI=2a: 6 patients, mTICI=2b: 24; mTICI=3: 31 patients. In the regression analysis, a short occlusion length was an independent predictor of favorable technical outcome (OR: 0.41, p < 0.05). Both collateralization grade (OR: 1.00, p > 0.05) and time delay to peak enhancement (OR: 0.90, p > 0.05) failed to predict a favorable outcome.

**CONCLUSION**

A shorter occlusion length as assessed by dynCTA is associated with a better recanalization success, while collateralization grade and time delay of maximum enhancement distal to the occlusion failed to predict thrombectomy outcome.

**CLINICAL RELEVANCE/APPLICATION**

Large vessel occlusion length as determined by dynamic CT angiography is an independent predictor for the technical outcome of stent-retriever thrombectomy in patients with acute ischemic stroke and may be considered as a possible decision-making parameter for patient selection.

**SSM17-05 Should Informed Radiation Consent Exist for Neurovascular Interventional Radiology Procedures? The Patient Perspective**

**Wednesday, Dec. 2 3:40PM - 3:50PM Location: N227**

**Participants**

Rebecca Zener, MD, London, ON (Presenter) Nothing to Disclose

Peter B. Johnson, MBBS, Kingston 7, Jamaica (Abstract Co-Author) Nothing to Disclose

Amol Mujoomdar, MD, London, ON (Abstract Co-Author) Speaker, Cook Group Incorporated; Speaker, Medtronic, Inc

Sachin Pandey, MD, Dedham, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Radiation exposure is inherent in neurovascular interventional radiology (IR). A potential exposure of 1 mSv has been suggested as a cutoff for provision of risk information, as it corresponds to a 1 in 10000 increased cancer risk. Informed consent requires disclosure of rare yet potentially significant risks, yet patient and non-radiologist physician knowledge of these risks is lacking. Neurovascular IR patient perception and knowledge of these risks remains unknown. The purpose of this study is to explore neurovascular IR patient perception of cancer-related radiation risk exposure and whether radiation consent is warranted.

**METHOD AND MATERIALS**

A multiple-choice survey was administered to 42 adult patients undergoing a non-emergent neurovascular IR procedure at a tertiary care centre. 67% of patients had previously undergone a neurovascular IR procedure. Statistical analysis of with Fisher Exact test was performed based on patient past neurovascular IR history (p<0.05).

**RESULTS**

Almost all subjects (90%) wanted to be informed if the radiation-related increased cancer risk was 1 in 100. Most (82%) wanted to be informed if the risk was moderate, 1 in 1000, or low, 1 in 10000 (70%). Only half of the patients were aware that they were exposed to radiation during their procedure, irrespective of previous neurovascular IR history. The majority (74%) believed that the ordering physician should be responsible for informing patients about radiation exposure. Most (85%) believed radiation consent should include radiation-related cancer risks, and that both verbal and written radiation consent should be obtained (74%). No significant difference was present based on past neurovascular IR history (p>0.05).

**CONCLUSION**

Neurovascular IR patient awareness of radiation exposure is suboptimal. Based on this survey, most patients want to discuss cancer-related radiation risks with the ordering physician in order to make informed decisions. This is potentially concerning as non-radiologist ordering physicians may not be as knowledgeable on radiation-related cancer risks. Neurointerventional radiologists should consider obtaining informed consent for procedures with anticipated doses of 1 mSv or greater.

**CLINICAL RELEVANCE/APPLICATION**

Neurovascular IR patients want to discuss cancer-related radiation exposure risk prior to undergoing an intervention in order to help them make an informed decision.

**SSM17-06 Successful Revascularization after Mechanical Thrombectomy with Stent Retrievers: Comparison**

A total of 69 patients (mean age 68±14yrs, 46% male) were included for statistical analysis. mTICI scores after recanalization were as follows: mTICI=0: 5 patients, mTICI=1: 3 patients, mTICI=2a: 6 patients, mTICI=2b: 24; mTICI=3: 31 patients. In the regression analysis, a short occlusion length was an independent predictor of favorable technical outcome (OR: 0.41, p < 0.05). Both collateralization grade (OR: 1.00, p > 0.05) and time delay to peak enhancement (OR: 0.90, p > 0.05) failed to predict a favorable outcome.

**CONCLUSION**

A shorter occlusion length as assessed by dynCTA is associated with a better recanalization success, while collateralization grade and time delay of maximum enhancement distal to the occlusion failed to predict thrombectomy outcome.

**CLINICAL RELEVANCE/APPLICATION**

Large vessel occlusion length as determined by dynamic CT angiography is an independent predictor for the technical outcome of stent-retriever thrombectomy in patients with acute ischemic stroke and may be considered as a possible decision-making parameter for patient selection.
The catheter system for mechanical thrombectomy (MT) with stent retrievers (SR) could be an important factor when it comes to successful and more rapid recanalization procedures. Multicenter retrospective data collection and comparative analysis were employed to assess the efficacy of intra-arterial mechanical thrombectomies carried out using the Balloon Guide Catheter (BGC) and the non-Balloon Guide Catheter (NBGC).

METHOD AND MATERIALS

170 consecutive patients with MCA or carotid terminus occlusions treated by SR with the BGC (N=90) or NBGC (N=80) at three stroke centers were analyzed retrospectively. Data on procedure duration, number of passes, initial and final angiographic findings were collected. The degree of vessel occlusion initially and post-intervention was defined as the Thrombolysis in Cerebral Infarction (mTICI) score. Successful revascularization was defined as a final mTICI score 2b achieved upon conclusion of the procedure after <=3 passes. Adjuvant therapy was defined as intra-arterial thrombolysis, intracranial angioplasty, or stenting performed after a failed MT.

RESULTS

Successful recanalization (mTICI grade 3 or 2b accomplished within <=3 passes) was achieved with the BGC in 80 out of 90 thrombectomies (88.8%), significantly different from the successful recanalization rates achieved using the NBGC (67%; p<0.001). The one-pass-thrombectomy rate with BGC was significantly higher than for NBGC (62.2% vs. 35%; p<0.001). The mean number of passes for a complete recanalization (mTICI 3 or 2b) was 1.5±0.8 in the BGC group and 2.0±1.1 in the NBGC group. Recanalization procedure duration for a TICI 3 or 2b was significantly shorter using the BGC (24.5±15.2 min) than the NBGC (53.2 ± 37.8 min; p<=0.05). Intra-arterial thrombolysis, intracranial angioplasty, and stent placement after a failed MT were performed in 6.6% and 12.5% of the BGC and NBGC patients (BGC vs NBGC, p<=0.90).

CONCLUSION

The efficacy of mechanical thrombectomy with stent retrievers in acute ischemic stroke in the anterior circulation in terms of angiographic results and procedure duration was improved when performed in combination with BGC.

CLINICAL RELEVANCE/APPLICATION

Efficacy of mechanical thrombectomy with stent retrievers in acute ischemic stroke is improved when performed in combination with Balloon Guide Catheter.
SSM18

Neuroradiology (Resting State Functional Brain Imaging)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: N226

Participants
Haris I. Sair, MD, Baltimore, MD (Moderator) Research support, Carestream Health, Inc
Joshua S. Shimony, MD, PhD, Saint Louis, MO (Moderator) Nothing to Disclose

SSM18-01 Altered Brain Neural Activity in Sellar-Tumor Patients: A Resting-State fMRI Study

Wednesday, Dec. 2 3:00PM - 3:10PM Location: N226

Participants
Zhongyan Wang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Tianyi Qian, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Binbin Sui, MD, Beijing, China (Presenter) Nothing to Disclose
Peiyi Gao, MD, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose of the current study was to explore how brain neural activity changes with visual deprivation in patients with sellar tumors by measuring the pattern of low-frequency fluctuation (0.1~0.01 Hz) of the BOLD signal.

METHOD AND MATERIALS
21 patients with sellar tumors and 21 sex-matched healthy volunteers participated in this study. The resting-state fMRI data were processed using the SPM8 MATLAB toolbox and DPARSF. The spontaneous brain neural activity was measured by calculating the amplitude of low-frequency fluctuations (ALFF), regional homogeneity (ReHo) and functional connectivity (FC) of BOLD (blood-oxygenation-level-dependent) signals. A two-sample t-test was performed to investigate the difference between the groups, thereafter computing the correlation coefficient between the patterns obtained from rs-fMRI of some regions and the tumor size, as expressed by its left-right radius.

RESULTS
The results of the group analysis showed that, compared to normal control subjects, patients with sellar tumors exhibited significantly decreased ALFF in the bilateral cuneus, left lingual gyrus and the right supplementary motor area (SMA). ALFF in bilateral lentiform nucleus has significantly increased (Fig.1). The sellar tumors showed decreased ReHo value in the bilateral cuneus, but increased ReHo value in the precuneus, the left insular, and left lentiform nucleus. The ReHo values in precuneus and insula are significantly correlated with the tumor radius in left-right direction (Fig.2).

CONCLUSION
The results of this study suggest that the function of the area response for high-level cognition function in visual network is less stable than primary visual cortex in the patient with sellar tumors. The decreased brain activity in the precuneus and other brain areas might reflect a maladjustment behavior caused by visual deprivation. The increased brain activity in the lenticular nucleus and insula might be related to a compensatory phenomenon. The results provide useful information for us to better understand how brain functional network change under the influence of visual deprivation.

CLINICAL RELEVANCE/APPLICATION
The value of the functional patterns in these areas could potentially be used for evaluating the recovery prognosis of visual function in the patients with sellar tumor.

SSM18-02 Changes of Brain Motor Functional Connectivity of Ischemic Stroke Patients in the Resting State after rTMS Treatments

Wednesday, Dec. 2 3:10PM - 3:20PM Location: N226

Participants
Jing Li, Beijing, China (Presenter) Nothing to Disclose
Xuewei Zhang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Zhentao Zuo, Beijing, China (Abstract Co-Author) Nothing to Disclose
Jie Lu, Beijing, China (Abstract Co-Author) Nothing to Disclose
Yuzhou Guan, Beijing, China (Abstract Co-Author) Nothing to Disclose
Wei-hong Zhang, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Yong Fan, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The study aimed to 1) investigate the resting-state functional connectivity (rsFC) changes of the ipsilesional primary motor cortex (M1) with the brain after acute stroke; 2) investigate the difference of rsFC of the ipsilesional M1 in stroke patients before and after high frequency repetitive Transcranial Magnetic Stimulation (rTMS) treatments.

METHOD AND MATERIALS
Nineteen patients with unilateral ischemic stroke and fourteen age- and gender-matched healthy volunteers were recruited. Five of
the patients achieved the rTMS treatment. Pearson correlation analysis between the time course of M1 and that of every voxel within the whole brain was performed for maps of correlation coefficients, which were Fisher's z-transformed and called as z-functional connectivity (z-FC) maps. Two sample t-tests were conducted to compare the z-FC maps between the patients and volunteers, and paired t-tests carried out between pre- and post-treatment groups. The Ethics Committee of hospital approved the study. All participants obtained written consent.

RESULTS

1) Compared with volunteers, the patients demonstrated decreased rsFC with the ipsilesional M1 and contralesional cerebellum, ipsilesional precentral gyrus, supplementary motor area(SMA) and precuneus. 2) The pre-treatment group showed higher rsFC of ipsilesional M1 with ipsilesional inferior temporal gyrus, while decreased ones with contralesional M1 and SMA. However, the post-treatment group showed higher rsFC of ipsilesional M1 with ipsilesional middle temporal gyrus, contralesional inferior temporal gyrus, middle frontal gyrus and precuneus, while decreased ones with the ipsilesional premotor cortex, M1, contralesional paracentral lobe and M1. Higher rsFC was found in the ipsilesional M1 and contralesional frontal medial gyrus in the post-treatment groups. 3) The National Institutes of Health Stroke Scale (NIHSS) of the post-treatment group decreased (p<0.05) compared to pre-treatment group, while the Fugl-Meyer Assessment (FMA) and Barthel Index (BI) increased (p<0.05).

CONCLUSION

The areas mentioned above may play an crucial role in acute stroke and the rTMS may facilitate motor recovery in stroke patients.

CLINICAL RELEVANCE/APPLICATION

High frequency repetitive transcranial magnetic stimulation elicits cortical excitation. We localized it on the ipsilesional primary motor cortex to facilitate the motor recovery in stroke patients.

SSM18-04 The Similar Aberrant Spontaneous Brain Activity Related to Cognitive Impairment in Subcortical Stroke Patients: Using Two different Resting-state fMRI Analysis Methods

Wednesday, Dec. 2 3:30PM - 3:40PM Location: N226

Participants
Cheng-Yu Peng, Nanjing, China (Presenter) Nothing to Disclose
Ying Cui, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Yun Jiao, PhD, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Shenghong Ju, MD, PhD, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Gao-Jun Teng, MD, Nanjing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

This study combined using two resting-state functional magnetic resonance imaging (rs-fMRI) analysis methods to investigate regional homogeneity (ReHo) and the amplitude of low frequency fluctuation (ALFF) changes in subcortical stroke patients and whether these changes were correlated with impaired cognitive performance.

METHOD AND MATERIALS

Subcortical stroke patients (n=30) and age-, sex-, and education-matched healthy controls subjects (n=30) underwent multimodality MRI examinations to calculate the ReHo and ALFF within the scope of the whole brain not limited in the DMN. In the process of data processing, the stroke patients were divided into two groups (the left- and right-sided lesion groups) by flipping the brain imaging, then, the two group results were compared with the controls respectively. Scores from neuropsychological tests were also obtained and compared between the two groups. The potential relationships between ALFF and ReHo values and cognitive performance were evaluated via partial correlation analysis.

RESULTS

The patients exhibited significant deficiencies in some cognitive domains (all P < 0.05). Compared with healthy controls, patients with stroke had significantly increased ALFF and ReHo values in the left inferior parietal lobule (IPL) consistently (Fig. 1). Moreover, the partial correlation results indicated that the ALFF values of the left IPL were positively correlated with the Digit Span Forwards Test scores (r = 0.427; P = 0.026) in the subcortical stroke patients.

CONCLUSION

The abnormalities of spontaneous brain activity reflected by ALFF and ReHo measurements in post-stroke patients may provide insights into the neurobiological consequences such as cognitive impairment no matter which side the lesions located in.

CLINICAL RELEVANCE/APPLICATION

ALFF and ReHo could be the important imaging biomarkers for the observation of neurobiological consequences in post-stroke patients no matter which side the lesions located in.

SSM18-05 Leveraging Microstructural White Matter Changes to Guide Investigation of Resting-state Functional Network Connectivity

Wednesday, Dec. 2 3:40PM - 3:50PM Location: N226

Participants
Susan Sotardi, MD, MS, Bronx, NY (Presenter) Nothing to Disclose
Roman Fleysher, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Namhee Kim, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Michael Stockman, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Craig A. Branch, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Jeremy Smith, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
David Gutman, MD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Michael L. Lipton, MD, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

This study combined using two resting-state functional magnetic resonance imaging (rs-fMRI) analysis methods to investigate regional homogeneity (ReHo) and the amplitude of low frequency fluctuation (ALFF) changes in subcortical stroke patients and whether these changes were correlated with impaired cognitive performance.

METHOD AND MATERIALS

Subcortical stroke patients (n=30) and age-, sex-, and education-matched healthy controls subjects (n=30) underwent multimodality MRI examinations to calculate the ReHo and ALFF within the scope of the whole brain not limited in the DMN. In the process of data processing, the stroke patients were divided into two groups (the left- and right-sided lesion groups) by flipping the brain imaging, then, the two group results were compared with the controls respectively. Scores from neuropsychological tests were also obtained and compared between the two groups. The potential relationships between ALFF and ReHo values and cognitive performance were evaluated via partial correlation analysis.

RESULTS

The patients exhibited significant deficiencies in some cognitive domains (all P < 0.05). Compared with healthy controls, patients with stroke had significantly increased ALFF and ReHo values in the left inferior parietal lobule (IPL) consistently (Fig. 1). Moreover, the partial correlation results indicated that the ALFF values of the left IPL were positively correlated with the Digit Span Forwards Test scores (r = 0.427; P = 0.026) in the subcortical stroke patients.

CONCLUSION

The abnormalities of spontaneous brain activity reflected by ALFF and ReHo measurements in post-stroke patients may provide insights into the neurobiological consequences such as cognitive impairment no matter which side the lesions located in.

CLINICAL RELEVANCE/APPLICATION

ALFF and ReHo could be the important imaging biomarkers for the observation of neurobiological consequences in post-stroke patients no matter which side the lesions located in.
Prior research has examined the relationship of diffusion measures of structural white matter integrity to cognitive outcomes. Additionally, resting-state functional connectivity (rs-FC) is correlated with behavioral outcomes. These parallel approaches have revealed important observations regarding the role of connectivity in brain disorders. However, the methodology is inherently limited by the essentially separate nature of structural and functional arms. We propose a method that uses abnormal structural integrity to guide investigation of rs-FC, in a cohort of patients with mild traumatic brain injury (mTBI).

METHOD AND MATERIALS

23 mTBI patients who presented to the emergency department within 48 hours of injury and 43 normal controls were recruited with IRB approval and gave informed consent. DTI and resting fMRI were performed at 3T. All individual FA maps were matched to the brain volume of a healthy volunteer for group analysis. A voxelwise t-test comparing mTBI and control subjects was used to identify regions of abnormally low FA. Regions of low FA were used as seeds for tractography with the entire cortex serving as the termination point. Gray matter regions thus reached then served as seed ROI for voxelwise analysis of rs-FC.

RESULTS

Multiple regions which showed low FA in mTBI subjects were identified. Using a region in the external capsule, tractography was used to delineate fiber tracts, (Figure 1). The intersection of the fiber tract and frontal gray matter, which included the frontal eye field region, served as the seed for rs-FC analysis. Voxel-wise comparison of the correlation maps from the mTBI and control groups identified gray matter clusters where connectivity in mTBI subjects was stronger than in controls (Figure 2).

CONCLUSION

Our results demonstrate a new approach to resting state fMRI analysis where diffusion tractography based on abnormal structural connectivity findings, is used to delineate cortical regions of interest for assessment of functional connectivity. The proposed method avoids the use of a priori seed ROI in rs-FC analysis to more directly interrogate the functional consequences of white matter injury.

CLINICAL RELEVANCE/APPLICATION

Our results demonstrate a new approach to rs-FC analysis where diffusion tractography, based on abnormal structural connectivity findings, is used to delineate cortical regions of interest for assessment of functional connectivity. The proposed method avoids the use of a priori seed ROI in rs-FC analysis to more directly interrogate the functional consequences of white matter injury.

SSM18-06 Mutual Connectivity Analysis with Graph Theoretic Measures for Identifying Regions with Altered Functional Connectivity in HIV Infection

Wednesday, Dec. 2 3:50PM - 4:00PM Location: N226

Participants
Anas Z. Abidin, MS, Rochester, NY (Presenter) Nothing to Disclose
Adora M. D’ Souza, BEng, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Mahesh B. Nagarajan, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Xizi Wang, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Axel Wismueller, MD, PhD, Rochester, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

To quantify resting state fMRI (rsfMRI) functional connectivity profiles obtained from analyzing graph theoretic measures based on a novel Mutual Connectivity Analysis (MCA) framework, and to demonstrate the applicability of this approach for differentiating between HIV+ and HIV- subjects.

METHOD AND MATERIALS

A cohort of 25 age-matched subjects (13 HIV+, 12 HIV-, 21-68 yrs, 15M, 10F) underwent rsfMRI scanning (3T, TR=1650ms, 25 slices, 240 acquisitions). After standard preprocessing and registration, the datasets were parcellated into 116 regions using the Automated Anatomic Labeling (AAL) atlas. The average time series of each of these regions was computed and used with the MCA framework, resulting in a pairwise affinity matrix describing the nonlinear mutual predictability for each region pair. We used generalized radial basis function neural networks as nonlinear time-series predictors. The resulting network graph can be characterized using graph theoretic measures for global properties, such as assortativity, transitivity, global efficiency, or for local/regional properties, such as modularity, clustering coefficient, local efficiency. Whole-brain and region-specific measures were computed to test for differences between HIV+ and HIV- subject cohorts. Statistical analyses were performed using a non-parametric Kolmogorov-Smirnov test.

RESULTS

Modularity and clustering-coefficient values of nodes corresponding to regions of the parietal lobe and the right and left posterior cingulate gyrus showed significant differences (p<0.01) between HIV+ and HIV- subject cohorts. In contrast, no significant differences between cohorts were seen when using statistics characterizing the global properties of the whole-brain network.

CONCLUSION

Graph theoretic analysis of brain network properties using the MCA framework is a novel method that can identify changes in rsfMRI functional connectivity patterns in patients with HIV infection. Significant regional differences between HIV+ and HIV- subjects were demonstrated for several network measures. The corresponding brain regions are in agreement with the findings of other studies investigating the effects of HIV infection on the brain.

CLINICAL RELEVANCE/APPLICATION

The regional differences in functional connectivity profiles from rsfMRI captured by our approach can be used to develop clinical imaging biomarkers in patients with HIV-related cognitive impairment.
SSM19

Neuroradiology (Cerebral Ischemia and Hemorrhage)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: N229

Participants
Ronald L. Wolf, MD, PhD, Philadelphia, PA (Moderator) Nothing to Disclose
Jalal B. Andre, MD, Seattle, WA (Moderator) Research Grant, Koninklijke Philips NV; Consultant, Hobbittview, Inc; Research Grant, Toshiba Corporation;

Sub-Events

SSM19-01 Comparison of Iodinated Contrast Staining and Hyperacute Hemorrhage on MRI : Phantom Study

Wednesday, Dec. 2 3:00PM - 3:10PM Location: N229

Participants
Sung-Hye You, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Kyu Ri Son, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Byung-Joon Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Nam Joon Lee, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Mina Song, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the effect of diluted iodinated contrast agents with normal saline or blood on the magnetic resonance (MR) imaging, especially on T1 weighted image (T1WI), T2 weighted image (T2WI) and gradient echo image (GRE) for distinguishing contrast staining from hyperacute hemorrhage which could occur after intraarterial thrombolysis in the patient with acute stroke.

METHOD AND MATERIALS
On a 3.0T MRI, T1WI, T2WI and GRE images were scanned using the phantom with diluted five different kinds of non-ionic iodinated contrast agents with different concentration (0, 0.1, 0.4, 0.6, 1.2, 2.4 M I mole/L). The contrast agents are diluted with normal saline or venous blood (which was sampled within 6 hours). We compared SI of the phantom visually, and quantitatively calculated T1- and T2-relaxation times.

RESULTS
Iodinated contrast agents showed T1 and T2 shortening effect. With increase in concentration of contrast agents, the effect of T1 and T2 shortening became more prominent. T2 shortening effect of the iodinated contrast agents was much weaker than that of the product of venous blood. Whereas diluted iodinated contrast agents with normal saline showed intermediate SI on GRE image, blood with/without iodinated contrast agents showed dark SI on GRE image. FIG Comparison of SI among the physiologic saline, undiluted iodinated contrast agent, diluted iodinated contrast agent with saline, contrast agent diluted with blood and undiluted blood itself on T2WI, T1WI and GRE image. Contrast agent mixed with blood or blood itself could be distinguished from diluted iodinated contrast agents at T2WI and GRE image.

CONCLUSION
By obtaining T2WI and GRE images, clinicians may be able to discriminate iodinated contrast staining from hyperacute hemorrhage in stroke patients receiving intraarterial thrombolysis.

CLINICAL RELEVANCE/APPLICATION
By obtaining T2WI and GRE images, clinicians may be able to discriminate iodinated contrast staining from hyperacute hemorrhage in acute stroke patients after intraarterial thrombolysis.

SSM19-02 Digital Subtraction Angiogram for Perimesencephalic Subarachnoid Hemorrhage: Is Once Enough? A Retrospective Study, Systematic Review and Meta-analysis

Wednesday, Dec. 2 3:10PM - 3:20PM Location: N229

Participants
Christopher A. Potter, MD, Boston, MA (Presenter) Nothing to Disclose
Kathleen R. Fink, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Amanda L. Ginn, BA, Seattle, WA (Abstract Co-Author) Nothing to Disclose
David R. Haynor, MD, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Non-aneurysmal subarachnoid hemorrhage (NASAH) accounts for 15% of subarachnoid hemorrhage (SAH) cases. A subset of NASAH patients with perimesencephalic hemorrhage distribution (PM-NASAH) has a relatively benign clinical course. Identifying these patients on initial imaging can prevent exposure to the risks of multiple conventional angiograms. Previous studies demonstrating adequacy of a single initial digital subtraction angiogram (DSA) have been suggestive, but underpowered.

METHOD AND MATERIALS
Our institutional retrospective study included consecutive patients from 01/2000-12/2013 with noncontrast head CT within 48 hours positive for SAH, negative initial DSA and followup DSA within 10 days. 252 subjects were identified. Head CT images were reviewed and strictly classified per criteria of van Gijn. 131 subjects with PM-NASAH were identified. DSA reports and images were
reviewed. The medical record was reviewed, including condition at last follow up. Systematic review and meta-analysis using MEDLINE and electronic databases from database inception through 11/01/2014 identified studies documenting workup of patients with SAH. Inclusion criteria were (a) consecutive patients, (b) head CT within 72h, (c) categorization of PM-NASAH as per Gijn et al, (d) initial negative DSA, (e) follow up DSA within 10 days. Exclusion criteria included cohort of less than 25 subjects. Data from 6 included studies were pooled. Methodology was assessed using the MOOSE guidelines for observational meta-analyses.

RESULTS

131 subjects from our institutional study were pooled with 298 subjects from 6 included studies. No aneurysm was seen on follow up DSA at our institution. 3 aneurysms were reported in the included studies. 2 of the 3 were reported in studies with cases that preceded current DSA technique. Diagnostic yield of subsequent DSA following initial negative DSA was 0.7% (95% CI, 0-1.4%), similar or less than the rate of DSA complication, reported from 0.3% to 2.6%.

CONCLUSION

In patients with SAH that strictly adheres to the PM-NASAH pattern, a single DSA essentially excludes a causative aneurysm. Subsequent DSA examinations are very unlikely to benefit and expose patients to unnecessary risk.

CLINICAL RELEVANCE/APPLICATION

Complications from SAH and hemorrhage recurrence in patients with PM-NASAH are rare. Reducing additive risk of multiple DSA examinations is essential in the preventing complications in a benign disease course.

SSM19-03 Dynamics of Cerebral Perfusion Deficits after Subarachnoid Hemorrhage - Predictive Value of an Early Incidence

Wednesday, Dec. 2 3:20PM - 3:30PM Location: N229

Participants
Christian Rubbert, MD, Dusseldorf, Germany (Presenter) Nothing to Disclose
Rebecca May, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Bernd Turowski, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

Delayed cerebral ischemia (DCI) is the major contributor to reduced functional outcome after subarachnoid hemorrhage (SAH). Although the pathogenesis of DCI is not fully understood, limitations in microcirculation appear to be one of the main drivers. CT perfusion (CTP) imaging can indirectly measure microcirculation and is increasingly used in treatment decisions. Early changes in perfusion might be able to predict the risk for critical changes in perfusion after SAH and allow for further risk stratification. To this end, the value of early CTP imaging is retrospectively analyzed.

METHOD AND MATERIALS

Between 1/2006 and 6/2010 351 patients with an aneurysmal SAH underwent CTP imaging. According to local guidelines, CTP imaging is acquired within 1 day after aneurysm treatment (range 0-2d after SAH), 6-8d and 9-11d after SAH or when there is clinical suspicion for deterioration in brain perfusion. Inclusion criteria were 1) at least one early CTP exam <72h after SAH and 2) at least 3 CTP exams in total. 813 CTP exams of 166 patients (4.9±1.8 exams/patient, aged 53.2±12.4, 65.1% female) were analyzed. Purpose-built software was used to automatically generate perfusion parameter maps, define a 1 cm wide circular ROI along the cortex and compute a running average over 10° every 2° for each parameter. The mean transit time (MTT) was evaluated. Critical changes in perfusion were defined as a mean MTT >=4.1s in a hemisphere according to prior work. Receiver-Operator-Characteristic analysis was performed to identify the MTT cutoff with the highest sensitivity and specificity in early CTP imaging to predict critical changes in perfusion in follow-up CTP imaging.

RESULTS

The optimal MTT cutoff was 3.58s (AUC 0.65). 88 of 166 patients (53%) had an early MTT >=3.58s. Critical changes in follow-up CTP imaging were observed in 67 of 166 patients (40.4%) and could be predicted with a sensitivity of 67.2% and specificity of 56.6%.

CONCLUSION

Critical changes in brain perfusion in follow-up CTP imaging can, to some degree, be predicted by early CTP imaging <72h after SAH. Further research is needed to improve the prediction model and include data on functional outcome. Given the potential disabilities due to DCI, a cutoff with a higher sensitivity and lower specificity may be of greater clinical value.

CLINICAL RELEVANCE/APPLICATION

Early CTP imaging might be used in the decision to escalate neuromonitoring.

SSM19-04 Diagnostic Yield of Cervical Spine MRI in the Setting of Angiogram-Negative Spontaneous Intracranial Subarachnoid Hemorrhage

Wednesday, Dec. 2 3:30PM - 3:40PM Location: N229

Participants
Gelareh Sadigh, MD, Atlanta, GA (Presenter) Nothing to Disclose
Chad A. Holder, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Jason W. Allen, MD, PhD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To assess the diagnostic yield of cervical spine (c-spine) magnetic resonance imaging (MRI) in identifying a structural cause for angiogram-negative spontaneous subarachnoid hemorrhage (SAH).

METHOD AND MATERIALS

Consecutive patients 18 years or older presenting with acute spontaneous (non-traumatic) intracranial SAH between February 2009
and October 2014 at two University Hospitals whose catheter angiography results did not reveal an etiology for the SAH, and who underwent c-spine MRI as part of the angiogram-negative SAH protocol, were eligible. Patients with acute intracerebral, subdural or epidural hematoma, parenchymal contusion, recent history of trauma, or previously known cerebral vascular malformation were excluded. All patients underwent noncontrast head CT, CT angiography of the head and neck, and MRI of the brain and c-spine as part of the angiogram-negative SAH protocol. Radiology reports from c-spine MRI scans, interpreted by board-certified (CAQ) neuroradiologists, were retrospectively reviewed, with IRB approval.

RESULTS

232 patients met inclusion criteria (mean age 54 years; 50% male; 53% white; 26% African-American). 77% of patients presented to the hospital within 24 hours of experiencing symptoms. SAH was diagnosed by head CT in 97% of cases and by lumbar puncture in 3%. Of 135 patients with reported Hunt and Hess classification of SAH in the electronic medical record, 70% were scored 1, 4% scored 2, 18% scored 3, 7% scored 4, and 1% scored 5. Catheter angiography was performed within the first 4 days after admission in all cases (median of 12 hours). C-spine MRI was performed within the first 19 days after admission in all cases (median of 24 hours). In all 232 patients (100%), c-spine MRI was negative for an etiology to explain the SAH.

CONCLUSION

In our large retrospective series, c-spine MRI following angiogram-negative spontaneous SAH, specifically following a negative head and neck CTA, had no diagnostic yield and is not routinely needed.

CLINICAL RELEVANCE/APPLICATION

C-spine MRI following angiogram-negative SAH has very low to no diagnostic yield. Our data indicate that routine MRI for cervical sources of intracranial SAH after a negative angiogram is not warranted.

SSM19-05 Blood Brain Barrier Permeability Imaging Correlates with Cerebrospinal Fluid Matrix Metalloproteinase-2 (MMP-2) Levels in Aneurysmal Subarachnoid Hemorrhage

Wednesday, Dec. 2 3:40PM - 3:50PM Location: N229

Participants
Jana Iivanidze, MD, PhD, New York, NY (Presenter) Nothing to Disclose
Omar N. Kallas, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Ashley E. Giambrone, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Michael Lerario, New York, NY (Abstract Co-Author) Nothing to Disclose
Alan Z. Segal, New York, NY (Abstract Co-Author) Nothing to Disclose
Ajay Gupta, MD, New York, NY (Abstract Co-Author) Research Consultant, Biomedical Systems; Research support, General Electric Company
Moonsoo Jin, New York, NY (Abstract Co-Author) Nothing to Disclose
Pina C. Sanelli, MD, Manhasset, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

CT Perfusion (CTP) allows assessment of quantitative blood brain barrier permeability (BBBP) parameters, including PS (flow across the vessel wall to the extravascular extracellular space (EES)), Ktrans (plasma flow per unit tissue volume), and VE (EES volume). However, sensitivity has to date not been established in the clinical setting. Matrix metalloproteinase 2 (MMP-2) is a known molecular upregulator of BBBP. The purpose of our study was to correlate quantitative BBBP parameters on CTP with MMP-2 cerebrospinal fluid (CSF) protein levels in aneurysmal subarachnoid hemorrhage (SAH) patients to assess the ability of CTP to detect BBB dysfunction in the clinical setting.

METHOD AND MATERIALS

In this prospective IRB-approved study, 10 SAH patients underwent extended whole brain CTP with an axial shuttle mode protocol on day 0-3 after aneurysmal rupture. CTP data were post-processed into quantitative PS, Ktrans and VE maps using Olea Sphere software (Olea Medical, La Ciotat, France). Global mean values were calculated from standardized cortically based ROIs. CSF was collected via ventriculostomy catheter (placed for intracranial pressure management) within 24 hours of CTP. MMP-2 protein levels were measured in CSF supernatant using multiplex microbead immunoassay technology (Luminex Corp, Austin, TX). Spearman correlation analysis was performed to determine correlation between MMP-2 levels with each BBBP parameter.

RESULTS

Median patient age was 55 years, and the median modified Fisher score was 4. 80% of patients had hydrocephalus and 70% had global cerebral edema at presentation. There was a statistically significant positive correlation between MMP-2 CSF levels and PS (r = 0.6565; p = 0.0448), Ktrans (r = 0.8024; p = 0.0075), and VE (r = 0.7477; p = 0.0164), respectively.

CONCLUSION

Elevation of PS, Ktrans and VE indicates increased flow across the BBB into the EES, or increased BBBP. MMP-2 is an established indicator of BBBP. We demonstrate that elevated BBBP, as evaluated by CTP, correlates with elevated CSF levels of MMP-2 in patients with SAH, further establishing CTP as a promising tool to assess BBB dysfunction in the clinical setting.

CLINICAL RELEVANCE/APPLICATION

This preliminary study supports the clinical application of quantitative BBBP imaging with CTP. In SAH, where elevated BBBP has been shown to correlate with poor clinical outcomes, this application may become an important prognostic indicator in future studies.

SSM19-06 Preliminary Evaluation of Arterial Spin Labeling as a Method to Predict Clinically Significant Vasospasm Following Aneurysmal Subarachnoid Hemorrhage

Wednesday, Dec. 2 3:50PM - 4:00PM Location: N229

Participants
Jalal B. Andre, MD, Seattle, WA (Presenter) Research Grant, Koninklijke Philips NV; Consultant, Hobbitview, Inc; Research Grant, Toshiba Corporation;
PURPOSE
To evaluate a multidelay, pseudocontinuous arterial spin labeling (MDpCASL)-based screening tool for the diagnosis of vasospasm (VSP) in patients with aneurysmal subarachnoid hemorrhage (aSAH).

METHOD AND MATERIALS
Patients with clinically suspected VSP after aSAH (based on clinical and/or Transcranial Doppler exam) underwent a 10-minute MDpCASL MRI en route to digital subtraction angiography (DSA) for endovascular VSP intervention. The multi-parametric MDpCASL sequence was performed with background suppression and 3-dimensional gradient- and spin-echo readout, at 4 postabel delays (=1.5/2/2.5/3s), and processed using an in-house post-processing pipeline to generate quantitative CBF maps. DSA images were independently reviewed by two blinded, expert neurointerventional readers at a PACS station for the presence, location and extent of VSP, and asked to provide treatment recommendations. Readers were then shown corresponding ASL images and asked how this information influenced treatment recommendations. ASL images were evaluated by a third, blinded expert reader with extensive ASL experience.

RESULTS
Ten patients were studied. ASL perfusion deficits were significantly associated with spasm on DSA (p=0.002). ASL detected clinically significant perfusion deficits in nearly 31% of evaluated vascular territories, in which no significant (≥50%) DSA spasm was identified. 25% of territories with significant spasm had minimal perfusion deficits by ASL. Expert neurointerventionalists also agreed that having ASL images available prior to performing DSA would have changed treatment recommendations in 60% of cases. Blinded two-reader neurointerventional assessment of ASL images suggested that evaluation of ASL-derived CBF would have prevented 3 of 10 patients from undergoing an unnecessary DSA.

CONCLUSION
Perfusion information from MDpCASL prior to DSA may reduce unnecessary DSA in select patients and modify therapy in others, possibly improving patient triage and management.

CLINICAL RELEVANCE/APPLICATION
Obtaining MDpCASL prior to DSA may alter treatment in patients suspected of VSP following aSAH.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Yoshimi Anzai, MD - 2014 Honored Educator
SSM20

**ISP: Pediatrics (General and Neonatal Imaging)**

Wednesday, Dec. 2 3:00PM - 4:00PM Location: S102AB

**OB PD**

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

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**Participants**
Richard A. Barth, MD, Stanford, CA (Moderator) Nothing to Disclose
Ellen M. Chung, MD, Bethesda, MD (Moderator) Nothing to Disclose

**Sub-Events**

**SSM20-01  Biomodeling and 3D Printing for Simulation of Surgical Separation of Conjoint Twins**

Wednesday, Dec. 2 3:00PM - 3:10PM Location: S102AB

Participants
Rajesh Krishnamurthy, MD, Houston, TX (Presenter) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation
Nicholas Dodd, Houston, TX (Abstract Co-Author) Nothing to Disclose
Darrell Cass, Houston, TX (Abstract Co-Author) Nothing to Disclose
Amrita Murali, Houston, TX (Abstract Co-Author) Nothing to Disclose
Jayanthi Parthasarathy, Dallas, TX (Abstract Co-Author) Employee, VanDuzen, Inc

**PURPOSE**

We describe a unique use of biomodeling and 3D printing in the setting of surgical simulation of thoracoabdominal conjoint twin separation.

**METHOD AND MATERIALS**

Surgical planning on thoraco-omphalo-pyopagus female twins commenced at 7 months for planned separation at 10 months of life. The modeling process was initiated by a volumetric CT using a 320 detector scanner with target mode prospective EKG gating for the cardiovascular structures, and helical ungated acquisition for the chest, abdomen and pelvis. Intravenous contrast was separately administered into both twins, while oral contrast was administered only into 1 twin. Image segmentation yielded individual segments of the skin, skeleton, heart, lungs, airway, GI tract, abdominal vasculature, urinary tract, and gynecologic structures. In preparation for 3D printing, structures to support the models in a vertical position were created. In one operation, polyjet multi-material 3D printing was used to print skeletal structures, base and supports in hard plastic resin, and the organs in rubber like material. The livers were printed as separate pieces of the transparent resin, with the hepatic and portal vessels in white for better visibility. Pegs were designed so the liver could be attached or removed from the assembly. The models were designed such that they could be assembled together or separated during the surgical planning process. Findings on biomodels and 3-D print were compared to findings at surgical separation.

**RESULTS**

The twins underwent surgical separation by a multidisciplinary surgical team. No discrepancy was noted involving the cardiopulmonary, hepatic, intestinal, renal and skeletal anatomy. Preoperative simulation successfully predicted assignment of the pelvic viscera to each twin based on the vasculature. There was one hemorrhagic complication at surgery, unrelated to preoperative anatomical characterization.

**CONCLUSION**

We have demonstrated a unique use of 3D modeling and 3D printing for simulation and planning of conjoint twin separation, with representation of the surgically relevant viscera and vasculature in a single 3D printed model.

**CLINICAL RELEVANCE/APPLICATION**

Describe a novel application of 3D printing for simulating conjoint twin separation, which involves representation of all surgically relevant visceral and vascular anatomy in a single 3D print.

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**SSM20-02  Estimates of Diagnostic Reference Levels for Common Pediatric Fluoroscopic Procedures**

Wednesday, Dec. 2 3:10PM - 3:20PM Location: S102AB

Participants
Keith J. Strauss, FAAPM, FACR, Cincinnati, OH (Presenter) Research Consultant, Koninklijke Philips NV; Speakers Bureau, Koninklijke Philips NV
Rami Nachabe, PhD, Best, Netherlands (Abstract Co-Author) Employee, Koninklijke Philips NV
Steven J. Kraus, MD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To survey radiation dose indices of four common general pediatric fluoroscopic procedures at a tertiary care pediatric hospital. These results allow estimates of diagnostic reference levels (DRLs) from dose indices.

**METHOD AND MATERIALS**

Radiation dose structured reports were retrospectively collected for > 2,000 pediatric general fluoroscopic cases. Kerma Area Product (KAP), air Kerma (Kair), fluoroscopy time (FT), thickness of body part irradiated, and patient age were collected for pediatric video swallow (VS), upper GI (UGI), lower GI (LGI) and voiding cystourethrogram (VCUG) studies. Each group of patients for a study was limited to a size variance of only 3 cm with targeted number of cases > 30 per group. 1st, 2nd, 3rd quartiles for
each group were calculated for each type of study. A fitted exponential curve of mean patient Kair vs thickness and 95% predictive bounds are presented with a scatter plot of data for each type of study. Nineteen of 20 additional patients should fall within the 95% predictive bounds.

**RESULTS**

Only data for the Kair for our 585 VCUG cases is presented here. For group sizes of 5-7, 8-10, 11-13, 14-16, 17-19, 20-22, 23-25 cm the number of cases and 3rd percentile estimate of DRL respectively were 16, 99, 229, 133, 67, 29,14 and 3.52, 6.39, 11.28 mGy. For an exponential fit of patient Kair vs thickness (ae-bx), a = 0.07 and b = 0.2. In addition to scatter plots of the data with fitted curves for each type of study, a data table is also provided for each study type that lists the 1st, 2nd, and 3rd quartile of AK, KAP, FT, AK/FT, KAP/FT as a function of the patient group thicknesses along with published average age, height, mass, and BMI corresponding to that measured thicknesses. Calculated DAP/AK ratios allow conversion between these two indices if one is known.

**CONCLUSION**

Estimates of 3rd quartile dose indices of four common pediatric fluoroscopic procedures as a function of patient thickness should assist departments in the development of DRL values using dose indices.

**CLINICAL RELEVANCE/APPLICATION**

Fluoroscopic DRL values based on a department's unique patients and imaging equipment foster better management of radiation dose and image quality to improve pediatric patient care.

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**SSM20-03 Optimizing the US Diagnosis of Biliary Atresia with a Modified Triangular Cord Thickness and More Objective Gallbladder Classification**

**Wednesday, Dec. 2 3:20PM - 3:30PM Location: S102AB**

**Participants**

Zhou Lu-Yao, Guangzhou, China (Presenter) Nothing to Disclose
Xiao-Yan Xie, Guangzhou, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate the diagnostic performance of US in identification and exclusion of biliary atresia by a modified triangular cord thickness metric together with agallbladder classification scheme, as well as hepatic artery(HA) diameter and liver and spleen size, in a large sample of jaundiced infants.

**METHOD AND MATERIALS**

Ethics Committee approved the study, and written informed parental consent was obtained.273 infants with conjugated hyperbilirubinemia(total bilirubin≥31.2µmol/L with direct bilirubin>indirect bilirubin)underwent detailed abdominal US examination to exclude biliary atresia and on this basis were classified as biliary atresia(n=129) or not-biliary atresia(n=144).A modified triangular cord thickness measured at the anterior branch of the right portal vein and a gallbladder classification scheme that incorporated the appearance of the gallbladder as well as length: width ratio≤5.2 when the lumen was visualized, as well as HA diameter, liver and spleen size, were identified and measured. Reference standard diagnosis was based on one or more of the following: surgery, liver biopsy, cholangiography, and clinical follow-up. Area under the receiver operating characteristic curve (AUC), binary logistic regression analyses, Fisher's exact test and unpaired t test were performed.

**RESULTS**

Triangular cord thickness, HA diameter, the ratio of gallbladder length to gallbladder width, liver size and spleen size exhibited statistically significant differences (all P<.05) between the biliary atresia and not-biliary atresia groups. AUCs of triangular cord thickness, gallbladder ratio of length over width and HA diameter were 0.952, 0.844 and 0.838, respectively. Logistic regression analysis demonstrated that these three US parameters were significantly associated (all P<.05) with biliary atresia. The combination of triangular cord thickness and gallbladder classification could yield a comparable AUCs (0.915 vs 0.933, P=.400) and a higher sensitivity (96.9% vs 92.2%), compare to triangular cord thickness alone.

**CONCLUSION**

Using the combination of the modified triangular cord thickness and a gallbladder classification scheme, most infants with biliary atresia could be identified.

**CLINICAL RELEVANCE/APPLICATION**

Use of a modified triangular cord thickness measurement and a gallbladder classification, can potentially reduce the number of patients requiring nuclear scintigraphy and liver biopsy.

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**SSM20-04 Pediatrics Keynote Speaker: How Does Fetal Imaging Influence Neonatal Imaging?**

**Wednesday, Dec. 2 3:30PM - 3:40PM Location: S102AB**

**Participants**

Richard A. Barth, MD, Stanford, CA (Presenter) Nothing to Disclose

**SSM20-05 Virtual Rounds: Bringing Radiology Back to the ICU**

**Wednesday, Dec. 2 3:40PM - 3:50PM Location: S102AB**

**Participants**

Janet R. Reid, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
David T. Saul, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Maria A. Bedoya, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Hannah Stinson, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Brian Hopely, BA, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Digital imaging has greatly improved clinician access to images and timely reports but may have eroded face-to-face communication between clinicians and radiologists, especially in the ICU. Increased radiology workload together with demands for on-site presence of ICU house staff have made it difficult to hold morning radiology rounds. Despite this, benefits of digital imaging have far outweighed the limitations, and the new hurdles require new thinking. This project leverages simple technology to create personalized point of care radiology consultation in the ICU.

Using Lync 13, 20 minute interactive rounds were delivered by a radiologist from a workstation located in the radiology reading room to a clinical team in a 55 bed pediatric ICU. Images were shared from PACS (Philips iSite) to a large screen in a central meeting space in the ICU, with both stations equipped with panoramic web-cams with built-in audio. There were 12 sessions over 1 month, first and last session reserved for testing. Ten micro-didactic lectures were prepared covering top 10 items from the AAB Core Content for Critical Care; each session started with the lecture followed by review of daily inpatient imaging including all modalities and body systems. Assessment tools: Demographics (experience and background); Skills (image-based pre- and post-test); Confidence (self-reporting questionnaire); Format (learning effectiveness, strengths and weaknesses). The study was granted IRB exemption with consent.

Participants
Susan C. Shelmerdine, MBBS, FRCR, London, United Kingdom (Presenter) Nothing to Disclose
Jeremy Lynch I, BMBC, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Owen Arthurs, MBBC., PhD, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose

Presentation of new research and emerging techniques at scientific conferences allows dissemination of expertise and enables future development within the specialty. Studies that do not result in a subsequent publication limit the impact of the work undertaken. This study establishes the conversion rate and identifies predictive factors for journal publication of oral scientific presentations within paediatric radiology.

Oral presentations from the European Society of Paediatric Radiology, International Society of Pediatric Radiology and Society of Pediatric Radiology conferences between 2010 and 2012 were identified from published conference proceedings. A literature search was performed to ascertain whether publication in a MEDLINE indexed journal was achieved by April 2015. Logistic regression was performed using R, version 3.1.3 to identify predictive factors.

300 out of 715 (41%) oral presentation abstracts were subsequently published, most commonly in the journals: Pediatric Radiology (74, 25%), AJR (34, 11%) and Radiology (22, 7%). The majority of presentations (169, 56%) were published within 24 months of the conference date (1 – 59 months). Countries with the highest abstract to publication conversion rates were USA (169, 56%), Canada (18, 6%), France (16, 5%) and United Kingdom (15, 5%). Factors that were predictive of publication included sample size (p=0.007), publication within the subspecialty subject areas of radiation protection (p=0.02), neurological imaging (p=0.03), and functional imaging (p=0.04). Factors that did not have any effect on subsequent publication included study type, prospective nature of the study or origin of study from an academic or paediatric tertiary centre.

In this retrospective study of pediatric radiology conference proceedings, fewer than half of all presented oral abstracts result in publication. Studies with a larger sample size and within certain subspecialty areas in paediatric radiology were associated with subsequent publication. Identification of predictive factors in journal publications may help future investigators plan and design successful research projects.
Participants
Gregory S. Karczmar, PhD, Chicago, IL (Moderator) Nothing to Disclose
Chen Lin, PhD, Indianapolis, IN (Moderator) Nothing to Disclose

Sub-Events

SSM21-01  Skeletal Muscle Mitochondrial Capacity and Pi-to-ATP Exchange Rate Relate to Alkaline Pi Pool and PDE Concentration Measured at Rest by ³¹P-MRS at 7T

Participants
Ladislav Valkovic, PhD, Vienna, Austria (Presenter) Nothing to Disclose
Marjeta Tusek Jelenc, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Barbara Ukpocova, Bratislava, Slovakia (Abstract Co-Author) Nothing to Disclose
Wolfgang Bogner, MSc, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Marek Chmelik, MS, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Ivan Frollo, Bratislava, Slovakia (Abstract Co-Author) Nothing to Disclose
Josef Ukropec, Bratislava, Slovakia (Abstract Co-Author) Nothing to Disclose
Siegfried Trattnig, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Martin Krassak, PhD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose

PURPOSE
Dynamic phosphorus MR spectroscopy (³¹P-MRS) and saturation transfer (ST) are established methods for measurement of muscle mitochondrial capacity and ATP turnover-kinetics, associated with metabolic and cardiovascular disorders. However, as a complex experimental setup or advanced sequences are required, the use of static ³¹P-MR spectra, i.e., concentration of phosphodiesters ([PDE]) and moreover the alkaline Pi (Pi₂), to obtain similar information, has been promoted recently. Therefore our aim was to assess the interrelations between parameters derived from static and dynamic ³¹P-MRS measurements at 7T.

METHOD AND MATERIALS
In total, data from thirty-seven subjects (25m/12f, a=32.9±7.3y) were analysed and divided into groups based on their physiological characteristics: obese sedentary subjects prior (ObSe) and after 3 months of training (ObAc), and lean subjects active on regular basis (LeAc). ³¹P-MRS was performed on a 7T MR system (Siemens Healthcare, Erlangen, Germany) equipped with a 1H/³¹P surface coil. The examination protocol was divided into three experiments: (i) acquisition of static spectra, for quantification of [PDE] and the Pi₂/Pi₁ ratio; (ii) ST experiment, for quantification of Pi-to-ATP reaction rate constant (kATP) and ATP flux (FATP); and (iii) dynamic examination, for quantification of mitochondrial capacity (Qmax). The physiological and ³¹P-MRS parameters were compared between the groups by a one-way ANOVA and a Tukey post-hoc test and their potential relations by a linear regression.

RESULTS
Group ObSe had significantly lower values of Qmax in comparison to the active groups. In addition, group LeAc had significantly lower PDE concentration and higher Pi₂/Pi₁ ratio when compared to the other groups. Apart from previously reported correlations between Qmax and FATP and between FATP and the [PDE], further significant correlations were found, i.e., Qmax correlated to Pi₂/Pi₁ and [PDE]; and Pi₂/Pi₁ correlated to kATP and [PDE].

CONCLUSION
Our investigation, performed on sedentary and active obese subjects as well as on lean active individuals, shows that resting measurements of Pi₂/Pi₁ ratio and [PDE] correlate with measures derived from dynamic and ST ³¹P-MRS measurements in skeletal muscle.

CLINICAL RELEVANCE/APPLICATION
Measurement of basal Pi₂/Pi₁ ratio and [PDE] at 7T might provide a surrogate marker of myocellular metabolism, alterations of which are connected to metabolic and cardiovascular disorders.
high peak pressure gradient across the mechanical heart valve (MHV). However, clinical implications of the sub-prosthetic pannus have not been fully understood. The present study aims to investigate the hemodynamic effect of the pannus by applying phase contrast MRI to aorta phantoms with different pannus formations.

METHOD AND MATERIALS
A flow phantom was constructed by implementing a supra-annular mechanical valve (St. Jude 25 mm medical masters HP series) into an aorta model fabricated by 3D printer. Five different types of pannus models were alternately installed at the inlet of aorta model and the axial position of the pannus was the same as the hinge tip of the MHV. The effective orifice area (EOA) reduced by pannus models was 8.2% - 47.66%, and the thickness of the modeled pannus was 3mm. Image acquisition was performed on a 3T scanner (MAGNETOM Skyra, Siemens) using a gradient echo sequence. The velocity encoding range was set as 120 cm/s and the imaging matrix was $256 \times 156$ on a field of view of $160\text{mm} \times 97.5\text{mm}$. Repetition and echo times were 23 ms and 3.16 ms, respectively. Flow information on MR images was analyzed using customized-Matlab software.

RESULTS
The minimal pannus showed a negligible flow interference, maintaining almost planar symmetric flow pattern (maximum velocity 66.3 cm/s). However, with larger single pannus, the peak velocity increases due to the reduced EOA (up to 11.2%) and the position of peak velocity was moved to between the leaflets. In the distal side of MHV, the flow was skewed toward the wall on the pannus side. For the paired pannus, peak flow was observed in the middle of flow area (26.8% increase) and the low velocity regions due to the leaflets were disappeared. For the largest pannus, the estimated pressure gradient using the averaged velocity of the far distal side (23 cm/s) increased by 70.3% of the smallest one.

CONCLUSION
The EOA reduction due to the pannus formation caused a higher peak velocity in the distal side of MHV and thereby increased the pressure difference estimated from the peak velocity.

CLINICAL RELEVANCE/APPLICATION
Sub-prosthetic pannus after AVR may cause a high pressure gradient across the MHV.

SSM21-03 Magnetic Resonance Elastography and Ultrasound Shear Wave Speed Imaging for Assessment of Renal Allograft Function

Wednesday, Dec. 2 3:20PM - 3:30PM Location: S404AB

Participants
Stephan Marticorena Garcia, MD, Berlin, Germany (Presenter) Nothing to Disclose
Jing Guo, MD, PhD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Bernd K. Hamm III, MD, Berlin, Germany (Abstract Co-Author) Research Consultant, Toshiba Corporation; Stockholder, Siemens AG; Stockholder, General Electric Company; Research Grant, Toshiba Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Siemens AG; Research Grant, General Electric Company; Research Grant, Elbit Imaging Ltd; Research Grant, Bayer AG; Research Grant, Guerbet SA; Research Grant, Bracco Group; Research Grant, B. Braun Melsungen AG; Research Grant, KRAUTH medical KG; Research Grant, Boston Scientific Corporation; Equipment support, Elbit Imaging Ltd; Investigator, CMC Contrast AB
Ingolf Sack, PhD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Fischer, MD, Berlin, Germany (Abstract Co-Author) Speaker, Toshiba Corporation; Advisory Board, Toshiba Corporation

PURPOSE
Kidney transplant rejection is associated with viscoelastic tissue changes. The purpose of this study is to non-invasively assess the renal elasticity in kidney transplant recipients with magnetic resonance elastography (MRE) and ultrasound shear wave speed imaging (SSI).

METHOD AND MATERIALS
10 kidney transplant recipients (age range 27-51 years, 2 females) were included (mean transplant duration 63±97 months). Among them, 3 patients have dysfunctional kidney (GFR <15 ml/min) with biopsy proven fibrosis. Recipients with normal renal function were identified by constant blood creatinine/GFR values, normal B-mode appearance and resistive index (RI), obtained during 6 months period before MRE/SSI. MRE (1.5 T scanner, Siemens) was performed with 7 slices (2.5 mm cubic voxel resolution) at 4 mechanical frequencies from 40 to 70 Hz. MRE data were processed giving $|G^*|$ (magnitude of the complex modulus) which relates to the shear stiffness of the kidney. In SSI (Aplio500, Toshiba), an ultrasonic burst was captured by a 14 MHz linear broadband transducer, and propagation speed reflecting tissue stiffness was compared to MRE results.

RESULTS
In combined cortex and medulla region, the group mean values of shear stiffness (MRE 6.12±0.95 kPa) and wave speed (SSI: 3.1±0.43 m/s) correlate very well with each other (r=0.76, p=0.01). In the same region, significant decrease of both stiffness and wave speed were observed in patients with dysfunctional kidney (MRE, functional: 6.09±0.39 kPa vs. dysfunctional: 4.00±0.79 kPa, p=0.012; SSI, functional: 3.44±0.33 m/s vs. dysfunctional: 2.86±0.33 m/s, p=0.019).

CONCLUSION
MRE and SSI are both sensitive in detecting renal allograft fibrosis.

CLINICAL RELEVANCE/APPLICATION
Mechanical properties obtained from both techniques could be used as biomarker for non-invasive assessment of renal allograft rejection.

SSM21-04 Time Efficient Estimation of Abdominal Fat Distribution in MRI

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S404AB

Participants
Nicolas Linder, Leipzig, Germany (Presenter) Nothing to Disclose
Alexander Schaudinn, MD, Leipzig, Germany (Abstract Co-Author) Nothing to Disclose
Nikita Garnov, Leipzig, Germany (Abstract Co-Author) Nothing to Disclose
Thomas K. Kahn, MD, Leipzig, Germany (Abstract Co-Author) Nothing to Disclose
Harald F. Busse, PhD, Leipzig, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the prediction of abdominopelvic visceral and subcutaneous adipose tissue (VAT, SAT) volume based on a single MRI slice.

METHOD AND MATERIALS
162 patients (Caucasians, mean BMI 35.6 kg/m², 43 males) were scanned at 1.5T (2 point Dixon, 50 slices of 10 mm thickness and 0.5 mm gap) and semi-automatic quantification of VAT and SAT volumes (V-VAT V-SAT) was performed. Fat areas at the level of 11 anatomical landmarks [levels of lumbar discs L1-L2 to L5-S1, umbilicus (UM) +/- 0.5,10 cm, femoral head] were used for estimation of VAT and SAT volumes (VE-VAT, VE-SAT). Statistical measures of agreement were the coefficient of determination R² of a linear regression through the origin as well as the standard deviations σ of the differences between measured and predicted volume.

RESULTS
Mean V-VAT and V-SAT were 3.6 and 15.4 L in females and 5.8 and 12.1 L in males. The optimum level of SAT volume prediction was at L5-S1 independent of sex and BMI (females: R²=0.82 and σ=1.4 L; males: R²=0.92 and σ=1.1L). Differences could be seen for VAT with the optimum level at L2-L3 for males (R²=0.84 and σ=0.9 L) and less obese women (BMI < 35kg/m²; R²= 0.83 and σ=0.6 L) whereas more obese females (BMI > 35 kg/m²) showed an optimum at L5-S1 (R²= 0.69 and σ=0.8 L). Looking at a single slice position to quantify both SAT and VAT best results were detected at L4-L5 for females and L5-S1 for males.

CONCLUSION
Whole abdominopelvic SAT and VAT volumes can be reliably predicted from a single slice at the level of a BMI and sex-dependent anatomic landmark.

CLINICAL RELEVANCE/APPLICATION
This study might be beneficial for standardization of VAT and SAT estimation in studies interested in obesity related risk factors.

SSM21-05 Non-Contrast 4D MR Myocardium Blood Flow

Wednesday, Dec. 2 3:40PM - 3:50PM Location: S404AB

Participants
Mitsue Miyazaki, PhD, Vernon Hills, IL (Presenter) Employee, Toshiba Corporation
Xiangzi Zhou, PhD, Oak Brook, IL (Abstract Co-Author) Employee, Toshiba Corporation
Tsunomu Hoshino, Vernon Hills, IL (Abstract Co-Author) Employee, Toshiba Corporation
Kenichi Yoyama, MD, Mitaka-Shi, Japan (Abstract Co-Author) Nothing to Disclose
Rieko Ishimura, MD, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Toshiaki Nitatori, MD, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
To develop a non-contrast 4-dimensional time-spatial labeling inversion pulse (4D Time-SLIP) technique (3D acquisition and time) for investigation of myocardial blood flow on healthy volunteers without administration of contrast materials.

METHOD AND MATERIALS
The non-contrast 4D Time-SLIP technique was applied on eight healthy volunteers to image myocardium blood flow at 1.5T. The Time-SLIP sequence has a tag-on block with a non-selective inversion recovery (non-sel-IR) pulse and a spatially selective inversion recovery (sel-IR) and a tag-off block with only the non-sel-IR pulse. The tagging plane was placed at the proximal ascending aorta and imaging slab was placed at mid-ventricle. The complex subtraction between tag-on and tag-off is performed to depict only the tagged blood flowing into the myocardium with cancellation of background signal. For each inversion time (TI), tag-on and tag-off acquisitions with a 3D bSSFP readout was alternately acquired within a breath-hold. To achieve variable TI, the tagging pulses were triggered with variable delay time while the readout was placed at a fixed mid-diastolic phase in the second RR interval. As a result, each 3D tag-on and tag-off acquisition can be repeated with multiple TIs. To visualize the blood flow, the time resolved 3D short axis myocardial images were registered and the myocardium was segmented for the visualization of myocardial signal changes caused by the tagged blood along the TI. The non-contrast perfusion curves were also generated to identify the perfusion peaks.

RESULTS
Both time-resolved 3D short axis images and perfusion curves were successfully obtained, where blood flow shows basal to apical directions. At the mid-ventricle, the blood flow reached peak about 200-400 ms after tagging the aortic root blood, and then blood signal returned to baseline. This observation of quick return to baseline is controversial to the results obtained from other non-contrast methods where the signal does not return to baseline.

CONCLUSION
The technique permits obtaining non-contrast 4D myocardium blood flow images and perfusion curves with high temporal resolution without administration of contrast materials.

CLINICAL RELEVANCE/APPLICATION
The 4D Time-SLIP technique permits obtaining non-contrast 4D myocardium blood flow images and perfusion curves with high temporal resolution without administration of contrast materials.

SSM21-06 Ultra-Fast Low Dose Dynamic Contrast Enhanced MRI for Prostate Cancer Diagnosis - A Preliminary Study

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S404AB
PURPOSE

The aim of this study is to investigate the effectiveness of ultra-high temporal resolution (Ufast) dynamic contrast enhanced MRI (DCE), with a low dose of contrast media, for prostate cancer (PCa) diagnosis.

METHOD AND MATERIALS

Eleven men (age 40-69 years) who were scheduled for prostatectomy after MRI were enrolled. Ufast DCE MRI was performed on a Philips Achieva 3T scanner, with temporal resolution of 1.5 sec, slice thickness 3.5mm, 24 slices, in plane resolution 1.5x2.8 mm², before and for 15 sec after a low dose (LD) of contrast agent was (.015 mM/Kg; 15% of conventional dose). Following ultrafast imaging, a routine clinical DCE scan was performed pre- and post I.V. injection of 0.085 mM/kg of contrast media. A ‘time of arrival’ (TOA) map was calculated from the Ufast images, based on the time at which significant (25%) enhancement was detected in each pixel. The TOA ratio (rTOA) was defined as the percentage of voxels in each ROI significantly enhanced during the first 60 seconds.

TOA and rTOA were compared in cancer (n=11), normal (n=10) and BPH (n=11) ROIs. Kruskal-Wallis Analysis of Variance (ANOVA) test and Welch two sample t-test were performed to compare results.

RESULTS

Enhancement in normal prostate was delayed by an average of 5.1±1.6 sec compared with cancer, and enhancement of BPH was delayed by an average of 7.5 sec relative to cancer, where delays were calculated for each patient, then averaged over all patients. Average TOAs were 45.6±4.4 sec, 48.3±3.9 sec and 49.2±4.1 sec in cancer, normal and BPH ROIs, respectively (where time of arrival was averaged over all pixels from all patients). TOAs for cancer and BPH were significantly different (p=0.04). rTOAs were 0.77, 0.85±0.3 and 0.94±0.1 in patient groups with GS=6,7and 9, respectively.

CONCLUSION

Ufast imaging, with measurement of TOA and rTOA has the potential to differentiate PCa from BPHs, and may also be sensitive to cancer grade. In this study a very low dose was used in the Ufast protocol so that total dose (sum of the low dose and high dose used for conventional DCE scan) was acceptable. Enhancement due to the low dose was easily detectable, and may have advantages, including reduced non-linear enhancement effects. In future studies, a range of contrast agent doses will be tested.

CLINICAL RELEVANCE/APPLICATION

Ufast DCE-MRI has potential to increase diagnostic accuracy. Very low doses of contrast media are effective.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Aytekin Oto, MD - 2013 Honored Educator
Radiation Oncology (Radiation Biology)
Wednesday, Dec. 2 3:00PM - 4:00PM Location: S104A

SSM22-01 Treatment of Primary Tumors through Immunogenic Cell Death, with Concurrent Treatment of Metastasized Tumors through the Abscopal Effect, Via Targeted anti-CD4 siRNA, HMGB1, and ATP Nanoparticles Combined with Radiotherapy

Participants
Meng X. Welliver, MD, Columbus, OH (Moderator) Nothing to Disclose
Sunil Krishnan, MD, Houston, TX (Moderator) Research Grant, Shell Oil Company; Researcher, Celgene Corporation

Sub-Events

SSM22-01 Treatment of Primary Tumors through Immunogenic Cell Death, with Concurrent Treatment of Metastasized Tumors through the Abscopal Effect, Via Targeted anti-CD4 siRNA, HMGB1, and ATP Nanoparticles Combined with Radiotherapy
Wednesday, Dec. 2 3:00PM - 3:10PM Location: S104A

Participants
Satoshi G. Harada, MD, Morioka, Japan (Presenter) Nothing to Disclose
Shigeru Ebara, MD, Morioka, Japan (Abstract Co-Author) Nothing to Disclose
Keizo Ishii, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Takahiro Satoh, DSc, Takasaki, Japan (Abstract Co-Author) Nothing to Disclose
Koichiro Sera, Takizawa, Japan (Abstract Co-Author) Nothing to Disclose

Purpose
We aimed to image and treat primary tumors through immunogenic cell death (ICD) and metastasized tumors through the abscopal effect in LM17 cell xenografts in BALB/c mice using microcapsules that release liposome-protamine-hyaluronic acid nanoparticles (LPH-NPs) in response to three sessions of radiation.

Method and Materials
For session one, LPH-NPs containing 5% iopamiron were mixed with 1.0 mL of a solution containing 4.0% alginate, 3.0% hyaluronate, 1 mg ascorbate, and 1 µg/mL P-selectin. LPH-NPs were then added to 0.5 mM FeCl2 supplemented with 1 µg/mL α4β1 antibody (Ab). Mice were injected intravenously (IV) with microcapsules. The primary tumor was exposed 9 h later to 10 or 20 Gy 60Co γ-rays. In session two, dendritic cell (DC)-associated cross-priming of CD8+ T cells was intensified for treatment of lung metastases by the abscopal effect. To this end, LPH-NPs containing 250 nmol anti-CD47 siRNA, 250 nmol anti-CD47 siRNA (modified with an scFv Ab against CD47), 40 ng HMGB1, and 10 μmol ATP were mixed with the abovementioned cocktail and added to 0.5 mM FeCl2 supplemented with 1 µg/mL anti-P-selectin Ab. Microcapsules (ten billion) were injected IV and they interacted with P-selectin. After 9 h, the second radiation session was conducted using the same protocol as for the first session. In session three, 4 cGy 60Co whole-body γ-rays were administered at 24-h intervals for 5 d to activate CD8+ T cells.

Results
Anti-α4β1 microcapsules accumulated around the primary tumor and metastases, which was detected by computed tomography. The microcapsules in the primary tumor released P-selectin-Ag with LPH-NPs after the first irradiation. In session two, microcapsules accumulated around the primary tumor through P-selectin the Ag-Ab reaction and released LPH-NPs containing anti-CD47 siRNA, HMGB1, and ATP, which intensified ICD in the primary tumor and DC-associated cross-priming of CD8+ T cells. In session three, primed CD8+ T cells were activated and targeted metastases. These treatments reduced the sizes of the primary tumor and metastases by 91.7%.

Conclusion
Our microcapsules improved diagnoses and promoted the effects of radiotherapy on metastases.

Clinical Relevance/Application
Imaging-targeted ICD and promotion of the abscopal effect by anti-CD47 siRNA, HMGB1, and ATP improved diagnoses and extended the effects of radiotherapy to metastases.

SSM22-04 Transient Hypoxia with Accelerated EPR pO2 Images using a Low-rank Tensor/navigator Projection Image Model

Participants
Howard J. Halpern, MD, PhD, Chicago, IL (Presenter) Nothing to Disclose
Boris Epel, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Zhi-Pei Liang, PhD, Urbana, IL (Abstract Co-Author) Nothing to Disclose
Anthony Christodoulou, Urbana, IL (Abstract Co-Author) Nothing to Disclose
Victor Tormyshev, PhD, Novosibirsk, Russia (Abstract Co-Author) Nothing to Disclose

Purpose
The role of transient hypoxia is an outstanding question in tumor physiology. Electron paramagnetic resonance (EPR) imaging has been shown to define regions of mouse tumors that are hypoxic and correlated the extent of this hypoxic region with sensitivity to radiation. Changes in hypoxia can significantly affect the relevance of such measurements. Thus we need to accelerate the rate at
which molecular oxygen images can be obtained.

**METHOD AND MATERIALS**

We developed a low-rank tensor image model to acquire and analyze dynamic pO2 maps from highly undersampled (k,t)-space data. The model represents a set of dynamic images collected with different pulse sequence parameters in a low-dimensional, time-varying parameter subspace. Correlations between images across time, parameter space (pO2), and location are captured and extends our previous work on accelerated parameter mapping using low-rank models and dynamic imaging using low-rank models. The model dictates a data acquisition scheme allowing direct determination of the time-varying parameter subspace and a reconstruction algorithm to recover high-quality images from highly undersampled (k,t)-space data using the resulting subspace constraint.

**RESULTS**

To demonstrate the model utility for dynamic pO2 imaging, we performed simulations and in vivo experiments. We will show results from a simulation using a numerical phantom for which one region experiences an instantaneous change in pO2. In vivo results were obtained from a mouse tumor image, wherein pO2 fluctuations were induced by cycling the fraction of inspired oxygen (FiO2), toggling the FiO2 with variable timing. 3D pO2 images at one time point as well as a graph of the pO2 variation over time for one voxel at the center of the tumor showed resolution and image quality of the low-rank tensor method to be superior to previous methods.

**CONCLUSION**

Low-rank tensor method captures oxygen fluctuations with a temporal resolution of 31 seconds.

**CLINICAL RELEVANCE/APPLICATION**

The oxygen variation frequency captured by this technique are comparable to the highest frequencies in the literature. This will show the biologic and clinical relevance of transient hypoxia.

**SSM22-06 DNA Double-strand Breaks in Blood Lymphocytes of Patients Undergoing Coronary CT: Comparison with the Physical CT Radiation Exposure Index**

**METHOD AND MATERIALS**

We obtained institutional review board approval and the written informed consent from 45 patients (40 men, 5 women, median age 63 years, range 30-76 years) with arrhythmia who underwent coronary CT before ablation therapy. Blood samples were obtained before- and 15 min- and a few days after CT performed before ablation therapy. We identified DSBs in lymphocytes as cytologically visible “foci” by using an antibody against γ-H2AX. For data analysis, we applied the Tukey-Kramer test. To assess the relationship between the physical CT radiation exposure index (CTDI), size-specific dose estimates (SSDE), and the dose length- and the SSDE length product (DLP, SSDE-LP).

**RESULTS**

The mean γ-H2AX foci number before CT, 15 min after CT, and a few days after CT were 1.21, 1.92, and 1.06 x10-3 foci/cell, respectively. The γ-H2AX foci number were significantly increased after CT and returned to baseline after a few days. The mean CTDI, SSDE, DLP, and SSDE-LP were 102.5 mGy, 138.2 mGy, 1560.5 mGy cm, and 1932.5 mGy cm, respectively. A statically significant correlation was observed between γ-H2AX foci number and CTDI, SSDE, DLP, and SSDE-LP (r=0.53, 0.54, 0.54, and 0.53).

**CONCLUSION**

DSBs were significantly increased after coronary CT and the radiation-induced γ-H2AX level correlated with the physical CT radiation exposure index.

**CLINICAL RELEVANCE/APPLICATION**

DSBs were induced by radiation exposure even after a single CT study. This finding alerts to the importance of reducing the radiation dose for CT.
SSM23-01  Transpulmonary Chemoembolization (TPCE) in Pulmonary Malignant Tumors: Evaluation of Treatment Response Using Parenchymal Blood Volume (PBV)

Wednesday, Dec. 2 3:00PM - 3:10PM Location: E351

Participants
Sarah B. White, MD, MS, Milwaukee, WI (Moderator) Nothing to Disclose
Hyun S. Kim, MD, Atlanta, GA (Moderator) Nothing to Disclose

Sub-Events
SSM23-01  Transpulmonary Chemoembolization (TPCE) in Pulmonary Malignant Tumors: Evaluation of Treatment Response Using Parenchymal Blood Volume (PBV)

Wednesday, Dec. 2 3:00PM - 3:10PM Location: E351

Participants
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Presenter) Nothing to Disclose
Thomas Lehnert, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Hanns Ackermann, Frankfurt On Main, Germany (Abstract Co-Author) Nothing to Disclose
Marcus Hezel, BS, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Nagy N. Naguib, MD, MSc, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate initial experiences with the assessment of parenchymal blood volume (PBV) of pulmonary malignant tumors by using C-arm CT for detecting early response to transpulmonary chemoembolization (TPCE) and clinical practicability.

METHOD AND MATERIALS
The study was approved by the institutional ethics committee. 21 patients (females: 15, males: 6; range: 41-77 years; mean: 56.77 years) were palliatively treated with TPCE. PBV and tumor diameter were analyzed and PBV maps were calculated from 3D-CTA data sets. Imaging was performed on a flat detector C-arm CT. Response groups were classified according to the RECIST criteria. Statistically significant differences were determined and PBV and diameter were correlated as parameters of response to treatment using the Pearson's regression analysis.

RESULTS
In a mean of 4.91 sessions the median diameter increased by 18.18% (p>0.05) and PBV was reduced by 39.62% (p>0.05). Functional and anatomical response per tumor was statistically significant (p≤0.05). Correlation coefficient was r=0.058. 2/41 tumors showed partial response, 31/41 tumors stable disease and 8/41 tumors progressive disease. Highest pre-treatment PBV values were measured in decreasing tumors (206.93 mL/L), lowest values in increasing tumors (60.17 mL/L; p>0.05). Lowest values also were measured in lung cancer (53.02 mL/L) vs. uterine leiomyosarcoma (103.31 mL/L) and renal cell cancer (113.14 mL/L; p≤0.05).

CONCLUSION
The assessment of PBV maps by using 3D-CTA image data should be easy to integrate into the clinical routine. PBV shows a stronger response to TPCE treatment than the measurement in diameter and should be considered as a response parameter for early detection.

CLINICAL RELEVANCE/APPLICATION
Parenchymal blood measurements allow optimization of TPCE treatment in pulmonary malignant tumors

SSM23-02  Chemosaturation with Percutaneous Hepatic Perfusion of Melphanal for Hepatic Metastases from Uveal Melanoma: Multiinstitutional Evaluation

Wednesday, Dec. 2 3:10PM - 3:20PM Location: E351

Participants
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Presenter) Nothing to Disclose
Silvia Koch, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Bernhard Gebauer, MD, Berlin, Germany (Abstract Co-Author) Research Consultant, C. R. Bard, Inc; Research Consultant, Sirtex Medical Ltd; Research Grant, C. R. Bard, Inc; Research Consultant, PAREXEL International Corporation; Winfried A. Willinek, MD, Bonn, Germany (Abstract Co-Author) Speakers Bureau, Bayer AG Speakers Bureau, Bracco Group Speakers Bureau, General Electric Company Speakers Bureau, Koninklijke Philips NV Speakers Bureau, Lantheus Medical Imaging, Inc Advisory Board, General Electric Company Advisory Board, Lantheus Medical Imaging, Inc Advisory Board, Bayer AG Roland D. Bruening, MD, Hamburg, Germany (Abstract Co-Author) Speakers Bureau, Bracco Group; Speakers Bureau, General Electric Company; Speakers Bureau, Koninklijke Philips NV; Speakers Bureau, Delcath Systems, Inc; Shareholder Delcath Systems, Inc; Alexander Enk, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
This multiinstitutional evaluation intends to retrospectively evaluate the results of the treatment of non-resectable hepatic metastases of uveal melanoma using percutaneous hepatic perfusion (PHP; Hepatic CHEMOSAT® Delivery System; Delcath Systems Inc., USA).

METHOD AND MATERIALS
Chemosaturation is well tolerated by the majority of all fourteen patients. After therapy seven patients developed leukopenia, six patients had thrombocytopenia and two patients showed neutropenia, infection and fever each. Out of the eleven patients evaluated by means of RECIST criteria, four patients (36%) showed PR, SD was observed in five patients (46%) and two patients (18%) had PD. Two patients underwent two further sessions. After the first session tumour response of one patient turned from SD to PR and returned to SD. The other patient’s treatment response showed PR in all three sessions. Survival time of all patients ranged from 1.5 to 23 months (median OS 6.5 months) following first Chemosaturation. Time to progression of the two patients with PD was 6.2 months in one patient. The other patient died 1.6 months after evaluation.

CONCLUSION

Chemosaturation-PHP has been manifested as a potential treatment for patients with non-resectable hepatic metastases of uveal melanoma.

CLINICAL RELEVANCE/APPLICATION

Chemosaturation-PHP provides a good treatment option in patients with unresectable liver metastases from uveal melanoma.

SSM23-03 Quantitative Real-time Fluoroscopy Analysis on Measurement of the Hepatic Arterial Flow During Transcatheter Arterial Chemoembolization of Hepatocellular Carcinoma: Comparison with Quantitative Digital Subtraction Angiography Analysis

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E351

Participants
Yi-Yang Lin, MD, Taipei City, Taiwan (Presenter) Research grant, Taipei Veterans General Hospital and Siemens, Grant No. T1100200.
Rheun-Chuan Lee, MD, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose
Wan-Yuo Guo, MD, PhD, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose
Cheng-Yen Chang, MD, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose

PURPOSE

To quantitatively measure the hemodynamic change of hepatic artery during transcatheter arterial chemoembolization (TACE) of hepatocellular carcinoma (HCC) by subtracted fluoroscopy quantitative color-coding analysis (f-QCA) and digital subtraction angiography quantitative color-coding analysis (d-QCA).

METHOD AND MATERIALS

This is a prospective study performed in a single medical institution from February 2014 to March 2015. Seventeen consecutive patients (mean 70.5 years old; male 12, female 5) underwent TACE with doxorubicin and Lipiodol emulsion or with microspheres for HCC. Patients were enrolled if superselective segmental TACE was technically feasible. The endpoint of TACE was sluggish antegrade arterial flow. Real-time subtracted fluoroscopic image and digital subtraction angiography image with a bolus injection were quantitatively analyzed. The f-QCA and d-QCA (syngo iFlow; Siemens) were used to determine the maximal density time (Tmax) of selected vessels. Relative Tmax (rTmax) was defined as the Tmax at the selected vessel minus the time of contrast medium spurtung from the catheter tip. Imaging acquisition and injection protocols remained the same before and after TACE.

RESULTS

The pre- and post-TACE rTmax of the embolized segmental artery in f-QCA and d-QCA were 1.39 ± .52s, 2.28 ± 1.09s, p < .001 and 1.60 ± .87, 3.14 ± 1.89s, p < .001, respectively. The Pearson correlation of pre- and post-TACE rTmax of the embolized segmental artery between f-QCA and d-QCA were .65, p < .01 and .73, p < .001. The rTmax of the proximal lobar hepatic arteries and proper hepatic artery had no significant change before and after TACE in f-QCA and d-QCA.

CONCLUSION

The f-QCA is a fast and convenient method with lower radiation dose to quantify arterial flow change of embolized segmental artery during TACE. Flow quantification of embolized segmental artery by f-QCA has high correlation with that by d-QCA.

CLINICAL RELEVANCE/APPLICATION

The f-QCA is a fast and convenient method to evaluate arterial flow change during TACE. The f-QCA can potentially replace the d-QCA with lower radiation dose.

SSM23-04 Transarterial Chemoembolization for the Treatment of Advanced Hepatocellular Carcinoma: A Retrospective Cohort Study with 508 Patients

Wednesday, Dec. 2 3:30PM - 3:40PM Location: E351

Participants
Yan Zhao, MS, Baltimore, MD (Presenter) Nothing to Disclose
Jae Ho Sohn, MD,MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Florian N. Fleckenstein, MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Sonia P. Sahu, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Rafael Duran, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Ruediger E. Schernthaner, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Howard Lee, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Li Zhao, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Susanne Smolka, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Ming De Lin, PhD, Cambridge, MA (Abstract Co-Author) Employee, Koninklijke Philips NV
Flatt-detector CT perfusion imaging is accurate for detecting residual viable tumor at the end of the TACE procedure and may be useful in planning further treatments without the need for intervening imaging.

**RESULTS**

Of the 508 patients, 79.3% were male and median patient age was 63 (range, 19–90). By multivariate analysis, extrahepatic metastasis (HR = 2.19, 95% CI 1.44–2.66), AFP > 400 ng/ml (HR = 1.73, 95% CI 1.38–2.17), portal vein invasion (HR = 1.62, 95% CI 1.3–2.02), Child–Pugh class B (HR = 1.37, 95% CI 1.09–1.73) and number of tumor nodules > 2 (HR = 1.39, 95% CI 1.11–1.74) were significantly associated with survival. Risk scores for individual patients were calculated by combining these five prognostic values with the corresponding regression coefficients. The concordance (c)-statistic [equivalent to the receiver operating characteristic (ROC) curve] was used to assess the validity of categorizing patients treated with TACE into two subgroups. Cut-off values were determined according to ROC curves.

**CONCLUSION**

TACE should be considered an effective therapy for select advanced HCC patients. We suggest modification of the BCLC stage C classification to improve staging of these patients.

**CLINICAL RELEVANCE/APPLICATION**

Select advanced stage (BCLC stage C) HCC patients with well-preserved liver function could benefit from TACE treatment.

**SSM23-05 Feasibility of Flat-detector CT Perfusion Imaging in TACE for HCC: Implications for Treatment Planning and Response**

Wednesday, Dec. 2 3:40PM – 3:50PM Location: E351

**METHOD AND MATERIALS**

Intra-procedural flat-detector CT perfusion imaging performed in the angiography suite at the time of TACE now allows assessment of tumor perfusion immediately before and after chemoembolization. This study examines the significance of areas of residual increased blood volume (indicating persistent tumor perfusion) immediately following TACE through comparison with the follow-up CT or MRI.

**RESULTS**

In five treatments, residual abnormally increased perfusion was visible on the post treatment DynaPBV images and in all cases this correlated well with residual tumor on the follow-up CT or MRI. In two treatments, there was no residual abnormally increased perfusion which was confirmed as a complete treatment response on follow-up imaging studies. In two patients, both with lesions adjacent to the liver capsule, no abnormally increased perfusion was visible on DynaPBV, but hyperenhancing tumor was visible on follow-up imaging likely due to extra-hepatic supply via the inferior phrenic artery.

**CONCLUSION**

Our results show flat-detector CT perfusion imaging to be accurate in detecting residual disease at the end of the TACE procedure. Challenges exist with anomalous anatomy and lesions with extra-hepatic supply.
SSM23-06  Four-dimensional CT Navigation for Precise Chemoembolization of Hepatocellular Carcinoma

Participants
Tianhao Su, MD, Beijing, China (Presenter) Nothing to Disclose
Long Jin, Beijing, China (Abstract Co-Author) Nothing to Disclose
Wen He, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To describe and explore four-dimensional (4D) CT navigation prior to transarterial chemoembolization (TACE) for hepatocellular carcinoma (HCC).

METHOD AND MATERIALS
Contrast-enhanced computed tomographic imaging with volume helical shuttle (VHS) technique were prospective performed at a 64-row multidetector scanner before TACE in HCC patients. The whole liver region was selected for dynamic study of the tumor. A series of 16 phases images from pre-arterial to portal venous phase were collected and 4D CT images were reconstructed with 1.25-mm thickness on a commercial workstation. Radiologists analyzed the volumetric data, being free to use axial slices as well as postprocessing reconstruction algorithms (e.g., MIP and MPR). All 4D CT angiography (CTA) images in cine mode were compared with DSA in TACE, including anatomy of hepatic artery, tumor supplying arteries, tumor vessels, tumor staining. Embolization effect was also evaluated on DSA and follow-up CT.

RESULTS
The study included 46 independent HCC lesions in 38 patients. Normal hepatic artery anatomy was found in 24 cases (63.2%, according to Michels’ classification) and variations in 14 cases (36.8%), which presented good hints for DSA selective hepatic arterial work. The diagnosis consistent rate was 100% between 4D CTA and DSA in showing the anatomy and variation of hepatic artery. 4D CTA noninvasively showed tumor supplying arteries (n = 41), tumor vessels (n = 36), and tumor staining (n = 42). DSA showed better tumor staining result and the visible rate of tumor staining in 4D CTA was 91.3% (42/46). However, 4D CTA had advantage in reproducibly delineating the three-dimension relationship between tumor and blood vessels while detecting tumor supplying arteries, especially for medium sized lesions lesions (diameter range from 3 to 7 cm). Since 4D CTA could dynamically show 3-5 levels of intrahepatic arterial branches, it provided a good navigation for effective superselective microcatheter placement. Upon 4D CT results, chemoembolization therapies were effectively performed. Successful lipiodol accumulations were achieved in specific region of liver.

CONCLUSION
Four-dimensional CT using VHS technique could be easy and helpful in evaluating hepatic artery anatomy and locating tumor supplying artery for interventional chemoembolization planning.

CLINICAL RELEVANCE/APPLICATION
Four-dimensional CT can be used as a planning and navigation tool for TACE in HCC.
SSM24

ISP: Vascular/Interventional (Gentiourinary Interventions-Treating Conditions of the Prostate and Uterus)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E450B

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Sandeep Bagla, MD, Woodbridge, VA (Moderator) Consultant, Hansen Medical Inc; Consultant, NeuWave Medical, Inc; Consultant, CeloNova BioSciences, Inc; Consultant, Medtronic, Inc; Consultant, DFINE, Inc; Consultant, Boston Scientific
Charles T. Burke, MD, Chapel Hill, NC (Moderator) Nothing to Disclose

Sub-Events

SSM24-01 Evaluation of Changes in Quality of Life Related to Uterine Fibroid Embolization (UFE): Preliminary Results of the French SFICV EFUZEN Study

Wednesday, Dec. 2 3:00PM - 3:10PM Location: E450B

Participants
Helene Kovacsik, MD, PhD, Montpellier, France (Abstract Co-Author) Nothing to Disclose
Sebastien Bommart, MD, Montpellier, France (Abstract Co-Author) Nothing to Disclose
Marc R. Sapoval, MD, PhD, Paris CEDEX 15, France (Abstract Co-Author) Nothing to Disclose
Denis Herbreteau, MD, Tours, France (Presenter) Nothing to Disclose
Jean-Paul Beregi, MD, Nimes, France (Abstract Co-Author) Nothing to Disclose
Jean-Michel Bartoli, MD, Marseille, France (Abstract Co-Author) Nothing to Disclose

PURPOSE
Main goal:- To evaluate quality of life before and one year after UFESecondary goals:- To determine impact of imaging findings (MRI data) before and 3-6months after UFE on changes in quality of life

METHOD AND MATERIALS
Study design: prospective, multicenter (25 centers) French observational studyPatients: 264 consecutive symptomatic women referred in the center for UFE using EmbozeneÒ (Celenova) particles. Methods: Clinical data: the quality of life score was calculated using the previously validated UFS-QOL by Spies, before and one year after UFE. Imaging data: MRI were performed before and 3-6 months after UFE. Data recorded were uterine and main fibroid volume, percentage of fibroid enhancement after injection of gadolinium. Impact of imaging data before and after UFE on QOL scores was searched.

RESULTS
189 patients (85.9%) showed monorrhagia at baseline. This was reduced to 39 patients (18%) at 1 year of follow up. 171 patients (78.1%) had pelvic pressure symptoms at baseline. This was reduced to 42 patients (19.4%) after 1 year of follow up. Complete QOL study was obtained in 192 women. Improvement of QOL score at one year after UFE a was found 183/203 (90.2%) for HRQL, 163/192 (84.9%) for Symptoms Severity. The probability of presenting a profuse bleeding was significantly reduced (by 62%) among patients with high reduction of fibroid volume (>=30%), as compared to patients with low fibroid volume reduction (<30%) (OR=0.38; 95%CI: [0.18;0.80]) (p = 0.011) The Impact of percentage of uterine volume or main fibroid reduction and decrease of fibroid enhancement on change in post embolization global UFS-QOL score was not established.

CONCLUSION
At one year post embolization, UFE improves significantly quality of life

CLINICAL RELEVANCE/APPLICATION
UFE is not only an effective technique but is also considered highly satisfactory by women

SSM24-02 Vascular/Interventional Keynote Speaker: Current Status of Prostate Artery Embolization as a Treatment for BPH

Wednesday, Dec. 2 3:10PM - 3:20PM Location: E450B

Participants
Sandeep Bagla, MD, Woodbridge, VA (Presenter) Consultant, Hansen Medical Inc; Consultant, NeuWave Medical, Inc; Consultant, CeloNova BioSciences, Inc; Consultant, Medtronic, Inc; Consultant, DFINE, Inc; Consultant, Boston Scientific

SSM24-03 Percutaneous Ablation of Oligometastatic Prostate Cancer: Oncologic Outcomes and Safety

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E450B

Participants
Andrew Erie, MD, Rochester, MN (Presenter) Nothing to Disclose
Jonathan M. Morris, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Brian T. Welch, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Anil N. Kurup, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Adam J. Weisbrod, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Thomas D. Atwell, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Grant D. Schmit, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Eugene D. Kwon, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Matthew R. Callstrom, MD, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Thermedic, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Gall Medical Ltd

PURPOSE
To determine the oncologic outcomes and safety of percutaneous ablation in the treatment of oligometastatic prostate cancer.

METHOD AND MATERIALS
This is a retrospective, single-institution review of 31 patients with oligometastatic prostate cancer who underwent 43 percutaneous ablations of their limited (≤5) metastatic sites. Eight patients (26%) were hormone deprivation therapy-naïve (ADT-naïve) and received ablation with the purpose of delaying ADT. Twenty-three patients (74%) underwent ablation either because of resistance to systemic therapies or a more aggressive multimodal treatment approach was preferred. Study endpoints included procedural complications, local control, progression free survival (PFS), and androgen deprivation therapy-free survival (ADT-FS). ADT-FS was defined as the time between percutaneous ablation and the initiation of ADT.

RESULTS
Local control was achieved in 35 (81.4%) of 43 tumors with a median follow-up of 8 months (range, 3-60 mo) after ablation. Tumor recurrence was found in 8 (18.6%) of 43 tumors at a median follow-up of 6 months (range, 2-38 mo). Median prostate-specific antigen (PSA) measurements were significantly lower approximately 2 months after ablation compared to before ablation (0.27 ng/dl [range <0.01 to 7.7] and 1.5 ng/dl [range <0.01 to 72.0], respectively (p=0.02)). Estimated PFS rates for all patients at 6 and 12 months after ablation were 65% (95% CI, 44-80) and 45% (95% CI, 24-64), respectively. Of the 8 ADT-naïve patients who underwent ablation with purpose to delay ADT, all (100%) achieved local control and the ADT-FS at 12 months was approximately 70%. None of the ablations were associated with major complications.

CONCLUSION
Percutaneous ablation of oligometastatic prostate cancer appears safe, achieves acceptable local control rates, and can delay disease progression when used in combination with other therapies. Percutaneous ablation may be particularly valuable in ADT-naïve patients who do not tolerate or prefer to delay ADT.

CLINICAL RELEVANCE/APPLICATION
Percutaneous ablation can be used as part of a multimodal treatment approach for oligometastatic prostate cancer and can delay hormone therapy in ADT-naïve patients.

SSM24-04 Frequency of Penile and Rectal Collateral Flow from Prostatic Arteries during Prostatic Artery Embolization

Participants
Ari J. Isaacson, MD, Chapel Hill, NC (Abstract Co-Author) Advisory Board, BTG International Ltd
Charles T. Burke, MD, Chapel Hill, NC (Presenter) Nothing to Disclose

PURPOSE
The most common mechanism of complication during prostatic artery embolization (PAE) is non-target embolization. Avoidance of branches supplying the bladder is commonly described. Less commonly discussed are intra-prostatic collaterals supplying the penis and rectum, although they are frequently seen during PAE. Because of the risks associated with non-target embolization as a result of these shunts, it would be beneficial to have an understanding of their incidence, as well as from what prostatic artery branches they arise. The purpose of this study was to retrospectively determine the frequency of rectal and penile collateral flow from each prostatic artery branch as seen during PAE.

METHOD AND MATERIALS
DSA images from PAEs performed between April 2013 and March 2015 were evaluated by two interventional radiologists experienced in performing PAE. A consensus determination was made about which arteries were catheterized (the anterolateral prostatic artery (ALPA), the posterolateral prostatic artery (PLPA) or a common trunk (CT) of the two) and about the presence of collateral flow to the arteries supplying the penis and/or the rectum from each catheterized artery. The overall incidence of such collaterals was calculated as well as the frequency in which they arose from each prostatic artery branch.

RESULTS
During 26 PAEs, 58 prostatic arteries were catheterized (36 ALPAs, 10 PLPAs and 12 CTs). Collateral flow to arteries supplying the penis or rectum was identified in 18/26 PAEs (69%). Flow to the penile arteries was seen in 13/36 (36%) ALPA catheterizations and in 5/12 (42%) CT catheterizations. Flow to rectal branches was seen in 8/10 (80%) PLPA catheterizations and in 4/12 (33%) CT catheterizations. No flow to penile branches was observed from a PLPA, nor was there flow to a rectal branch seen from an ALPA.

CONCLUSION
Shunting to the penis and/or rectum was present during the majority of PAEs. Collateral flow to the rectum from the PLPA or from a CT was seen quite frequently and collateral flow to the penis from an ALPA or CT was seen with moderate frequency during prostatic artery catheterization.

CLINICAL RELEVANCE/APPLICATION
Understanding the incidence of rectal and penile collateral pathways from the specific branches of the prostatic arteries will allow for greater detection of these findings during PAE in order to avoid complications.
**PURPOSE**

Irreversible Electroporation (IRE) is a novel tissue ablation method. It selectively destroys cells whilst preserving tissue infrastructure and is hence an ideal method for focal prostate cancer (PCa) therapy. It preserves (or allows regeneration of) vital surrounding structures such as neurovascular bundle, inferior sphincter and rectum, thus minimizing the side-effects of PCa therapy, mainly being impotence and incontinence.

**METHOD AND MATERIALS**

We have employed IRE for the treatment of 222 patients with primary (stages T1-T4) and recurrent PCa after surgery (18/222), radiation therapy (4/222) and HIFU (3/222). All patients underwent mp-MRI prior to and after IRE (T2, diffusion, perfusion, in selected cases 1H spectroscopy). 44% of patients underwent additional 3D-transperineal biopsy before IRE. Treatment was carried out by rectal US-guided transperineal IRE-electrode insertion under general anesthesia and deep muscle relaxation. 161 patients had focal and 61 whole gland ablations. All patients had follow-ups with PSA and mp-MRI for documentation of local tumor control.

**RESULTS**

Initial tumor control was achieved in all patients. Within the follow-up period of up to 4y, the recurrence rates were 0/45 (Gleason \(<7\), 4/103 (Gleason 7) and 5/54 (Gleason >7). There were no IRE-related complications and toxicity was extremely low: 16 patients reported a transient reduction of erectile function (EF) (recurred after 6-8m), 5 a permanent reduction and 2 a permanent loss of EF. There were no cases of IRE-related incontinence, even when the lower urinary sphincter was included in the treatment field; a partially included rectum also remained intact. Treatment was completed within 24h in all patients with a single overnight stay in the clinic. Patients had no wound pain.

**CONCLUSION**

IRE treatment of PCa is safe. In the short-term follow-up with MRI and PSA (maximum 4.5y) it is effective. Toxicity is significantly lower compared to other PCa treatments. Based on our data incontinence can be avoided altogether. MRI and 3D-biopsy are suitable for pre-treatment work-up and MRI for post-treatment follow-up. IRE has the potential to become an important tool for PCa therapy.

**CLINICAL RELEVANCE/APPLICATION**

IRE treatment is an alternative to the current treatment options for PCa, with much lower invasiveness and toxicity. It is effective in all stages of PCa and offers treatment options in advanced and recurrent PCa not amenable to other therapies.

**SSM24-06 Phase II Clinical Trial for Evaluation of MRI-guided Laser Induced Interstitial Thermal Therapy (LITT) for Low-to-intermediate Risk Prostate Cancer**

Wednesday, Dec. 2 3:50PM - 4:00PM Location: E450B

Participants

Aytekir Oto, MD, Chicago, IL (Presenter) Research Grant, Koninklijke Philips NV; ;
Shiyang Wang, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Ambereen Youssuf, MBBS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Sydeaka Watson, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Tatjana Antic, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Scott Eggener, Chicago, IL (Abstract Co-Author) Research Grant, Visualase, Inc Speakers Bureau, Johnson & Johnson

**PURPOSE**

To assess the oncologic efficacy and safety of MRI-guided laser-induced interstitial thermal therapy of biopsy confirmed and MR-visible prostate cancer.

**METHOD AND MATERIALS**

27 patients with biopsy proven low-to-intermediate risk prostate cancer underwent MRI-guided laser ablation of the cancer using Visualase laser ablation device. All patients had a pre-procedure endorectal MRI which showed suspicious foci concomitant with the positive sextant on TRUS-guided biopsy. The area of interest was targeted transperineally using 1.5 T Philips MRI scanner and Visualase ablation device. Ablation was monitored by real time MR thermometry using Visualase MRI thermometry software. Perioperative, early and late complications and adverse events were recorded. Follow-up was performed with 3-month MRI and MR-guided biopsy, 12-month MRI and TRUS guided biopsy and validated quality of life questionnaires to assess urinary and sexual function.

**RESULTS**

MRI-guided laser ablation of prostate cancer was successfully performed in all 27 patients without significant peri-procedural complications. All patients were discharged home the same day. Average duration of the procedure was 3 hours 17 minutes and average duration of a single laser ablation was 1 minute 22 seconds. Total number of ablations per patient ranged from 2-8, with a median of 4. The treatment created an identifiable hypovascular defect in all cases. Post procedure complications were minor and included urinary symptoms, perineal bruising and erectile dysfunction, all of which self-resolved. Validated quality of life urinary and sexual questionnaires obtained before and 12 months after the procedure did not reveal any significant differences (ps0.05). 1/27 and 3/17 patients had residual cancer in the ablation zone at 3 months and 12 months respectively.
CONCLUSION

Short-term follow-up results of MRI-guided focal laser ablation for treatment of clinically localized, low-to-intermediate risk prostate cancer appear promising. It may offer a minimally invasive procedure for select patients that does not appreciably alter sexual or urinary function.

CLINICAL RELEVANCE/APPLICATION

Short-term results of our phase II trial show that MRI-guided focal laser ablation can be a safe and feasible option for treatment of low-to-intermediate risk prostate cancer.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Aytekin Oto, MD - 2013 Honored Educator
Breast Imaging (MR Diagnostics)
Thursday, Dec. 3 10:30AM - 12:00PM Location: E450A

SSQ01 Correlation between MR Imaging and Level of Tumor Infiltrating Lymphocyte (TIL) in Triple Negative Breast Cancer (TNBC)
Thursday, Dec. 3 10:30AM - 10:40AM Location: E450A

Participants
- Linda Moy, MD, New York, NY (Moderator) Nothing to Disclose
- Janice S. Sung, MD, New York, NY (Moderator) Nothing to Disclose

Sub-Events
- SSQ01-01 Correlation between MR Imaging and Level of Tumor Infiltrating Lymphocyte (TIL) in Triple Negative Breast Cancer (TNBC)

Purpose
Triple negative breast cancer (TNBC) is a heterogeneous disease with varying prognosis. Recently, the importance of tumor-infiltrating lymphocyte (TILs) has been determined. That is, increased TIL positively correlated with the pathologic complete response rate and increased patient survival. The purpose of this study is to investigate associations between TIL and magnetic resonance (MR) imaging in TNBC.

Method and Materials
This retrospective study was approved by the institutional review board, and informed consent was waived. From February 2006 to December 2014, 112 consecutive women (mean age; 47 years, range ; 25-73 years) with TNBC who had undergone MR imaging were selected. All lesions were evaluated according to Breast Imaging Reporting and Data System (BI-RADS) lexicon by two radiologists. Apparent diffusion coefficient (ADC) values, lymph node involvement and multifocality were also assessed. According to the level of TIL, we divided into two groups: low TIL; <50% and high TIL; 50-100%. Associations between TIL and imaging features were evaluated. Statistical analysis was performed by using independence test.

Results
One hundred twelve malignant lesions (range, 9-73mm; mean, 27.8mm) were evaluated, of which 62 (55.4%) were in low TIL and 50 (44.6%) were in high TIL. Tumors with high TIL show more round shape (n = 23, 46%), circumscribed margin (n = 38, 76%), homogenous enhancement (n = 16, 32%) and absence of multifocality (n = 44, 88%) (p <0.005). Low TIL group show more irregular shape (n = 43, 69.3%), not circumscribed margin (n = 49, 79.0%), heterogeneous enhancement (n = 47, 75.8%) and multifocality (n = 44, 70.9%) (p <0.005). All lesions show typical washout kinetic findings of malignancy without significance. ADC value was higher in high TIL group without reaching significance.

Conclusion
MR imaging features of round shape, circumscribed margin, homogenous enhancement and lack of multifocality are typical pattern of TNBC with high TIL.

Clinical Relevance/Application
TNBC with high TIL shows characteristic features and it may provide added diagnostic benefit in identifying TNBC with relatively good prognosis.

SSQ01-02 Contralateral Parenchymal Enhancement in DCE-MRI of Patients with Unilateral Node-negative ER+/HER2-breastcancer: Potential Value for Chemotherapy Selection
Thursday, Dec. 3 10:40AM - 10:50AM Location: E450A

Participants
- Bas H. van der Velden, MSc, Utrecht, Netherlands (Presenter) Nothing to Disclose
- Claudette E. Loo, MD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
- Ruud Pijnappel, MD, PhD, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose
- Kenneth G. Gilhuijs, PhD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose

Purpose
Low parenchymal enhancement in the contralateral breast at dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) has been associated with inferior invasive disease-free survival (IDFS) of patients with estrogen-receptor positive and human-epidermal-growth-factor-receptor-2 negative (ER+/HER2-) breast cancer. The aim of this retrospective study is to explore whether contralateral parenchymal enhancement has complementary value to existing guidelines to identify patients who may benefit from
METHOD AND MATERIALS
Between 2000 and 2008, 531 consecutive patients eligible for breast-conserving therapy based on conventional imaging and physical examination received a preoperative DCE-MRI in study context. Two-hundred-and-sixty-five patients had ER+/HER2-breast cancer and negative lymph nodes, of whom 66 received hormonal therapy. Forty-two of these patients did not receive chemotherapy. In this group, high-risk and low-risk patients for IDFS were identified based on parenchymal enhancement in the contralateral breast, using a previously reported method. In short, parenchyma was automatically segmented in 3D, enhancement was calculated as the mean of the top-10% of the relative signal increase over time, which was associated with IDFS. The MRI-based risk groups were compared with the Dutch guidelines for systemic therapy based on Adjuvant! Online. Kaplan-Meier estimators and log-rank tests were used.

RESULTS
The average age at diagnosis in the subgroup treated with hormonal therapy without chemotherapy was 58 years (range: 35-79). The median follow-up was 86 months (range: 37-146). An event occurred in 4/42 (10%) patients. Twenty-one patients (50%) were in the high-risk MRI group. All events occurred in this group (P=0.034). Thirty-three patients (88%) were indicated for chemotherapy based on the Dutch guidelines, which was not found to be specific for IDFS (P=0.320). Eighteen patients (43%) were in the high-risk MRI group and were indicated by the guidelines, containing all events (P=0.009).

CONCLUSION
Parenchymal enhancement in the contralateral breast may have potential as a prognostic biomarker to complement clinical indication for chemotherapy in patients who receive hormonal therapy.

CLINICAL RELEVANCE/APPLICATION
Contralateral parenchymal enhancement may have prognostic potential to complement clinical indication for chemotherapy in node negative ER+/HER2- breast cancer patients receiving hormonal therapy.

SSQ01-03 Characterization of Breast Lesion Kinetics with Accelerated DCE-MRI Using Conventional Sampling Methods

Thursday, Dec. 3 10:50AM - 11:00AM Location: E450A

Awards
Trainee Research Prize - Resident

Participants
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PURPOSE
To characterize the kinetics of breast lesions in DCE-MRI with high temporal resolution during the first minute post contrast injection using conventional sampling methods.

METHOD AND MATERIALS
23 women with known enhancing lesions (17 malignant and 18 benign lesions) underwent a combined high temporal/standard protocol DCE-MRI. Patients were imaged on a Philips Achieva 3T-TX with a bilateral breast coil and a protocol consisting of 8 fat-suppressed fast acquisitions after injection of contrast media (0.1mM/kg MultiHance) followed by 5 fat-suppressed 'standard' acquisitions. Temporal resolution for the fast scans was 6.2-9.9s, with spatial resolution of 1.5x1.5x3mm^3; standard protocol temporal resolution was 58-79s and 0.8x0.8x1.6mm^3 spatial resolution. Percent signal enhancement data were fit to a 2-parameter (uptake only) empirical mathematical model (EMM). Time-of-arrival (TOA) was defined as the time at which a lesion enhanced by 20%, relative to the time when arterial enhancement in the breast first reached 20%. Time to 90% of maximum enhancement (T90) and initial area under the contrast curve (iAUC) were calculated from the EMM parameters. Lesion conspicuity was defined as the ratio of lesion signal increase to background parenchymal enhancement (BPE).

RESULTS
Significant differences (p<0.005) between benign and malignant lesions were measured for: uptake rate, initial slope, iAUC, TOA, and T90. The average TOA of malignant lesions was 7.2 ± 3.7s, and 25 ± 18.7s for benign lesions. T90 was 50 ± 34s and 191 ± 127s for malignant and benign lesions respectively. Average initial uptake rate was 34 ± 64%/s for malignancies and 2 ± 3%/s for benign lesions. Lesion conspicuity was highest in 4th fast time-point when its average was 11:1, compared to 4:4:1 by the final fast acquisition.

CONCLUSION
Malignant lesions, on average, had significantly faster signal enhancement than benign lesions, and significantly shorter TOA. Fast sampling may show larger differences between benign and malignant lesions compared to conventional DCE-MRI, and allows measurement of kinetics relative to arterial TOA. Lesion conspicuity was highest at early times after injection, before the sampling of the center of k-space in standard protocols.

CLINICAL RELEVANCE/APPLICATION
Fast sampling allows accurate measurement of early lesion kinetic parameters, which may be diagnostically useful. Higher lesion
The purpose of this project is to assess the impact of pre-operative breast MRI on surgical waiting time (defined as from the time of biopsy to the time of surgery), and to identify possible factors contributing to the delay in management, specifically in a publicly funded healthcare system.

METHOD AND MATERIALS

We tested our informatics modeling in a group of 86 patients who were ER+ and candidates for the OncotypeDX gene array test and underwent breast MRI imaging at 3T. The clinical and imaging parameters included, breast density, morphology, lesion volume, mass enhancement, Ki-67, Pharmacokinetic(PK)-DCE MRI, ADC mapping, and others. There were 36 patients with OncotypeDX gene array scores of low risk(0-17), 40 patients with intermediate risk(18-31), and 10 patients with high risk(>31). Our non-linear dimensionality reduction(NLDR) informatics algorithm computes the similarity matrix using a hybrid k-means algorithm. We then employed multidimensional scaling to embed the similarity matrix into a two-dimensional representation via random forest decision trees to model the clinical parameters to the risk groups. T-tests were used to determine statistical significance.

RESULTS

There was no age difference(51-56y/o) between groups. The PK-DCE parameters, Ktrans for the high and intermediate risk groups were higher (0.45 and 0.50 (1/min)) compared to the low-risk group (0.35(1/min)) with similar results for the extra vascular fraction(EVF). The ADC values for high and intermediate risk groups were significantly lower than those for the low-risk group(1.09 vs 1.38x10-3mm2/s). However, the ADC values in glandular tissue were similar across all groups(2.14-2.17x10-3mm2/s). These results are visualized in our novel informatics heat map.

CONCLUSION

The most important surrogate imaging and histological parameters determined from the informatics model were the ADC values, the PK-DCE parameters, lesion size, Ki-67, and breast lesion volume.

CLINICAL RELEVANCE/APPLICATION

Informatics modeling of clinical and radiological imaging metrics can provide the foundation to relate these variables to the OncotypeDX gene array score.

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Katarzyna J. Macura, MD, PhD - 2012 Honored Educator
Riham H. El Khouli, MD, PhD - 2014 Honored Educator
Katarzyna J. Macura, MD, PhD, Baltimore, MD (Abstract Co-Author) Research Grant, F. Hoffmann-La Roche Ltd

SSQ01-05 The Impact of Pre-operative Breast MRI on Surgical Waiting Time

Thursday, Dec. 3 11:10AM - 11:20AM Location: E450A

Presenters

Michelle Zhang, MD, Montreal, QC (Presenter) Nothing to Disclose
Simon Sun, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Ann E. Alidis, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose
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Benoit D. Mesurolle, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this project is to assess the impact of pre-operative breast MRI on surgical waiting time (defined as from the time of biopsy to the time of surgery), and to identify possible factors contributing to the delay in management, specifically in a publicly funded healthcare system.
funded healthcare system.

**METHOD AND MATERIALS**

This is a retrospective cohort study that includes 1265 patients. Patients evaluated for pre-operative planning for newly diagnosed breast cancer from 2007 to 2013 at a tertiary center were divided into 2 groups: those who had a pre-operative MRI and those who did not (control group). Linear regression using matched populations was then used to compare the surgical waiting time between the 2 patient groups. Potential influences on surgical waiting time and subgroup analysis of the pre-operative MRI patient group were obtained using median regression analysis and Kruskal-Wallis test respectively.

**RESULTS**

There was a statistically significant increase \( p < 0.001 \) in the surgical waiting time for the MRI group, after matching for confounding characteristics such as age, pathology and surgeon. The mean surgical waiting time for patients having had a pre-operative breast MRI was 57.9 days \( (95\% \text{ CI: } 55.6-60.1) \) compared to the control group which was 47.0 days \( (95\% \text{ CI: } 45.1-48.9) \). Increased surgical waiting time was associated with more favorable pathology \( (i.e. \text{ DCIS}, \text{ later year of diagnosis (e.g. 2013 vs. 2007) and older patient age. Second}-\text{look ultrasound and subsequent biopsies were also associated with a statistically significant increase in surgical waiting time (p}=0.001). Within the different subgroups of patients who underwent pre-operative MRI, surgical waiting time was mostly affected by the waiting time from MRI to the time of surgery, rather than from time of cancer diagnosis to MRI \( p<0.0005 \).

**CONCLUSION**

Pre-operative breast MRI increased surgical waiting time on average from 47.0 to 57.9 days. The waiting time length also correlated with histology, year of diagnosis, patient’s age and second-look US/biopsy. A main contributor to the waiting time was the delay between completion of the MRI to surgery, rather than from the delay between initial diagnosis to MRI.

**CLINICAL RELEVANCE/APPLICATION**

Pre-operative breast MRI in a publicly funded system may increase surgical waiting time; this increase is in large part due to the wait time from MRI to surgery, rather than the MRI waitlist time.

**SSQ01-06 Integrated Axillary Lymph Node (ALN) Screening during Pre-operative Breast MRI**

Thursday, Dec. 3 11:20AM - 11:30AM Location: E450A

Participants
Sabine M. Detering, Aachen, Germany (Presenter) Nothing to Disclose
Simone Schrading, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Timm Dimichs, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

According to the ACOSOG Z001 trial, axillary lymph node dissection (ALND) does not improve survival in women with positive sentinel lymph nodes (SLN). Therefore, an increasing number of women with positive SLNB do not proceed to ALND. However, this could lead to (axillary) relapse in patients with undetected advanced ALN disease. Purpose of this study was to analyze whether a short additional pulse sequence, integrated into our routine pre-operative breast MRI protocol, is sufficient to detect such ALN disease.

**METHOD AND MATERIALS**

218 women with biopsy-proven invasive breast cancer underwent preoperative MRI at 1.5 T. The standardized protocol included a pre-contrast coronal T1w-TSE-sequence acquired with the system's built-in body coil and prescribed to cover the axilla, TR/TE 550/15ms, FOV: 370 mm, scan time: 3 min. Two radiologists rated the likelihood of ALN metastasis on a 4 point scale ranging from 1 = definitely absent to 4 = definitely positive. Results of axillary surgery served as standard of reference.

**RESULTS**

Histology revealed that 80/218 (37%) patients were node-positive, 138/218 (63%) were node-negative. Of the 80 node-positive, 52 (65.0%) were staged pN1 (up to 1-3 ALN with micromets or 1 macrometastasis > 2 mm), whereas 28 (35.0%) had significant nodal disease, defined as all pN stages > pN1. Of the 28 patients with significant nodal disease, MRI classified 25 (89.3%) correctly as node positive. Stratified by nodal stages, MRI had a sensitivity of 7% (1/15) for pN1mic, 54% (22/41) for pN1a-c, 86% (12/14) for pN2 and of 100% (10/10) for pN3. MRI correctly excluded presence of ALN metastases in 127/138 patients (specificity: 92.0%).

**CONCLUSION**

A fast, 3-minute, additional T1-w MRI of the axilla as part of routine pre-operative breast MRI seems useful for complimentary staging of the axilla in addition to SLNB: MRI has predictably a poor sensitivity for ALN micrometastases - i.e. information on disease that is needed for accurate stage categorization, but not requiring specific treatment, and information that will be provided by SLNB. SLNB alone will, in turn, be unable to detect clinically significant ALN disease outside the sentinel node - a task that appears to be accomplished by MRI.

**CLINICAL RELEVANCE/APPLICATION**

A fast MRI of the axilla, as part of routine pre-operative breast MRI, seems suitable to complement SLNB in order screen the axilla for clinically important axillary node disease.

**SSQ01-07 Kinetic Analysis of the Ultra Early Phase on Breast MRI: Comparison between Benign and Malignant Lesions using Ultrafast Dynamic Contrast Enhanced MRI**

Thursday, Dec. 3 11:30AM - 11:40AM Location: E450A

Participants
Hiroyuki Abe, MD, Chicago, IL (Presenter) Consultant, Seno Medical Instruments, Inc
Naoko Mori, MD, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
To evaluate the kinetic data of benign and malignant breast lesions in ultra early phase after contrast injection, using a whole breast ultrafast scanning technique.

**METHOD AND MATERIALS**

15 patients (10 benign and 10 malignant breast lesions) were scanned with an acquisition protocol of Ultrafast MRI, consisting of 5 pre and 8 post-contrast bilateral, fat-suppressed T1 weighted images of whole breasts, with temporal resolution of 7 second followed by four regular whole breast acquisitions with temporal resolution of 75 second with Philips Achieva 3T-TX with a dedicated 16 channel bilateral breast coil. Spatial resolution of the ultrafast scan was 1.5 x 1.5 x 3 mm3; for the standard protocol spatial resolution was 0.8 x 0.8 x 1.6 mm3. Kinetic curves of each lesion during the ultrafast phase (0 - 56 sec) were assessed with a commercially available CAD system (Dynacad) in terms of initial enhancement ratio (IER), peak enhancement ratio (PER) and curve shape (persistent, plateau, or wash-out). IER was obtained at the second phase after the lesion was visualized. To make the kinetic curve, the time-point for the early phase was set at the second phase after the lesion was visualized, and the late phase was set at the last phase of ultrafast scan.

**RESULTS**

Statistically significant differences between benign and malignant lesions were obtained. IER of benign lesions ranged from 32% to 117% (mean 68%), and that of malignant lesions ranged from 107% to 241% (mean 149%) (p<.001). PER ranged from 48% to 163% (mean 107%), and that of malignant lesions ranged from 147% to 268% (mean 184%) (p<.001). As for curve shape, all benign lesions showed persistent type kinetics except for one lesion that had plateau type kinetics. For malignant lesions, 6 had persistent type kinetics and 3 had plateau type kinetics.

**CONCLUSION**

Kinetic analysis of the ultra early phase is useful for differentiation between benign and malignant lesions.

**CLINICAL RELEVANCE/APPLICATION**

Ultrafast MRI, which is less influenced by background parenchymal enhancement, could be more clinically useful with the inclusion of kinetic assessment.
surgeons to decide the treatment plan such as neoadjuvant endocrine therapy or immediate surgery omitting chemotherapy.

SSQ01-09  Early-stage Invasive Breast Cancer: Association of Tumor Apparent Diffusion Coefficient Values with Axillary Lymph Node Metastasis

Thursday, Dec. 3 11:50AM - 12:00PM Location: E450A

Participants
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Ji Il Moon, MD, Busan, Korea, Republic Of (Presenter) Nothing to Disclose
Ji Won Lee, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate any association between tumor apparent diffusion coefficient (ADC) values and axillary node metastasis in early-stage breast cancer.

METHOD AND MATERIALS
The institutional review board approved this retrospective study, and waived the need for informed consent. Between May 2013 and November 2014, the records of 270 patients (mean age, 51.3 years; range, 23-85 years) with stages T1 and T2 breast cancer (mean tumor size, 2.2 cm; range, 0.5-5.0 cm) who underwent preoperative breast magnetic resonance imaging, including diffusion-weighted (DW) imaging with b values of 0 and 1,000 s/mm² were reviewed. The ADC values of the breast tumors were measured and compared with clinicopathological variables. Receiver operating characteristic (ROC) curve and multivariate regression analyses were used to test the predictive power of the tumor ADC values with regard to axillary node metastasis.

RESULTS
Of the 270 patients, 58 (21.5%) experienced axillary lymph node metastasis. The mean tumor ADC values were significantly lower in patients with axillary node metastasis versus those without metastasis (0.880×10⁻³ vs. 0.999×10⁻³ mm²/s; P < 0.001). A ROC curve demonstrated a tumor ADC value of 0.991×10⁻³ mm²/s to be the optimal cut-off for predicting axillary node metastasis. Multivariate regression analysis revealed that lower tumor ADC value (≤ 0.991×10⁻³ mm²/s; adjusted odds ratio (OR) = 5.861, P < 0.001) was an independent variable associated with axillary node metastasis, along with large tumor size (> 2 cm; adjusted OR = 3.156, P = 0.002) and presence of lymphovascular invasion (adjusted OR = 4.125, P < 0.001). When tumor ADC value was added to known risk factors (i.e., tumor size and lymphovascular invasion) a significant improvement in the accuracy of risk prediction for axillary node metastasis was shown (c-statistic = 0.758 vs. 0.816, P = 0.026).

CONCLUSION
Tumor ADC values obtained at DW imaging may be an independent predictive factor for axillary lymph node metastasis in patients with early-stage breast cancer.

CLINICAL RELEVANCE/APPLICATION
In early-stage breast cancer, tumor ADC values may be a predictor of axillary node metastasis, which may assist selection of therapeutic strategies regarding management of axillary nodes.
**PURPOSE**

The transluminal attenuation gradient (TAG), the gradient of intraluminal radiological attenuation, is a novel index that improves the classification of coronary artery stenosis in coronary CT angiography (CCTA). However, the quantitative TAG value affected by the scan timing after the injection of contrast material because it is calculated from the difference between the pre- and post-stenosis CT numbers. Using a flow phantom and a 320-MDCT volume scanner we investigated the quantitative TAG value at different scan timing points after contrast material injection for coronary CT angiography.

**METHOD AND MATERIALS**

Using a contrast-material flow phantom we performed one-volume scans on a 320-MDCT volume scanner (Aquilion ONE ViSION, Toshiba). We employed two types of connecting tubes mimicking 0% and 70% stenosis. The heart rate (HR) was set at 60 bpm, cardiac output at 2.0 and 4.0 l/min; the injection volume of contrast material was 40 ml delivered in the course of 10 sec. Flushing was with 20 ml of physiological saline. The tube voltage and rotation time were 120 kVp and 275 msec. Acquisition of the 80-mm coverage area (160 x 0.5 mm) along the z-axis was started 5.0 sec post-injection and repeated at 0.5 sec intervals for 40 sec with no table movement. We measured the CT numbers on the same slice level and calculated the time density curve (TDC) for 40 sec at 0.5-sec intervals. The TAG value was also calculated from the difference in the CT number obtained at 0% and 70% stenosis at each time point.

**RESULTS**

At 70% stenosis and a cardiac output of 2.0 l/min, the time to peak enhancement (PE) from the arrival time was 15.5 sec. In contrast, the time from the arrival time for the lowest TAG value was 6.5 sec at -6.6 Hounsfield units (HU)/cm, i.e. 9.0 sec earlier from the time to PE. At the same time point of 6.5 sec from the arrival time, The TAG value at 0% stenosis was -1.4 HU/cm. At 70% stenosis and a cardiac output of 4.0 l/min, the time for the lowest TAG was 6.0 sec earlier and the TAG value was -4.0 HU/cm; it was -1.7 HU/cm at 0% stenosis.

**CONCLUSION**

The TAG value depends on the scan timing after contrast material injection and optimal scan timing dose not correspond to the time to peak enhancement.

**CLINICAL RELEVANCE/APPLICATION**

The time to PE differs by 6.0-9.0 sec when the TAG value is obtained with optimal scan timing on a 320-MDCT volume scanner.
Amir K. Durrani, MD, St Louis, MO

**Participants**

H-MRS may be useful for noninvasively evaluating HF patients post-acute hospitalization. We believe that metabolic imaging for measurement of myocardial UFA content by nuclear medicine and its correlates with LV mass and, to a lesser degree, cardiac output. We found a higher level of UFA in the low LVEF group compared to the normal LVEF group. Myocardial UFA was strongly correlated with LVEDV, LV mass index (BMI, 20-25 kg/m2) who were randomly assigned into 2 groups. The scan protocol for group 1 was 100kVp, 600mAs with 70mll contrast medium at an injection rate of 4.5 to 5.5mll/s, and images were reconstructed by a hybrid iterative reconstruction technique (IDose4, Philips Healthcare), while the protocol for group 2 was 80kVp, 600mAs with 35ml contrast medium at an injection rate of 3.5 to 4.5mll/s, and images were reconstructed with IMR. The mean image noise and CNR of different groups were measured on CT images and compared using the paired-t test. In addition, image quality evaluation was performed by two radiologists who were blinded to scan protocol, using a five-point scale (1 [poor] to 5 [excellent]). The results of the two groups were compared between two groups with the Mann-Whitney U-test.

**RESULTS**

Compared to group 1, group 2 reduced the iodine delivery rate by 52.4% from 2.1±0.5 g/s to 1.0±0.5 g/s and the effective radiation dose by 56.4% from 5.5±1.4 mSv to 2.4±1.2mSv. The mean CT attenuation, CNRs and image quality of all segments on group 2 were significantly improved compared to those on group 2 (all, p<0.01).

**CONCLUSION**

By using knowledge based iterative reconstruction technique, an ultra-low tube voltage combined with low contrast medium protocol for cCTA can reduce both radiation dose and contrast medium dose with even better image quality.

**CLINICAL RELEVANCE/APPLICATION**

The use of 80kV-IMR with low injection dose protocols offers even lower image noise and better image quality especially of distal segments despite a 56.4% radiation dose reduction and a 52.4% contrast medium dose reduction when compared to 100kV-HIR with standard injection dose protocols on non-obese patients.

**SSSQ02-03**

**Myocardial Triglyceride and Left Ventricular Systolic Function: A Cross-Sectional CMR Study in Post-Acute Hospitalization Heart Failure Patients**

**Thursday, Dec. 3 11:00AM - 11:10AM Location: SS02AB**

**Participants**

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**PURPOSE**

Myocardial triglyceride (TG) is related to increased risk of heart disease. However, its relation with cardiac function in recovery status of acute heart failure (HF) has not been investigated. We aim to study the association between myocardial TG content measured on magnetic resonance spectroscopy (1H-MRS) and left ventricular (LV) function revealed on cardiac MR (CMR) in post-acute hospitalization HF patients.

**METHOD AND MATERIALS**

We enrolled 50 HF patients discharged from acute hospitalization 6-12 month ago and recruited 21 age- and gender-matched normal controls. Myocardial TG content and left ventricular (LV) function and LV mass were measured by using a 3.0 T MR system. Myocardial TG resonances, comprising fatty acid (FA) and unsaturated fatty acid (UFA), were analyzed and normalized with water (W) signal by using the LC-Model algorithm. According to their LV ejection fraction (LVEF) at the time of CMR examination, our patients were dichotomized into the low LVEF group (LVEF < 50%) and the normal LVEF group (LVEF >= 50%).

**RESULTS**

There were 48 patients and 21 controls with successful 1H-MRS available for analysis. Among our 48 patients, 25 had their low LVEF (mean, 31.2%) while the other 23 had normal LVEF (mean, 60.2%). Myocardial UFA/W, but no TG/W or FA/W, showed significant differences among the low LVEF group, the normal LVEF group and the control group (7.9% vs 2.1% vs 1.4%, p = 0.02). Myocardial UFA/TG was strongly correlated with LV mass (r = 0.39, p < 0.001) and marginally correlated with LV end-diastolic volume (LVEDV) (r = 0.24, p = 0.039), while myocardial FA/TG was negatively correlated with LV mass (r = -0.39, p < 0.001) and LVEDV (r = -0.24, p = 0.039).

**CONCLUSION**

Increased myocardial UFA was observed in post-acute hospitalization HF patients as compared with controls, with a significantly higher level of UFA in the low LVEF group than in the normal LVEF group. Myocardial UFA was strong correlated with LVEDV, LV mass and, to a lesser degree, cardiac output. We believe that metabolic imaging for measurement of myocardial UFA content by 1H-MRS may be useful for noninvasively evaluation for HF patients post-acute hospitalization.

**SSSQ02-04**

**13N-ammonia PET/MR Myocardial Stress Perfusion Imaging Early Experience**

**Thursday, Dec. 3 11:00AM - 11:10AM Location: SS02AB**

**Participants**

Amir K. Durrani, MD, St Louis, MO (Presenter) Nothing to Disclose
Doppler-Ultrasound in Comparison to Electrocardiogram and Pulse Oximetry for Gating Cardiac MRI at 3T

Thursday, Dec. 3 11:10AM - 11:20AM Location: S502AB

Participants
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Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Bjoern Schoenagel, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Electrocardiogram (ECG) triggering for cardiac magnetic resonance (CMR) may be influenced by magnetic interferences with increasing magnetic field strength. Doppler Ultrasound (DUS) is not objected to magneto-hydro-dynamic effects (MHD) and does not interact with the electromagnetic field of the MRI. The purpose of this study was to evaluate the performance of Doppler ultrasound (DUS) as a trigger technique for CMR in comparison to ECG and pulse oximetry (POX) at 3 Tesla.

METHOD AND MATERIALS
Balanced Turbo Field Echo 2D short axis cine CMR and 2D phase-contrast angiography of the ascending aorta was performed in 11 healthy volunteers using ECG, DUS and POX for CMR. The E-wave in early diastole was selected for DUS trigger time points to obtain a marker for quiescent heart phases which were subsequently compared to quiescent heart phases determined manually based on ECG triggered cine images by two observer. Trigger signals were recorded simultaneously in reference to standard ECG trigger signals and compared in terms of trigger quality. Image quality was assessed by endocardial border sharpness (EB) and functional assessment in terms of LV volumetry and aortic blood flow velocimetry.

RESULTS
The mean sensitivity of trigger recognition for all sequences was similar between DUS (99±1%), ECG (99±1%) and POX (99±1%). DUS trigger points correlated strong with manually determined cardiac quiescence (R=0.9, Obs. 1; R=0.9, Obs. 2). Mean EB averaged over the entire cardiac cycle was similar for ECG, DUS and POX with no significant differences (pECG/DUS = 0.6; pECG/POX = 0.5; pDUS/POX = 0.8). Early diastolic EB was significantly reduced for DUS compared to ECG (pECG/DUS = 0.007) and POX (pDUS/POX = 0.03), but not for ECG versus POX (pECG/POX = 0.3). Mean EDV (pECG/DUS = 0.8, pECG/POX = 0.7), ESV (pECG/DUS = 0.9, pECG/POX = 0.6) and mean aortic velocity (pECG/DUS = 0.6, pECG/POX = 0.6) were not significantly different.

CONCLUSION
This study demonstrated the feasibility of DUS for gating human CMR at 3T. With the benefit of not being influenced by
**CLINICAL RELEVANCE/APPLICATION**

Doppler ultrasound measures physiological motion of the heart rather than electrical activation and, hence, may enable a more accurate gating, especially for higher field strength.

**SSQ02-06 Hybrid Cardiac 18F-FDG PET/MRI in Patients with Suspected Myocarditis**

Thursday, Dec. 3 11:20AM - 11:30AM Location: S502AB

**Awards**

RSNA Country Presents Travel Award

**Participants**

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**PURPOSE**

To evaluate the diagnostic performance of hybrid 18F-FDG PET/MRI in comparison to late gadolinium-enhancement (LGE) and T2-weighted imaging in patients with suspected myocarditis.

**METHOD AND MATERIALS**

A total of 60 consecutive patients (24 female, age: 35±13 y) with suspected myocarditis were prospectively assessed using integrated cardiac 18F-FDG PET/MRI (mMR Biograph, Siemens Healthcare). The MR imaging protocol consisted of functional cine images, T2-weighted triple inversion recovery images and LGE images 10 minutes after injection of gadobutrol. PET data acquisition was performed simultaneously to MR imaging. Physiological glucose uptake in the myocardium was suppressed with a high-fat, low-carbohydrate diet and i.v. administration of unfractionated heparin. Consent diagnosis by three experienced cardiologists, who were blinded to PET/MR data, was used as standard of reference.

**RESULTS**

PET/MRI examination was successful in 50 of 60 enrolled patients: 2 patients were excluded due to incomplete PET/MRI examinations because of claustrophobia, 8 patients were excluded due to failed inhibition of physiological myocardial glucose uptake. No significant difference in left ventricular ejection fraction was found between patients with clinical evident myocarditis and those clinically diagnosed as not having myocarditis (59.2±7.2% vs. 60.3±12.8%, p=0.298, n=50). Sensitivity and specificity of LGE for the detection of clinically evident myocarditis were 71% and 88% (80% accuracy). Sensitivity and specificity of T2-weighted images for the detection of clinically evident myocarditis were 58% and 88% (74% accuracy). Sensitivity and specificity of PET for the detection of clinically evident myocarditis were 75% and 88% (82% accuracy). Odd ratios for the detection of myocarditis were 5.5 for LGE, 5.0 for T2-weighted imaging and 7.0 for PET. Of all combinations, the best diagnostic performance was obtained when at least one of three parameters (LGE, T2, PET) was positive in the same patient yielding 92% sensitivity, 81% specificity, and 86% diagnostic accuracy.

**CONCLUSION**

Hybrid 18F-FDG PET/MRI can improve the non-invasive diagnosis in patients with suspected myocarditis.

**SSQ02-07 Correlating Corrected Coronary Opacification Gradients to PET Myocardial Perfusion: CT Angiography in Functional Assessment of Coronary Lesions**

Thursday, Dec. 3 11:30AM - 11:40AM Location: S502AB

**Participants**

Leonid Chepelev, MD, PhD, Ottawa, ON (Presenter) Nothing to Disclose
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Frank J. Rybicki III, MD, PhD, Ottawa, ON (Abstract Co-Author) Research Grant, Toshiba Corporation;

**PURPOSE**

To explore the potential use of corrected coronary opacification (CCO) gradients in predicting functional severity of coronary artery disease as assessed by PET myocardial perfusion imaging.

**METHOD AND MATERIALS**

We retrospectively evaluated 42 consecutive patients who underwent CCTA and 82Rb PET MPI within 180 days of each other. CCO was defined as mean coronary intraluminal attenuation normalized to mean aortic attenuation within the same axial slice. Coronary artery geometries and corresponding CCO measurements were automatically derived based on expert vessel centerline annotations with a 1.5mm diameter cutoff and fused with PET perfusion polar maps using software developed by our group in Java and MATLAB. CCO gradients, corrected and uncorrected by coronary artery diameter, were measured in the distal, proximal, and entire coronary arteries and corresponding CCO measurements were automatically derived based on expert vessel centerline annotations.
arteries, excluding non-diagnostic, calcified, stenotic, and stented regions. The CCO gradients were correlated to PET myocardial perfusion in the immediate vessel vicinity and projected perfusion territory of a given vessel.

**RESULTS**

The maximal Pearson correlation coefficients were observed when considering distal 40% vessel segments and immediately adjacent (±30 degrees on polar map) perfusion territories while omitting calcific and stenotic vessel regions. For the correlation between CCO and PET myocardial perfusion in the immediate vicinity, this yielded absolute Pearson correlation coefficients of 0.71±0.18, 0.70±0.25, and 0.80±0.23 for LAD, LCX, and RCA respectively. Correction of CCO by vessel diameter at the distal 40% vessel segments yielded coefficients that were not significantly different: 0.70±0.20, 0.70±0.24, and 0.80±0.22, respectively.

**CONCLUSION**

The correlation between CCO gradients and PET MPI data supports their use in functional lesion assessment.

**CLINICAL RELEVANCE/APPLICATION**

Corrected coronary opacification gradients may supplement functional assessment of coronary artery lesions and potentially predict the functional status of the myocardium using existing CCTA data.

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**SSQ02-08**  
Quantitative Assessment of Diffuse Myocardial Fibrosis in Patients with Diabetic Cardiomyopathy by T1-Mapping: Correlates with Diabetic History

**Participants**
- Xiao-Chun Zhang, Chongqing, China (Presenter) Nothing to Disclose
- Shang Yongning, Chongqing, China (Abstract Co-Author) Nothing to Disclose
- Jun Zhao, Chongqing, China (Abstract Co-Author) Nothing to Disclose
- Tianjing Zhang, Beijing, China (Abstract Co-Author) Employee, Siemens AG
- Jian Wang, Chongqing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The purpose of this study was to use cardiac magnetic resonance (CMR) T1-mapping technique to evaluate diffuse myocardial fibrosis and to explore its relationship with diabetic history.

**METHOD AND MATERIALS**

Thirty three patients with diabetic cardiomyopathy (DCM) (16 men, 17 women, mean age 46±8 years) and 48 healthy controls were performed in Siemens Trio 3.0T, the WIP sequence. T1 Mapping was used for measurement of T1 values, ECV values were calculated from pre and post T1 values. The results' correlation with patients' diabetic history were analyzed as well.

**RESULTS**

Pre-contrast myocardial T1 time and myocardial extracellular volume (ECV) in patients with DCM was significantly higher than the measurement in control cases, and post-contrast myocardial T1 time in DCM patients was significantly lower than that in control cases (p<0.001, respectively). In DCM patients, diabetic history was correlated with pre-contrast T1, ECV and post--contrast T1 (r=0.92, 0.95 and -0.93, respectively. p<0.001).

**CONCLUSION**

Diffuse myocardial fibrosis in patients with DCM can be assessed by CMR T1-mapping. The study results demonstrate that increased diabetic history is likely to be a major contributor to the severity of diffuse myocardial fibrosis.

**CLINICAL RELEVANCE/APPLICATION**

As a new imaging modality, CMR T1-mapping can provide four dimensional data to quantitatively assess the severity of diffuse myocardial fibrosis in DCM patients, which is useful for the clinical decision.

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**SSQ02-09**  
Rate of Incidental Findings at Myocardial Perfusion Scintigraphy

**Participants**
- Andrea O. Vergara Finger, MD, Burlington, VT (Presenter) Nothing to Disclose
- Sean Reynolds, MD, Burlington, VT (Abstract Co-Author) Nothing to Disclose
- Janusz K. Kikut, MD, Burlington, VT (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The SNMMI/ASNC/SCCT consensus guidelines on cardiac SPECT/CT and PET/CT advocate for reporting of incidental findings (IF) noted on PET/CT and SPECT/CT and SPECT cardiac imaging. However, the definition of a reportable incidental finding is left to the discretion of the interpreting physician. The incidence of IF is reported at 34% in the literature; however, the incidence of clinically important findings is significantly lower, reported as around 5%. However, image quality is often quite different between SPECT/CT and PET/CT with image quality substantially better for the latter. We retrospectively evaluated the rate of IF defined as an unknown or potentially unknown new diagnosis and compared the rate in SPECT/CT as compared to PET/CT to see if the improved image quality available at PET/CT affected the IF rate.

**METHOD AND MATERIALS**

A total of 10,520 Sestamibi SPECT/CT and Rb-82 PET/CT cardiac studies performed at our institution in from 2011-2014 were retrospectively evaluated by querying the dedicated IF field of a NM structured reporting database (Vericis, Merge Healthcare, Chicago, IL). All IF were evaluated by ABR certified readers. Only significant findings as determined by the interpreting radiologist were placed into the field. IF were categorized into those seen on the emission scan and those seen on CT.

**RESULTS**
IF were discovered on 370 (3.5%) of studies. Of these, 9 (0.08%) were noted on the emission scan, while 362 (3.4%) were noted on the CT. The rate on Sestamibi SPECT/CT was 166/9446 (1.7%) while the rate on Rb-82 PET was 204/1074 (19.0%).

CONCLUSION

IF considered significant by the interpreting radiologist are more prevalent in our practice than previously reported especially when CT quality approaches diagnostic quality as with PET/CT. On hybrid imaging, they are more common on the CT portion of the study than on the emission scan. This underscores the recommendation for reporting these findings and argues for having physicians familiar with conventional CT imaging interpret the CT portion of hybrid imaging studies.

CLINICAL RELEVANCE/APPLICATION

The majority of IF at hybrid cardiac imaging appear on CT, arguing for having interpreters experienced in conventional CT review the CT portion of the study.
**SSQ03-02 The Impact of Iterative Reconstruction on Detectability and Quantification of Calcifications in CT Coronary Calcium Scoring: Individual Lesion-by-lesion Comparison**

**Participants**
André J. Duerinckx, MD, PhD, Washington, DC (Moderator) Nothing to Disclose
James C. Carr, MD, Chicago, IL (Moderator) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

**METHOD AND MATERIALS**
The study included 101 consecutive patients who underwent non-contrast-enhanced ECG-triggered cardiac CT for CAC scoring (256-detector row CT, 120 kVp, 55 mAs). Five series with 3 mm slice thickness were reconstructed for each CT: one with FBP and four with increasing IR levels (iDose4 L1, L3, L5, L7). CAC lesions (>= 130 HU) in the FBP series were identified by an expert and matching lesions in the IR series were identified at corresponding locations. Calcium volume (in mm³) and calcium mass (in mg) of matching lesions in different series were compared. The Friedman test (significance level P < 0.05) was used to analyze overall differences among series. The Wilcoxon signed-rank test with Bonferroni correction (significance level P < 0.007) was used to analyze pairwise differences between series.

**RESULTS**
The FBP series contained 416 CAC lesions with median (interquartile range) volume 16.0 (5.6-41.1) mm³ and mass 3.3 (0.9-10.6) mg. Out of these, 14 (3%), 25 (6%), 35 (8%) and 42 (10%) lesions with volume/mass below 2.4 mm³/0.4 mg, 4.7 mm³/0.8 mg, 4.7 mm³/0.8 mg, and 6.3 mm³/0.9 mg were identified in the FBP series but not in the L1, L3, L5 and L7 series, respectively. For lesions identified in all series, calcium volume and mass differed significantly among series (P < 0.05). A significant reduction in calcium volume and mass was present between the FBP series and each IR series (P < 0.007), as well as between series with increasing IR levels (P < 0.007).

**CONCLUSION**
IR causes significant reductions in volume and mass of CAC lesions. Small low-density lesions are increasingly likely to be missed in CAC scoring when higher IR levels are used.

**CLINICAL RELEVANCE/APPLICATION**
CAC scoring in IR CT may underestimate cardiovascular risk, especially in patients with small low-density CAC lesions.

**SSQ03-03 In vivo Coronary Artery Plaque Assessment with Computed Tomography Angiography – Is There an Impact of Iterative Reconstruction on Plaque Volume and Attenuation Metrics?**

**Participants**
Zhongyi Chen, Montreal, QC (Presenter) Nothing to Disclose
Irina Boldeanu, Montreal, QC (Abstract Co-Author) Nothing to Disclose
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Claude Kauffmann, PhD, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Gilles P. Soulez, MD, Montreal, QC (Abstract Co-Author) Speaker, Bracco Group Speaker, Siemens AG Research Grant, Siemens AG Research Grant, Bracco Group Research Grant, Cook Group Incorporated Research Grant, Object Research Systems Inc
Coronary computed tomography (CT) angiography allows to evaluate coronary plaque characteristics, such as low attenuation (lipid-filled) component, and can impact on plaque vulnerability assessment and patient prognostication. The objective of the study is to determine the effect of iterative reconstruction (IR) on coronary plaque volume and composition assessment.

Approval was obtained from Institutional Review Board and written consent from all subjects. Asymptomatic patients without known coronary artery disease were prospectively enroled for low-dose 256-slice CT. Images were reconstructed with both filtered back projection (FBP) and hybrid IR algorithm (iDose4, Philips) levels 1, 3, 5 and 7 (noise reduction 11, 23, 37, 56%, respectively). Noise, signal-to-noise (SNR) and contrast-to-noise ratio (CNR) in aorta and coronary arteries were measured. Coronary plaques were assessed using a Hounsfield unit (HU)-mapping method, according to five intervals: <51 HU, 51-100 HU, 101-150 HU, 151-350 HU and >350 HU. For each plaque, total absolute volume, absolute and percentage HU-interval volumes were calculated. ANOVA repeated-measure analyses were used.

Fifty-three patients (mean age 53.6 yo) were included. In comparison to FBP, IR reduced image noise ad 53%, increased SNR ad 111% and CNR ad 99% (p<0.0005, respectively). Plaque characterization performed in 35 patients for a total of 96 plaques showed a mean total plaque volume of 99.1±116.3 to 100.2±117.6 mm3 across all IR levels and FBP (p=0.628). In per-HU-interval analysis within the 101-150 HU interval, absolute plaque volume showed slight differences between FBP (11.7±12.6 mm3) and IR level 7 (10.8±11.7 mm3) (p=0.03) and between IR levels 5 (11.4±12.8 mm3) and 7 (p=0.03). For percentage volume, a slight difference was observed within the 101-150 HU interval between FBP (12.6±5.1%) and IR level 7 (11.9±4.8%) (p=0.04). Absolute and percentage plaque volume was similar across other IR levels and HU-intervals.

Total coronary plaque volume measured at all IR noise reduction levels was similar to FBP. Plaque volumetric assessment in low HU-interval domains was slightly affected at high IR levels.

Total coronary plaque volume with IR is similar to FBP. However low attenuation plaque volume, a marker for plaque vulnerability, is slightly modified at high IR levels.

Anderson Fabry disease (AFD) is a rare intracellular lipid disorder which can lead to LV-hypertrophy and myocardial fibrosis. We propose that besides late gadolinium enhancement (LGE), T1-mapping is a promising diagnostic tool in AFD allowing an early detection of cardiac involvement. Furthermore we suggest, that MRI findings correlate with serum biomarkers indicating myocardial damage.

46 patients (20 LGE positive [group 1], 26 LGE negative [group 2]) with manifest AFD were examined. In addition, 28 healthy subjects were examined as a reference [group 3]. T1-mapping was performed with a modified Look-Locker IR sequence (MOLLI) at a 3T MR-scanner after i.v. gadolinium administration. Results were derived from 8 slices moving continuously from basal to apical. Separate ROIs were drawn in the anterior, inferior, septal, lateral and inferolateral wall. In addition, an average value from the entire myocardial ring (SAX) was acquired for each slice. Absolute T1 values were compared in between those three groups. In addition, T1 values of the patient groups were correlated with the biochemical markers NT-proBNP, Troponin T and lyso-Gb3.

Final results show visible changes in the T1-maps wherever fibrosis in the LGE imaging was observed. Absolute T1 values for several ROIs were significantly lower in group 1 compared to group 2 and 3 (inferolateral wall: p<0.01; others: p<0.05), even in areas where no fibrosis was detected by LGE imaging (anterior and septal wall). T1 mapping was not able to distinguish between LGE-negative patients and healthy controls. NT-proBNP and Troponin T levels were significantly higher in group 1 compared to group 2 (p=0.01). Lyso-Gb3 serum levels were elevated in 100% [group 1] and 86% [group 2] of patients, there was no significant difference in lyso-Gb3 values in between those groups.

Our data suggest that T1-mapping is a sensitive tool to detect early replacement fibrosis in AFD, and might be more sensitive than visual LGE analysis in the detection of regional myocardial involvement. Elevated levels of Troponin T and NT-proBNP indicate myocardial involvement and correlate with findings in cardiac MRI.

T1 mapping may be useful to identify AFD patients with myocardial involvement. This method could be especially useful in follow up as it offers the possibility to absolutely quantify the extent of fibrosis and monitor therapy effects.
Angiography (CCTA): Effect on Image Quality

SSQ03-05

Image Quality of Cardiac Magnetic Resonance Imaging in Patients with an ICD System Designed for the MRI Environment

Thursday, Dec. 3 11:10AM - 11:20AM Location: SS04CD

Participants
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Juerg Schwitter, MD, Lausanne, Switzerland (Abstract Co-Author) Research Consultant, Medtronic, Inc

PURPOSE
To evaluate the image quality performance of various cardiac MR pulse sequences in a clinical trial of patients (pts) implanted with an MR-conditional ICD system.

METHOD AND MATERIALS
The Evera MRI randomized clinical trial enrolled 275 pts from 42 centers worldwide. 263 pts were implanted with an Evera MRI single or dual chamber ICD and randomized to the MRI group (n=175) or control group (n=88). Per protocol 156 MRI pts underwent an MRI examination at 9-12 weeks post implant. Steady-state free precession (SSFP) and fast gradient echo (FGE) sequences were acquired each in short-axis (SA) and horizontal long axis (HLA) views to optimize image quality. Acquisitions with correct slice orientations on both, SA and HLA of at least one sequence type were graded for image quality using a 7-point scale (grade 1: excellent image quality, grade 6-7: non-diagnostic quality). Grades were analyzed by Generalize Estimating Equation. Presence and size of ICD- and lead-related artifacts were evaluated.

RESULTS
Complete cardiac MR data were obtained in 104 pts for SSFP covering the left ventricle (LV), in 89 pts for FGE on LV, in 103 pts for SSFP on the right ventricle (RV), and in 76 for FGE on the RV. The corresponding proportions of diagnostic image quality (grades 1-5) were 53% (55/104), 74% (66/89), 69% (71/103) and 84% (83/103), respectively. In 107 pts at least one evaluable sequence was obtained. The odds of having a better image quality (i.e. a lower grade) was greater for RV vs LV (OR: 1.8, 95% CI: 1.5-2.2, p<0.0001, regardless of sequence type) and greater for FGE vs SSFP (OR: 3.4, 95% CI: 2.5-4.7, p<0.0001, regardless of ventricle type). Compared to SSFP, the ICD-related artifacts on FGE were smaller (141.0±65 vs 75.3±56.7 mm, respectively, p<0.0001) irrespective of imaging plane. Lead artifacts were much smaller than ICD artifacts (p<0.0001); differences in lead artifact diameters between SSFP (8.3±3.3 mm) and FGE (10.2±3.2 mm) were small, but statistically significant (p<0.0001).

CONCLUSION
FGE produces better quality and smaller artifacts for cardiac MRI than SSFP in pts with an MRI ICD system. Diagnostic image quality is obtainable with FGE in 74% and 84% of studies of the LV and RV, respectively.

CLINICAL RELEVANCE/APPLICATION
Diagnostic image quality of cardiac MRI cine scans in patients with an ICD system designed for the MRI environment can be obtained in the majority of cases using fast gradient echo sequences.

SSQ03-06

Advanced Modelled Iterative Reconstruction (ADMIRE) in Coronary Computed Tomography Angiography (CCTA): Effect on Image Quality

Thursday, Dec. 3 11:20AM - 11:30AM Location: SS04CD

Participants
Christina Kolb, Dresden, Germany (Presenter) Nothing to Disclose
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Michael Laniado, MD, Dresden, Germany (Abstract Co-Author) Reviewer, Johnson & Johnson
Ruth Strasser, 01307 Dresden, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose is to assess the effect of ADMIRE on image quality in CCTA.

METHOD AND MATERIALS
30 patients who underwent CCTA on a third generation dual source CT scanner were included in this retrospective study. CCTA datasets were reconstructed using filtered back projection (FBP) and increasing strength levels of ADMIRE 1-5. The signal-to-noise ratio (SNR) in the ascending aorta and the proximal part of both coronary arteries were determined for each data set. Furthermore, a qualitative evaluation of image quality was undertaken independently by two readers using a five-point scale. Repeated measures analysis of variance was used to compare SNR for different modes of image reconstruction. The Friedman test was applied to compare image quality scores.
RESULTS
CCTA was performed successfully in all patients. In the ascending aorta, mean SNR (± SD) was 11.5 (± 4.3) in FBP, 12.9 (± 4.9) in ADMIRE 1, 14.5 (± 5.7) in ADMIRE 2, 16.3 (± 6.3) in ADMIRE 3, 19.4 (± 7.7) in ADMIRE 4 and 23.6 (± 10.6) in ADMIRE 5. In the proximal right coronary artery, mean SNR (± SD) was 13.2 (± 6.1) in FBP, 15.4 (± 7.0) in ADMIRE 1, 17.5 (± 7.9) in ADMIRE 2, 21.3 (± 10.5) in ADMIRE 3, 24.6 (± 12.3) in ADMIRE 4 and 30.1 (± 16.4) in ADMIRE 5. In the left main coronary artery, mean SNR was 11.7 (± 4.7) in FBP, 13.5 (± 5.8) in ADMIRE 1, 15.3 (± 6.4) in ADMIRE 2, 17.5 (± 7.1) in ADMIRE 3, 20.7 (± 8.2) in ADMIRE 4 and 25.1 (± 10.2) in ADMIRE 5. In the ascending aorta, the proximal RCA and the left main, higher strength levels of iterative reconstruction showed significantly higher SNR in comparison to all lower strength levels and FBP (p < 0.001 in all cases). Image quality scores improved significantly from FBP to ADMIRE 4 (p < 0.05) with each successive level of iterative reconstruction strength. However, image quality scores did not differ significantly between ADMIRE 4 and 5 datasets (p > 0.05).

CONCLUSION
ADMIRE significantly improves image quality in CCTA, both in regard to SNR and qualitative scores. However, as there was no significant difference between ADMIRE 4 and 5 for subjective image quality, this high strength levels can be used interchangeably, depending on the preference of the respective radiologist. As a consequence of our results, further dose reduction seems to be feasible in CCTA.

CLINICAL RELEVANCE/APPLICATION
As ADMIRE improves image quality compared to FBP, the use of ADMIRE has the potential for further reduction of CCTA radiation exposure while retaining adequate image quality.

SSQ03-07 Qualitative and Quantitative Evaluation of Myocardial Alterations by Grating-Based Phase-Contrast Computed Tomography
Thursday, Dec. 3 11:30AM - 11:40AM Location: S504CD

Participants
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Maximilian F. Reiser, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Tobias Saam, MD, Munich, Germany (Abstract Co-Author) Research Grant, Diamed Medizintechnik GmbH; Research Grant, Pfizer Inc

PURPOSE
Grating-based phase-contrast computed tomography (gb-PCCT) relies on X-ray refraction rather than absorption to generate high-contrast images in biological soft tissue. The aim was to evaluate the potential of gb-PCCT for the depiction of structural changes in different cardiomyopathies.

METHOD AND MATERIALS
Samples of four human heart specimens from patients with hypertensive, ischemic and dilated cardiomyopathy and cardiac lipomatosis were examined. The gb-PCCT set-up consists of X-ray tube (40 kV, 70 mA), grating-interferometer and detector and allows the calculation of phase- and absorption-contrast data. Normal myocardium, fibrotic scars, diffuse interstitial fibrosis and fatty tissue were evaluated by visual inspection and quantitative absorption- and phase-contrast Hounsfield units (HUabs and HUp, respectively). Histopathology served as standard of reference. Measurements of diagnostic accuracy including sensitivity and specificity were calculated. Systematic differences in HUabs and HUp were assessed by ANOVA.

RESULTS
A total of 35 corresponding gb-PCCT and histopathology cross-sections were available. Normal myocardium was found in 35 (100%), fibrotic scars in 6 (17.1%), interstitial fibrosis in 7 (20%) and fatty tissue in 25 (71.4%) cross-sections and were accurately detected by gb-PCCT (sensitivity and specificity >90%). Mean HUp for normal myocardium, fibrotic scars, interstitial fibrosis and fatty tissue were 52.5, 86.6, 62.4 and -38.6. Corresponding mean HUabs were 54.1, 69.7, 62.3 and -258.9, respectively. We observed an overlap in HUabs for normal myocardium and interstitial fibrosis but not for HUp. Contrast-to-noise ratio was significantly higher in phase- than in absorption-contrast for myocardium/fat (32.7 vs. 7.2; p<0.01) and for myocardium/fibrotic scar (3.6 vs. 0.2; p<0.01).

CONCLUSION
Given its superior soft tissue contrast, gb-PCCT is able to depict structural changes in different cardiomyopathies, which can currently not be obtained by X-ray absorption based imaging methods.

CLINICAL RELEVANCE/APPLICATION
If current technical limitations can be overcome, gb-PCCT may evolve as a powerful tool for the anatomical assessment of cardiomyopathy.

SSQ03-08 Diagnostic Performance of Stress Perfusion Cardiovascular Magnetic Resonance with 1.5-T and 3-T Scanners in Comparison with Invasive Coronary Angiography
Thursday, Dec. 3 11:40AM - 11:50AM Location: S504CD

Participants
Sung Min Ko, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Intravascular attenuation modified the attenuation of coronary atherosclerotic plaques in our in vivo validation study. CLINICAL RELEVANCE/APPLICATION enhancement in subtraction CCTA may be helpful for the characterization of the plaques.

RESULTS
The ΔHU for the plaque and the lumen showed a strong correlation (r=0.62). There was no significant correlation between plaque attenuation on non-enhanced coronary artery images and luminal attenuation with and without contrast enhancement (r=0.14 and 0.2, respectively).

CONCLUSION
Intravascular attenuation modified the attenuation of coronary atherosclerotic plaques and CT images without coronary artery enhancement, were obtained to remove calcium from the images. The CT number of the plaque and the adjacent vessel lumen were measured in a circular region of interest (ROI) on curved planar reconstruction (CPR) images. The ROI setting was consistent between the two CT datasets. We performed linear regression analysis of the changes in the CT number (ΔHU) for the lumen and the plaque. We also evaluated the relationship between plaque attenuation on non-enhanced coronary artery images and luminal attenuation with and without contrast enhancement. The ΔHU for the plaque and the lumen showed a strong correlation (r=0.62). There was no significant correlation between plaque attenuation on non-enhanced coronary artery images and luminal attenuation with and without contrast enhancement (r=0.14 and 0.2, respectively).

CONCLUSION
Intravascular attenuation modified the attenuation of coronary atherosclerotic plaques and CT images without coronary artery enhancement in subtraction CCTA may be helpful for the characterization of the plaques.
PURPOSE
To compare the capability of pulmonary MR imaging with ultra-short echo time (UTE) for lung nodule detection and nodule type evaluation with thin-section low- and standard-dose CTs.

METHOD AND MATERIALS
170 consecutive patients (96 males: mean age, 70 years and 74 females: mean age, 70 years) with suspected pulmonary nodules at near-by hospital were examined with chest standard- and low-dose CTs (270 mA [SDCT] and 50 mA [LDCT]) and pulmonary MR imaging with UTE. According to standard-dose CT findings, all nodules were divided into solid and part-solid nodules and ground glass nodules. In each patient, probability of presence at each pulmonary nodule was assessed on all three methods by means of 5-point visual scoring system. To determine inter-observer and inter-method agreement for nodule detection, kappa statistics with χ² test were performed. Then, ROC analyses were performed to compare detection capability among all methods. Finally, detection rate was compared each other by means of McNemar's test. To determine inter-observer and inter-method agreement for nodule type evaluation on each method, kappa statistics with χ² test were also performed.

RESULTS
On nodule detection, inter-observer agreements on all methods (0.81<κ<0.85, p<0.0001) and inter-method agreement among all methods (0.87<κ<0.96, p<0.0001) were determined as almost perfect. Area under the curves (Azs) of all methods (SDCT: Az=0.97, LDCT: Az=0.96, MRI: Az=0.96) had no significant difference (p>0.05). In addition, detection rates of all three methods (SDCT: 92.0 [252/274] %, LDCT: 91.5 [247/270] %, and MRI: 91.5 [247/270] %) had also no significant difference (p>0.05). On nodule type assessment, inter-observer agreement of each method was almost perfect (0.87<κ<0.91, p<0.0001). In addition, inter-method agreements among all methods were also determined as almost perfect (0.81<κ<0.89, p<0.0001).

CONCLUSION
Pulmonary MR imaging with UTE is considered at least as valuable as low- and standard-dose CTs for lung nodule detection and nodule type evaluation.

CLINICAL RELEVANCE/APPLICATION
Pulmonary MR imaging with UTE is considered at least as valuable as low- and standard-dose CTs for lung nodule detection and nodule type evaluation.
To investigate the natural courses of persistent pulmonary subsolid nodules (SSNs) with solid parts ≤5mm and the clinico-radiological predictors for their interval growth over follow-ups.

METHOD AND MATERIALS
From 2005 to 2013, natural courses of 213 persistent SSNs detected on chest CT (slice thickness ≤1.25mm) in 213 patients (mean age, 57.88 ± 10.38 years; range, 24-87 years) were evaluated in this study (median follow-up, 849 days; range, 90-2900 days). To identify significant predictors for interval growth, Kaplan-Meier analysis and Cox proportional hazard regression analysis were performed.

RESULTS
One-hundred thirty-six were pure ground-glass nodules (GGNs) (growth in 18; stable in 118) and 77 part-solid GGNs with solid parts ≤5mm (growth in 24; stable in 53). For 213 SSNs, lung cancer history (Hazard ratio (HR), 3.884; p=0.001), part-solid GGNs (HR, 3.570; p<0.001), and nodule diameter (HR, 3.576; p<0.001) were significant predictors for interval growth. In subgroup analysis, nodule diameter was an independent predictor for interval growth of both pure GGNs (HR, 6.620; p<0.001), and part-solid GGNs (HR, 2.749; p=0.037). For part-solid GGNs, lung cancer history (HR, 5.917; p=0.002) was another significant predictor for interval growth. The frequency of interval growth of pure GGNs ≥10mm (12.9%, 30.4%; 42.0%, 42.0%, 71.0% at 1, 2, 3, 4, 5 year's follow-up) and part-solid GGNs ≥8mm (11.5%, 38.0%, 43.6%, 78.9%, 78.9%) was significantly higher than those of pure GGNs <10mm (1.9%, 4.0%, 10.9%, 13.5%, 13.5%) (p<0.001) and part-solid GGNs <8mm (11.5%, 21.5%, 21.5%, 21.5%, 21.5%) (p=0.003), respectively.

CONCLUSION
Natural course of SSNs with solid parts ≤5mm was significantly different regarding their nodule types and nodule diameters, with which their managements can be subdivided.

CLINICAL RELEVANCE/APPLICATION
Nodule type and nodule diameter are significant predictors for interval growth of SSNs with solid parts ≤5mm, and managements of SSNs with solid parts ≤5mm can be categorized based on these predictors.

SSQ04-03  Ground Glass Nodule Detectability in Seven observers of Seventy-nine Clinical Cases: Comparison between Ultra-Low-Dose Chest Digital Tomosynthesis with Iterative Reconstruction and Chest Radiography by Receiver-Operating Characteristics Analysis

Participants
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PURPOSE
To compare ground glass nodules detectability (GGND) between ultra-low-dose chest digital tomosynthesis (ULD-CDT) with 2 different reconstruction algorithms and chest radiography (CR) by using low-dose computed tomography (LDCT) as the standard of reference (SOR).

METHOD AND MATERIALS
The Institutional Review Board approved this study and written informed consent was obtained. In a single visit each, 79 subjects underwent ULD-CDT at 120kV and 10mA, CR both in posterior-anterior and lateral direction and LDCT (effective dose: 0.081, 0.117 and 3.52 mSv, respectively). In each of 79 cases, 63 reconstructed coronal images were obtained using CDT (SONIALVISION Safire 17 radiography/fluoroscopy system, Shimadzu, Kyoto, Japan) with and without iterative reconstruction (IR). SOR as to GGN presence with the longest diameter (LD) of 3mm or more was determined based on LDCT images by consensus reading of two radiologists. Receiver-operating characteristic (ROC) analysis and detection sensitivity (DS) was used to compare GGND of ULD-CDT with IR, ULD-CDT without IR and CR in total and subgroups classified by nodular LD (> or < 9mm) and CT attenuation value (CTAV) (> or < -600 Hounsfield of Unit (HU)). DS were also compared between any pairs of 4 sub-groups in each of three modalities using t-test.

RESULTS
For SOR, 105 GGNs were identified. The minimal and maximal LDs of GGN were 3.0 and 26 mm, respectively, with a mean LD of 8.56 mm. In total as well as any sub-group, GGND at ULD-CDT with IR was higher than either that at ULD-CDT without IR or CR, as area under ROC curve was 0.66 ± 0.02, 0.59 ± 0.01 and 0.52 ± 0.01, respectively (p < 0.05). DS at ULD-CDT with IR in more attenuated GGNs (CTAV >-600 HU) was higher than that in less attenuated GGNs (47.5 ± 8.1% vs 26.6 ± 6.7%) (p < 0.05). DS at ULD-CDT with IR in larger GGNs (LD > 9mm) was higher than that in smaller GGNs (44.6 ± 7.7% vs 22.1 ±5.4%) (p < 0.05).

CONCLUSION
ULD-CDT with IR demonstrated better GGND than that without IR or CR, with increased DS for larger or more attenuated GGNs.

CLINICAL RELEVANCE/APPLICATION
ULD-CDT with IR has a potential to be used for detection of larger and more attenuated GGN.
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PURPOSE
To compare the diagnostic performance of breath-hold lung MR imaging with that of low-dose CT from PET/CT in the detection of nodular lesions.

METHOD AND MATERIALS
We included 21 consecutive patients who underwent diagnostic CT, PET/CT, and MR of the whole lung from August 2014 to March 2015. MR images were acquired using Ingenia 3.0T MR (Philips) or the 3.0T MR part of Ingenuity TF PET/MR (Philips). The MR protocol consisted of T1-weighted image (T1WI) with 3D modified Dixon (mDixon) sequence, and black-blood fat-saturated T2-weighted image (FS-T2WI) with Half-Fourier Acquisition Single-shot Turbo Spin-echo (HASTE) sequence. Both were performed with breath-hold, and the mean scan duration was 21.2 s for T1WI and 14.5 s (two stations) for FS-T2WI. Low-dose CT was performed under free breathing. Diagnostic CT images were used as the reference standard. The location, number, size, and characterization (solid, pure, or mixed ground-grass opacity [GGOs]) of nodular lesions were recorded. Two radiologists reviewed the MR and CT images from PET/CT in consensus, with an interval of one week. Lesion-based sensitivity and lung lobe-based specificity were calculated. Statistical analyses were performed with McNemar test and Wilcoxon signed-rank test.

RESULTS
Overall sensitivity and specificity were 64.6% (31/48) and 96.9% (62/64) for MR, and 77.1% (37/48) and 82.8% (53/64) for low-dose CT, respectively. On the MR images, 76.9% (30/39) of nodules measuring ≥5 mm were pointed out, while only 11.1% (1/9) of nodules <5 mm were detected. For nodules ≥5 mm, detection rates were 81.5% (22/27) for solid lesions and 66.7% (8/12) for GGOs. The size of solid lesions on the MR images did not differ significantly from the reference group. On the other hand, mixed GGOs tended to appear smaller on T1WI, and pure GGOs were only visible on T2WI.

CONCLUSION
Breath-hold lung MR imaging with combined use of 3D mDixon T1WI and black blood FS-T2WI HASTE provides brief examination with acceptable diagnostic accuracy and could be feasible as a part of whole-body PET/MR hybrid imaging.

CLINICAL RELEVANCE/APPLICATION
Breath-hold lung MR imaging has fair sensitivity and good specificity to detect nodular lesions. In addition to previously reported T1WI, FS-T2WI might be necessary to accurately depict GGOs.
nODULES AT CHEST CT.

**CLINICAL RELEVANCE/APPLICATION**

In the pretreatment evaluation of non-small cell lung cancer detected as part-solid nodules at chest CT, additional imaging study with FDG-PET/CT is not necessary.

**SSQ04-06  Optimal Window Settings to Improve Visual Detection of Ground-glass Nodules (GGN) - Effect on Agreement and Time-to-detection**

Thursday, Dec. 3 11:20AM - 11:30AM Location: E351

**Participants**
Julia Alegria, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Claudio S. Silva Fuente-Alba, MD, MSc, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Daniela Barahona, MD, Santiago, Chile (*Presenter*) Nothing to Disclose

**PURPOSE**

To assess different window settings for visual detection of ground glass nodules (GGN), regarding inter-reader agreement for localization and diameter, measurement bias and time-to-detection (TTD).

**METHOD AND MATERIALS**

IRB approved retrospective study. Chest CT dataset with 40 GGN and 10 sets with no detectable nodules, was designed. After de-identification, all datasets were presented to two thoracic radiologists (acting as reference standard) and a fellow, independently, in four different reading sessions two weeks apart from each other, using IMPAX PACS viewers. Only axial slices were analysed, no MPR or MIP reconstructions were allowed. The settings assessed were Lung Window (W 1500 UH, L -500 UH), Emphysema Window (W 800 UH, L -800 UH), Inverted Lung Window and Inverted Emphysema Window. Location, maximum diameter and TTD were recorded for each nodule. Interreader agreement for localization was analyzed with Cohen's Kappa statistics with 95% CI, diameters agreement with Lin's correlation-concordance coefficient Rho 95%CI with average bias assessed with Bland-Altman with 95% limits of agreement (LOM).

**RESULTS**

High agreement was identified in all settings with Kappa values for Lung Window (LW) 0.71 (0.53-0.78), Emphysema Window (EW) 0.72 (0.63-0.82), Inverted Lung Window (ILW) 0.71 (0.62-0.74) and Inverted Emphysema Window (IEW) 0.79 (0.73-0.88). Lin's Rho ranged from 0.85 (0.78-0.92) in LW, 0.80 (0.72-0.89) in EW, 0.89 (0.84-0.95) in ILW and 0.92 (0.88-0.96) in IEW. Bland-Altman analysis showed average bias in mm (LOM) of -0.64 (-4.19 to 2.9) in LW, -0.69 (-4.91 to 3.52) in EW, -0.29 (-3.75 to 3.17) in ILW and 0.09 (-2.83 to 3.02) in IEW. Average TTD ranged from 21.3 sec in LW to 58.1 sec in ILW, and was significantly higher in all settings in the fellow's readings versus thoracic radiologists' (p<0.01), with a reduced TTD for both groups only in IEW (p<0.01).

**CONCLUSION**

IEW provides a visual setting with high reader agreement, measurements concordance with low measurement bias, and reduced TTD for GGN detection.

**CLINICAL RELEVANCE/APPLICATION**

IEW could be used as a visual aid for identifying GGN, in a similar fashion as MIP reconstructions assist in solid nodule detection.

**SSQ04-07  The Moment of Recognition: Method and Analysis of Gaze Behavior in the Search for Lung Nodules in CT Scans**

Thursday, Dec. 3 11:30AM - 11:40AM Location: E351

**Participants**
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Justus E. Roos, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Kingshuk Choudhury, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To understand the relationship between the distance from a reader’s gaze point to visible lung nodule and the momentary likelihood that the nodule will be recognized by the reader.

**METHOD AND MATERIALS**

Time-varying gaze paths were recorded while 13 radiologists interpreted 40 lung CT scans with between 3 and 5 synthetic nodules (5-mm diameter) embedded randomly within the lung parenchyma. Viewing conditions resulted in a 5° visual angle (approx. foveal limits) corresponding to a 100 pixel distance from the center of gaze. True positive (TP) gaze path segments, corresponding to all x, y, z gaze positions preceding each TP detection, were analyzed. The moment of recognition (MoR) was derived based upon analysis of gaze velocity and direction. Proceeding backwards in time from the reader’s confirmation of detection, the trajectory of the gaze path was analyzed for a distinct deviation of the gaze point toward the nodule. We modeled nodule recognition as a Markov process characterized by $R(d,z)$, the instantaneous probability of recognizing a nodule when the gaze is centered d pixels and z sections away from the target nodule.

**RESULTS**

$R(d)$ was a decreasing function of d for all readers that was well approximated by an exponential distribution. Across readers, $R(d)$ had a median(SD) of 84.43(3) and 90th percentile(SD) of 269(129) pixels. The average (SD) proportion of nodules that were recognized beyond the 100 pixel foveal limit was 51.2% (15.6%) indicating a substantial contribution of peripheral vision for lung
nodule detection. R(z) was roughly equal at CT sections that were 0, 1, and 2 from the nodule centroid and was smaller 3 sections away, with no significant difference across readers (p = 0.99).

**CONCLUSION**

The momentary likelihood of lung nodule recognition appears to decrease exponentially with distance from a lung nodule center. While on average approximately half of detected nodules are recognized with peripheral vision, readers rely on their peripheral vision for nodule detection to varying degrees. Further study of search behavior and nodule recognition may lead to strategies for greater consistency and sensitivity for lung nodules detected in CT scans.

**CLINICAL RELEVANCE/APPLICATION**

Understanding the process of lung nodule detection in CT scans is important to assuring that radiologists maximize their effectiveness in diagnosing lung disease.

**SSQ04-08 Association of Focal Radiation Dose Adjusted on Body Cross Sections with Ground Glass Nodules Visibility and Quantification on Computed Tomography Images Using AIDR 3D: Comparison Among Ultra-Low-Dose, Low-Dose and Standard-Dose Scanning**

**PURPOSE**

To compare the visibility, dimension and density of ground glass nodules (GGNs) on computed tomography (CT) images using AIDR 3D between ultra-low-dose scanning (ULDS) and low-dose scanning (LDS) and assess the association of size specific dose estimate (SSDE) with difference in the measured values between ULDS as well as LDS, and standard dose scanning (SDS).

**METHOD AND MATERIALS**

This was part of the ACTive Study, a multi-center research project in Japan. The Institutional Review Board of each institution approved this study, and written informed consent was obtained. In a single visit, 50 subjects underwent chest CT (64-row helical mode) using identical 320-row scanners with different tube currents: 240 (SDS), 120 (LDS), and 20 mA (ULDS). GGN visibility was assessed by 3-grade scales (1: obscure to 3: definitely visible) using SDS as standard of reference and compared between ULDS and LDS using t-test. Dimension and mean CT density (MCTD) of 71 larger GGNs with the diameter of 5mm or more and SSDE based on antero-posterior and lateral body width were determined as the average value of two-times measurements in cross sections including GGN center. Measured values were compared using Friedman and Wilcoxon signed rank test among ULDS, LDS and SDS. Pearson's correlation analyses were performed to assess the association of SSDE with relative value change between ULDS and SDS (RVC#(ULDS/SDS): 100(ULDS-SDS)/SDS) and between LDS and SDS (RVC#(LDS/SDS): 100(LDS-SDS)/SDS).

**RESULTS**

GGN visibilities were similar between ULDS and LDS (2.746 versus 2.774) (p=0.67). SSDE had mild negative correlation with RVC# (ULDS/SDS) in dimension and MCTD (r=-0.40, p=0.01 and r=-0.31, p=0.05). Dimensions were larger at ULDS than those at LDS and SDS (p<0.01) (88.1±73.7, 82.4±69.3 and 80.2±66.9, respectively), whereas, MCTD were similar among three dose levels (p=0.131), as -626±110 Hounsfield of Unit (HU) at ULDS, -619±117 HU at LDS and -614±120 HU at SDS.

**CONCLUSION**

In larger GGNs at ULDS, nodular exaggerating effect in association with decreased SSDE exceeded nodular obscuration deficit due to reduced MCTD by enhanced smoothing effect, and paradoxically may result in visibilities comparable to LDS.

**SSQ04-09 A New Quantitative Radiomics Approach for Non-Small Cell Lung Cancer (NSCLC) Prognosis**

**PURPOSE**

To determine if computed tomographic (CT) phenotypic features of Non-Small Cell Lung Cancer (NSCLC) have the predictive ability of auxiliary diagnosis for pathological type, TNM stage by a quantitative radiomics approach.

**METHOD AND MATERIALS**

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The proposed method has been evaluated on a clinical dataset including 973 patients with NSCLC and a public dataset including 819 patients from the LIDC-IDRI database labelled by benign or malignancy. The proposed method consists of three phases: feature set extraction, key features selection and production. First we extracted a set of features, consisting of 3D features, Gabor features, texture features. Then a unified feature selection framework for general loss functions based on a generalized sparse regularizer was used for key feature selection. Then 25 key features were selected, the the key features were used to certify their prognostic ability.

RESULTS
A score of 83.21% accuracy for lung nodule classification on 819 patients from the LIDC-IDRI dataset was obtained by the features such as Gabor 'Entropy', wavelet 'Sum Entropy' and 'Gray Level Nonuniformity'. 83.80% pathology prediction accuracy between adenocarcinoma and squamous cell carcinoma was gained from the clinical dataset by the features such as 'Maximum 3D Diameter' and run length 'Long Run Emphasis'. And 84.40% diagnosis accuracy for the early phase cancer (T1, T2) and terminal cancer (T3, T4) classification in TNM staging was achieved by 'Energy' and run length 'Long Run High Gray Level Emphasis'.

CONCLUSION
Based on the key features selected from a predefined feature set we may provide a credible aided diagnosis for a tumor whose pathology type and TNM staging are unknown. The radiomics key features will be further expanded in larger data samples, which may provide more predictive information for clinical practice. Radiomics has a big potential to aid clinical diagnosis and treatment for NSCLC.

CLINICAL RELEVANCE/APPLICATION
By the new quantitative radiomics method a credible diagnosis of pathological type could be obtained, it may avoid invasive frozen section and anesthesia in the clinical surgery. TNM staging is an important reference for the assessment of tumor stage and now is always determined by doctor's subjective experience. The proposed radiomics method could provide a more objective and efficient clinical staging strategy.
Chest CT has prognostic value in the setting of CHP.

**CLINICAL RELEVANCE/APPLICATION**

Chest CT may be a valuable biomarker in HP, aside from diagnosis and follow-up.

### SSQ05-01 Distribution and Associated High-Resolution CT findings Predict Survival in Chronic Hypersensitivity Pneumonitis

**Participants**

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### SSQ05-02 Prevalence of Pulmonary Fibrosis in Asymptomatic 1st Degree Relatives of Patients with Familial Pulmonary Fibrosis (FPF)

**Participants**

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David A. Lynch, MBChB, Denver, CO (Abstract Co-Author) Research support, Siemens AG; Scientific Advisor, PAREXEL International Corporation; Consultant, Boehringer Ingelheim GmbH; Consultant, Gilead Sciences, Inc; Consultant, F. Hoffmann-La Roche Ltd; Consultant, Veracyte, Inc;

Evans R. Fernandez Perez, Denver, CO (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

It is unknown if the presence of air-trapping and disease distribution on chest CT, which may be a clue to the diagnosis, predicts mortality among patients with chronic hypersensitivity pneumonitis (CHP).

**METHOD AND MATERIALS**

The earliest CT chest scans from subjects with HP were scored. Fibrotic HP on CT was defined as presence of reticulation with associated traction bronchiectasis and/or bronchiolectasis. The predominant zonal and axial distribution of lung disease, the presence or absence as well as total percentage of lung involvement (to the nearest 5%) for air-trapping was scored. The most likely diagnosis with level of confidence (possible, probable, or definite) was also determined. A Cox proportional hazards (PH) model was used to identify independent predictors in time-to-death analysis.

**RESULTS**

Of 82 subjects, 60 (73%) had fibrotic HP, and 22 (27%) had non-fibrotic HP on chest CT. The most common patterns were HP (43, 52%), UIP (19, 23%), NSIP (11, 13%), and other (9, 10%). Compared to other CT patterns, the HP pattern was most often zonally diffuse or upper and axially diffuse or peripheral (p<0.01). Compared with survivors, patients who died had lower FVC% predicted, were more likely to have pulmonary fibrosis, and were less likely to have ground-glass opacity on CT. In a Cox PH model, the presence of UIP pattern of fibrosis, axially diffuse disease, and absence of air-trapping/mosaic perfusion were independent predictors of survival (Hazard ratios 2.82 [p-value 0.02], 2.46 [p-value 0.01], and 0.39 [p-value 0.01]; respectively).

**CONCLUSION**

Chest CT has prognostic value in the setting of CHP.
quantification system, can predict survival of IPF patients.

The baseline extent and 1-year change of regional disease patterns at TSCT, which is measured with texture-based automated

CONCLUSION
change in extent of AbN were predictive of survival. After adjustment, the baseline extent of RO and FIB, change of AbN, HC, RO, FIB were predictive of survival, and increased extent of AbN, HC, RO, FIB at follow-up TSCT (cut-off value 5%) were significantly shorter than in patients with lower baseline extent and stable or higher baseline extent of AbN, HC, RO, FIB (cut-off value 35%, 10%, 25%, 20%, respectively) and increased extent of AbN, HC, GGO, CON, EM, RO and FIB were predictive of survival.

Measured relative extents of AbN, HC, GGO, CON, EM, RO and FIB at baseline and 1-year follow-up TSCT were as follows; baseline: 43.0% ± 17.1, 7.0 ± 6.7, 12.3 ± 11.9, 2.9 ± 1.3, 3.9 ± 5.5, 16.8 ± 9.8, 23.9 ± 12.3; follow-up: 45.3 ± 19.5, 7.2 ± 7.6, 13.8 ± 11.6, 3.2 ± 1.5, 3.6 ± 5.6, 17.6 ± 11.6, 24.8 ± 14.4, respectively. Survival analysis indicate that disease-free survival of patients with higher baseline extent of AbN, HC, RO, FIB (cut-off value 35%, 10%, 25%, 20%, respectively) and increased extent of AbN, HC, RO, FIB at follow-up TSCT (cut-off value 5%) were significantly shorter than in patients with lower baseline extent and stable or decreased extent of those regional patterns (all p<0.001). Univariable analysis revealed that baseline FVC%pred, DLCO%pred and SpO2% were predictive of survival, and increased extent of AbN, HC, RO, FIB were predictive of survival, and in change in extent of AbN were predictive of survival.

CONCLUSION
The baseline extent and 1-year change of regional disease patterns at TSCT, which is measured with texture-based automated quantification system, can predict survival of IPF patients.
**Parallel Bands of Lung Involvement Along the Direction of Ribs: A New Sign of Systemic Sclerosis on Volume-rendered Computed Tomography of the Chest**

**Participants**
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**PURPOSE**
To differentiate between systemic sclerosis-related interstitial lung disease and usual interstitial pneumonia on volume-rendered computed tomography (CT) of the chest.

**METHOD AND MATERIALS**
The multi-detector CT examinations of the chest of 50 patients with systemic sclerosis and 50 patients with usual interstitial pneumonia have been post-processed to obtain volume-rendered images of the lungs. On these images, normally aerated lung parenchyma has been encoded blue and increased attenuation of lung parenchyma has been encoded white. The images have been randomized and provided to an experienced radiologist to note the presence or absence of parallel bands of increased attenuation of the lung parenchyma along the direction of the ribs (the parallel-band sign). Statistical analysis has been done by the chi-square test.

**RESULTS**
The parallel-band sign has been seen in 32 patients with systemic sclerosis-associated interstitial lung disease and in none of the patients with usual interstitial pneumonia. The parallel-band sign has sensitivity of 64.0%, specificity of 100.0%, positive predictive value of 100.0%, negative predictive value of 73.5%, and accuracy of 82.0% for the diagnosis of systemic sclerosis-associated interstitial lung disease on volume-rendered CT of the chest.

**CONCLUSION**
Lung involvement in systemic sclerosis-related interstitial lung disease may take the characteristic distribution of parallel bands at the surface of the lungs along the direction of the ribs. The parallel-band sign differentiates systemic sclerosis-related interstitial lung disease from usual interstitial pneumonia with high specificity on volume-rendered CT of the chest.

**Regional Variation in Ventilation in the Asthmatic Human Lungs Using Magnetic Resonance Imaging and Computed Tomography**

**Participants**
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Scott K. Nagle, PhD, Madison, WI (Abstract Co-Author) Research Grant, General Electric Company Research Consultant, Marvel Medtech, LLC

**PURPOSE**
To investigate regional patterns of ventilation abnormalities in asthmatics with both automated and manual methods.

**METHOD AND MATERIALS**
A total of 83 asthmatic subjects (normal/moderate/severe: n=14/49/20) underwent hyperpolarized (HP) 3He magnetic resonance imaging (MRI), spirometry, and computed tomography (CT). The right and left lungs were segmented from proton MRI using a region-growing algorithm written in MATLAB and further separated into the lung lobes (right upper-RUL, middle-RML and lower-RLL; left upper-LUL and lower-LLL) by a deformable registration to lobar segmentation derived from CT (VIDA Diagnostics, IA). 3He was registered to proton using a rigid registration method. Ventilation defects were identified independently using both manual segmentation and an automated approach which corrected for B1 inhomogeneity, excluded pulmonary vasculature and determined defects adaptively. A linear mixed-effects model was used to perform the pairwise comparison of percent defect volume (PDV) amongst lobes. Spearman correlation was used to evaluate the association between PDV and spirometry. A p<0.05 is considered significant.

**RESULTS**
The automated defect quantification took ~3min versus 20min per study for manual segmentation. The two method yielded similar whole lung PDV (p=0.12). The whole lung PDV measured by both methods correlated inversely with the percent predicted forced
expiratory volume in 1 second (% FEV1) (manual/automated: p = -0.41, p=0.0002/p = -0.24, p=0.040) and % FEV1 over forced vital capacity (p = -0.46, p<0.0001/p = -0.32, p=0.0045). Both methods found PDV was significantly larger in the RML (automated: 8.21±13.64%) than all other lobes (all p<0.013). The RUL (5.52±8.83%) was less ventilated than the RLL (3.55±4.24%) and LLL (2.62±3.82%) with p<0.047. The automated method also suggested a more defected RUL than LUL (3.26±4.76%) with p=0.011 whereas the difference was not significant by manual measurements.

CONCLUSION
Compared to manual assessment, the automated approach provides comparable PDV measurements and similar association to spirometric measures. Both methods suggest the RML is most affected in asthmatic lungs and that the RUL is measurably more defected than RLL and LLL.

CLINICAL RELEVANCE/APPLICATION
The automated defect quantification can facilitate the application of HP 3He MRI as a potential tool for guiding bronchoscopic assessment of cellular and molecular markers of asthma progression.

SSQ05-06  Lobar Analysis of Hyperpolarised Xenon MR Lung Imaging (Xe-MRI) in Chronic Obstructive Pulmonary Disease (COPD)

Thursday, Dec. 3 11:20AM - 11:30AM Location: S404CD

Participants
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PURPOSE
To determine lobar ventilation and apparent diffusion coefficient (ADC) values acquired using hyperpolarised xenon MR lung imaging (Xe-MRI) in subjects with chronic obstructive pulmonary disease (COPD), and to correlate these with quantitative CT (QCT) and pulmonary function tests (PFTs).

METHOD AND MATERIALS
Eighteen patients with COPD (stage II - IV GOLD criteria classification) underwent Xe-MRI at 1.5T, QCT and PFTs. Whole lung and lobar Xe-MRI parameters were obtained using semi-automated segmentation of multi-slice Xe-MRI ventilation images and Xe-MRI diffusion-weighted images \( b =20.855 \text{sec/cm}^2 \) following co-registration to CT using in-house software. Percentage predicted PFT results were established. Whole lung and lobar QCT-derived emphysema was calculated from percentage of lung tissue with density of <-950 HU. Pearson’s correlation coefficients were used to evaluate the relationship between imaging measures and PFTs.

RESULTS
Lobar Xe-MRI percentage ventilated volume and lobar Xe-MRI average ADC showed significant correlation with lobar QCT percentage emphysema \( (r=0.61, \ p<0.001 \text{ and } r=0.72, \ p<0.001 \) respectively). Whole lung Xe-MRI average ADC showed significant correlation with the PFTs: percentage predicted transfer factor of the lung of carbon monoxide (TLCO) \( (r=0.69, \ p<0.03) \) and percentage predicted functional residual capacity (FRC) \( (r=0.65, \ p<0.007) \). Whole lung QCT percentage emphysema showed a similar significant correlation with percentage predicted TLCO \( (r=0.71, \ p<0.001) \) and percentage predicted FRC \( (r=0.48, \ p<0.05) \).

CONCLUSION
This is the first study to generate lobar analysis of Xe-MRI ventilation and ADC. The excellent correlation of whole lung Xe-MRI average ADC with PFTs and lobar Xe-MRI derived measures with lobar QCT percentage emphysema provide supportive evidence for employment of this technique in patients with COPD. This is particularly relevant for those undergoing regional treatments, where Xe-MRI has the potential to accurately guide treatment options or predict post-treatment lung function.

CLINICAL RELEVANCE/APPLICATION
The potential clinical value of Xe-MRI regional lung assessment is becoming increasingly relevant with the possibility of regional lung treatments e.g. lung volume reduction surgery, endobronchial valve placement and radiotherapy. The excellent correlation of Xe-MRI with QCT-derived measures of COPD and PFTs suggests it may be of value in patients considered for these treatments.

SSQ05-07  MR Perfusion Parameters and Apparent Diffusion Coefficient in Lung Cancer: Relation to Microvessel Density Based on Surgical Specimen

Thursday, Dec. 3 11:30AM - 11:40AM Location: S404CD

Participants
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Hyek-Jun Won, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Microvessel density is a direct biomarker of tumor angiogenesis. Perfusion parameters of dynamic contrast-enhanced MRI (DCE-MRI) and apparent diffusion coefficient (ADC) of diffusion-weighted MR imaging (DWI) can be measured as a quantitative, non-invasive, and repetitive method for the estimation of tumor angiogenesis in the lung cancer. The purpose of this study was to correlate MR perfusion parameters and ADC with microvessel density in lung cancers patients who underwent surgical resection.

METHOD AND MATERIALS
Ninety three patients (53 men, 40 women; age range, 40-79 years) with non-small cell lung cancers underwent diffusion-weighted and dynamic contrast-enhanced MR imaging before surgery. Surgical specimens were obtained and microvessel density was measured with immunohistochemistry staining for CD 31. Perfusion parameters (Ktrans; volume transfer coefficient, ve; fraction of extravascular extracellular space, vp; the time lag between bolus arrival times of arterial input function and tissue concentration) and ADC were measured and compared with quantitative histologic microvessel density by using the Pearson correlation test.

RESULTS

The significant positive correlations were found between microvessel density and Ktrans (r=0.22, P=0.03) and vp (r=0.29, P < .01). An inverse correlation was found between T0 and microvessel density (r=-0.34, P < .01), whereas no significant correlation was found between ADC and microvessel density.

CONCLUSION

Perfusion parameter such as Ktrans, ve, and T0 showed significant correlation with microvessel density in lung cancers, whereas no correlation was found between ADC and microvessel density.

CLINICAL RELEVANCE/APPLICATION

Perfusion parameter such as Ktrans, ve, and T0 may play a role as indirect biomarkers indicating the extent of microvessel density in lung cancers.

SSQ05-08  Pulmonary Perfusion Phase Imaging using Self-Gated Fourier Decomposition MRI Reveals Perfusion Inhomogeneities in Patients with Cystic Fibrosis

Participants

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Helge Hebestreit, MD, Wuerzburg, Germany (Abstract Co-Author) Nothing to Disclose
Thorsten A. Bley, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Herbert Koestler, PhD, Wuerzburg, Germany (Abstract Co-Author) Research support, Siemens AG

PURPOSE

Fourier Decomposition (FD) MRI provides site-resolved functional lung imaging without application of contrast media. Perfusion and ventilation-weighted images are reconstructed using a Fourier analysis of a non-triggered time series of morphologic lung images. In this work, we demonstrate that perfusion-weighted data also carries information regarding the pulmonary perfusion phase.

METHOD AND MATERIALS

Lung perfusion measurements were performed using SENCEFUL, an advancement of the FD technique, obtaining morphologic image series by cardiac and respiratory self-navigation of data sampled in quasi-random fashion. Signal variations over the cardiac cycle allow for determining perfusion-weighted images (perfusion amplitude) and the perfusion phase, which indicates the phase shift in the lungs in relation to a reference voxel in a central vessel (e.g. pulmonary trunk). Pulmonary perfusion amplitude and phase measurements on 3 volunteers and 3 cystic fibrosis patients were performed on a 1.5T system. A 2D FLASH sequence providing a DC signal acquisition for self-navigation was used.

RESULTS

Perfusion amplitude maps of the healthy subjects revealed homogeneous lung perfusion. In the perfusion phase maps, the perfusion-induced signal changes exhibited similar behavior in all lung parts. In contrast, the maps of the cystic fibrosis patients showed areas with reduced perfusion and a significantly higher phase dispersion. The attached image example of a 27 year old cystic fibrosis patient shows reduced perfusion e.g. in the upper lobes and the perfusion phase map reveals an higher phase dispersion when compared to the healthy volunteer. Similar results were found in the other examined volunteers and cystic fibrosis patients.

CONCLUSION

Signal intensities in lung MRI are pulsatile as a function of the cardiac triggered inflow. While a balanced perfusion phase in healthy volunteers indicates a homogeneous pulse wave velocity throughout the lungs, results in patients with cystic fibrosis show regionally varying delays.

CLINICAL RELEVANCE/APPLICATION

Based on a time series' FD, the maps describe a new contrast in pulmonary MRI. First measurements revealed that perfusion phase maps of cystic fibrosis patients differ from those of healthy subjects. Hence, the perfusion phase may contain valuable diagnostic information. Detailed examination of the diagnostic capabilities of FD based perfusion phase MRI is subject to future work.

SSQ05-09  Functional Evaluation of Chronic Lung Allograft Dysfunction with Novel Computed Tomography Lung Deformation Algorithms

Participants

Miho Hori, MSc, Toronto, ON (Presenter) Research Grant, Toshiba Corporation
TomoHito Saito, MD, PhD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Joanne Moseley, Toronto, ON (Abstract Co-Author) Royalties, RaySearch Laboratories AB;
Shafique Keshavjee, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
PURPOSE

Lung transplantation is the destination therapy for end stage chronic lung disease. Chronic lung allograft dysfunction (CLAD) limits the 5-year survival after lung transplantation (Tx). It is important to diagnose and distinguish the CLAD subtypes: Bronchiolitis Obliterans Syndrome (BOS) and Restrictive Allograft Syndrome (RAS). CLAD diagnosis with conventional techniques is limited, deformable registration provides qualitative and quantitative assessment of focal and global lung function. The purpose of this study is to determine the utility of using deformable registration CT data in the diagnosis of CLAD.

METHOD AND MATERIALS

A retrospective study of 30 patients post bilateral Tx followed with PFT and low dose lung CT (conventional tests) scheduled every 3mths. The study cohort had confirmed diagnosis, based on conventional tests and pathology: No-CLAD (n=10); BOS (n=10); RAS (n=10). The CT data was assessed qualitatively and quantitatively using finite element based image registration software (MORFEUS) to document changes in lung deformation between baseline and disease onset. Surface vector analysis was performed and indicated expansion (+) or contraction (-) of regional lung volume; the mean and percentage change for inward and outward vectors was compared using the Mann-Whitney U test.

RESULTS

Qualitative analysis: Upper lobe deformation; No-CLAD 20% (2/10); BOS 20% (2/10) and RAS 70% (7/10). Quantitative analysis: mean vector change from baseline (% change from baseline); for the right (R) and left (L) lungs. No-CLAD: R= +4.0mm (55%); L= +3.2mm (59%). BOS: R= +3.8mm (61%); L= +3.4mm (57%). RAS: R= -8.6mm (71%); L= -9.9mm (74%).

CONCLUSION

Deformable lung registration can quantitatively detect and distinguish between No-CLAD/BOS and RAS.

CLINICAL RELEVANCE/APPLICATION

Lung deformation analysis is a promising technique in evaluating the subtypes of CLAD and in assessing regional change when conventional techniques are limited.
PURPOSE

Liver steatosis is the most common liver disease in Western Countries and it may progress to steatohepatitis and cirrhosis. Magnetic Resonance Spectroscopy (MRS) has been shown to strongly correlate with histology in fat quantification. However, MRS has some limitations such as breathing artifact and difficulties in avoiding vessels or bile ducts within the voxel. 3D VIBE-Dixon is a MR sequence which can quantify fat content. The aim of this study was to compare fat quantification of liver using 3D VIBE-DIXON to that using MRS.

METHOD AND MATERIALS

IRB approved this prospective, HIPAA compliant study. Thirty potential liver donors (14 males, 12 females; mean age 38 yo) underwent liver MR, including single voxel MRS, within the right (RL) and left lobe (LL) and axial 3D VIBE-Dixon. Liver biopsy was performed in 8 patients. Fat percentage (FP) was generated by MRS. Two readers blinded to MRS results independently quantified the FP on 3D VIBE-Dixon by drawing a ROI in both lobes in the same locations of the MRS voxels. Lin's concordance correlation was used to assess concordance between MRS and 3D VIBE-Dixon, for the two readers. Intraclass correlation coefficient was used to compare 3D VIBE-Dixon to histology. Inter-observer agreement was calculated. A p ≤0.05 was considered statistically significant.

RESULTS

In the RL, mean FP was 5.8% by MRS, and 4.8% and 4.8% by 3D VIBE-Dixon for readers 1 and 2, respectively, with a strong concordance between the two technique (rho = 0.78 and 0.76 for reader 1 and 2, respectively, p<0.001). In the LL, mean FP was 5.2% by MRS, and 4.2% and 4% by 3D VIBE DIXON for readers 1 and 2, respectively, with medium concordance between the two sequences (rho=0.44 and 0.38 for readers 1 and 2, respectively). Inter-observer agreement was excellent in both RL and LL (rho=0.96 and 0.92, respectively, p<0.001). In the 8 patients who underwent biopsy FP by 3D VIBE-DIXON highly correlated to histological results (ICC=0.85).

CONCLUSION

In this prospective study, fat quantification using 3D VIBE-DIXON was highly reproducible, with strong correlation to MRS in the RL. Correlation was moderate in the LL, probably due to artifacts on MRS.

CLINICAL RELEVANCE/APPLICATION

3D VIBE-DIXON is a highly reproducible MR sequence, which may allow non-invasive fat quantification in the liver. Further studies with larger cohort and pathology comparison are required.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Ihab R. Kamel, MD, PhD - 2015 Honored Educator
IRB-approved study. Same-day 3T MRI and CAP measurement were performed by a single examiner within 27 (17-50) days of liver
Forty NAFLD patients (M/F: 29/11) with median (IQR) age of 52.6 (48.5-57.3) and BMI of 27.1 (25.4-33.1) were included in this

METHOD AND MATERIALS

Participants
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Consultant, Bayer AG ; ;

PURPOSE

To assess the inter-site reproducibility of 2D magnetic resonance elastography (MRE) analysis for hepatic stiffness in obese adults

METHOD AND MATERIALS

In this HIPAA compliant, IRB approved study, obese (BMI ≥ 30 kg/m²) adults underwent 2D MRE on a 1.5T or 3.0T GE scanner at
one of two sites. A passive driver produced 60 Hz acoustic shear waves through the liver, and MRE-generated wave images, magnitude images, and stiffness maps (elastograms) were transferred offline for manual analysis. Analysts at each of the two separate sites evaluated all exams from both sites. Analysts drew regions of interest (ROIs) on the elastograms in areas of the liver where parallel wave propagation was observed on the corresponding wave image. From these ROIs, stiffness values were recorded. Weighted average was applied to obtain a single per-liver stiffness value. Bland-Altman plot and intraclass correlation coefficient (ICC) were used to assess inter-site reproducibility. Paired t-test was used to examine systematic shifts.

RESULTS

87 adults (74 female, 13 male) underwent MRE. The mean (± standard deviation) age and BMI were 48.3 (± 12.5) years and 42.6
(± 5.8) kg/m² respectively. Fourteen scans were considered unanalyzable by at least one of the two sites due to low signal-to-
noise or poor wave propagation. Hence, data from 73 subjects were used in reproducibility analyses. ICC for the two sites was .833
[0.724, 0.898]. Mean (± standard deviation) stiffness values for site A and site B were 2.90 (± 1.06 kPa) and 3.13 (±1.15 kPa)
respectively. A small, clinically non-meaningful, but statistically significant bias was observed (mean difference .23 kPa, paired t-
test p=0.0016).

CONCLUSION

MRE analysis for hepatic stiffness from independent analysts at two separate sites had high reproducibility. There was a small
systematic bias observed between the two participating study sites, which was not clinically meaningful in the context of staging
liver fibrosis.

CLINICAL RELEVANCE/APPLICATION

In order for 2D MRE to be clinically useful in the staging of hepatic fibrosis, liver stiffness results must be analyst and site
independent. Studies such as this will help demonstrate the reproducibility of MRE stiffness values.

SSQ06-03 ¹H-Magnetic Resonance Spectroscopy is Superior to Controlled Attenuation Parameter (CAP) in Assessing Liver Fat Content in Human Non-alcoholic Fatty Liver Disease (NAFLD)

Thursday, Dec. 3 10:50AM - 11:00AM Location: E350

Awards
Trainee Research Prize - Resident

Participants
Jurgen H. Runge, MD, PhD, Amsterdam, Netherlands (Presenter) Nothing to Disclose
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Jaap Stoker, MD, PhD, Amsterdam, Netherlands (Abstract Co-Author) Research Consultant, Robarts Clinical Trials

PURPOSE

Non-alcoholic fatty liver disease (NAFLD) is an increasingly recognized health problem worldwide. Liver biopsy is the diagnostic
standard, but liver fat content is preferably assessed noninvasively and quantitatively. Recently, the Controlled Attenuation
Parameter (CAP) technique was introduced on the FibroScan®, a transient elastography device with FDA approval since 2013. Only
limited data are available regarding CAP's accuracy compared to established quantitative measures. Therefore, we prospectively
compared CAP and ¹H-Magnetic Resonance Spectroscopy (¹H-MRS) derived fat fractions (FF) against liver biopsy in a cohort of
patients with NAFLD.

METHOD AND MATERIALS

Forty NAFLD patients (M/F: 29/11) with median (IQR) age of 52.6 (48.5-57.3) and BMI of 27.1 (25.4-33.1) were included in this
IRB-approved study. Same-day 3T MRI and CAP measurement were performed by a single examiner within 27 (17-50) days of liver
Iron overload is associated with hereditary hemochromatosis, chronic transfusions, hemolytic conditions and diffuse liver diseases such as chronic hepatitis C, alcoholic liver disease and NAFLD. Pancreatic iron can be also found in some of these conditions. Our objective was to assess R2* values of the liver and pancreas in patients with chronic diffuse liver disorders, comparing the R2* values with serum ferritin levels and liver biopsy.

METHOD AND MATERIALS
A total of 99 consecutive patients with chronic diffuse liver disorders who underwent liver biopsy and abdominal MR examination were included. The 3T MR examination included a single breath-hold multiecho GRE sequence with 12 echoes. Iron related-R2* quantification was performed with a dedicated software selecting a ROI within the biopsied liver segment and also in the pancreas (head, body and tail). Liver biopsy was used as gold standard for liver iron deposits grading (0-4).

CONCLUSION
There is an excellent relationship between liver R2*-iron quantification against liver biopsy and serum ferritin, in different chronic liver disorders. Pancreas R2* is significantly correlated with serum ferritin, liver R2* and histologic iron grading.

CLINICAL RELEVANCE/APPLICATION
In patients with diffuse chronic liver disorders, pancreas R2* correlate with liver R2* and biopsy-proved liver iron overload.

PURPOSE
to determine whether liver function as determined by indocyanine green (ICG) clearance can be estimated quantitatively from gadoxetic acid (Gd-EOB-DTPA)-enhanced magnetic resonance (MR)-Relaxometry and to estimate the impact of liver liver volumes.

METHOD AND MATERIALS
132 patients underwent an ICG clearance test and Gd-EOB-DTPA-enhanced MRI, including MR-Relaxometry at 3 Tesla. A transverse
3D VIBE sequence with an inline T1 calculation was acquired prior to and 20 minutes post-Gd-EOB-DTPA administration. Volumetric analysis of respective livers was performed on Aquarius iNtuition Viewer (TeraRecon Inc.). The reduction rate of T1 relaxation time (rT1) between pre- and post-contrast images and the liver volume-assisted index of T1 reduction rate (LVrT1) were evaluated. The plasma disappearance rate of ICG (ICG-PDR) was correlated with the liver volume (LV), rT1 and LVrT1, providing an MRI-based estimated ICG-PDR value (ICG-PDRest).

RESULTS
Regression model showed a significant log-linear correlation of ICG-PDR with LV (r = 0.31; p = 0.001), T1post (r = 0.62; p < 0.001) and rT1 (r = 0.85; p < 0.001). Assessment of LV and consecutive evaluation of multiple linear regression model revealed a stronger log-linear correlation of ICG-PDR with LVrT1 (r = 0.91; p < 0.001), allowing for the calculation of ICG-PDRest.

CONCLUSION
Liver function as determined using ICG-PDR can be estimated quantitatively from Gd-EOB-DTPA-enhanced MR-Relaxometry. Volume-assisted MR-Relaxometry has a stronger correlation with liver function than does MR-Relaxometry.

CLINICAL RELEVANCE/APPLICATION
Global and regional liver function may be visualized by Gd-EOB-DTPA-enhanced MRI, which might be of importance for planning liver resections.

SSQ06-06  Liver Volume Predicts the Clinical Outcome of Patients with Decompensated Alcoholic Steatohepatitis
Thursday, Dec. 3 11:20AM - 11:30AM Location: E350

Participants
Maxime Ronot, MD, Clichy, France (Abstract Co-Author) Nothing to Disclose
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Matthieu Lagadec, MD, Clichy, France (Presenter) Nothing to Disclose

PURPOSE
To evaluate the prognostic value of abdominal multidetector computed tomography (MDCT) in patients with decompensated alcoholic steatohepatitis (ASH).

METHOD AND MATERIALS
This ancillary study was based on the analysis of data collected during a randomized trial on ASH treatment. Response to treatment was defined as the improvement of the baseline MELD score ≥3 points at 3 months. All patients underwent contrast-enhanced MDCT of the abdomen. The following parameters were measured: 1/ liver (DL) and spleen (DS) density on unenhanced images, and DL/DS ratio, 2/ liver volume-to-body weight ratio (VLBW), 3/ subcutaneous fat (FSC), visceral fat (FV) and muscular (M) surfaces at the level of L3-L4. Responders and non-responders were compared with uni-, multivariate and ROC analyses. Results were compared with a validation cohort of patients, clinically and biologically similar to the study cohort.

RESULTS
Fifty-eight patients (34 males; mean age, 56 years) were analyzed, including 34 (59%) responders. Baseline mean MELD and ABIC scores were 19 (13–28) and 8.3 (6.5–10.3). On multivariate analysis, VLBW ≥ 2.4% predicted response with 88% and 63% sensitivity and specificity. In the validation cohort (n=24, 75% responders), the same cut-off value predicted response with 83% and 67% sensitivity and specificity.

CONCLUSION
In patients suffering from decompensated ASH, the liver volume appears to be a major positive prognostic factor. This simple morphometric parameter may be added to the initial evaluation of the liver disease to improve patient management.

CLINICAL RELEVANCE/APPLICATION
The liver volume-to-body weight ratio appears to be a major prognostic factor in patients with ASH. This morphometric parameter could be added to the initial workup of patients, to better predict the response to treatment and improve the management.

SSQ06-07  MRI Based Quantification of Hepatic Uptake and Excretion of Gadoxetic Acid: Preliminary Results
Thursday, Dec. 3 11:30AM - 11:40AM Location: E350

Participants
Daniel Truhn, MD, Cologne, Germany (Presenter) Nothing to Disclose
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PURPOSE
Recent research in liver MRI has shown that quantification of hepatic uptake of gadoxetic acid is a promising method for determination of local liver function and correlates well with established clinical measures of liver function. The aim of this study was to evaluate a method for combined measurement of hepatic uptake and excretion.
**METHOD AND MATERIALS**

After intravenous administration of gadoxetic acid, signal enhancement of liver tissue in 14 healthy patients was measured over the time course of 30 minutes. First, the data was assessed using previously published methods that do not consider excretion. Then, a dual inlet two compartment model was appended by a parameter describing the excretion of contrast medium into the bile. A least squares fit was performed to extract the following parameters: extra- and intracellular volume fraction, uptake and excretion rates, arterial and portal venous flow fractions. Results for the models without and with consideration of excretion were subsequently compared.

**RESULTS**

The dual inlet two compartment model provided the best agreement between modeled and measured signal values when compared to previously published methods that do not consider excretion of contrast agent. The mean value for the uptake rate in healthy liver tissue was 4.76±0.54 /100/min. Excretion half-time was 21.9±2.4 min. Inter-patient variance was significantly greater when conventional models (uptake only) models were applied. We found a significant deviation between modeled and measured signal values with an uptake rate of 3.56±1.34 /100/min. Excretion rates could only be obtained with the dual inlet two compartment model.

**CONCLUSION**

The model not considering the excretion was only valid in the first 5 minutes of hepatic signal enhancement and failed over the course of 30 minutes. Accurate modeling of gadoxetic acid induced hepatic enhancement over a longer time course requires a dual inlet two compartment model. Including this parameter into models of liver tissue might lead to a more precise correlation between hepatic function and MRI.

**CLINICAL RELEVANCE/APPLICATION**

When aiming to measure hepatic function using MRI not only the hepatic uptake, but also the excretion should be taken into account to get better correlations between MRI and liver function.

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**SSQ06-08  The Attenuation Distribution Across the Long Axis (ADLA): Evaluation of Predictive Performance in a Large Clinical Trial**

Thursday, Dec. 3 11:40AM - 11:50AM Location: E350

**METHOD AND MATERIALS**

Under a data sharing agreement from Genentech (San Francisco, CA) and an IRB waiver from our institution, we obtained de-identified imaging and clinical data from RIBBON-1, a multi-site phase 3 trial of bevacizumab (Avastin) in metastatic breast cancer. We analyzed all RIBBON-1 patients treated with Avastin who had at least 1 liver metastasis measuring ≥ 15 mm on baseline contrast-enhanced CT. For each patient at every time point, up to 2 target liver lesions were evaluated using both RECIST 1.1 criteria and ADLA. The ADLA was obtained as the standard deviation of the post-contrast CT attenuation values in the portal venous phase across a long-axis diameter function. To define a treatment response using ADLA, Brier scores were computed to establish the optimal percent decrease for separating patients with longer OS. Using Kaplan-Meier survival analysis, the log-rank test was then used to evaluate the ability of the ADLA method to predict OS in a larger clinical trial.

**RESULTS**

165 patients met inclusion criteria. Median OS was 461 days (range 60-916). The ADLA method discriminated patients with longer OS at an optimal threshold of a 21.5% decrease from baseline. At this threshold, a treatment response by the ADLA method successfully separated patients with longer OS (p<0.001). Furthermore, a treatment response by ADLA was superior to a response by RECIST 1.1 for discriminating patients with longer OS (95% confidence interval for the Brier score difference: [0.070-0.52]). Kaplan-Meier survival curves are shown below.

**CONCLUSION**

In retrospective data analysis from a large clinical trial, the ADLA method was superior to RECIST 1.1 for predicting overall survival.

**CLINICAL RELEVANCE/APPLICATION**

The ADLA measurement is an easily extractable parameter that may be useful for assessing cancer treatment response.
PURPOSE

To conduct a prospective systematic analysis of factors contributing to variability of response classification in RECIST1.1 beyond factors related to disease measurement, i.e. variability that persists even if dedicated software for response assessment is used.

METHOD AND MATERIALS

63 patients (60 ± 9 years) underwent a total 132 contrast-enhanced CT studies for initial staging or follow-up after systemic chemotherapy. A target or non-target lesion satisfying RECIST1.1 criteria could be identified in 52/63 patients (82.5%) and 113/132 (85.6%) of (re-)staging CT studies. Data were independently interpreted by three radiologists with > 4 years of experience who used specialized software (MintMedical) for standardized response assessment. Response was classified in complete or partial response (CR, PR), or stable or progressive disease (SD, PD), and stratified as progressive (PD) vs. non-progressive (CR, PR, SD).

RESULTS

Overall, readers agreed in terms of response classification in 58.4% of studies (66/113) and disagreed in 41.6% (47/113). In 50/113 studies, readers had chosen the same, and in 63/113 studies, readers had chosen different target lesions. Selection of the same target lesion was associated with an 88% rate (44/50) of agreement; selection of different target lesions was associated with a 74.6% rate (47/63) of disagreement. After dichotomizing response classes according to their therapeutic implication in PD vs. non-PD RECIST1.1 response classes, disagreement was observed in 17/113 staging examinations (15%). In 13 of these 17 patients (76.5%), readers had chosen different target lesions.

CONCLUSION

The basic assumption of standardized response assessment is that different readers should yield the same response classification for a given patient. In fact, however, different readers disagree in almost half of patient cases, and in 15%, they disagree even with regards to the basic distinction between PD vs. non-PD. Major source of variability appears to be the fact that different readers may choose different target lesions. The resulting variability between readers will not be compensated for by software tools for automated response assessment.

CLINICAL RELEVANCE/APPLICATION

Even with standardized RECIST readings and use of dedicated automated software, different radiologists will yield different results with regards to response classification, even with regards to broadly different categories (PD vs. non-PD).
**SSQ07**

**Gastrointestinal (Colon and Appendix)**

Thursday, Dec. 3 10:30AM - 12:00PM Location: E353C

**GI CT MR**

AMA PRA Category 1 Credits ™: 1.50  
ARRT Category A+ Credits: 1.50  
FDA  
Discussions may include off-label uses.

**Participants**
Andrea Laghi, MD, Rome, Italy (Moderator)  
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Speaker, Bayer AG  
Speaker, General Electric Company  
Koninklijke Philips NV  
Rizwan Aslam, MBBC, San Francisco, CA (Moderator)  
Research support, Bayer AG

**Sub-Events**

**SSQ07-01**  
**Diffusion-weighted MRI for Evaluating Ileocolonic Inflammation in Crohn' Disease**

Thursday, Dec. 3 10:30AM - 10:40AM Location: E353C

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Nothing to Disclose  
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Nothing to Disclose

**PURPOSE**
To assess the efficacy of Diffusion-weighted MRI (DWI) for evaluating ileocolonic inflammation in patients with Crohn's disease (CD).

**METHOD AND MATERIALS**
25 CD patients underwent MR enterography (MRE) with DWI using three b values of 50, 400 and 800 s/mm² and ileocolonoscopy within one month. The conventional MRE findings (including mural thickness, T2 weighted signal intensity and contrast enhancement) and DWI signal intensity in bowel segments were qualitatively scored from 0 to 3. Apparent diffusion coefficient (ADC) map was generated by using monoeponential model. Disease activity was scored by simple endoscopic score for Crohn's disease (SES-CD) immediately after each endoscopy and was graded as inactive (0-2) and active CD (≥3). The relationship between SES-CD and MRI results was analyzed. All MRI results were interpreted by two radiologists who blinded to clinical data independently.

**RESULTS**
Of the 102 evaluated segments (terminal ileum=20, colon/rectum=82), 55 segments were active CD. The ADCs of active CD were significantly lower than those of inactive CD (P < 0.001), while DWI scores were higher in active CD (P < 0.001). The SES-CD correlated closely with ADCs (r = -0.92, P < 0.001), followed by DWI scores (r = 0.88, P < 0.001), MRE+DWI scores (r = 0.88, P < 0.001) and MRE scores (r = 0.85, P < 0.001). ADCs discriminated between active and inactive CD with an area under the ROC curves of 0.99, followed by DWI scores (AUC=0.98), MRE+DWI scores (AUC=0.98) and MRE scores (AUC= 0.94). The threshold ADC of 1.59×10⁻³ mm²/s yielded 95.70% sensitivity and 96.40% specificity. Inter-observer agreements were good with regard to DWI scores (κ = 0.65, P<0.001) and ADC measurement (intra-class correlation coefficient=0.97, P < 0.001).

**CONCLUSION**
DWI and ADC correlate with disease activity in ileocolonic Crohn's disease with excellent diagnostic accuracy for differentiating active from inactive CD.

**CLINICAL RELEVANCE/APPLICATION**
DWI and ADC are conducive to assess disease activity of Crohn's disease.

**SSQ07-02**  
**Dual Energy Spectral CT for Assessing the Stages of Colon Cancer**

Thursday, Dec. 3 10:40AM - 10:50AM Location: E353C

Participants
Yang Chuangbo, MM, Xianyang City, China (Presenter)  
Nothing to Disclose  
Chenglong Ren, Shaxi, China (Abstract Co-Author)  
Nothing to Disclose  
Qi Yang, Xianyang, China (Abstract Co-Author)  
Nothing to Disclose  
Tian Xin, MM, Xianyang City, China (Abstract Co-Author)  
Nothing to Disclose  
Zhanli Ren, Xianyang, China (Abstract Co-Author)  
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Tian Qian, MM, Xianyang City, China (Abstract Co-Author)  
Nothing to Disclose  
Ma Guangming, MM, Xianyang City, China (Abstract Co-Author)  
Nothing to Disclose  
Taiping He, Xianyang, China (Abstract Co-Author)  
Nothing to Disclose

**PURPOSE**
To evaluate the value of dual energy spectral CT in assessing the stages of colon cancer.

**METHOD AND MATERIALS**
This study was approved by our ethics committee. We retrospectively analyzed 47 colon cancer patients who underwent
PURPOSE
Sung Hwan Jiyoung Seong Sook Sujin Participants
surgery and adjuvant chemotherapy. ceMDCT can demonstrate extramural venous invasion and is recommended for the initial evaluation of colon cancer before curative CLINICAL RELEVANCE/APPLICATION
EMVI may be used as a significant adverse feature to predict an increased risk of synchronous metastases in colon cancer patients. CONCLUSION
Quantitative parameters obtained in spectral CT in the arterial phase improve accuracy for differentiating well-differentiated and un-differentiated colon cancers.
CLINICAL RELEVANCE/APPLICATION
Quantitative iodine concentration measurement in spectral CT may be used to improve accuracy for the differentiation of well-differentiated and poorly and un-differentiated colon cancers.
SSQ07-04 Extramural Venous Invasion Detected by Contrast-enhanced Multiple-row Detectors Computed Tomography (ceMDCT) as a Predictor of Synchronous Metastases in Patients with Colon Cancer

Participants
Suxing Yang, Beijing, China (Presenter) Nothing to Disclose
Xun Yao, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Xinghe Song, Beijing, China (Abstract Co-Author) Nothing to Disclose
Yancheng Cui, Beijing, China (Abstract Co-Author) Nothing to Disclose
Yingjiang Ye, Beijing, China (Abstract Co-Author) Nothing to Disclose
Nan Hong, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Yi Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine whether extramural venous invasion (EMVI), detected by contrast-enhanced multiple-row detectors computed tomography (ceMDCT), can be used as an adverse feature to predict synchronous metastases in patients with colon cancer.

RESULTS
There were 18 well-differentiated cases (group A) and 20 poorly differentiated and 9 undifferentiated cases (group B). CT numbers on the 70keV images were statistically the same in both groups (48.6±49.03HU vs. 63.97±15.86HU, p>0.05). On the other hand, The IC, NIC and slope (k) values in AP for group A were significantly lower than those for group B (1.01±40.20mg/ml vs. 1.59±40.57mg/ml for IC; 0.12±40.03 vs. 0.19±40.09 for NIC; 1.41±40.29 vs. 2.03±40.85 for slope, all p<0.05). Using iodine concentration value of 1.13mg/ml in AP as a threshold, one could obtain an area-under-curve of 0.85 for ROC study with sensitivity of 81.8% and specificity of 71.4% for differentiating well-differentiated from poorly differentiated colon cancers. These values were significantly higher than the respective values of 72.7% and 64.3% with conventional CT numbers at 70keV.

CONCLUSION
To determine whether extramural venous invasion (EMVI), detected by contrast-enhanced multiple-row detectors computed tomography (ceMDCT), can be used as an adverse feature to predict synchronous metastases in patients with colon cancer.

METHOD AND MATERIALS
Patients with pathology-proven colon cancer from January 2009-December 2013 were included in this retrospective study. Patients with other malignancies and/or intussusception were excluded. Two radiologists reviewed patients’ ceMDCT images and reached a consensus on tumor classification and lymph node categorization in accordance with the American Joint Committee on Cancer (AJCC)-7th Edition. Furthermore, two radiologists reached a consensus regarding EMVI status, extramural tumor depth, and tumor location. Tumor and lymph node categories, and AJCC stage and tumor differentiation were determined from patients’ pathology records. Synchronous metastases were confirmed by whole body ceMDCT within 3 months after initial diagnosis or by surgery, if available. Chi-squared and Fisher’s exact tests were used to analyze the association between EMVI and tumor characteristics. Logistic regression analyses were performed to analyze whether EMVI status was a predictive factor of metastases in colon cancer.

RESULTS
250 patients were reviewed. EMVI was observed in 106 patients (106/250, 42.4%). In the EMVI-positive group, synchronous metastases were seen in 39 patients (39/106, 36.8%) while 10 (10/144, 6.9%) patients in the EMVI-negative group had confirmed metastases. EMVI was moderately associated with extramural tumor depth and AJCC stage (contingency coefficient 0.443 and 0.401 respectively, P<0.001), which were then excluded from all multivariable analyses. EMVI status and pathologic lymph node categories were demonstrated to be significant factors (Odds ratio 7.8 and 9.6, P<0.001) in predicting synchronous metastases.

CONCLUSION
EMVI may be used as a significant adverse feature to predict an increased risk of synchronous metastases in colon cancer patients.

CLINICAL RELEVANCE/APPLICATION
ceMDCT can demonstrate extramural venous invasion and is recommended for the initial evaluation of colon cancer before curative surgery and adjuvant chemotherapy.

SSQ07-05 Stercoral Perforation and Colorectal Cancer Perforation; Differentiating CT Features

Participants
Sujin Ko, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Seong Sook Hong, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jiyoung Hwang, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyun-Joo Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sung Hwan Bae, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the computed tomography (CT) signs associated with stercoral perforation and colorectal cancer perforation.

METHOD AND MATERIALS

From 8 years, all surgically and pathologically confirmed patients with stercoral perforation (n=8, mean age 68.3 years) or colon cancer perforation (n=11, mean age 66.3 years) were retrospectively reviewed by two board-certified radiologists blinded to the proven diagnosis. The following CT findings were evaluated and recorded for each patient: wall thickness of distal colon adjacent to perforation site, presence of fecaloma, eccentric bowel wall thickening at the distal portion of the perforation site, pattern of colon wall thickening and enhancement, length of thickened bowel wall, presence of fecaloma, degree of proximal colon dilatation, and pericolonic inflammation or presence of pericolonic abscess, and number of enlarged pericolonic lymph nodes. These findings were correlated with the pathologic diagnosis.

RESULTS

The mean thickness of the distal colonic wall adjacent to the perforation site was 13.6 mm in patients with colorectal cancer perforation and 5.1 mm with stercoral perforation, which was statistically different. There was a significant correlation between colorectal cancer perforation and eccentric wall thickening (p<0.01). CT findings of layered enhancing wall thickening (p<0.01) and presence of fecaloma in proximal colon (p<0.01) were significant findings for stercoral perforation. Patients with colorectal cancer displayed more pericolonic lymph nodes (mean 2.27, p<0.05).

CONCLUSION

Fecaloma in the proximal colon and layered enhancing wall thickening adjacent to perforation site are likely due to stercoral perforation. Eccentric bowel wall thickening at the distal portion of the perforation site with many enlarged pericolonic lymph nodes is most likely colorectal cancer perforation.

CLINICAL RELEVANCE/APPLICATION

Resection of the diseased segment of colon and exteriorization is sufficient for stercoral perforation, while extensive bowel resection with lymph node dissection is required for treatment of colorectal cancer perforation. Thus, distinguishing these two conditions and accurate preoperative diagnosis can facilitate early therapeutic management and improve survival.

SSQ07-06  Comparison of Diagnostic Performance of US Re-evaluation and CT Reassessment for Patients with Equivocal CT Findings of Acute Appendicitis

Thursday, Dec. 3 11:20AM - 11:30AM Location: E353C

Participants
Ji Ye Sim, MD, MS, Seongnam-Si, Korea, Republic Of (Presenter) Nothing to Disclose
Hyuk Jung Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Suk Ki Jang, Sungnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jae Woo Yeon, Sungnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Il Dong Kim, Sungnam, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
June-Sik Cho, MD, Daejeon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
So Ya Paik, Sungnam, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young Rock Ha, Sungnam, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To compare diagnostic performance between US re-evaluation and CT reassessment for patients with equivocal CT findings of acute appendicitis, overall and coexistent inflammation group

METHOD AND MATERIALS

Our Institutional Review Board approved this retrospective study and waived informed consent. 115 patients who had equivocal CT findings of acute appendicitis and underwent US re-evaluation were included. All CTs were reviewed independently by two abdominal radiologists. They analyzed four CT findings (appendiceal wall enhancement, appendiceal wall thickening, intraluminal air in appendix, and a coexistent inflammatory lesion) and made a diagnosis of acute appendicitis. In US analysis, patients were categorized into positive and negative appendicitis, based on previous structured US reports. The diagnostic performance of CT reassessment and US re-evaluation, interobserver agreement of CT findings and the likelihood of appendicitis were calculated.

RESULTS

The overall AUC, sensitivity and specificity of US re-evaluation (0.960, 100% and 92.1%) was higher than CT reassessment (reviewer 1: 0.697, 51.9% and 87.5%, reviewer 2: 0.759, 66.7% and 85.2%). In the coexistent inflammation group, the AUC, sensitivity and specificity of US re-evaluation (reviewer 1 and 2: 0.990, 100% and 98.0%) were also higher than CT reassessment (reviewer 1: 0.607, 27.3% and 94.1%, reviewer 2: 0.561, 14.3% and 98.0%). Interobserver agreement of diagnosing appendicitis and alternative diagnosis were moderate (κ=0.44 and 0.51).

CONCLUSION

For patients with equivocal CT findings of acute appendicitis, US re-evaluation shows better diagnostic performance than CT reassessment in both of overall and coexistent inflammation group.

CLINICAL RELEVANCE/APPLICATION

When patient have equivocal findings of appendicitis on CT, US re-evaluation can improve diagnostic accuracy.

SSQ07-07  CT Differentiation of the Non-Mucocele Type Appendiceal Neoplasm: Benign versus Malignant

Thursday, Dec. 3 11:30AM - 11:40AM Location: E353C

Participants
Youngjong Cho, Seongnam, Korea, Republic Of (Presenter) Nothing to Disclose
Hyuk Jung Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Suk Ki Jang, Sungnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jae Woo Yeon, Sungnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
**PURPOSE**

The purpose of this study was to evaluate the feasible CT findings for differentiating malignant from benign lesions in cases of non-mucocele type appendiceal neoplasms.

**METHOD AND MATERIALS**

All consecutively registered patients with pathologic confirmed appendiceal neoplasms and pre-operative CT scans (n=60) were obtained over a 14-year period from January 2000 through December 2014. Of these patients, borderline malignancy (n=28) and mucocele type appendiceal neoplasm (n=4) were eliminated by pathologic reports and the remaining 28 patients with non-mucocele type appendiceal neoplasm finally formed the study sample. The patients were classified into benign and malignant group depending on their pathologic reports. The colonic type adenoma (n=3), mucinous cystadenoma (n=10), benign appendiceal neuroendocrine tumor (n=4), and ganglioneuroma (n=1) were included in the benign group and the colonic type adenocarcinoma (n=4), malignant appendiceal neuroendocrine tumor (n=3), lymphoma (n=1) and metastasis (n=2) formed into the malignant group. Two experienced radiologists analyzed the presence of mass, irregular wall thickening, perforation, cecal wall thickening, appendicolith, peritoneal thickening, ascites, lymphadenopathy suggestive of malignancy, and periappendiceal fat infiltrations in consensus reading. The CT results were compared for malignant and benign groups.

**RESULTS**

CT showed statistically significant difference in irregular wall thickening, presence of mass and perforation between the benign and malignant groups (p<0.05). Cecal wall thickening, appendicolith, peritoneal thickening, ascites, lymphadenopathy suggestive of malignancy, and periappendiceal fat infiltrations did not exhibit significant difference between the benign and malignant groups (p>0.05).

**CONCLUSION**

It is difficult to distinguish underlying malignancy from benign condition, regarding non-mucocele type appendiceal neoplasm. However, irregular wall thickening, presence of mass and perforation can be useful CT features associated with malignancy.

**CLINICAL RELEVANCE/APPLICATION**

Irregular wall thickening, presence of mass, and perforation can be applicable CT features in the pre-operative diagnosis of underlying malignancy concerning non-mucocele type appendiceal neoplasm.

**SSQ07-08 Preoperative CT Predictors Associated with 30-day Adverse Events in Patients with Appendiceal Inflammatory Masses that Underwent Immediate Appendectomies**

**Thursday, Dec. 3 11:40AM - 11:50AM Location: E353C**

Participants

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Heon-Ju Kwon, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate preoperative CT predictors that are associated with 30-day adverse events in patients that underwent an immediate appendectomy for appendiceal inflammatory masses.

**METHOD AND MATERIALS**

One hundred forty-four patients who underwent immediate appendectomy, and were diagnosed with an appendiceal inflammatory mass by the preoperative CT examination, were included. The main outcome was the 30-day adverse events. Patient demographics, preoperative CT and laboratory parameters were evaluated. Factors associated with 30-day adverse events were assessed using logistic regression analysis.

**RESULTS**

A total of 22 (15%) of the 144 patients had 30-day adverse events: 10 intra-abdominal abscesses, three wound infections, two cases of peritonitis, two small bowel obstructions, two intra-abdominal abscesses with peritonitis, one intra-abdominal abscess with wound infection, one intra-abdominal abscess with obstructed ileus, and one case of peritonitis with obstructed ileus. In univariate analysis, the presence of appendicolith (odds ratio [OR], 2.49; p = 0.048), and obstructed ileus (OR 3.79; p = 0.01) were associated with adverse events. Obstructed ileus (adjusted OR, 3.05; p = 0.04) was the only independent preoperative predictor associated with 30-day adverse events in patients with appendiceal inflammatory masses.

**CONCLUSION**

Obstructed ileus was an independent preoperative CT predictor associated with 30-day adverse events in patients that underwent immediate appendectomy for appendiceal inflammatory masses.

**CLINICAL RELEVANCE/APPLICATION**

Non-operative approach, such as percutaneous drainage or use of antibiotics might be considered if obstructive ileus was accompanied preoperatively in patients having appendiceal inflammatory mass.

**SSQ07-09 Initial Performance of Radiologists and Radiology Residents in Interpreting Low-dose (2-mSv) Appendiceal CT**

**Thursday, Dec. 3 11:50AM - 12:00PM Location: E353C**

Participants

Hyun Kyung Yang, MD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
PURPOSE
To prospectively evaluate the initial diagnostic performance and learning curve of a community of radiologists and residents in interpreting 2-mSv appendiceal CT.

METHOD AND MATERIALS
The institutional review boards approved the study. We included 46 attending radiologists and 153 radiology residents from 22 hospitals, who completed an online training course of 30 2-mSv CT cases. Appendicitis was confirmed in 14 cases. Most of the readers had limited (≤ 10 cases, n = 32) or no (n = 118) prior exposure to low-dose (LD) appendiceal CT. The order of cases was randomized for each reader. Multi-reader multi-case receiver operating characteristic (ROC) analysis was performed. Generalized estimating equations were used to model the learning curves in diagnostic performance.

RESULTS
Diagnostic performance gradually improved with years of training. Average area under the ROC curve was 0.94 (95% confidence interval, 0.90, 0.98) 0.92 (0.88, 0.96), 0.90 (0.85, 0.96), and 0.86 (0.80, 0.92), for the attending radiologists, senior residents, second-year residents, and first-year residents, respectively. We did not observe any notable intra-reader learning curves over the training course of the 30 cases, except for a decrease in reading time. Diagnostic accuracy and sensitivity were significantly affected by the reader training level and prior overall experience with appendiceal CT, but not by the prior specific exposure to LD appendiceal CT.

CONCLUSION
The learning curve is likely prolonged and forms gradually over years by overall radiology training and clinical experience in general rather than by the exposure to LD appendiceal CT specifically.

CLINICAL RELEVANCE/APPLICATION
The clinical implementation of 2-mSv CT may be feasible in many hospitals, assuming qualified site radiologists can carefully supervise the practice. The learning curve is likely prolonged and forms gradually over years by overall radiology training and clinical experience in general rather than by the exposure to LD appendiceal CT specifically. Performance improves with years of CT experience, with senior residents' performance nearly matching that of attending radiologists.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Perry J. Pickhardt, MD - 2014 Honored Educator
Gastrointestinal Keynote Speaker: New MRI Techniques in the Abdomen

Thursday, Dec. 3 10:30AM - 10:40AM Location: E353A

Participants
Hero K. Hussain, MD, Ann Arbor, MI (Moderator) Nothing to Disclose
Bachir Taouli, MD, New York, NY (Moderator) Consultant, Guerbet SA
Scott B. Reeder, MD, PhD, Madison, WI (Moderator) Institutional research support, General Electric Company Institutional research support, Bracco Group

Shortened Breath-hold Contrast-enhanced MRI of the Liver Using a New Parallel Imaging Technique, CAIPIRINHA (Controlled Aliasing in Parallel Imaging Results in Higher Acceleration): A Comparison with Conventional GRAPPA Technique

Thursday, Dec. 3 10:40AM - 10:50AM Location: E353A

Participants
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Yoshiyuki Ozawa, MD, PhD, Nagoya, Japan (Abstract Co-Author) Nothing to Disclose
Yuta Shibamoto, MD, PhD, Nagoya, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
Respiratory motion artifact is one of the major causes of image degradation in dynamic contrast-enhanced imaging of the abdomen. The parallel imaging (PI) technique can decrease the acquisition time but lead to PI artifacts and a loss of signal-to-noise ratio (SNR) at a high acceleration factor (AF). They depend heavily on the geometry of the coil array used and various vendor-specific PI reconstruction techniques. The purpose of this study was to examine whether the shortened breath-hold 3-dimensional volumetric interpolated breath-hold examination (3D-VIBE) sequence for high AF using the controlled aliasing in parallel imaging results in higher acceleration (CAIPIRINHA) technique could substitute for the conventional sequence using generalized autocalibrating partially parallel acquisition (GRAPPA) in patients undergoing routine gadoxetic acid-enhanced liver MRI.

METHOD AND MATERIALS
30 patients with clinically suspected focal liver lesions were scanned using 3D-VIBE sequences with GRAPPA with AF=2 and AF=4 and CAIPIRINHA with AF=4 (acquisition times: 21, 14, and 12 seconds, respectively) at the same spatial resolution during the hepatobiliary phase on a 3T MRI scanner. Visual evaluations using a 3- or 5-point scale and SNR analysis were performed for the 3 sequences.

RESULTS
For CAIPIRINHA with AF=4, there was significantly less image noise in both visual evaluation and SNR analysis and fewer PI artifacts than for GRAPPA with AF=4 (P<0.0005); it was equal to GRAPPA with AF=2, and had fewer motion artifacts than GRAPPA with AF=2 and 4 (P<0.0012). The liver edge sharpness and hepatic vessel clarity, lesion conspicuity, and overall image quality were rated significantly higher with CAIPIRINHA with AF=4 than GRAPPA with AF=2 and AF=4 (P<0.009). For GRAPPA with AF=4, lesion conspicuity and overall image quality were rated significantly lower than for GRAPPA with AF=2 (P<0.012).

CONCLUSION
The shortened breath-hold 3D-VIBE sequence using the new CAIPIRINHA technique with a high AF of 4 was superior to the conventional GRAPPA sequence. The shortened breath-hold sequence using GRAPPA with a high AF of 4 worsened the image quality and lesion conspicuity.

CLINICAL RELEVANCE/APPLICATION
The shortened breath-hold 3D-VIBE sequence using the CAIPIRINHA with a high AF of 4 can reduce the acquisition time to almost half without significantly increasing image noises and artifacts.
**SSQ08-03** New Quiet MR Sequences in Clinical Routine: First Experience in Abdominal Imaging

**Participants**
Sebastian Fischer, MD, Frankfurt, Germany (Presenter) Nothing to Disclose  
Markus Domschke, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose  
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose  
Claudia Frellesen, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose  
Patricia Dewes, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose  
Jan-Erik Scholtz, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose  
Stefan Zangos, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Purpose of our study was to demonstrate the feasibility and limitations of acoustic noise reduction in a standard clinical MRI protocol for abdominal imaging.

**METHOD AND MATERIALS**
The acoustic noise and image quality were assessed for a standard liver imaging protocol including TSE and GRE sequences and compared to a protocol with new quiet optimizations in 17 patients with suspected liver lesions (10 men, 7 women; 58.7±12.0 years). For each sequence the SI, SNR and CNR were measured. Two independent, blinded readers with a different level of training interpreted both examinations, while scoring artefacts, the overall image quality, the delineation of the abdominal organs and the level of confidence in visualization of the anatomy and pathologies. Afterwards a side-by-side comparision for readers’ image preference was performed. The results of the sound level measurements, the SI, SNR and CNR were compared in a paired comparative t-test using Holm-Sidak method. The Wilcoxon rank test determined differences in readers ratings and their level of agreement was derived from Spearman correlations.

**RESULTS**
Significant reduction of acoustic noise was measured for T2 TSE (-5.16 dBA) and T2 HASTE (-3.75 dBA) and less differences for T1 FLASH (-0.42 dBA) and T1 DIXON (-0.29 dBA). SI, SNR and CNR were significantly lower for quiet T2 TSE (-11.3%, -18.0%, -23.1%) and T2 HASTE (-25.4%, -46.2%, -37.7%) and higher for T1 DIXON (+4.6%, +32.0%, +24.4%). All sequences were independently rated with an comparable image quality and confidence in visualization of the anatomy and pathologies against the standard sequences, except from the quiet T1 FLASH sequences (structure identification -29.5%, diagnostic confidence -37.5%). Accordingly in the side-by-side comparision standard T1 FLASH sequences were strongly preferred against new quiet sequences, while less preference was observed for T2 TSE and T2 HASTE and no difference in T1 DIXON sequences. Inter-rater correlation was k=0.987 with p<0.001.

**CONCLUSION**
An acoustic noise reduction was achieved with the new quiet optimizations while maintaining diagnostic quality and confidence in T2 TSE, T2 HASTE and T1 DIXON sequences. The quiet T1 FLASH sequence seems not to be comparable with regard image quality and diagnostic confidence.

**CLINICAL RELEVANCE/APPLICATION**
The results can be used to render MRI scans more patient-friendly in clinical practice, in particular for young, scared or elderly patients.

**SSQ08-04** Intravoxel Incoherent Motion Diffusion-weighted Imaging is a Better Indicator of High Grade Hepatocellular Carcinoma Than Conventional Apparent Diffusion Coefficient

**Participants**
Shintaro Ichikawa, MD, Chuo-Shi, Japan (Presenter) Nothing to Disclose  
Utaro Motosugi, MD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose  
Hiroyuki Morisaka, MD, Kofu, Japan (Abstract Co-Author) Nothing to Disclose  
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Tomoki Ichikawa, MD, PhD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose  
Hirosi Onishi, MD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To evaluate the utility of intravoxel incoherent motion (IVIM) derived parameters for discrimination of histological grade of hepatocellular carcinoma (HCC). Measurement reproducibility was also studied by assessing inter- and intra-reader variation.

**METHOD AND MATERIALS**
Fifty-eight patients with 60 pathologically confirmed HCCs underwent IVIM imaging with 11 b values (0-1000 s/mm²). The diffusion parameters, i.e., apparent diffusion coefficient (ADC), slow diffusion coefficient (D), fast diffusion coefficient (D*), and perfusion fraction (f) were calculated for all HCCs. All measurements were performed by two radiologists, and one of them repeated the measurements after a 4-week interval to minimize memory bias. These parameters were compared between lesions with high and low-to-moderate histologic grade using Wilcoxon test. Further, receiver operating characteristic (ROC) analysis was performed to evaluate the discrimination ability, and inter- and intra-reader agreements were analyzed with intraclass correlation coefficients (ICC).

**RESULTS**
The D and D* values (%x10⁻³ mm²/s) were both significantly lower in high grade HCC than in low-to-moderate grade HCC for both observers (P<0.0183) (D = 0.78 vs. 0.98 [reader 1-1st], 0.73 vs. 0.96 [reader 1-2nd], and 0.76 vs. 0.96 [reader 2]; and D* = 24.5 vs. 39.7 [reader 1-1st], 22.7 vs. 40.7 [reader 1-2nd], and 23.5 vs. 37.0 [reader 2]). The ADC values (%x10⁻³ mm²/s) measured by reader 1-1st and f (%) measured by reader 1-2nd also showed a statistical difference (ADC = 0.99 vs. 1.14, and f = 27.1 vs. 21.8, P < 0.0129). The ROC analysis demonstrated that the D value had significantly greater Az values than the ADC for...
discriminating high grade HCC from low-to-moderate grade HCC (0.859 vs. 0.753 [reader 1-1st], 0.885 vs. 0.635 [reader 1-2nd], and 0.816 vs. 0.651 [reader 2], P < 0.047). The inter- and intra-reader ICC values were excellent for D (0.814 and 0.851) and good for other parameters (ADC, 0.786 and 0.732; D*, 0.688 and 0.724; f, 0.689 and 0.623).

CONCLUSION
The IVIM-derived D values showed a significantly better diagnostic performance than the ADC values in differentiating high grade HCC from low-to-moderate grade HCC. The results by the two readers and repeated measurements by one reader are reproducible, especially for the D value.

CLINICAL RELEVANCE/APPLICATION
D values derived from IVIM modeling may be helpful in the preoperative differentiation of the histologic grade of HCC.

SSQ08-05  Quantification of Liver Fibrosis by T1rho MR - Phantom Validation and Pilot In-Vivo Imaging at 3T

Thursday, Dec. 3 11:10AM - 11:20AM Location: E353A

Participants
David T. Fetzer, MD, Dallas, TX (Presenter) Nothing to Disclose
Xiang He, PhD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Alessandro Furlan, MD, Pittsburgh, PA (Abstract Co-Author) Author, Reed Elsevier; Research Grant, General Electric Company
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PURPOSE
To assess the performance of T1rho MR in noninvasive fibrosis quantification through protein phantom validation, healthy subject reproducibility testing, and liver disease patient imaging.

METHOD AND MATERIALS
This prospective study was HIPAA-compliant and IRB-approved. T1rho imaging was performed on a Siemens MAGNETOM Trio 3T scanner with a phased-array body coil. Single-slice measurements were obtained using spin-lock preparation ranging from 10-80 msec followed by a balanced steady state free precession readout. T1rho values were calculated by single exponential fitting of the signal decay profile. Phantoms containing various concentrations of polysaccharides and proteins (cross-linked bovine serum albumin) were imaged. 19 healthy subjects (12M, 7F, mean age 30) were recruited; 11 liver disease subjects (8M, 3F, mean age 50) were enrolled following liver biopsy (fibrosis stages F1=2; F2=5; F3=2; F4=2). Correlation (Pearson r) was calculated between T1rho value and fibrosis stage, inflammatory grade, and degree of steatosis, as well as time since last meal and days since last alcoholic beverage.

RESULTS
In phantoms, T1rho values correlated strongly with protein concentration (r=0.97), further validating T1rho quantification. Good inter- and intra-subject reproducibility was demonstrated in healthy volunteers. In liver disease subjects, good correlation was found between T1rho and fibrosis stage (r=0.74). No significant correlation between T1rho and inflammatory activity was found (r=-0.26). There was a moderate negative correlation with degree of steatosis (r = -0.66). There was no significant correlation with hours since last meal or days since last drink (r=0.12 and 0.16, respectively).

CONCLUSION
T1rho quantification was validated using a protein solution phantom. T1rho hepatic imaging is feasible at 3T in human subjects and values appear unaffected by food or alcohol intake. A positive correlation with fibrosis stage in disease subjects was found.

CLINICAL RELEVANCE/APPLICATION
T1rho values appear to correlate with macromolecular concentration and may provide an additional tool for noninvasive quantification of fibrosis, an important indicator of chronic liver disease severity.

SSQ08-06  Rectal Cancer: Short-Term Reproducibility of Intravoxel Incoherent Motion Parameters at 3.0T MR

Thursday, Dec. 3 11:20AM - 11:30AM Location: E353A

Participants
Hongliang Sun, MD, Beijing, China (Presenter) Nothing to Disclose
Yanyan Xu, Beijing, China (Abstract Co-Author) Nothing to Disclose
Wu Wang, MD, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the short-term test-retest reproducibility of IVIM (intravoxel incoherent motion) parameters of rectal cancer at 3.0T MR.

METHOD AND MATERIALS
This prospective study was HIPAA-compliant and IRB-approved. T1rho imaging was performed on a Siemens MAGNETOM Trio 3T scanner with a phased-array body coil. Single-slice measurements were obtained using spin-lock preparation ranging from 10-80 msec followed by a balanced steady state free precession readout. T1rho values were calculated by single exponential fitting of the signal decay profile. Phantoms containing various concentrations of polysaccharides and proteins (cross-linked bovine serum albumin) were imaged. 19 healthy subjects (12M, 7F, mean age 30) were recruited; 11 liver disease subjects (8M, 3F, mean age 50) were enrolled following liver biopsy (fibrosis stages F1=2; F2=5; F3=2; F4=2). Correlation (Pearson r) was calculated between T1rho value and fibrosis stage, inflammatory grade, and degree of steatosis, as well as time since last meal and days since last alcoholic beverage.

RESULTS
In phantoms, T1rho values correlated strongly with protein concentration (r=0.97), further validating T1rho quantification. Good inter- and intra-subject reproducibility was demonstrated in healthy volunteers. In liver disease subjects, good correlation was found between T1rho and fibrosis stage (r=0.74). No significant correlation between T1rho and inflammatory activity was found (r=-0.26). There was a moderate negative correlation with degree of steatosis (r = -0.66). There was no significant correlation with hours since last meal or days since last drink (r=0.12 and 0.16, respectively).

CONCLUSION
T1rho quantification was validated using a protein solution phantom. T1rho hepatic imaging is feasible at 3T in human subjects and values appear unaffected by food or alcohol intake. A positive correlation with fibrosis stage in disease subjects was found.

CLINICAL RELEVANCE/APPLICATION
T1rho values appear to correlate with macromolecular concentration and may provide an additional tool for noninvasive quantification of fibrosis, an important indicator of chronic liver disease severity.
RESULTS

Resonance imaging (DCE-MRI) by the pharmacokinetic parameters' repeatability. To investigate necessity of three-dimensional non-rigid registration application in hepatic dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) by the pharmacokinetic parameters' repeatability. The repeatability coefficient and Bland-Altman biases were 11.1%, 55.4%, 40.3%; 1.0%, -8.0%, 2.9%, respectively. The repeatability coefficient and Bland-Altman biases for D, f and D* were 47.3%, 126.3%, 197.4% and 10.9%, -21.6%, 20.1%, respectively with short-term test and retest DW-MR scan.

CONCLUSION

Relatively good reproducibility of D value measurement were observed in rectal cancer between short-term test and retest IVIM imaging, compared to f and D* values. The IVIM parameters (f and D*) showed large repeatability coefficient and extent of 95% confidence interval. More efforts should be invested to improve the measurement reproducibility of IVIM parameters in rectal cancer.

CLINICAL RELEVANCE/APPLICATION

The Intravoxel Incoherent Motion (IVIM)-derived parameters are increasingly used for clinical management decisions in rectal cancer. However intravoxel incoherent motion (IVIM) parameters (f and D*) showed worse measurement reproducibility compared to D. In serial DW-MRI for rectal cancer evaluation such as treatment response, measurement variations should be considered.

SSQ08-07 Semi-quantitative Assessment of Respiratory Motion Compensation Techniques in T2-weighted Abdominal MR Imaging Using a Novel MRI-compatible Motion Platform

Thursday, Dec. 3 11:30AM - 11:40AM Location: E353A

Participants
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Rajiv Chopra, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Ivan Pedrosa, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE

For T2-weighted (T2) fast spin echo imaging of the abdomen, multishot (MSFSE) may be preferred over faster single shot (SSFSE) because of superior contrast-to-noise, increased sharpness and spatial resolution. However, studies evaluating the effect of motion on T2W strategies are lacking. Our goal was to assess the effects of respiratory motion on various k-space sampling and motion compensation approaches, utilizing a novel motion-simulating platform.

METHOD AND MATERIALS

Respiratory waveforms were recorded in a healthy volunteer by tracking diaphragm excursion during breath-hold, diaphragmatic drift, cough, and free-breathing. Waveforms were used to drive a computer-controlled MRI-compatible motion platform. Using a 3T Philips Ingenia and a 32-element phased-array coil, T2 axial images of a torso phantom were acquired during simulated respiratory motion using SSFSE, interleaved (iMSFSE) and sequential (sMSFSE) MSFSE, and a new MultiVane XD (MVXD) acquisitions. These were repeated during simulated free breathing without and with respiratory trigger (RT) and navigator (NAV) motion compensation. Three fellowship-trained radiologists, blinded to acquisition used, independently assessed motion artifacts, clarity of edges, signal uniformity, slice registration, and overall quality using a 5-point scale. Scores for each radiologist were normalized and analyzed by one-way ANOVA for equality of mean scores between acquisitions.

RESULTS

Imaging scores during breath-hold and cough showed no significant differences between acquisitions. During diaphragmatic drift and free breathing (without/with RT and NAV), SSFSE scores of motion artifacts, signal uniformity, and overall quality were superior to those of iMSFSE and sMSFSE, and statistically different (p<0.01). MVXD had better scores than iMSFSE and sMSFSE for all categories with RT and for motion artifact and signal uniformity with NAV, and these differences were significant (p<0.01).

CONCLUSION

Our novel MRI-compatible motion phantom allows detecting differences in the effects of respiratory motion in various k-space sampling and respiratory compensation techniques for T2W abdominal MRI. SSFSE and novel acquisitions such as MVXD resulted in better image quality scores.

CLINICAL RELEVANCE/APPLICATION

Phantom motion simulation studies enable systematic quality assessment of MR acquisitions during motion and facilitate development and validation of new motion-compensated MR imaging techniques.

SSQ08-08 Is 3D Non-rigid Registration Necessary in Hepatic DCE-MRI: A Repeatability Study

Thursday, Dec. 3 11:40AM - 11:50AM Location: E353A

Participants
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Jian Lu, Nantong, China (Abstract Co-Author) Nothing to Disclose
Peng Cao, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate necessity of three-dimensional non-rigid registration application in hepatic dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) by the pharmokinetic parameters' repeatability.

RESULTS

p=0.088, p=0.112), and the corresponding repeatability coefficient and Bland-Altman biases were 11.1%, 55.4%, 40.3%; 1.0%, -8.0%, 2.9%, respectively. The repeatability coefficient and Bland-Altman biases for D, f and D* were 47.3%, 126.3%, 197.4% and 10.9%, -21.6%, 20.1%, respectively with short-term test and retest DW-MR scan.
There is significant difference between means of discrepant pixels' value pre and post registration data in same slice (t=2.637, p<0.05). RPD box chart showed that mean of inter- and intra [Ktrans], [kep] and [Ve] of lesion, liver and sacrospinal muscle after registration was smaller than that before registration. Outliers and extreme value were reduced or disappeared for most pharmacokinetic parameters in pre and post registration comparison, with the exception of the [Ve] from liver in interobserver comparison (number of outliers pre/post- registration:0/3) and [kep] from lesion in intraobserver comparison (number of outliers pre/post- registration: 2/3). Repeatability of [Ktrans] and [kep] measured from lesion, liver and sacrospinal muscle was improved after registration in both inter- and intra-measurements. Concordance correlation coefficient (CCC) of [Ktrans], [kep],[Ve] obtained from lesion, sacrospinal muscle was augmented in post -registration group than that of in pre group(for example, CCC of interobserver comparison pre/post- registration:0.5561/0.8510).

CONCLUSION
The 3D non-rigid registration is relatively useful to improve the repeatability of pharmacokinetic parameters and necessary in hepatic DCE-MRI.

METHODS
This prospective study was approved by the institutional review board. 18 patients with confirmed hepatocellular carcinoma underwent DCE-MRI examination. We applied a 3D non-rigid registration on the dynamic enhanced sequence and pharmacokinetic parameters such as transfer constant [Ktrans], rate constant [kep], and relative extravascular extracellular space [Ve] were obtained with a Reference Model. Firstly, we compared the value of each pixel in the same slice of pre and post-registration images and all the images in dynamic phases were studied. Paired t-test was used to evaluate the discrepant pixels in this two groups. [Ktrans], [kep] and [Ve] value of lesion, liver and sacrospinal muscle were obtained by the mean value of the fixed ROI in the same slice. Then, their values of pre and post registration groups were compared by using relative percent difference(RPD) and The Bland-Altman Plot method. Inter- and intra variations, repeatability and concordance correlation were performed for DCE-MRI quantitative parameters.

SSQ08-09  
Limitations of Gd-EOB-DTPA-enhanced MRI: Can Clinical Parameters Predict Suboptimal Hepatobiliary Phase?

Participants

Victoria Chernyak, MD, Bronx, NY (Presenter) Nothing to Disclose
Milana Fiusberg, MD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
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Viktoriya Paroder, MD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Alla M. Rozhenblit, MD, Bronx, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
Hepatobiliary phase (HBP) of Gd-EOB-DTPA-enhanced MRI offers additional information not available with extracellular Gd agents. According to Liver Imaging Reporting and Data System (LI-RADS), adequate HBP is essential for reliable characterization of observations relative to the liver parenchyma. LI-RADS deems HBP to be adequate when liver parenchyma is unequivocally hyperintense relative to intrahepatic vessels. Suboptimal HBP would negate the advantage of Gd-EOB-DTPA. Thus, accurate prospective identification of patients who would have suboptimal HBP would be helpful in clinical practice. The goal of this study was to establish cut-off levels for clinical parameters which would predict suboptimal HBP.

METHOD AND MATERIALS
This retrospective study included patients with chronic liver disease who had hepatocellular carcinoma screening with Gd-EOB-DTPA-enhanced MRI between 1/1/11-3/1/13. For each case HBP was rated as adequate or suboptimal, based on LI-RADS criteria. The following laboratory data obtained within 3 months of MRI date was extracted: total bilirubin (TB), direct bilirubin (DB), serum glutamic oxaloacetic transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT) and alkaline phosphatase (ALP). Model For End-Stage Liver Disease (MELD) scores were calculated as 3.78×ln[TB] + 11.2×ln[INR] + 9.57×ln[creatinine] + 6.43. Receiver operating curve (ROC) analysis was used to establish cut-off values for predicting suboptimal HBP.

RESULTS
Of 179 patients, 158 (88.3%) patients (91 [57.6% male) had adequate HBP and 21 (11.7%) patients (13 [61.9%] male) had suboptimal HBP, mean ages 57.7 [±9.9] years and 52.7 [±14.4] years, respectively (p=0.140). Areas under the curve for predicting suboptimal HBP were 0.86 (95%CI 0.78-0.94) for MELD score, 0.87 (95%CI 0.80-0.95) for TB, 0.92 (95%CI 0.86-0.97) for DB, 0.58 (95%CI 0.46 - 0.69) for SGOT, 0.39 (95%CI 0.27 - 0.51) for SGPT. Accuracy, positive likelihood ratios and cut-off values for predicting suboptimal HBP were, respectively: 88.6% and 11.5 for MELD score ≥16.7, 90.0% and 35.5 for TB ≥4.3 mg/dL, 92.9% and 71.0 for DB ≥1.3 mg/dL.

CONCLUSION
Values above cut-off levels of MELD score, direct and total bilirubin can predict suboptimal hepatobiliary phase with high accuracy.

CLINICAL RELEVANCE/APPLICATION
Prospective identification of patients with high likelihood of suboptimal HBP can help avoid administering a more costly agent to patients who would not benefit from its unique properties.
PURPOSE

Although follow-up CT or MRI has been advised for further evaluation of incidental hyperechoic renal lesions on ultrasound (US), this approach is variably followed in clinical practice given the lack of robust data to guide optimal follow-up recommendations. Thus, the purpose of our study was to determine the outcomes of incidental hyperechoic renal lesions measuring ≤ 1cm based on a large single-center cohort in order to better inform management strategies for such lesions.

METHOD AND MATERIALS

We retrospectively identified 161 hyperechoic renal lesions on US measuring ≤ 1cm (mean size 0.7 ± 0.2 cm) that had either (a) a follow-up CT or MRI or (b) at least 2 year follow-up by US. Mean patient age was 63 ±13 years (range 30-88 years). The initial US and follow-up imaging were reviewed to assess for a change in size or definitive lesion characterization.

RESULTS

Follow-up imaging consisted of US in 23.0% (37/161), CT in 45.3% (73/161) and MRI in 31.7% (51/161). 57.1% (92/161) of lesions were confirmed as angiomyolipomas on CT or MRI. 19.9% (32/161) showed less than 4mm growth on long-term US follow-up (mean 62±26 months, range 24-110 months). 11.8% (19/161) had no correlate on CT or MRI. 6.2% (10/161) were too small to definitively characterize on CT. 3.1% (5/161) were not visualized on follow-up US. CT characterized one lesion (0.6%) as a stone and one lesion (0.6%) as a hyperdense cyst. One lesion (0.6%) on CT was an enhancing solid mass without macroscopic fat, presumed to represent an RCC, although was lost to follow-up. This lesion was not as hyperechoic as the renal sinus fat on the initial US.

CONCLUSION

The overwhelming majority of hyperechoic renal lesions ≤ 1cm with the classic US appearance of an angiomyolipoma were benign or stable on follow-up imaging. Thus, these lesions may not warrant any further imaging evaluation.

CLINICAL RELEVANCE/APPLICATION

To our knowledge, we have provided the largest study to date to assess outcomes of small hyperechoic renal lesions on follow-up imaging that support the benignity of this US finding.
Our retrospective study included 1315 consecutive patients who received surgery for single sporadic RCC and had adequate pre-operative CT for analysis. The cystic proportion of RCC was calculated on pre-operative CT by a radiologist. The optimal cut-off of cystic proportion in RCC was explored by locating the minimum P value on log rank test regarding cancer-specific survival. The RCCs were categorized as cystic and non-cystic groups according to (1) conventional cut-off (i.e. proportion of cystic component ≥ 75%) and (2) the optimal cut-off, and then cancer-specific and recurrence-free survival rates were compared between the two groups. The clinical, pathologic, and imaging variables were analyzed using the Cox regression analysis to determine the independent predictor of cancer-specific survival.

RESULTS

Of the 1315 RCCs, 107 (8.1%) were identified as cystic RCCs using the conventional cut-off. During a median follow-up of 4.9 years, patients with cystic RCC revealed neither metastasis nor recurrence after surgery. The cancer-specific and recurrence-free survival rates of cystic RCCs were significantly better than those of non-cystic RCCs (both P < 0.001). In association with cancer-specific survival rate, the optimal cut-off of cystic proportion in RCC was 45%, and 197 (15.0%) patients were defined as cystic RCCs accordingly. On multivariate Cox regression analysis, cystic RCC defined by the optimal cut-off (45%) was one of the independent predictors of cancer-specific survival (hazard ratio, 0.34; P = 0.03).

CONCLUSION

Cystic RCCs defined on pre-operative CT are associated with low metastatic potential and favorable outcomes after surgery. Furthermore, the optimal cut-off of cystic proportion in association with cancer-specific survival is 45%.

CLINICAL RELEVANCE/APPLICATION

Cystic renal cell carcinomas (RCCs) defined by preoperative CT may be managed differently from non-cystic RCCs for selecting optimal treatment methods.

SSQ09-04 The Radiogenomic Risk Score: Construction of a Prognostic Quantitative, Noninvasive Image-based Molecular Assay for Renal Cell Carcinoma

Thursday, Dec. 3 11:00AM - 11:10AM Location: E353B

Participants
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PURPOSE

Quantitative multi-gene assays are effective clinical decision making tools in oncology, however cost, risks associated with tissue procurement, and difficulty in framing subcellular information within a larger physiological context limits their overall utility. We evaluated the feasibility of reconstructing quantitative non-invasive molecular assays (NIMA) in clear cell renal cell cancer (ccRCC) using data extracted from a single computed tomography (CT) scan.

METHOD AND MATERIALS

In this IRB approved study, gene expression profile data and contrast enhanced CT scans from 70 ccRCC patients in a training set were initially analyzed. A NIMA for a previously validated ccRCC-specific SPC prognostic gene signature was constructed termed the Radiogenomic Risk Score (RRS), using the microarray data and a 28 trait image array to evaluate each CT scan using multiple regression of gene expression analysis. The predictive power of the RRS NIMA was then prospectively validated in an independent dataset (n=77) to confirm its relationship to the SPC gene signature and to quantify individual risk.

RESULTS

Our quantitative NIMA faithfully represents the tissue-based molecular assay it models. The RRS scaled with the SPC gene signature (R=0.57, p=6.2e-4, classification accuracy 70.1%, p<0.001) and predicted disease-specific survival (log rank p<0.001). Independent validation confirmed the relationship between the RRS and the SPC gene signature (R=0.45, p=1.3e-4, classification accuracy 68.6%, p<0.001) and disease-specific survival (log-rank p<0.001) and that it was independent of stage, grade and performance status (multivariate Cox model p=0.05, log-rank p=0.001).

CONCLUSION

A NIMA for the ccRCC-specific SPC prognostic gene signature that is predictive of disease-specific survival and independent of stage was constructed and validated confirming that quantitative NIMA construction is feasible.

CLINICAL RELEVANCE/APPLICATION

Non-invasive molecular assays can be constructed that efficiently capture both pre-specified quantitative molecular phenotypes as well as systems-level phenotypes not accessible by genomic-based tests alone, with a range of potential clinical applications including prognostication and patient stratification in human clinical trials.

SSQ09-05 CAD Derived Absolute Attenuation Discriminates Clear Cell Renal Cell Carcinoma from Benign Mimics and RCC Subtypes at Four-Phase MDCT
The 6 patients with progressive disease (PD) by RECIST, and the 22 patients with PD by the subjective reader assessment, had...
significantly worse OS compared to patients with SD or PR. There was no significant difference in OS between responders and nonresponders by Choi, modified Choi, or MASS criteria. When MSKCC risk factors were combined with imaging criteria, the combined criteria defined groups of patients with significantly worse OS. Patients with PR by modified Choi criteria showed significantly longer PFS compared to those with SD (p=0.033). PR and SD groups defined by other criteria did not show a significant difference in PFS. The MSKCC risk factors did not improve the prognostic ability of imaging-based criteria to predict patients with longer PFS.

CONCLUSION

Patients with PD by either RECIST or the subjective reader assessment had significantly worse survival compared to SD or PR groups. The addition of MSKCC risk factors significantly increased the predictive value of all criteria for OS. This effect was dominated by the MSKCC criteria, which were strongly correlated with survival.

CLINICAL RELEVANCE/APPLICATION

In the salvage therapy setting, the addition of clinical risk factors improves the predictive value of imaging-based tumor response criteria.

SSQ09-07  Diagnostic Accuracy of Unenhanced MRI for Suspicious Malignant Renal Lesions in End Stage Renal Failure Patients with Acquired Cystic Disease

Thursday, Dec. 3 11:30AM - 11:40AM Location: E353B

Participants

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Shadi Qasem, Winston-Salem, NC (Abstract Co-Author) Nothing to Disclose
Keyanoosh Hosseinzadeh, MD, Winston-Salem, NC (Abstract Co-Author) Consultant, Bayer AG

PURPOSE

To determine sensitivity, specificity and accuracy of unenhanced MRI in detecting malignant lesions in end stage renal failure patients with acquired renal cystic disease (ARCD). To assess added value of diffusion weighted imaging (DWI) in characterizing lesions. To identify MRI features associated with malignant lesions.

METHOD AND MATERIALS

Unenhanced renal MRIs of 55 patients with ARCD were retrospectively reviewed in consensus by two blinded radiologists. Lesions less than 1 cm were excluded. Lesions were scored based on size, T1 and T2 signal, homogeneity, hemosiderin, and DWI on a 5 point scale: 1 as definitely benign, 2 as probably benign, 3 as indeterminate, 4 as probably malignant and 5 as definitely malignant. Preliminary scoring was performed without DWI and repeated with DWI. Scores 1-2 were grouped as benign and 3-5 as malignant. Sensitivity, specificity and accuracy of diagnosis was calculated by comparing to nephrectomy samples performed within 6 months of the MRI in 40 patients and five year imaging and clinical follow up in 15 patients. Stability over a 5 year period was deemed benign. Chi square test assessed the imaging features. Scores were renumbered to a 3-level confidence score: 0, indeterminate; 1, probably benign and malignant; 2, definitely benign and malignant, and a paired t-test was performed to compare confidence levels.

RESULTS

There were 26 cysts (8 nephrectomy, 18 imaging follow up) and 34 solid lesions including 1 urothelial carcinoma, 2 oncocytomas and 31 renal cell carcinomas. Lesion size ranged from 1-17 cm. MRI features suggestive of malignancy included T1 iso or hyperintensity (p=0.0003), T1 heterogeneity (p=0.0037), T2 heterogeneity (p=0.0092), and presence of hemosiderin (p=0.0034). The sensitively, specificity and accuracy for preliminary diagnosis versus final diagnosis using DWI were 82, 69, 77 and 82, 73, 78 respectively. The area under the receiver operator curve for the diagnosis with DWI was 0.8512. The addition of DWI resulted in an increase of the confidence score (p=0.001).

CONCLUSION

Unenhanced renal MRI is an accurate modality in characterizing lesions in ARCD. DWI can increase the confidence for the diagnosis of malignant renal lesions. T1 iso and hyperintensity, T1 and T2 signal heterogeneity and the presence of hemosiderin are associated with malignant lesions.

CLINICAL RELEVANCE/APPLICATION

Unenhanced renal MRI is accurate in the detection of malignant lesions in ARCD.

SSQ09-08  Impact of Imaging and Histological Findings on the Prognosis of Xp-11 Translocation Renal Cell Cancer

Thursday, Dec. 3 11:40AM - 11:50AM Location: E353B

Participants

Pauley T. Gasparis, MD, Indianapolis, IN (Presenter) Nothing to Disclose
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Clinton D. Bahler, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
Chandru P. Sundaram, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose

PURPOSE

Xp11 translocation renal cell cancer (Xp11RCC) is an uncommon RCC (<1%) in the general population but accounts for 30% of RCC presenting under the age of 18 years. We wanted to identify imaging features at presentation and histological findings of the resected tumor that predicted overall survival (OS), progression-free survival (PFS), and the occurrence of local and distant metastases.
METHOD AND MATERIALS

Retrospective review of pathology database from Jan 2001 to Mar 2015 revealed 22 cases with Xp11RCC. Imaging findings at presentation were available in 18 of these cases. Detailed analysis of imaging findings for tumor size, calyceal invasion, necrosis, hemorrhage, exophytic growth, presence of local or distant metastases at presentation were recorded. Pathological findings including T-staging, margin positivity, Fuhrman grade and immunostain positivity were recorded. Clinical and imaging databases were used to determine OS, and PFS. Multivariate regression analysis and Kaplan-Meier survival statistics were performed.

RESULTS

Mean age at surgery was 40.2 (range 10-83) years. 15 of 22 patients were over 18 years. 1-, 2- and 3-year survivals were 88%, 79%, and 73% respectively. On CT / MRI, the majority of tumors enhanced to a lesser degree than adjacent cortex (13/18), were heterogeneous (11/18) and exophytic (14/18). Necrosis was seen in 5 tumors and correlated with larger tumor size (p<0.01), while calyceal invasion (seen in 6 tumors) did not (p=0.07). On multivariate logistic regression analysis, PFS correlated only with Fuhrman grade (p=0.04) and calyceal invasion (p=0.05) and recurrence of metastatic disease correlated only with initial tumor size (p=0.05). Age and gender at presentation, tumor heterogeneity, and necrosis did not correlate with prognosis. On analysis of overall survival, tumors > 5 cm had a substantially worse outcome than those < 5 cm (log rank test, Chi Square 6.73, p<0.01).

CONCLUSION

For staging scans of Xp11RCC, radiologists should assess tumor size and calyceal invasion as these have the most impact on survival. Unlike previous studies, we did not find younger patients to have better clinical outcomes.

CLINICAL RELEVANCE/APPLICATION

Calyceal invasion by tumor and tumor size > 5cm predict adverse outcome in Xp11 RCC.

Honored Educators

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Kumaresan Sandrasegaran, MD - 2013 Honored Educator
Kumaresan Sandrasegaran, MD - 2014 Honored Educator

SSQ09-09 How Does the Surrounding Background Fat Affect Enhancement of Exophytic Renal Lesions? A Phantom Study

Thursday, Dec. 3 11:50AM - 12:00PM Location: E353B

Participants

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Vahid Yaghmai, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the effect of surrounding tissue composition on renal lesion enhancement at multidetector computed tomography.

METHOD AND MATERIALS

Two phantoms (A and B) simulating renal lesions were constructed with 15 test tubes (1.5 cm in diameter) each. For phantom A, the tubes were embedded in fat (-90 HU); and for phantom B, the tubes were embedded in agar gel (neutral medium; 7.3HU). The tubes were filled with a serial dilution of iodinated contrast (iohexol [300mg/mL]). Both phantoms were scanned twice using a 64-slice scanner at 120kVp and constant 150mAs. Attenuation was calculated by a centrally placed region-of-interest within each test tube and the surrounding medium and averaged over five slices for each acquisition. Mean of measurements from both acquisitions were used for analysis. The amount of contrast needed to attain an enhancement of 10HU and 20HU were determined. Regression, paired t and Wilcoxon signed rank tests were used for analysis.

RESULTS

Iodine concentration of 0.285 and 0.675 mg/mL resulted in enhancement of 10 HU and 20 HU, respectively, for a lesion surrounded by fat and 7.3 HU and 16.62 HU when lesion surrounded by neutral medium. At any given iodine concentration, the contrast enhancement was significantly greater for a lesion surrounded by fat when compared with the lesion surrounded by neutral medium (P<0.0001).

CONCLUSION

A renal mass surrounded by fat tends to show greater enhancement compared with one surrounded by a neutral medium.

CLINICAL RELEVANCE/APPLICATION

Thresholds for enhancement may be different for renal lesions surrounded by fat when compared to intraparenchymal or partially exophytic lesions.

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Vahid Yaghmaei, MD - 2012 Honored Educator
Vahid Yaghmaei, MD - 2015 Honored Educator
SSQ10

Genitourinary (Benign and Malignant Gynecological Diseases)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E450B

Participants
Harris L. Cohen, MD, Memphis, TN (Moderator) Nothing to Disclose
Mindy M. Horrow, MD, Philadelphia, PA (Moderator) Spouse, Director, Merck & Co, Inc

Sub-Events

SSQ10-01 Fractal Analysis of the Leiomyoma before Uterine Artery Embolization Using Contrast-Enhanced MRI and Its Effect on the Outcome

Thursday, Dec. 3 10:30AM - 10:40AM Location: E450B

Participants
Nagy N. Naguib, MD, MSc, Frankfurt Am Main, Germany (Presenter) Nothing to Disclose
Nour-Eldin A. Nour-Eldin, MD,PhD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Lehnert, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Renate M. Hammerstingl, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Stefan Zangos, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To test whether fractal analysis of the leiomyoma using contrast-enhanced MRI correlates with the leiomyoma volume before and after uterine artery embolization (UAE) and with the percentage change at 3 month follow-up enabling its usage as a prognostic factor for treatment success.

METHOD AND MATERIALS
The study was retrospectively performed on 33 females (Mean Age: 44.85 +/- 3.95) with 64 leiomyomas. For fractal analysis; MRI images were exported and converted into 8-Bit greyscale images. The greyscale images were then loaded into the computer program ImageJ and analysis was performed using the FracLac plugin. The analysis was performed using the differential-box-counting method at 12 different grid positions. The Mean Fractal dimension for each leiomyoma was calculated by drawing a ROI around each leiomyoma. On the other hand the volume of each leiomyoma was calculated before and 3 months after UAE using contrast-enhanced MRI. The correlation between the mean fractal dimension of each leiomyoma and its volume before and after UAE as well as the percentage change in leiomyoma volume was tested for statistical significance using Spearman-Rank Correlation test.

RESULTS
The mean Fractal Dimension of all leiomyomas was 1.0622 +/- 0.1472 (Range: 0.74 - 1.31). The mean leiomyoma volume before UAE was 97.38 ml +/- 160.86 (Range: 1.65 - 987.34). At follow-up the mean leiomyoma volume was 68.08 ml +/- 138.3 (Range: 0.15 - 875.05). The mean percentage volume change at follow-up was 52.54% [reduction] +/- 26.99 (Range: 40.05%[increase] - 96.57%[reduction]). A statistically significant strong positive correlation between the mean fractal dimension of each leiomyoma and its volume before and after UAE was observed (rho = 0.77, p<0.0001 and rho = 0.78, p<0.0001 respectively). A statistically significant strong negative correlation between the mean fractal dimension of each leiomyoma and its percentage volume change at 3 month follow-up was noted (rho = -0.68, p<0.0001).

CONCLUSION
The smaller the mean fractal dimension of a leiomyoma before UAE the higher will be the percentage volume reduction at 3 month follow-up after UAE.

CLINICAL RELEVANCE/APPLICATION
Leiomyomas with low mean fractal dimension tend to have a significantly better response at 3 month follow-up following UAE. Hence fractal dimension can be used as a prognostic factor for patient selection.

SSQ10-02 Color Doppler Evaluation Of Utero-Ovarian Circulation In Polycystic Ovarian Syndrome and Its Correlation With Hormonal and Biochemical Parameters

Thursday, Dec. 3 10:40AM - 10:50AM Location: E450B

Participants
Shivi Jain, MD, Varanasi, India (Presenter) Nothing to Disclose
Akanksha Singh, MD, Varanasi, India (Abstract Co-Author) Nothing to Disclose
Madhu Jain, MD, Varanasi, India (Abstract Co-Author) Nothing to Disclose
Ram C. Shukla, MD, MBBS, Varanasi, India (Abstract Co-Author) Nothing to Disclose
Ashish Verma, MBBS,MD, Varanasi, India (Abstract Co-Author) Nothing to Disclose
Arvind Srivastava, Varanasi, India (Abstract Co-Author) Nothing to Disclose

PURPOSE
To find out the variations in utero-ovarian circulation and their association with various endocrinial and biochemical parameters in women with Polycystic Ovarian Syndrome (PCOS).
METHOD AND MATERIALS

65 patients of reproductive age group who had clinical and biochemical findings suggestive of PCOS by Rotterdam criteria (2003) were selected for TVS with Color Doppler study in early follicular phase (3rd-5th day of menstrual cycle). 58 age-matched women with normal clinical and biochemical parameters were taken as controls. The RI (Resistance Index), PI (Pulsatility Index) and PSV (Peak Systolic Velocity) of ovarian stromal and uterine arteries were assessed after the estimation of LH, LH: FSH ratio, free testosterone level, fasting Insulin level and fasting glucose:insulin ratio.

RESULTS

The mean value of LH, LH: FSH, free testosterone and fasting glucose:insulin ratio was significantly higher (p<0.001) in PCOS patients in comparison to control (LH 7.95 ± 1.34 vs 5.60 ± 0.51; LH: FSH=1.93 ± 0.17 vs 1.16 ± 0.22; free testosterone 3.63 ± 0.40 vs 1.71 ± 0.31; fasting glucose:insulin ratio 4.0 ± 0.60 vs 7.51 ± 0.49). The mean ovarian stromal RI, PI and PSV in PCOS was significantly lower (p<0.001) as compared to control (0.43 ± 0.08, 0.58 ± 0.10, 11.41 ± 2.53 vs 0.79 ± 0.21, 0.86 ± 0.03, 9.40 ± 0.73 respectively). Similarly, uterine artery PI was significantly higher (p<0.001) in PCOS when compared to control (3.05 ± 0.45 vs 2.43 ± 0.31). There was significantly negative correlation of ovarian stromal RI with serum LH: FSH ratio(r=0.617,p< 0.01). The Uterine artery PI positively correlated with LH: FSH ratio(r=0.548, p<0.01), free testosterone (r=0.532, p< 0.01), fasting Insulin(r=0.414, p< 0.01), fasting glucose:insulin ratio (r=0.484, p<0.01) and inversely with ovarian stromal RI (r=0.410, p<0.01).

CONCLUSION

Hormonal dysfunction is responsible for hemodynamic changes in utero-ovarian circulation in patients with PCOS. Ultrasonography along with color Doppler plays a significant role in the diagnosis and monitoring of Polycystic Ovarian Syndrome.

CLINICAL RELEVANCE/APPLICATION

The decreased PSV and increased PI and RI of uterine artery may explain recurrent early abortions in PCOS. Significant negative correlation between ovarian stromal RI and LH: FSH ratio confirms hormonal dysfunction.

SSQ10-03 Contrast Enhanced 3D STIR T2-Weighted SPACE in Evaluating Sacral Nerve Plexus in Pelvic Endometriosis: Compared with Conventional 2D Sequence

Thursday, Dec. 3 10:50AM - 11:00AM Location: E450B

Participants
Xiaoling Zhang, Guangzhou, China (Presenter) Nothing to Disclose
Meizhi Li, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Jian Guan, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Mingjian Liu, MMEd, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Shurong Li, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Yan Guo, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Huanjun Wang, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To prospectively evaluate microstructural abnormalities in sacral nerve plexus in women with pelvic endometriosis at 3.0T MRI.

METHOD AND MATERIALS

Twenty women with clinically diagnosed pelvic endometriosis and 20 age-matched healthy women were enrolled in this study. In addition to conventional coronal 2D T2WI TSE imaging, contrast enhanced coronal 3D STIR T2-weighted SPACE was obtained to produce multiplanar (MPR) images. All examinations were assessed independently by two radiologists for the infiltration of the sacral plexus by endometriotic lesions and the abnormal anatomical features of the sacral plexus. Agreement between 2D- and 3D-sequences and inter-observer-agreement was evaluated using kappa-statistics.

RESULTS

The sacral nerve roots in healthy subjects and patients were clearly visualized on both sequences. The diameter of the sacral nerve roots in patients was larger than in the control group. Most of the patients with endometriosis displayed local thickening or indistinction in the fibers of sacral plexus. There were no significant difference between the results of the 2 radiologists (F=2.563, P=0.086). Contrast enhanced 3D STIR T2-weighted SPACE was preferable in evaluating sacral nerve plexus in pelvic endometriosis than regular 2D sequences.

CONCLUSION

Changes of the microarchitecture of the sacral nerve plexus were revealed in the patients with pelvic endometriosis on MRI. Contrast enhanced 3D STIR T2-weighted SPACE can display the infiltration of scarpal nerve fibers by endometriotic lesions and the abnormal anatomical features of scarpal nerve plexus.

CLINICAL RELEVANCE/APPLICATION

Contrast enhanced 3D STIR T2-weighted SPACE was applied as a method of magnetic resonance neurography to reveal the correlation between the changes of scarpal plexus and chronic pelvic pain in patients with pelvic endometriosis .

SSQ10-04 MRI-US Fusion Imaging in Real-Time Virtual Sonography for the Evaluation of Pelvic Endometriosis: Preliminary Study

Thursday, Dec. 3 11:00AM - 11:10AM Location: E450B

Participants
Valeria Vinci, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Lucia Manganaro, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Silvia Bernardo, MD, Rome, Italy (Presenter) Nothing to Disclose
Matteo Saldari, MD, PhD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Maria Eleonora Sergi, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Federica Capozza, Rome, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
Real-time virtual sonography (RVS) is a new technique that uses magnetic navigation and computer software for the synchronized display of real-time US and multiplanar reconstruction MRI images. The purpose of this study was to evaluate the feasibility and ability of RVS to detect pelvic endometriosis.

METHOD AND MATERIALS
This study was conducted over a two-month period in March-April 2015 on 25 patients referred for a Clinical and US suspect of endometriosis. Patients underwent pelvic MRI at 3 T and fusion imaging was offered (Hitachi Hi Vision Ascendus). The MRI image dataset acquired at the time of the examination was loaded into the fusion system and displayed together with the US image on the same monitor. Both sets of images were then manually synchronized and image were registered using multiple planes MR imaging.

RESULTS
2 patients had endometriosis of the vesico-uterine pouch, with urinary symptoms associated. 7 patients had endometriosis of the middle compartment mainly shown as ovarian endometriomas in 6 cases and adenomyosis in 3 cases. 19 had signs of endometriotic implants in the posterior compartment shown as fibrotic plaque over the serosal surface of the uterus and rectum in 12 cases. In 1 case there was a deep infiltrating intestinal endometriosis over the rectum. A retroflexed uterus was associated in 6 cases. 6 cases showed fibrotic strands between the uterus and the rectum with thickening of the uterosacral ligaments. Regarding endometriosis of the medial compartment, there was an overlap of data of 100% between MRI and RVS, both appearing superior to a standard US evaluation. Endometriosis of the vesico-uterine pouch was better visualized in MRI. Fibrotic strands were displayed in both methods with an overlap of 100%; on the contrary, relying on RVS it was more difficult to differentiate between active plaque and predominantly fibrotic plaque because of the difficulty in visualizing the hemorrhagic foci. However the infiltration of the bowel wall was better undressed in RVS.

CONCLUSION
Thanks to information from both US and MRI, fusion imaging allows better identification of the pelvic implants, superior to the standard US evaluation.

CLINICAL RELEVANCE/APPLICATION
Thanks to information from both US and MRI, fusion imaging allows better identification of the pelvic implants, superior to the standard US evaluation.

SSQ10-05 Diagnostic Value of MR Imaging to Diagnose Adnexal Torsion

PURPOSE
To retrospectively evaluate the diagnostic performance of MR imaging for the diagnosis of adnexal torsion (AT) in a series of patients with an equivocal adnexal mass at ultrasonography in a context of acute or sub acute pelvic pain.

METHOD AND MATERIALS
Our institutional ethics committee approved the study and granted a waiver of informed consent. All patients with acute or subacute pelvic pain undergoing MR exam for the exploration of an equivocal adnexal mass (January 2007 to December 2012) with surgical exploration or clinical and radiological follow up at least of 3 months were retrospectively included (n=58). Three radiologists blinded to the clinical, ultrasonographic and surgical data retrospectively and independently reviewed MR images. Features associated with AT were identified using univariate and recursive partitioning multivariate analysis.

RESULTS
Twenty-two patients (38%) had a diagnosis of AT. The accuracy of MR image interpretation by each reader was 83.8% (26/31), 90.3% (28/31), 83.8% (26/31) in a context of acute pelvic pain and 92.5% (25/27), 88.8% (24/27), 81.5% (22/27) in a context of sub acute pelvic pain for reader 1, 2 and 3 respectively. On multivariate analysis, whirlpool sign (OR=6.5 [1.36-31], p=0.01) and a thickened tube (OR=8.2 [1.2-56.8], p=0.03) were associated with adnexal torsion, with substantial inter-reader agreement (kappa 0.71-0.84, and 0.82-0.86, respectively). The presence of adnexal hemorrhagic content helps to predict ovarian viability (p=0.009)

CONCLUSION
MR imaging is an accurate technique for the diagnosis of adnexal torsion in the setting of patients with adnexal mass having acute or sub acute pelvic pain.

CLINICAL RELEVANCE/APPLICATION
MR imaging is an accurate second line technique to diagnose adnexal torsion without any pelvic irradiation with the ability to predict ovarian viability without any gadolinium injection.

SSQ10-06 Can Diffusion-weighted MR Imaging Differentiate Uterine Sarcomas from Leiomyomas?

Participants
Sophie Beranger-Gibert, Paris, France (Abstract Co-Author) Nothing to Disclose
Hajer Sadky, Paris, France (Abstract Co-Author) Nothing to Disclose
Marcos Ballester, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Marie Bornes, Paris, France (Abstract Co-Author) Nothing to Disclose
Marc J. Bazot, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Emile Darai, Paris, France (Abstract Co-Author) Nothing to Disclose
Isabelle Thomassin-Naggara, MD, Paris, France (Presenter) Speakers Bureau, General Electric Company; Research Consultant, Olea Medical

PURPOSE
To retrospectively evaluate the diagnostic value of magnetic resonance imaging (MRI) at diffusion-weighted imaging (DWI) for the differentiation of uterine sarcomas from uterine leiomyomas.

METHOD AND MATERIALS
This study included 29 patients with MRI performed for the evaluation of a pelvic mass between March 2010 and September 2015. MRI was performed using a 1.5 T scanner, and DWI was obtained with a b-value of 800 s/mm². The Signal Intensity-Intensity-Normalization (SIN) ratio was calculated to differentiate sarcomas from leiomyomas.

RESULTS
The SIN ratio was significantly higher in sarcomas (mean: 2.98, SD: 0.35) compared to leiomyomas (mean: 2.35, SD: 0.29, p<0.001). The area under the receiver operating characteristic curve was 0.95, indicating excellent diagnostic accuracy.

CONCLUSION
Diffusion-weighted MRI with SIN ratio analysis is a promising tool for differentiating uterine sarcomas from leiomyomas, potentially avoiding unnecessary surgical procedures.

CLINICAL RELEVANCE/APPLICATION
The ability to accurately differentiate uterine sarcomas from leiomyomas using diffusion-weighted MRI could improve patient management and reduce surgical interventions.
established guidelines. A recommendation for evaluation of PMB with endometrial stripe thickness measuring 5mm with only 30% of reports adhering to these guidelines. The purpose of this study was to evaluate the variability in reporting recommendations for sonographically determined endometrial stripe thickness is an established criteria for predicting risk of cancer and thereby serving as a guide to trigger endometrial sampling. Current guidelines recommend tissue sampling for endometrial stripe measuring >5mm, however, there is limited data on adherence to these guidelines. The purpose of this study was to evaluate the variability in reporting recommendations for endometrial stripe thickness measuring 5mm in patients with PMB at a subspecialty practice in an academic teaching institution.

METHOD AND MATERIALS
Between January 2010 and August 2014, 188 patients with surgically confirmed 38 uterine sarcomas (16 leiomyosarcomas, 12 malignant mixed Mullerian tumors, 9 endometrial stromal sarcomas, and 1 undifferentiated pleomorphic sarcoma) and 150 leiomyomas were enrolled in this retrospective study. All patients underwent preoperative routine pelvic MR imaging at 3T, including DWI. DWI was obtained using a STIR single-shot echo-planar imaging technique with background suppression (b= 0 and 1000 s/mm²). The apparent diffusion coefficient (ADC) and signal intensity on T2-weighted imaging (T2SI) were calculated in the tumors, normal myometrium and gluteus muscle. In the differentiation of sarcomas from leiomyomas, various parameters (ADC, diffusion restriction, tumor-myometrium or gluteus muscle contrast ratio [TCRm or TCRg] on T2-weighted imaging, necrosis, hemorrhage, and size) were evaluated.

RESULTS
The mean ADC values of sarcomas (0.939 ± 0.253) were statistically lower than those of leiomyomas (1.347 ± 0.327 × 10⁻³mm²) (p < 0.001). For differentiating sarcomas from leiomyomas, the parameters including diffusion restriction, T2SI, TCRm, TCRg, necrosis and hemorrhage were statistically significant (all p-values < 0.001). At receiver operating characteristics curve analysis, the area under the curves of diffusion restriction and ADC in differentiating sarcomas from leiomyomas were 0.902 and 0.860, respectively and were statistically greater than other parameters (TCRm, TCRg, necrosis, hemorrhage and size) (p < 0.05): with a cutoff ADC value of 1.111 × 10⁻³mm², the sensitivity and specificity were 79% and 80%, respectively. For the degree of diffusion restriction, sarcomas showed moderate or strong in 97% (37/38), while leiomyomas revealed absent or mild in 69% (104/150).

CONCLUSION
DWI at 3T may be a useful technique for the differentiation of uterine sarcomas from leiomyomas.

CLINICAL RELEVANCE/APPLICATION
As a noninvasive technique, preoperative DWI at 3T can be used to predict sarcomas in patients with uterine myometrial masses, which may give potential for planning treatment strategies.

Variations in Reporting Recommendations for Son Graphically Evaluated Endometrial Stripe in Post Menopausal Bleeding in a Subspeciality Practice

Thursday, Dec. 3 11:30AM - 11:40AM Location: E450B

Participants
Aife Kilcoyne, MBCh, Boston, MA (Presenter) Nothing to Disclose
Avinash R. Kambadakone, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Colin J. McCarthy, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Giles W. Boland, MD, Boston, MA (Abstract Co-Author) Principal, Radiology Consulting Group; Royalties, Reed Elsevier
Susanna I. Lee, MD, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Debra A. Gervais, MD, Chestnut Hill, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Endometrial cancer is the most common gynecologic cancer in the United States. Early diagnosis and intervention is imperative to improve prognosis and survival. In the setting of postmenopausal vaginal bleeding (PMB), sonographically determined endometrial stripe thickness is an established criteria for predicting risk of cancer and thereby serving as a guide to trigger endometrial sampling. Current guidelines recommend tissue sampling for endometrial stripe measuring >5mm, however, there is limited data on adherence to these guidelines. The purpose of this study was to evaluate the variability in reporting recommendations for sonographically determined endometrial stripe thickness measuring 5mm in patients with PMB at a subspecialty practice in an academic teaching institution.

METHOD AND MATERIALS
In this ongoing study, we performed a review of the ‘RENDER’ radiology database to identify pelvic ultrasound exams performed on women aged 18-80years between January 1st 2009 and December 31st 2014 for evaluation of PMB. Using natural language processing, the radiology reports of these exams were then analysed for endometrial stripe thickness, reporting patterns in the body, impression of radiology report and the recommendations, if any. The search terms used for the focused search included ‘endometrial stripe’, ‘5mm’, ‘postmenopausal’. The variations in the reporting recommendations based on the endometrial stripe thickness were then evaluated.

RESULTS
Of the 253 reports reviewed, 58 (24.6%) were not relevant - the search identified patients with an endometrial stripe of greater or less than 5mm. In 74 reports (29.2%), no recommendation was made. In 73 reports (28.8%), endometrial biopsy was recommended. Other recommendations included: biopsy or imaging 14 (6%), no intervention 11 (4%), further imaging 8 (3%), gynaecology review 4 (2%), gynaecology review and biopsy 4 (2%), follow-up imaging 2 (1%).

CONCLUSION
In a subspecialty abdominal imaging practice at an academic institution, considerable variation exists on the reporting recommendation for evaluation of PMB with endometrial stripe thickness measuring 5mm with only 30% of reports adhering to established guidelines.
CLINICAL RELEVANCE/APPLICATION

The findings of this study highlight the need for development of standardised approaches/tools to bring about clarity in terms of management options/further investigation of abnormal endometrial thickening in the setting of postmenopausal bleeding.

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Debra A. Gervais, MD - 2012 Honored Educator
Susanna I. Lee, MD, PhD - 2013 Honored Educator

SSQ10-08  Cystic Adnexal Lesions Analyzed by International Ovarian Tumor Analysis (IOTA) Criteria in Routine Clinical Practice

Thursday, Dec. 3 11:40AM - 11:50AM Location: E450B

Participants
Claire E. Beaumont, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Jessica B. Robbins, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Elizabeth A. Sadowski, MD, Madison, WI (Presenter) Nothing to Disclose
Mark A. Kliwer, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Lisa Barroilhet, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Laura Huffman, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Katherine E. Maturen, MD, Ann Arbor, MI (Abstract Co-Author) Consultant, GlaxoSmithKline plc; Medical Advisory Board, GlaxoSmithKline plc

PURPOSE

The simple rules developed by the IOTA group direct management of adnexal cysts based on sonographic imaging features. The diagnostic performance of these criteria in routine practice has not been formally evaluated since the original study was published in 2010. The goal of our research is to determine how well the IOTA simple rules criteria perform in stratifying cystic lesions and detecting ovarian cancer in routine radiology practice.

METHOD AND MATERIALS

Patient consent was waived for this IRB approved retrospective review of transvaginal US studies on non-pregnant post-menarchal women performed between January-March 2011. Adnexal cysts larger than 3 cm were evaluated according to the IOTA rules. The incidence of benign adnexal lesions, borderline tumors and ovarian carcinoma was calculated. Surgical pathology, resolution on follow-up imaging and/or normal gynecological pelvic examination at 2 years were the accepted end points.

RESULTS

108 lesions in 104 women met inclusion criteria. Mean age=41±14 years; range=13-84. 3 lesions (2.8%) met simple rule 1 (malignant): 30% (1/3) were cystadenomas and 30% (1/3) carcinoma, with no borderline tumors. 95 lesions (88%) met simple rule 2 (benign): 10.5% (10/95) were benign ovarian neoplasms (dermoids=2; cystadenomas=8), with no borderline tumors or carcinomas. 10 lesions (9.2%) met simple rule 3 (indeterminate): 20% (2/10) were benign ovarian neoplasms, 20% (2/10) borderline tumors, and 10% (1/10) carcinoma. Thus, the IOTA rules gave a definitive (non-indeterminate) result in 98/108 (90.7%) of cases and correctly triaged 100% of borderline and malignant neoplasms either to further imaging evaluation or surgery.

CONCLUSION

The results of this pilot study indicate that the IOTA rules successfully detect borderline and malignant neoplasms. However, the vast majority of lesions in routine practice are benign in both sonographic appearance and clinical behavior. Full and nuanced evaluation of diagnostic performance in routine clinical practice will require a larger number of cancers, to be evaluated in our ongoing research.

CLINICAL RELEVANCE/APPLICATION

The IOTA simple rules were able to detect borderline and malignant ovarian neoplasms in our clinical practice and aided in directing women with such lesions to oncologic specialists.

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Katherine E. Maturen, MD - 2014 Honored Educator

SSQ10-09  MR Imaging and Semi-automated Texture analysis for Differentiating Atypical Appearing Uterine Leiomyomas from Leiomyosarcomas

Thursday, Dec. 3 11:50AM - 12:00PM Location: E450B

Participants
Yuliya Lakhman, MD, New York, NY (Presenter) Nothing to Disclose
Joshua L. Chaim, DO, New York, NY (Abstract Co-Author) Nothing to Disclose
Harini Veeraraghavan, New York, NY (Abstract Co-Author) Nothing to Disclose
Diana S. Feier, MD, Cluj-Napoca, Romania (Abstract Co-Author) Nothing to Disclose
Hebert Alberto Vargas, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Ramon E. Sosa, BA, New York, NY (Abstract Co-Author) Nothing to Disclose
PURPOSE
To investigate whether qualitative magnetic resonance (MR) imaging features and texture analysis (TA) can distinguish between atypical appearing uterine leiomyomas (ALM) and leiomyosarcomas (LMS)

METHOD AND MATERIALS
Forty-one women with ALM (n=22) or LMS (n=19) at histopathology and MRI between January 1, 2007 and December 31, 2013 were included in this retrospective study. Two readers (R1 and R2), blinded to histopathologic diagnoses, independently evaluated all cases. R2 manually segmented each tumor on axial T2-weighted image. Intensity based gray scale correlation matrix (GLCM) textures and Gabor edge based GLCM textures were computed for each segmented tumor. Relationships between clinical characteristics, imaging features, and histopathology were tested with Fisher's exact test. Each tumor was assigned a score of 0 to 4 based on the total number of most statistically significant features present. Diagnostic accuracy with exact 95% confidence intervals was calculated for each feature and score. Texture features were analyzed with a random forest (RF) classifier to automatically distinguish ALM from LMS. RF classifier was optimized by varying the number of decision trees and its performance was tested with five-fold cross validation.

RESULTS
Nodular borders, hemorrhagic foci, "T2 dark" areas, and central (±peripheral) unenhanced area(s) were significant predictors of LMS (p<0.0001 for each feature and reader). Sensitivity and specificity of each feature for LMS were 0.84/0.74 and 0.91/0.86 for nodular borders, 0.95/1.0 and 0.82/0.95 for hemorrhagic foci, 0.84/0.79 and 0.86/0.86 for "T2 dark" areas, and 0.95/1.0 and 0.73/0.68 for central (±peripheral) unenhanced area(s) for R1/R2, respectively. When any 3 of these features were detected in a lesion, the sensitivities and specificities were 1.0/0.95 and 0.95/1.0 for R1/R2, respectively. The best classification accuracy of computer-generated image features was achieved with 25 decision trees (AUC=0.86, sensitivity=0.95, specificity=0.69). The Gabor edge-based texture features were more relevant than the intensity based texture features for the classification.

CONCLUSION
Presence of certain qualitative MRI features can reliably distinguish ALM from LMS. Texture analysis as a semi-automated adjunct may add certainty to the diagnosis of LMS.

CLINICAL RELEVANCE/APPLICATION
MR imaging and semi-automated texture analysis are useful in distinguishing atypical appearing leiomyomas from leiomyosarcoma.

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Evis Sala, MD, PhD - 2013 Honored Educator
**Participants**

Woojin Kim, MD, Philadelphia, PA (Moderator) Co-founder, Montage Healthcare Solutions, Inc; Shareholder, Montage Healthcare Solutions, Inc; Board of Directors, Montage Healthcare Solutions, Inc; Advisory Board, Zebra Medical Vision Ltd

Kevin W. McEnery, MD, Houston, TX (Moderator) Advisor, Koninklijke Philips NV

Kevin L. Junck, PhD, Birmingham, AL (Moderator) Nothing to Disclose

**Sub-Events**

**SSQ11-01  Informatics Keynote Speaker: Role of Informatics in Quality**

Thursday, Dec. 3 10:30AM - 10:40AM Location: S403A

Participants

Woojin Kim, MD, Philadelphia, PA (Presenter) Co-founder, Montage Healthcare Solutions, Inc; Shareholder, Montage Healthcare Solutions, Inc; Board of Directors, Montage Healthcare Solutions, Inc; Advisory Board, Zebra Medical Vision Ltd

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Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Woojin Kim, MD - 2012 Honored Educator

**SSQ11-02  How I Missed Your Cancer? An Eye-Tracking Study of Radiological Error in the Detection of Lung Nodules**

Thursday, Dec. 3 10:40AM - 10:50AM Location: S403A

Participants

Gregory DiGirolamo, PhD, Worcester, MA (Abstract Co-Author) Nothing to Disclose

Zachary Zaniewski, Worcester, MA (Presenter) Nothing to Disclose

Max P. Rosen, MD, MPH, Worcester, MA (Abstract Co-Author) Stockholder, Everett Scientific Inc; Consultant, PAREXEL International Corporation; Stockholder, Cynvenio Biosystems, Inc; Medical Advisory Board, Cynvenio Biosystems, Inc

**PURPOSE**

Radiologists may miss findings on ~30% cases. These misdiagnoses can result from visual or cognitive decision-making errors. Visual errors may include: Scanning errors – not visually fixating on the region that contains an abnormality. Cognitive/Decision errors include: Decision errors – visually fixating on an abnormality, but declaring it normal, and/or Recognition errors – visually fixating on the region of an abnormality, but not identifying it. We investigated conscious recognition errors and whether Radiologists might have unconscious detection of lung nodules despite no conscious recognition.

**METHOD AND MATERIALS**

6 experienced Radiologists interpreted 18 axial chest CT scans (9 normal and 9 abnormal), each consisting of 200-400 slices. There were 16 lung nodules in total across the 9 abnormal CT scans. The presence and location of lung nodules were identified by a mouse click. Using an Eye-Link 1000, we tracked the location and duration of eye fixations using an invisible (to the observer) grid on each image. Error rates were calculated as our main index of accuracy, and duration of eye movements in each grid region were used to determine if there was unconscious detection of a lung nodule.

**RESULTS**

On average, 8/16 (50%, +/- 9%) lung nodules were consciously identified, and registered by a mouse click. However, even when no conscious detection of the lung nodule was registered, Radiologists made significantly longer fixations to the grid regions where the lung nodules were located. (p < .007). Radiologists fixated longer in the grid region where a nodule was located when compared to any other region in that same image (p < .02), even when the nodule was not consciously detected. Radiologists also fixated longer in the grid region where a lung nodule was present (even when not consciously detected) than any grid region in a normal image, p < .03.

**CONCLUSION**

Our data suggest that even when not consciously recognized, experienced radiologists unconsciously detect the location of lung nodules.

**CLINICAL RELEVANCE/APPLICATION**

Many findings missed in clinical practice, may actually be detected unconsciously. The use of eye-tracking, or other technologies may improve Radiologists' performance.

**SSQ11-03  Scanning Clinical Security Worldwide: Maps and Country Ratings**
SSQ11-04  
Institution Certification System for Low-Dose Lung Cancer CT Screening in Japan: Development of a New Web-based Image Evaluation Function

Participants
Rikuta Ishigaki, PhD, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Yoshihisa Muramatsu, PhD, Kashiwa, Japan (Presenter) Nothing to Disclose
Yuichiro Maruyama, MD,PhD, Komoro, Japan (Abstract Co-Author) Nothing to Disclose
Isao Yamaguchi, PhD, RT, Sakai, Japan (Abstract Co-Author) Nothing to Disclose
Michael F. McNitt-Gray, PhD, Los Angeles, CA (Abstract Co-Author) Institutional research agreement, Siemens AG; Research support, Siemens AG; ; ; ;
Yoshito Tabata, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Masato Mori, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Masafumi Shinozaki, RT, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Kouzou Hanai, PhD,RT, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose

Background
In Japan, an institution certification system is being established by the Accreditation Council for Lung Cancer CT Screening. Given progress in database systems with a dose index registry (DIR) function known as the combined application dose index (CADI), the CADI system will be used to evaluate both dose and image quality. A special image evaluation function has been developed for this new use.

Evaluation
The CADI system consists of a CADI server and clients. Image data and dose information are compiled in DICOM and IHE-REM databases. Web-based access to the CADI server is possible from approved CADI clients, permitting image evaluation for lung cancer CT screening. This system was certified as meeting the IHE REM Profile at the NA Connectathon 2013, and the web-based access is WADO compliant. A demonstration study was conducted between January 5 and March 31, 2015. A chest phantom containing simulated lesions (LSCT-001, Kyoto Kagaku) was scanned using the CT screening protocols at each institution (16 institutions, 22 CT systems). CT images (as a 5 mm-slice and a 1 mm interval) and dose reports were sent to CADI clients and transferred to the CADI server, and dose information and image interpretation by certified radiologists were analyzed. The calculated CTDIvol values were 1.9±0.8 mGy (mean ± SD). The calculated DLP values were 65.1±26.7 mGy (mean ± SD). The submitted phantom images are reviewed for image quality and the detectability of the simulated lesions is assessed. The average detected diameter (mean ± SD) was 8.9±0.8 mm for the right lung (Design contrast = 100 HU) and 5.7±0.4 mm for the left lung (Design contrast = 270 HU).

Discussion
It is essential to ensure the appropriate image quality at reduced dose for CT screening in healthy people. Dose and image quality evaluations were performed from the CADI client on Web, and statistical analyses were performed. This allows standardization of CT screening across Japan; Institutions certified by the Accreditation Council will be able to provide reliable CT screening services.

Conclusion
We have developed a new web-based image evaluation function for the CADI system to establish an institution certification system for lung cancer CT screening.
SSQ11-05  Conventional X-ray Dose Analysis in Pediatrics Patients in Different Hospitals Using a Centralized Electronic Platform

Thursday, Dec. 3 11:10AM - 11:20AM Location: S403A

Participants
Eduardo Fraile Moreno, MD, PhD, San Sebastian de Los Reyes, Spain (Presenter) Nothing to Disclose
Carlos Benito, Madrid, Spain (Abstract Co-Author) Nothing to Disclose
Jose Carmelo Albillos, Alcorcon, Spain (Abstract Co-Author) Nothing to Disclose
Patricia Fraga Rivas, MD, Coslada, Spain (Abstract Co-Author) Nothing to Disclose
Esther Dominguez-Franjo, MD, PhD, Madrid, Spain (Abstract Co-Author) Nothing to Disclose
Josefa Galobardes Monge, MD, Parla, Spain (Abstract Co-Author) Nothing to Disclose
Trinidad Villarejo, Parla, Spain (Abstract Co-Author) Nothing to Disclose

Background
Imaging diagnostics studies using X-ray modalities are increasing the impact on cumulative dose of irradiation delivered to patients. At the same time, a new legislation (2013/59/Euratom) will be put in place to register dose patient history on his Electronic Health Record. Dose is a concern for everybody in healthcare environment and especially sensitive when we speak about dose delivered to kids. Our objective is to analyze variability on the dose in non-focused pediatric departments and determinate root causes to fix them.

Evaluation
The analysis for pediatric segment has been done in 6 hospitals connected in the same network. The studies have been performed in Emergency departments with the same manufacturer and model of digital X-ray equipments and same configuration. Data are stored on real time from modalities to a central server used to analyze them. Data from patient studies were collected over a period of one month. They were classified according to patient age (0-1 year; 1-5 years; 5-10 years and 10-15 years) and gender. For each category of patient, the most used protocols were evaluated and their associated dose levels were collected. For each protocol, an alert threshold was calculated based on the usual clinical practice (2 times the percentile median). The root causes were classified (bad patient positioning, bad collimation on patient, pediatric study protocol not selected, bad protocol selected depending on morphology) and measured.

Discussion
This analysis demonstrates that 15.28% of the extra dose applied to pediatric population is caused directly by misunderstanding or lack of knowledge of how to handle this type of patients. Most of these mistakes can be fixed by dose education through Change Acceleration Process (CAP) to take in account seriously the pediatric segment in radiology studies and specific trainings to remind X-ray technology basis. Consciousness will be done with explanations of dose effect on kids (stochastics and determinists effects).

Conclusion
Dose monitoring electronic solution allow us reusing the variability on the dose in non-focused pediatric departments and determinate root causes to fix them.

SSQ11-06  Biometric Patient Identity Verification during Magnetic Resonance Imaging of the Brain Using Multi-planar Reconstruction Scout Image

Thursday, Dec. 3 11:20AM - 11:30AM Location: S403A

Participants
Yasuyuki Ueda, Fukuoka, Japan (Presenter) Nothing to Disclose
Junji Monshita, PhD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Shohei Kudorni, Ube, Japan (Abstract Co-Author) Nothing to Disclose
Katsuhiko Ueda, BS, Ube, Japan (Abstract Co-Author) Nothing to Disclose

Purpose
Patient misidentification error management is one of the important factors of patient safety. We studied the use of magnetic resonance (MR) images for the purpose of biometric patient identity verification, and show the accuracy of verification performance for clinical use.

Method and Materials
Anatomy-related multi-planar reconstruction (MPR) images, including posterior surface of brainstem and the internal auditory canal (IAC), generated from one three-dimensional fast scout scan of each MR examination were used as biological-fingerprint images in this study. We calculated a correlation value as a similarity score between current and prior biological-fingerprint images. This procedure consists of three major steps, i.e., biological feature extraction, normalization, and calculation of correlation value. In order to evaluate the verification performance, we calculated a false rejection rate (FRR), a false acceptance rate (FAR) and a half-total error rate (HTER) by the discriminant analysis utilizing the squared Mahalanobis distance to declare the patient as genuine or an impostor. Moreover, to evaluate overall performance deliverance from a receiver operating characteristic (ROC) curve, the area under the ROC curve (AUC), and the equal error rate (EER) were calculated.

Results
The database of this study consisted of 730 temporal pairs of MR examination of the brain. Many patients of this study have the following disorders: brain tumor and cerebrovascular angiopathy, and 168 patients have undergone surgical operation of the brain before the current examination. Our results indicated a high performance in verifying patients. Our method gave an HTER of 1.59% with an FAR of 0.023% (62/266,085), and an FRR of 3.15% (23/730). The AUC and EER were achieved at 0.998 and 1.37%, respectively.

Conclusion
Our method makes it possible to verify the identity of the patient only using some existing medical images without the addition of incidental equipment. We expect our method to be a key solution to patient misidentification problems.
SSQ11-07  CT Dose Monitoring and Management System Based on Open-source Software Resources and In-House Development

Thursday, Dec. 3 11:30AM - 11:40AM Location: S403A

Participants
Da Zhang, PhD, Boston, MA (Presenter) Nothing to Disclose
Larry Babaras, Boston, MA (Abstract Co-Author) Nothing to Disclose
Matthew R. Palmer, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The monitoring and management of radiation dose have become crucial requirements of modern radiology departments. Powerful open-source DICOM utilities could facilitate the implementation of professional-grade systems for collecting CT radiation dose data. However, the heterogeneity of dose data and inconsistent implementations of the DICOM SR standard among different CT models and vendors require additional customization and programming. We present the development, unique features, and clinical applicability of a CT dose tracking system based on freely-available software resources.

METHOD AND MATERIALS
Radiation dose structured reports (RDSR) are auto-transmitted from the CT scanners to a Conquest DICOM server. The server spawns two external processes: 1) 'dcm2xml' (from DCMTK) translates RDSR into XML; 2) a PowerShell script mines the XML data and populates database tables. Dose dashboards on the server provide query and display functionality for individual CT exams, while a data dump service provides massive output of dose records for periodic dose analysis and protocol management. Also, a web service that receives real-time queries from the dictation system returns customized dose strings for automatic inclusion in the radiologic reports. For protocol review, dose entries in the dumped data are cleaned and validated. Heterogeneous protocol identifiers are normalized and re-mapped to core protocol names, using a regular expression based method. Similar protocol names are grouped together for per-scanner analysis and cross-scanner comparison. The core protocols that comprise the majority of exams were identified, and summary data were prepared for visual analysis.

RESULTS
Over 5000 CT dose records per month have been collected from ten CT scanners (of 7 models and 3 vendors) distributed in three practice sites. Non-trivial inconsistencies in the adoption of RDSR capabilities, especially in the handling of protocol names, were observed. Comparison of dose performance across scanners and against national data was used to trigger root-cause analysis and protocol review.

CONCLUSION
Using open-source software resources and in-house expertise, a highly functional and customizable dose monitoring and management system can be developed with limited expense and effort.

SSQ11-08  Implementation of a Virtual 'Learning from Discrepancy' Meeting: A Method to Improve Radiologist Attendance and Facilitate Shared Learning from Radiological Error

Thursday, Dec. 3 11:40AM - 11:50AM Location: S403A

Participants
Anoma Lalani, Carlton Jones, MBBS, FRCR, London, United Kingdom (Presenter) Nothing to Disclose
Mary E. Roddie, MD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Matthew R. Palmer, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Our method is useful when we have no other way of confirming whether the registered patient information is correct or not and will contribute to patient misidentification error management caused by human errors.

METHOD AND MATERIALS
Submitted radiological discrepancy cases were added to an OsiriX database after anonymisation with clinical information available at the time and any relevant previous imaging. Prepared cases were loaded onto iMacs in the radiology reporting rooms on each site. For each virtual LDM radiologists were given a 3-week period to review cases either on their own or in groups and send their feedback to the LDM convenor. The learning points and consensus feedback were attached to each case before it was added to a permanent LDM library on the iMacs. Attendance was recorded and compared with that from the previous 4 years of conventional meetings. We obtained radiologist feedback comparing the two types of LDM using an anonymous online questionnaire sent out after the first year of virtual LDMs.

RESULTS
Numbers of radiologists attending increased significantly from a mean of 12.5 ± 3.1 for the conventional LDM to 27.3 ± 6.2 for the virtual LDM (p < 0.0001) and the percentage of radiologists achieving the UK standard of participation in at least 50% of LDMs per year (the UK standard) rose from an average of 18% to 68%. The number of cases submitted per meeting rose significantly from an average of 11.1 ± 2.9 for conventional LDMs to 15.2 ± 6.2 for virtual LDMs (p < 0.02). Analysis of 30 returned questionnaires showed that radiologists welcomed being able to review cases at a time and place of their choosing and at their own pace. They reported that they were able to give more honest feedback in the absence of peer pressure. Many felt that the LDM library was a useful educational resource and had changed their clinical practice by highlighting frequently occurring errors.

CONCLUSION
SSQ11-07  CT Dose Monitoring and Management System Based on Open-source Software Resources and In-House Development

Participants
Da Zhang, PhD, Boston, MA (Presenter) Nothing to Disclose
Larry Babaras, Boston, MA (Abstract Co-Author) Nothing to Disclose
Matthew R. Palmer, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
The monitoring and management of radiation dose have become crucial requirements of modern radiology departments. Powerful open-source DICOM utilities could facilitate the implementation of professional-grade systems for collecting CT radiation dose data. However, the heterogeneity of dose data and inconsistent implementations of the DICOM SR standard among different CT models and vendors require additional customization and programming. We present the development, unique features, and clinical applicability of a CT dose tracking system based on freely-available software resources.
Replacement of conventional LDMs rotating between hospital sites in a large radiology department by virtual LDMs improved radiologist participation in the process of group learning from radiological discrepancy and increased the number of submitted cases.

CLINICAL RELEVANCE/APPLICATION

Introduction of a virtual 'learning from discrepancy' meeting (LDM) and an LDM library can increase radiologist participation in the process of learning from discrepancy and increase the number of cases submitted.

SSQ11-09 Does Dose Awareness Increase after Implementation of a Dose Monitoring Software in Computed Tomography

Thursday, Dec. 3 11:50AM - 12:00PM Location: S403A

Participants
Christina Heilmaier, MD, Zurich, Switzerland (Presenter) Nothing to Disclose
Niklaus Zuber, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Dominik Weishaupt, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose

PURPOSE

Dose monitoring becomes more and more important and is an important part of quality control. We wanted to examine whether dose awareness of medical staff increased after a dose monitoring software was installed and implemented in clinical routine.

METHOD AND MATERIALS

Dose data of two computed tomography scanners was collected from April 2014 to February 2015. We used a dose management software to separately analyze data from April to June 2014 (period 1) and July 2014 to February 2015 (period 2). Starting July 2014 radiographers were instructed look for and answer alarms ('alerts') when dose exceeded predefined thresholds. Chi-square tests were applied to check for statistical significant changes in number and reasons for alerts between both periods. Thresholds were set as 75th-percentile of the distribution of dose length product (DLP, Gy*cm).

RESULTS

A total of 13,217 scans were conducted (period 1, n=4,943; period 2, n=8883) and dose data was successfully transferred to the software in all cases. A total of 609 alerts occurred (period 1, n=293; period 2, n=316), mean alert quota 5%. Comparison of both periods showed a significant decrease of mean alert quota in period 2 (4%; period 1, 6%; p<0.001). Decline was mainly caused by a reduced number of notifications due to patient off-centering (period 1, n=129; period 2, n=77; p<0.001), which means patient was not positioned properly in the isocenter of the scanner. Relative number of high body weight alerts (BMI≥25 kg/m2) grew in period 2 (51%, n=160; period 1, 36%. n=106), but difference was not statistical significant (p=0.159). All other alert causes were comparable in both periods (p>0.05): scan repetition due to severe motion artifacts (period 1, n=32, 11%; period 1, n=36, 11%), osteosynthesis material (OSM) in scanning area and leading to dose up-regulation (period 1, n=24, 8%; period 2, n=28, 9%) and others such as imaging on spine-board (period 1, n=3, 1%; period 2, n=15, 5%).

CONCLUSION

A dose monitoring software can be successfully implemented in clinical routine and increases dose awareness in medical staff, thereby leading to a reduction of the number of dose alerts due to human error.

CLINICAL RELEVANCE/APPLICATION

Implementation of a dose monitoring software in clinical routine can be successfully accomplished and is an important tool for increasing dose awareness in medical staff, thereby improving quality assurance and patient safety.
**Molecular Imaging (New Tracers/Methods)**

**Thursday, Dec. 3 10:30AM - 12:00PM Location: S504AB**

**Hyperpolarized 13C MRI for Non-Invasive Assessment of Liver Injury in a Mouse Model**

**Participants**
Brian M. Rodgers, MD, Rockville, MD (Moderator) Nothing to Disclose  
Bernadette V. Marquez, PhD, Saint Louis, MO (Moderator) Nothing to Disclose

**METHOD AND MATERIALS**

11 male CD1 mice were treated via IP injection with either 1 ul/g of the hepatotoxin CCl4 (n=6) to induce liver injury, or with vehicle alone (n=5, control group). Mice were imaged with a 14 T preclinical MRI scanner prior to and 48 hours after treatment. 350 ul of 80mM [1-13C]pyruvic acid was polarized in a Hypersense DNP polarizer (Oxford Instruments) and injected via tail vein. Metabolite images were obtained for pyruvate, alanine and lactate at 29 s using a fast spectrally-selective 3D imaging sequence (resolution 2x2x3.3 mm). Metabolite images were overlayed onto T2 images. An ROI was drawn on the center liver slice avoiding large vessels. Ratios of lactate and alanine to pyruvate were measured. Mice were sacrificed and livers stained for histology. Liver damage graded by an experienced hepatologist blinded to the imaging.

**RESULTS**

Imaging was successful in all 11 mice before and after treatment. Histologic liver damage was seen in 5/6 CCl4-treated mice. Mean lactate/pyruvate ratio was significantly higher after CCl4 treatment (2.8, SD 0.9) than for untreated mice (1.8, SD 0.6, p<0.05) or the control group (1.7, SD 0.5, p<0.05). Mean alanine/pyruvate ratio was also significantly higher after CCl4 treatment (2.2, SD 0.6) than for untreated mice (1.3, SD 0.6, p<0.05) or the control group (1.4, SD 0.4, p<0.05). There was no significant difference in either ratio between the pre-treatment and the control group.

**CONCLUSION**

Treatment of mice with a single dose of the hepatotoxin CCl4 leads to a significant and rapid rise in hepatic lactate and alanine production measured by hyperpolarized 13C MRI. Future experiments will determine whether the observed lactate and alanine production results from activated inflammatory cells within the liver or metabolic alterations within hepatocytes themselves.

**CLINICAL RELEVANCE/APPLICATION**

Hyperpolarized 13C MRI is a promising tool for non-invasively imaging evaluating liver injury and inflammation.

**Synthesis and Characterization of Novel Hydrophilic Molecules for 19F-MR Contrast Imaging**

**Participants**
Eric Tanifum, PhD, Houston, TX (Presenter) Nothing to Disclose  
Matthew Liaw, Houston, TX (Abstract Co-Author) Nothing to Disclose  
Ananth Annapragada, PhD, Houston, TX (Abstract Co-Author) Stockholder, Marval Pharma Ltd Stockholder, Alzeca Biosciences LLC Stockholder, Sensulin LLC Stockholder, Abbott Laboratories Stockholder, Johnson & Johnson

**PURPOSE**

Conventional MRI contrast agents employ paramagnetic metal ions to generate contrast in 1H MRI scans. While this approach is
Hydrophilic moieties were linked to fluorinated moieties with equivalent 19Fs, to generate water-soluble monomer units and then condensed to dimers and oligomers with high 19F content. Structures were confirmed by NMR and MS. Liposome formulation was achieved using standard protocols and size distribution determined by DLS. 19F content was assessed by UV-VIS and 19F NMR, and 19F MRI scans performed using a TurboRARE 3D scan in a 9.4 T Bruker instrument equipped with a 1H/19F dual-tunable volume RF coil.

RESULTS

Molecular synthesis was achieved in excellent yields, and 1H and 19F NMR indicated purity of the final products at >97%. All compounds dissolved readily in saline to give 500 mM to 1 M solutions used to prepare stable liposome formulations. 19F MR scans showed that formulations are detectable at 2-5 mM concentrations of the molecules, comparable to the high micromolar to millimolar intravoxel concentrations required for Gd contrast detection.

CONCLUSION

This is a new and facile paradigm to formulate 19F MRI contrast agents in aqueous media and their use to prepare stable liposome formulations, a proven nanoparticle platform for both passive and active delivery of contrast for molecular imaging, highlights the potential of this approach.

CLINICAL RELEVANCE/APPLICATION

We believe this approach will have significant impact on molecular imaging.

METHOD AND MATERIALS

Hydrophilic moieties were linked to fluorinated moieties with equivalent 19Fs, to generate water-soluble monomer units and then condensed to dimers and oligomers with high 19F content. Structures were confirmed by NMR and MS. Liposome formulation was achieved using standard protocols and size distribution determined by DLS. 19F content was assessed by UV-VIS and 19F NMR, and 19F MRI scans performed using a TurboRARE 3D scan in a 9.4 T Bruker instrument equipped with a 1H/19F dual-tunable volume RF coil.

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CLINICAL RELEVANCE/APPLICATION

We believe this approach will have significant impact on molecular imaging.
**CONCLUSION**

abolished TRL uptake into BAT.

and by quantitative metabolic studies using radioactive lipid tracers. In both setups inhibition of insulin secretion using diazoxide resulted in a significant lower uptake of TRL-SPIO into BAT (ΔR²* = 21.1s⁻¹; p<0.001). MRI results were confirmed by IVM analyses for 4 hours before imaging. MRI at 7T ClinScan (Bruker) was performed before and 20 minutes after iv injection of TRL-SPIOs using a T²*w Multiecho-GRE sequence (TR/TEfirst 400/2ms, ETL 12, ES 1ms, FA 25°). ΔR²* in BAT was estimated. In addition to the MRI setup, IVM analysis was performed for real time imaging of TRL-QD uptake into BAT. In order to quantify TRL clearance, the fate of radioactively labelled TRLs were analysed under the same experimental conditions.

**RESULTS**

Excellent affinity (Kd of 0.21±0.07nM) and selectivity (DAT/NET>1940; SERT/NET=9700) were already shown for [¹¹C]Me@HAPTHI. Now, both logD (2.27±0.01) and Pm (1.15±0.25) were found to be in a range for expectable BBB penetration. After 60min incubation with human liver microsomes, 99.6±0.3% of the tracer were still intact. If was found to be 8.2±0.3%.In the autoradiographic experiments, highest uptake of [¹¹C]Me@HAPTHI was observed in NET-rich regions identified with IHC and a concentration dependent binding displacement was seen for both competitors.(see figure)

**METHOD AND MATERIALS**

LogD was assessed using HPLC (Donovan and Pescatore 1 Chrom A, 2002). Immobilized artificial membrane (IAM) chromatography was performed using a standard method (Vraka C et al. EJNNMI, 2014) to achieve Pm (permeability) values. For evaluation of stability, incubation with human liver microsomes was performed. Plasma protein binding was determined quantifying the free fraction (ff) in human pooled plasma (Huang Y et al. J Cereb Blood Flow Metab, 2002). In vitro autoradiography was performed on

**CONCLUSION**

Side from its high affinity and selectivity, we now demonstrated [¹¹C]Me@HAPTHI's stability, expectable BBB penetration and specific binding in autoradiography. This encourages us for in vivo application in small animal PET experiments and future clinical trials.

**CLINICAL RELEVANCE/APPLICATION**

N/A

**RESULTS**

The aim was to determine the metabolic activity of brown adipose tissue (BAT) and its dependence on signalling pathway mediated by the anabolic hormone insulin using superparamagnetic iron oxide nanoparticles (SPIO - for MRI) or quantum dots (QD - for intravital microscopy (IVM)) embedded into triglyceride-rich lipoproteins (TRL).

**METHOD AND MATERIALS**

BAT activity of C57BL/6J wild-type was stimulated by treatment with the β3 receptor agonist CL316,243. Inhibition of insulin secretion during the course of BAT activation was performed using the potassium channel agonist diazoxide. All mice were starved for 4 hours before imaging. MRI at 7T ClinScan (Bruker) was performed before and 20 minutes after iv injection of TRL-SPIOs using a T²*w Multiecho-GRE sequence (TR/TEfirst 400/2ms, ETL 12, ES 1ms, FA 25°). ΔR²* in BAT was estimated. In addition to the MRI setup, IVM analysis was performed for real time imaging of TRL-QD uptake into BAT. In order to quantify TRL clearance, the fate of radioactively labelled TRLs were analysed under the same experimental conditions.

**RESULTS**

While no signal difference in BAT before and after the injection of TRL-SPIO was detectable for control mice, a significant signal drop and increase of ΔR²* (82.9s⁻¹; p<0.001) was estimated for CL treated, BAT activated mice. Inhibition of insulin signalling resulted in a significant lower uptake of TRL-SPIO into BAT (ΔR²* = 21.1s⁻¹; p<0.001). MRI results were confirmed by IVM analyses and by quantitative metabolic studies using radioactive lipid tracers. In both setups inhibition of insulin secretion using diazoxide abolished TRL uptake into BAT.

**CONCLUSION**

R²-receptor activation via CL with following acute insulin release lead to BAT activation, which can be visualised in vivo by MRI.
β3-receptor activation via CL with following acute insulin release lead to BAT activation, which can be visualized in vivo by MRI using TRL-SPIO and estimating ΔR2*. Accordingly, the inhibition of insulin signalling blocks TRL uptake into BAT. Thus, MRI can visualize physiological lipid processing in the vascular endothelium of activated BAT.

**CLINICAL RELEVANCE/APPLICATION**

MRI in combination with nanoparticle-labelled lipoproteins can be used to noninvasively monitor the molecular pathway of insulin-dependent lipoprotein metabolism.

**SSQ12-06  Using MPI as High Temporal Resolution Imaging Technique for in Vivo Bolus Tracking of Ferucarbotran in Mouse Model**

**Participants**

Caroline Jung, Hamburg, Germany (**Presenter**) Nothing to Disclose

Johannes M. Salamon, MD, Hamburg, Germany (**Abstract Co-Author**) Nothing to Disclose

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Michael G. Kaul, Hamburg, Germany (**Abstract Co-Author**) Nothing to Disclose

Gerhard B. Adam, MD, Hamburg, Germany (**Abstract Co-Author**) Nothing to Disclose

Tobias Knopp, DIPLENG, Hamburg, Germany (**Abstract Co-Author**) Nothing to Disclose

Harald Ittrich, MD, Hamburg, Germany (**Abstract Co-Author**) Nothing to Disclose

Kolja Them, Hamburg, Germany (**Abstract Co-Author**) Nothing to Disclose

**PURPOSE**

Magnetic particle imaging (MPI) is a new radiologic imaging method, potentially capable of rapid 3D dynamic imaging of magnetic tracer. The goal of this study was to follow and visualize the intravenous injected nanoparticles in real time through cardiovascular system at MPI.

**METHOD AND MATERIALS**

MPI scans of FVB mice (n=4) were carried out using a 3D imaging sequence (1 T/m gradient strength, 10 mT drive-field strength, FOV 40x40x20 mm³). After a first baseline control measurement a dynamic scan consisting of 100 000 repetitions (duration of about 35min and temporal resolution of 21.5ms per 3D volume) was performed. After the 13953th repetition 50µl ferucarbotran (Resovist, Bayer Schering Pharma AG) was injected into the tailvein via pump (53.7ml/h). As MPI delivers no anatomic information, MRI scans at 7T ClinScan (Bruker) were performed before and after MPI examination using a T2-weighted 2D turbo spin echo sequence (FOV 32mm, matrix 256x256, TR 1100ms, TE 28ms). The reconstruction was performed on the MPI console (ParaVision 6.0/MPI, Bruker). Image fusion was done using additional image processing software (Imalytics, Philips). The dynamic information was extracted using self-written software using the Julia programming environment.

**RESULTS**

The combined MR-MPI measurements were carried out successfully. No dislocation of the mouse was observed. In the sagittal views it is clearly visible how the tracer enters the vena cava inferior before it moves to the heart and then into the liver. (Fig. 1 shows different time points over a range of 1.5 s). By co-registration with MRI the anatomical regions were identified. Due to the frame rate of about 46 volumes per second a signal modulation with the frequency of the heart beat is detectable and a heart beat of 520bpm can be appreciated. Moreover the bloodflow velocity of approximately 5cm/s in the vena cava can be estimated.

**CONCLUSION**

The high temporal resolution of MPI allows real-time imaging and bolus tracking of intravenous injected nanoparticles and offers a tool to estimate blood flow velocity. MRI was successful used for anatomical informations.

**CLINICAL RELEVANCE/APPLICATION**

Blood flow velocity measurements by MPI may allow the estimation of luminal narrowing in atherosclerotic disease.

**SSQ12-07  In Vivo Noninvasive Characterization of Brown Adipose Tissue in Rat by Spectral CT**

**Awards**

Molecular Imaging Travel Award

**Participants**

Xin-Gui Peng, MD,PhD, Nanjing, China (**Presenter**) Nothing to Disclose

Zhen Zhao, Nanjing, China (**Abstract Co-Author**) Nothing to Disclose

Di Chang, Nanjing, China (**Abstract Co-Author**) Nothing to Disclose

Shenghong Ju, MD, PhD, Nanjing, China (**Abstract Co-Author**) Nothing to Disclose

**PURPOSE**

Brown adipose tissue (BAT) has lower lipid content, more abundant iron content and mitochondrion campared to white adipose tissue (WAT). Our study is to evaluate the lipid/water and iron/water content in both types of adipose tissue using material decomposition and effective atomic number of spectral CT.

**METHOD AND MATERIALS**

The animal study was approved by the institutional Committee on Animal Research. Six Wistar rats (14 weeks, 304g ±12g) underwent Spectral CT scan (GE, Discovery CT750 HD). Data were transmitted to AW4.6 workstation to obtain base material mappings, including fat (water) based imaging and iron (water) based imaging. The fat/water and iron/water concentration of brown adipose tissue (interscapular) and white adipose tissue (visceral) were measured on base material mapping. In addition, we also calculate the effective atomic number of both types of adipose tissue. Statistical analysis was performed with independent sample t test.

**RESULTS**
The base fat (water) material concentration of BAT was significantly lower than that of WAT (587.29 ± 187.61mg/cm³ and 1587.43 ± 70.11mg/cm³, respectively; P< 0.001). However, the water (fat) concentration of BAT was significantly higher than that of WAT (395.81±189.53mg/cm³, and -655.1 ± -69.141mg/cm³, respectively; P<0.001). The based iron (water) material concentration of BAT was also higher than that of WAT (989.33±7.29mg/cm³ and 951.63±-5.49mg/cm³, respectively; P<0.001). Water (iron) concentration of BAT was also higher than that of WAT (6.95±0.28 and 4.7±0.11, respectively; P< 0.001).

CONCLUSION

The quantification of base material concentration and effective atomic number analysis of spectral CT revealed different characterization of both types of adipose tissue.

CLINICAL RELEVANCE/APPLICATION

It is anticipated that spectral CT provided a new noninvasive method to be translated to a clinical setting for evaluating the difference of adipose tissue and monitoring the responses to specific therapeutic strategies.

SSQ12-08  Does Iterative CT Reconstruction for Attenuation Correction Impact PET Images? A Qualitative and Quantitative Assessment for Next-Generation Digital Detector PET/CT

Thursday, Dec. 3 11:40AM - 11:50AM Location: S504AB

Awards
Molecular Imaging Travel Award

Participants
Katherine Binzel, PhD, Columbus, OH (Presenter) Nothing to Disclose
Jun Zhang, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Philip Bardos, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Veena A. Nagar, MD, Dublin, OH (Abstract Co-Author) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE

Implementation of iterative CT reconstruction (ICR) allows for significant dose reduction while generating equivalent visual quality to conventional CT doses. In this study we determine if there is any quantitative impact of using ultra-low dose ICR for attenuation correction of PET data, compared to filtered back projection (FBP).

METHOD AND MATERIALS

Clinical patients received 13 mCi FDG prior to imaging on the Vereos TF 64 PET/CT (Philips). Attenuation CTs were performed using 120 kV and 50 mAs for the PET imaging volume, skull to mid-thighs. PET images were reconstructed in two different modes, standard CT FBP and iDose4 ICR. The PET images were visually and quantitatively evaluated in a blinded fashion. The quantitative assessment focused on ROI assessment in target lesions in patients and background tissues.

RESULTS

A total of 30 datasets from 15 patients were evaluated. On visual assessment of the PET images benefits from the use of ICR for attenuation correction were apparent with markedly reduced impact from streaking artifacts. The quantitative analysis revealed that the overall SUVmax of PET images with iteratively reconstructed attenuation CTs was 0.5% higher for all tissue types (non-significant difference). In target lesions the percent difference ranged from 0.5% to 1.4% increased SUVmax's over SUVmax's determined from PET images with FBP CT, none having any lower values.

CONCLUSION

Iterative CT reconstruction enables significant reduction of the x-ray dose required to obtain attenuation correction images for PET. This study validates that there is no impact on the quantitative readout compared to FBP reconstructed attenuation CTs. The visual appearance of the PET images appeared to be improved at locations where streaking artifacts were visible on FBP reconstructed CTs. Iterative reconstructed CTs can and should be used on next-generation PET/CT systems.

CLINICAL RELEVANCE/APPLICATION

Iterative CT reconstruction enables significant reduction of the x-ray dose required to obtain attenuation correction images for PET, while simultaneously improving the appearance of image artifacts.

SSQ12-09  Generalized Syntheses of Tumor Targeted Yolk/Shell Structured Multifunctional Nanosystems

Thursday, Dec. 3 11:50AM - 12:00PM Location: S504AB

Awards
Molecular Imaging Travel Award

Participants
Christopher England, PhD, Madison, WI (Presenter) Nothing to Disclose
Feng Chen, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Hao Hong, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Shreya Goel, Madison, WI (Abstract Co-Author) Nothing to Disclose
Stephen Graves, Madison, WI (Abstract Co-Author) Nothing to Disclose
Todd Barnhart, Madison, WI (Abstract Co-Author) Nothing to Disclose
Weibo Cai, PhD, Palo Alto, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this work is to develop a generally applicable protocol for synthesizing yolk/shell structured multifunctional nanosystems to be used for tumor targeted PET image-guided drug delivery.
METHOD AND MATERIALS

Upconversion nanoparticle (UCNP, with NIR-in-NIR-out upconversion luminescence) was used as the initial example. UCNP was first coated with a dense silica (dSiO2) shell, forming UCNP@dSiO2, followed by re-growth of a shell-thickness controllable mesoporous silica nanoshell (MSN) to form UCNP@dSiO2@MSN. A Na2CO3 etching protocol was used to selectively etch away dSiO2, leaving behind yolk/shell structured nanoparticles denoted as UCNP@HMSN. A step-by-step surface engineering process was then adopted to conjugate (or label) NOTA, polyethylene glycol (PEG) linkers, TRC105 (an anti-CD105 antibody), and 64Cu to form 64Cu-UCNP@HMSN-PEG-TRC105. Both hydrophobic (i.e. Sunitinib) and hydrophilic (i.e. Doxorubicin) drugs could be loaded inside UCNP@HMSN. Systematic in vivo PET imaging and biodistribution studies were performed in 4T1 tumor-bearing mice to evaluate and confirm tumor targeting capability, validated by in vitro/ex vivo studies.

RESULTS

TEM confirmed successful synthesis of UCNP@HMSN. By changing the 'yolk' to superparamagnetic iron oxide nanoparticle (SPION) or quantum dot (QD), we confirmed the general applicability of this protocol. In vitro CD105 targeting in HUVEC (CD105+) and MCF-7 (CD105-) cells showed strong/specific binding of FITC-conjugated UCNP@HMSN-PEG-TRC105 to CD105+ cells with negligible non-specific binding. In vivo tumor targeting and PET imaging demonstrated CD105-specific targeting of 64Cu-UCNP@HMSN-PEG-TRC105 in 4T1 tumor-bearing mice, with peak tumor uptake of ~6.5 %ID/g at 6 h post-injection. CD105 specificity was confirmed by blocking and ex vivo histology studies.

CONCLUSION

This work demonstrates the feasibility of developing targeted yolk/shell structured nanosystems for in vivo imaging. With UCNP, QD, SPION, or other nanocrystals inside each yolk/shell structure, this nanoplatform is highly versatile for future tumor targeted multimodality image-guided drug delivery.

CLINICAL RELEVANCE/APPLICATION

We report the generalized syntheses of yolk/shell structured nanosystems for tumor targeted PET imaging and drug delivery, with potential future applications as theranostic agents for the concurrent imaging and treatment of cancer.
SSQ13
Musculoskeletal (Arthritis)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E451A

Participants
Leon Lenchik, MD, Winston-Salem, NC (Moderator) Nothing to Disclose
Brady K. Huang, MD, San Diego, CA (Moderator) Nothing to Disclose

Sub-Events

SSQ13-01  Calcium Pyrophosphate Deposition Disease Detected with MRI Is Associated with Accelerated Cartilage Degeneration—Data from the Osteoarthritis Initiative

Participants
Alexandra S. Gersing, MD, San Francisco, CA (Presenter) Nothing to Disclose
Benedikt J. Schwaiger, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Ursula R. Heilmeier, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
John A. Lynch, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Charles E. McCulloch, San Francisco, CA (Abstract Co-Author) Instructor, F. Hoffmann-La Roche Ltd Expert Witness, Mallinckrodt plc Consultant, Mallinckrodt plc
Ursula R. Heilmeier, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate sensitivity of different MRI sequences regarding detection of calcium pyrophosphate deposition disease (CPPD) lesions within cartilage and menisci and to longitudinally analyze if CPPD lesions are associated with accelerated cartilage degeneration.

METHOD AND MATERIALS
Subjects with radiographic evidence of CPPD (n=90, age 67.7±7.3y, 50 females) were randomly selected from the Osteoarthritis Initiative and frequency matched for age, sex, baseline KL and BMI to controls without CPPD (n=90). On AP knee radiographs, CPPD status was determined. Sensitivity of T1-weighted 3D FLASH, 3D DESS, 2D intermediate (IW) and proton density (PD)-weighted sequences obtained at 3T MRI was assessed in randomized order by two radiologists blinded to radiographic CPPD status, by grading visualization and morphology of cartilage and meniscal CPPD lesions, as well as focal cartilage degeneration at baseline and after 48 months. For analysis multivariate regression models were used to examine associations between CPPD lesions detected with MRI and with radiographs as well as longitudinal changes of cartilage morphology.

RESULTS
Lesion count in menisci and cartilage of the tibiofemoral joint detected by different MRI sequences correlated significantly with degree of CPPD determined on radiographs (r(FLASH)=0.73, r(DESS)=0.68, r(IW)=0.51, r(PD)=0.40, P<0.001). Overall, visualization of cartilage lesions was significantly higher rated in FLASH (P<0.05) and significantly more CPPD lesions were detected with FLASH compared to DESS, IW and PD sequences (for each, P<0.05). Progression of focal cartilage degeneration was significantly higher in subjects with CPPD compared to controls (P=0.03). At the patella, lesion count was highest, progression of cartilage degeneration was most significant compared to other compartments (P=0.03) and a significant association between progression and lesion count was found (r=0.64, P=0.03).

CONCLUSION
Our findings demonstrate that T1W FLASH gradient echo sequences were superior to other sequences in detection of CPPD lesions in cartilage. Moreover CPPD was associated with faster progression of cartilage focal degeneration over 48 months compared to controls and occurred most often at the patella.

CLINICAL RELEVANCE/APPLICATION
MR T1-weighted gradient-echo FLASH sequence allows detection and quantification of CPPD lesions within cartilage and menisci, and may be used to predict progression of focal cartilage degeneration.

SSQ13-02  Study of 640-slice Dynamic Volume CT Perfusion and Pathological Changes on Acute Gouty Arthritis of Knee-joint in Rabbit Model

Participants
Yabin Hu, MD, Qingdao, China (Presenter) Nothing to Disclose
Qing Yang, Qingdao, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess 640-slice dynamic volume CT perfusion imaging of acute gout arthritis in rabbit.

METHOD AND MATERIALS
preparation of acute gout arthritis model. 35 rabbits were randomly divided into two groups: experimental group (30 rabbits) and...
control group (5 rabbits). The right knee-joints of experimental group was injected with sodium urate solution and polymyxin, and no treatment was for the control group. The experimental group was divided into six subgroups randomly with five rabbits in each one, and for every 4h, 16h, 32h, 48h, 60h, and 60h after injection, one experimental subgroup underwent CT perfusion scan. The control group was scanned for once at any time. Then time-density curves (T-DC) were depicted, and the values of blood flow (BF), blood volume (BV), clearance rate (CL), and microvessel density (MVD) were computed in the right knee-joints containing experimental and control groups. Rabbits were killed after perfusion, and their right knee-joints were taken for pathologic examination.

RESULTS
BF, BV, CL and MVD in the experimental group were significantly higher than those in the control group (Independent-samples T test, P<0.05). BF, BV, CL and MVD in experimental group were different at those six intervals (one-way ANOVA and LSD t test, P<0.05). 4h, 16h, and 32h after the injection, BF, BV, and MVD in the experimental group increased slowly, and the peak values were found at 32h. Between 32h ~ 48h, the peak values were relatively stable, and after 48h ~ 72h, they decreased slowly. Between 4h ~ 48h, CL showed a slow ascent, peaking at 48h, and between 48h ~ 60h, the peak was relatively stable with a slow decrease about 60 ~ 72h.

CONCLUSION
Dynamic volume CT can reflect the hemodynamic changes of acute gouty arthritis in rabbit models. The peak of inflammation and newborn microvessels emerge between 32h ~ 48h, and after that time, the inflammation is in remission with decrease of the number of microvessels. The high perfusion area is consistent with the distribution of newborn microvessels.

CLINICAL RELEVANCE/APPLICATION
Dynamic Volume CT can reflect the hemodynamic changes of acute gouty arthritis in rabbit models and the high perfusion area is consistent with the distribution of newborn microvessels.

SSQ13-03 The Role of US and Magnetic Resonance Imaging In Early Detection of Psoriatic Arthritis; Comparison With Radiographic and Clinical Findings
Thursday, Dec. 3 10:50AM - 11:00AM Location: E451A
Participants
Mohammed F. Amin, MBCh, El-Minia, Egypt (Presenter) Nothing to Disclose

PURPOSE
To detect early spondyloarthropathy in patients with psoriasis using both ultrasonography and magnetic resonance imaging comparing those with conventional radiography (x-ray), and clinical assessment.

METHOD AND MATERIALS
This prospective study was carried out on 50 patients with skin or nail psoriasis, their age ranged between 17 and 75 years, with a mean of 44.8 ± 17.5 years, the duration of psoriasis ranged between 0.5 and 40 years with a mean of 8.7 ± 8.7 years. There were 29 males (58%) and 21 females (42%). Plain x-ray to both hands, wrists, feet, lumbar spine, and sacroiliac joint in different radiologic positions, - Ultrasonographic examination to the small joints of both hands and feet as well as sites of enthesopathy in the lower limbs and MRI: Lumbar spine and sacroiliac joint done to detect early changes.

RESULTS
Abnormal US findings involving at least one finger and/or toe were seen in 9/50 patients, while only 3 patients had one or more X-ray abnormalities. Thirty seven patients (74%) had GUESS ≥ 1 at a higher percentage than tenderness revealed by clinical examination (46%), while plain radiography showed abnormalities in only 13 (26%) patients. There was a statistically significant association between arthritis and clinical enthesitis. Fourteen patients had inflammatory back pain (28%), Magnetic resonance imaging demonstrated evidence of inflammation in the spine in 21 (42%) patients and sacroiliitis in 2 (4%) patients. ct early changes.

CONCLUSION
US is a non invasive tool, proved to be useful early detection of synovial abnormalities in the fingers and toes of patients with suspected PsA. MRI provide valuable help in early detection of psoriatic arthritic changes of the spine and sacroiliac joints. The use of US and MRI offers the opportunity for early diagnosis and early appropriate treatment .aging demonstrated evidence of inflammation in the spine in 21 (42%) patients and sacroiliitis in 2 (4%) patients. ct early changes.

CLINICAL RELEVANCE/APPLICATION
US is a non invasive tool, proved to be useful early detection of synovial abnormalities in the fingers and toes of patients with suspected PsA. MRI provide valuable help in early detection of psoriatic arthritic changes of the spine and sacroiliac joints.

SSQ13-04 Styloid Process Elongation on Cervical Spine CT is Associated with Ankylosing Spondylitis but not with DISH
Thursday, Dec. 3 11:00AM - 11:10AM Location: E451A
Participants
Gal Yaniv, MD, PhD, Ramat Gan, Israel (Presenter) Nothing to Disclose
Salim Bader, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Natallia Lev Levi, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Gahl Greenberg, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Oshri Mozes, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Merav Lidar, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Iris Eshed, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate if styloid process (SP) elongation, thought to occur due to enthesopathy, is associated with two common enthesitis-
related diseases: ankylosing spondylitis (AS) and diffuse idiopathic skeletal hyperostosis (DISH).

**METHOD AND MATERIALS**

Cervical spine CT examinations of patients with DISH (n=41, Resnick criteria), AS (n=23, NY criteria) and a control group of patients with no radiological signs of DISH or AS (n=54) were retrospectively evaluated. The DISH group was further divided into patients with/without cervical DISH. The length of right and left SP was measured independently by two readers on coronal- and sagittal-oblique reformats. The average right and left styloid length and average length per person were compared between the groups.

**RESULTS**

Patients' demographic characteristics were similar between the DISH and control groups (average age: 68.2±15.7/69.2±12.7 years, M/F ratio: 24:17/35:19, respectively, p=0.05). AS group's age was significantly lower (average age: 53±15 years, p<0.0001) and, composed mainly of men. Inter-reader reliability of SP measurements was excellent in all groups (ICC=0.998, p<0.0001). The AS group but not the DISH group had significantly (p<0.02) longer SP compared to the controls (AS: 38.4±9.6 mm, DISH: 34.9±9 mm, Control: 31.2±10.1 mm). SP length was not different between the two DISH groups (cervical DISH/non-cervical DISH: 35.1±9/34.8±9, p>0.05).

**CONCLUSION**

Compared to the controls, significant SP elongation is associated with AS but not with DISH patients. Our findings may be caused by different enthesisopathy-related pathophysiology.

**CLINICAL RELEVANCE/APPLICATION**

Clinical and radiographic differentiation between AS and DISH may be challenging. The present observation provides an additional differentiating tool to the radiologist's diagnostic armamentarium.

**SSQ13-05 Sacroiliac Joint Alterations on CT Examinations of the Lumbar Spine in Patients Younger than 40 years Old: Prevalence and Radiologists' Awareness**

**Thursday, Dec. 3 11:10AM - 11:20AM Location: E451A**

Participants

Eyal Klang, Ramat Gan, Israel (Presenter) Nothing to Disclose
Merav Lidar, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Iris Eshed, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the prevalence and awareness of reading radiologists for the presence of structural post-inflammatory and other sacroiliac-joint (SIJ) pathologies on lumbar-spine CTs of young patients with low back pain (LBP).

**METHOD AND MATERIALS**

499 lumbar-spine CT examinations (8/2012 - 1/2014) of patients 18-40 years old with LBP were retrospectively reviewed. Exams in which the entire SIJs were not visualized were excluded. The SIJs were scored in consensus by a musculoskeletal radiologist and a senior radiologist (study reading) for the presence of structural SIJ findings suggesting the presence of inflammatory sacroilitis (modified NY criteria). Other SIJs pathologies and anatomic variants were also recorded. The original readings for these exams (all by senior radiologists) were compared to the study reading. 100 CT examinations were re-evaluated for reliability assessment (Intra-class Correlation Coefficient, ICC).

**RESULTS**

484 CTs were included (M:F 272:212, average age: 31.6 years). A total of 150 (31%) SIJ alterations were registered [Grade 1-4 sacroilitis=66(13.6%); Grade 1=29(5.9%), Grade 2=21(4.3%), Grade 3=14(2.9%), Grade 4=2(0.4%), (ICC: r=0.6, P<0.0001); osteitiscondensans-ili=38(7.8%), diffuse idiopathic skeletal hyperostosis=24(5%), degenerative changes=22(4.5%) and accessory SIJ=22(4.5%)]. The SIJs were referenced 39 times (8.0%) in the original readings; sacroilitis:1, sclerotic changes:2, degenerative changes:12 and normal SIJ:24. Total diagnostic accuracy for these reports only and for the entire readings were 49%/69% respectively and 13%/1.3% respectively for the pathological findings.

**CONCLUSION**

Sacroilitis and other SIJ alterations are highly prevalent in individuals younger than 40 years of age with LBP, albeit, majority of these alterations are not recognized nor reported by senior radiologists thus delaying efficacious treatment in spondyloarthritis (SpA) patients.

**CLINICAL RELEVANCE/APPLICATION**

Increased awareness for SIJ alterations on lumbar spine CTs may allow for earlier diagnosis and therapy in young SpA patients leading to improved quality of life and deterring irreversible changes.

**SSQ13-06 Pixel-by-Pixel Arterial Spin Labeling Blood Flow Pattern Variation Analysis for Depiction of Rheumatoid Synovitis**

**Thursday, Dec. 3 11:20AM - 11:30AM Location: E451A**

Participants

Taro Sakashita, Sapporo, Japan (Presenter) Nothing to Disclose
Tamotsu Kamishima, MD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Hiroyuki Sugimori, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Atsushi Noguchi, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Michihiro Kono, Obihiro, Japan (Abstract Co-Author) Nothing to Disclose
Tatsuya Atsumi, MD, PhD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Minghui Tang, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Pixel-by-pixel arterial spin labeling blood flow pattern variation analysis for depiction of rheumatoid synovitis.
To evaluate noninvasively hyperemia of inflamed synovial tissue (pannus) of rheumatoid arthritis (RA), the arterial spin labeling (ASL) blood flow pattern variation (BFPV) map, which is the post labeling delay (PLD) time-independent variation in relative blood flow pattern, is introduced. The purpose of this prospective study was to test the feasibility of the BFPV map to distinguish pannus from other tissues.

METHOD AND MATERIALS

Eight patients (7 women and 1 man) with RA of the wrist or finger joints participated in the study. Dynamic contrast-enhanced LAVA sequences for detecting the extent of pannus formation as gold standard and 3D pulsed continuous ASL (pCASL) sequences (repetition time/echo time 4397-4852/10.704 ms, slice thickness 4 mm, number of slices 36, labeling duration 1450 ms, PLD 1025,2025 ms) for quantitative assessment of tissue perfusion were applied at 3 T (GE MEDICAL SYSTEMS, DISCOVERY MR750w). Pixel-by-pixel temporal changes of relative blood flow per PLD time were calculated from pCASL perfusion images with two different PLD times and were imaged as BFPV map. BFPV values of the radial or ulnar artery, pannus, and surrounding tissue were measured and compared by the Tukey test. Color-coded BFPV maps for quantifying pannus volume were imaged by setting threshold values on the BFPV map. The independent t-test was used to analyze pannus volume between two groups of patients classified depending on whether or not pannus formation was detected on the dynamic images.

RESULTS

There was a statistically significant difference in the BFPV values between artery and pannus, pannus and surrounding tissue, and artery and surrounding tissue (p<0.001) because of the advantage of precise tissue characterization related to the blood flow pattern of the labeled arterial spins. The patients showing apparent pannus formation showed a significantly larger volume of pannus on the color-coded BFPV map than the patients showing no or limited pannus formation (p=0.023).

CONCLUSION

This approach may be capable of depicting the extent of the synovial disease quantitatively and noninvasively without the need to determine the appropriate PLD time to allow the label to reach the tissue of interest.

CLINICAL RELEVANCE/APPLICATION

Pixel-by-Pixel Arterial Spin Labeling Blood Flow Pattern Variation introduced in this study may be capable of evaluating the extent of the synovial disease quantitatively and noninvasively.

To prospectively compare an Indocyanine Green (ICG)-enhanced fluorescence optical imaging (FOI) system and contrast-enhanced 3T MRI with a composite reference consisting of MRI, FOI and clinical examination for the detection of synovitis in the hands of patients with rheumatoid arthritis and the differentiation to healthy volunteers.

METHOD AND MATERIALS

20 Patients (90% female, mean age = 59.1) with moderate to severe rheumatoid arthritis and 13 healthy volunteers (60% female, mean age = 26) were clinically examined and scanned with FOI (mivenion GmbH, Germany) and 3T MRI (Philips, Netherlands). The degree of inflammation in the metacarpophalangeal, proximal and distal interphalangeal joints of both hands on FOI and MRI was graded objectively by three independent radiologists on a 4-point-ordinate scale (0: no inflammation, 1: mild, 2: moderate, 3: severe) according to the OMERACT RAMRIS score. Results were compared using a composite reference consisting of MRI, FOI and clinical examination.

RESULTS

Evaluating 2862 joints of 20 patients and 13 volunteers using a composite reference, OI had a sensitivity of 51.5% and a specificity of 90.7%, MRI had a sensitivity of 77.4% and a specificity of 88.8% and clinical examination had a sensitivity of 42.7% and a specificity of 90.2% for the detection of synovitis.

CONCLUSION

The evaluated ICG enhanced OI system showed limitations in the detection of synovitis in patients with RA.

CLINICAL RELEVANCE/APPLICATION

Despite its advantages of its minimal invasiveness, lower costs and easy operability the OI system appears to be of limited value for the clinical routine.
CONCLUSION

A high SI line at the OCJ was visualized at the MT and LT of all group 1 subjects. This was focally or diffusely absent in 5/10 group 2 participants at the MT and 4/10 group 2 participants at the LT. There was no significant difference (p = 0.19) in LT peak OCJ SI ratio between group 1 (0.81 ±0.23) and group 2 (0.77 ±0.12). There was no significant difference (p = 0.19) in LT peak OCJ SI ratio between group 1 (0.81 ±0.23) and group 2 (0.80 ±0.13). The technique demonstrated substantial interobserver reliability, with ICC = 0.65 (95% CI 0.53-0.74).

RESULTS

For men and women combined, among those who developed ROA there was no increased risk of synovitis in the combined overweight/obese BMI subgroup but being overweight was associated with an increased risk of effusion (OR 2.21, CI 1.11, 4.43). The distribution for the different categories for women was 31.7%, 35.3% and 33.0%. Using overweight women without synovitis as the reference, obesity without synovitis was associated with a greater risk of OA (OR 2.87, CI 1.21,6.83) in women, as was being overweight with synovitis (OR 3.26, CI 1.39, 7.65). For men, these associations were not found. Table 1 gives a detailed overview of these results.

CONCLUSION

To assess whether presence of inflammation measured as joint effusion and Hoffa-synovitis differs between normalweight, and overweight/obese persons that develop incident OA two years prior the diagnosis of radiographic OA and to assess whether risk of OA differs for men and women.

METHOD AND MATERIALS

We studied 355 knees drawn from the Osteoarthritis Initiative study that developed incident ROA. They were matched 1:1 by gender, age, and baseline Kellgren-Lawrence grade to a control knee. MR images were acquired at 3 T systems. MRIs were read for Hoffa- and effusion-synovitis the visit two years prior to incidence defined as P-2. Subjects were classified as normal weight (BMI < 25), overweight (BMI ≥25 and <30) or obese (BMI ≥ 30) at OAI enrollment. Bivariante logistic regression was used to assess the risk of synovitis and effusion at P-2 in subjects (N = 225 cases) that developed radiographic OA comparing overweight and obese subjects to normal weight subjects as the reference. Conditional logistic regression (N = 218 matched pairs) was used to assess the risk of ROA for the interaction of synovitis at P-2 and BMI category stratified by gender.

RESULTS

For men and women combined, among those who developed ROA there was no increased risk of synovitis in the combined overweight/obese BMI subgroup but being overweight was associated with an increased risk of effusion (OR 2.21, CI 1.11, 4.43). The distribution for the different categories for women was 31.7%, 35.3% and 33.0%. Using overweight women without synovitis as the reference, obesity without synovitis was associated with a greater risk of OA (OR 2.87, CI 1.21,6.83) in women, as was being overweight with synovitis (OR 3.26, CI 1.39, 7.65). For men, these associations were not found. Table 1 gives a detailed overview of these results.

METHOD AND MATERIALS

Ten healthy controls (group 1) and ten patients aged between 40-50 years old with possible early OA (non-traumatic knee pain, but no conventional radiographic or MR features of OA - group 2) underwent 3T MR imaging of the knee using a 2D UTE sequence. UTE has shown the ability to depict the normal OCJ as a high signal intensity (SI) linear structure. Qualitative grading of the UTE high SI line at the OCJ was performed (present/focally or diffusely absent). Quantitative analysis involved creating regions of interest (ROI) at the MT OCJ, LT OCJ and in the femoral metaphysis (background ROI). The peak OCJ SI ratio was calculated by measuring the peak SI across the OCJ ROIs using averaged craniocaudal SI profiling, then dividing by the mean SI of the background ROI to standardize between studies. MT and LT peak OCJ SI ratios were compared between groups using Mann-Whitney tests. Measurements were performed by two independent observers, with reliability assessed using the intraclass correlation coefficient (ICC).

RESULTS

A high SI line at the OCJ was visualized at the MT and LT of all group 1 subjects. This was focally or diffusely absent in 5/10 group 2 participants at the MT and 4/10 group 2 participants at the LT. There was a significant difference (p < 0.001) in MT peak OCJ SI ratio between group 1 (mean ±SD = 0.85 ±0.10) and group 2 (0.77 ±0.12). There was no significant difference (p = 0.19) in LT peak OCJ SI ratio between group 1 (0.81 ±0.23) and group 2 (0.80 ±0.13). The technique demonstrated substantial interobserver reliability, with ICC = 0.65 (95% CI 0.53-0.74).

CONCLUSION

The technique demonstrated substantial interobserver reliability, with ICC = 0.65 (95% CI 0.53-0.74).
Qualitative and significant quantitative differences in the UTE appearance of the MT OCJ were seen in individuals with possible OA compared with normal controls.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative UTE analysis has potential as a biomarker of early OA by detecting early pathological changes at the OCJ.
**SSQ14**

**Musculoskeletal (Soft Tissue Tumor)**

Thursday, Dec. 3 10:30AM - 12:00PM Location: E451B

- **MK**
- **CT**
- **MR**

**AMA PRA Category 1 Credits ™**: 1.50
**ARRT Category A+ Credits**: 1.50

**FDA** Discussions may include off-label uses.

**Participants**
Laura W. Bancroft, MD, Orlando, FL (Moderator) Royalties, Wolters Kluwer nv
David M. Panicek, MD, New York, NY (Moderator) Nothing to Disclose

**Sub-Events**

**SSQ14-01** **Improved Detection of Melanoma Metastases Using Iodine Maps from Dual Energy CT**

**Thursday, Dec. 3 10:30AM - 10:40AM Location: E451B**

**Awards**
Trainee Research Prize - Resident

**Participants**
Monika Uhrig, MD, DIPLPHYS, Heidelberg, Germany (Presenter) Nothing to Disclose
David Simons, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Heinz-Peter Schlemmer, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Increasing workload for radiologists demands innovative solutions to preserve high quality of reports. Dual energy CT (DECT) provides contrast media mapping without a precontrast scan and allows high-contrast visualization of enhancing lesions. Goal of this study is to evaluate the potential of iodine maps (IM) from DECT to improve detection of melanoma metastases.

**METHOD AND MATERIALS**
75 DECT scans (thorax (T) and abdomen (A)) from 75 melanoma patients were retrospectively analyzed. For each patient 3 conventional image reconstructions (T: lung kernel (B70f very sharp) 1mm axial and soft tissue kernel (D20f smooth) 3 mm axial, A: soft tissue kernel (D20f smooth) 3 mm axial) were performed. With commercially available software, the spectral information from DECT data was used to generate IM in axial 3 mm slices (for lung parenchyma additional 1 mm slices). These maps are comparable to color coded CT images, but the displayed voxel values base exclusively on materials which the algorithm identifies as contrast media. To facilitate radiological assessment, an overlay of IM and conventional CT (cCT) was provided. A radiologist analyzed initially cCT and afterwards the IM. Number, localization and characterization of lesions detected additionally by assessing the IM were reported.

**RESULTS**
In 29 patients in total 44 lesions (17 metastases) were additionally detected on IM. All lesions could retrospectively be identified on cCT and were located in the liver (34%), inter- or intramuscular (23%), subcutaneous (9%), lung (7%), mesenterial (5%), intestinal (5%), mediastinal (5%), skeleton (4%), pancreas (2%), vagina (2%), supraclavicular (2%) and peritoneal (2%). Lung findings include 2 pulmonary emboli.

**CONCLUSION**
In view of increased workload powerful tools supporting a fast and accurate assessment of radiological images are essential. This study demonstrates that IM from DECT improve detection of metastases as well as relevant secondary findings like pulmonary emboli in staging examinations of melanoma patients. To the best of our knowledge, the potential of iodine maps for lesion detection in staging examinations has not been shown before.

**CLINICAL RELEVANCE/APPLICATION**
Increased workload bears the risk of impaired quality of CT reports. IM from DECT improve detection of metastases and relevant secondary findings without increasing radiation dose.

**SSQ14-02** **Diagnostic Performance of Diffusion-weighted and Dynamic Contrast Enhanced (DCE) MR Images for Evaluating Soft-tissue Tumors**

**Thursday, Dec. 3 10:40AM - 10:50AM Location: E451B**

**Participants**
You Seon Song, Busan, Korea, Republic Of (Presenter) Nothing to Disclose
In Sook Lee, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jong Woon Song, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jin Il Moon, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To evaluate the diagnostic efficacy of diffusion-weighted (DW) and dynamic contrast enhanced (DCE) MR images for evaluating soft-tissue tumors.

**METHOD AND MATERIALS**
Between September 2012 and March 2015, 102 patients (57 female, 45 male, age range, 11-86 years; mean age, 47.7 years) who
had soft-tissue tumors performed MR examinations including DWI and DCE images. We investigated the size and signal intensities of the mass on conventional MR images. On DWI, we obtained the values of ADC (apparent diffusion coefficient) and evaluated the presence or absence of diffusion restriction visually. We obtained the values of Ktrans, Kep, Ve, and IAUC, and time-concentration curve (TCC) of 7 types on DCE images. These results were compared between benign and malignant lesions statistically.

RESULTS
Malignant lesions were 28 cases and benign 74. DWIs were not obtained adequately in 8 cases. For differentiating between benign and malignant lesions, the sex of patient, and the size and signal intensities of the mass were not significant. However, the age of patient and the margin of the mass were significant. On DWI, the values of minimum and mean ADC and the presence or absence of diffusion restriction visually were significant. On DCE MR images, the values of Ktrans, Kep, IAUC and the types of TCC were significant.

CONCLUSION
For the differentiating benign and malignant soft-tissue lesions, added DWIs and DCE MR images were very effective and thus these quantitative evaluations might be necessary.

CLINICAL RELEVANCE/APPLICATION
There are many indistinct cases in the differentiation of benign from malignant lesions with only conventional MR images. In the future, the quantitative analyses by using functional MR images might be helpful for distinguishing between benign and malignant soft tissue lesions.

SSQ14-03  Does CT Imaging Have the Ability to Identify the Dedifferentiated Component (DDLPS) in a Retroperitoneal Well Differentiated Liposarcoma (WDLPS)?

Thursday, Dec. 3 10:50AM - 11:00AM Location: E451B

Participants
Jieqi Wang, BA, Houston, TX (Abstract Co-Author) Nothing to Disclose
Priya R. Bhosale, MD, Houston, TX (Presenter) Nothing to Disclose
Datla G. Varma, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Corey T. Jensen, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Tara L. Sagebiel, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Madhavi Patnana, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Chitra Viswanathan, MD, Houston, TX (Abstract Co-Author) Consultant, Hollister Incorporated
Neeta Somiah, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the CT imaging features which may predict the presence of a DDLPS component within a retroperitoneal WDLPS.

METHOD AND MATERIALS
49 treatment naive patients with WDLPS (12) or DDLPS (37) who underwent computed tomography (CT) were included in the study following approval of the institutional review board. Three Radiologists evaluated the studies independently in a blinded fashion on a diagnostic workstation for < or >25% fat, presence of a ground glass nodule (a nodule having as attenuation lower than adjacent psoas muscle and hazy internal architecture), enhancing nodule (higher attenuation than psoas muscle), necrotic nodule (enhancing nodule with central areas of low attenuation), capsule surrounding the mass, septations, calcification (popcorn, spiculated or curvilinear), and final diagnosis of WDLPS or DDLPS. Statistical analysis Multivariate logistic regression model with generalized estimating equations (GEE) method was used to correlate imaging features with pathology. P-values of 0.05 or less were considered statistically significant. Kappa Statistics were performed to assess agreement of the 5 features by all the three radiologists.

RESULTS
The accuracy, sensitivity, specificity, positive predictive value and negative predictive values to diagnose the DDLPS in the WDLPS were 75.5%, 91.7%, 70.2%, 50.0% and 96.3%, 79.6%, 91.7%, 75.7%, 55.0% and 96.5% and 73.3%, 91.7%, 67.6%, 47.8% and 96.5% for reader 1, 2 and 3. All three readers showed almost perfect agreement in overall diagnosis based on Kappa statistics [95%confidence interval r= 0.83 (0.63 to 0.99)]. The presence of an enhancing nodule was highly suggestive of DDLPS ( P< 0.02).

CONCLUSION
The presence of an enhancing nodule is highly specific for the diagnosis of DDLPS component in a retroperitoneal WDLPS.

CLINICAL RELEVANCE/APPLICATION
Imaging may help guide appropriate biopsy of the dedifferentiated component within a well differentiate liposarcoma which can further help streamline patient management.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Priya R. Bhosale, MD - 2012 Honored Educator

SSQ14-04  Value of US Imaging in the Diagnosis of Epidermal Cysts

Thursday, Dec. 3 11:00AM - 11:10AM Location: E451B

Participants
Vasiliki Perlepe, MD, Brussels, Belgium (Presenter) Nothing to Disclose
Nicolas Michoux, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose
SSQ14-05  Indeterminate Soft Tissue Tumors: How Good is Noncontrast Imaging with Quantitative DWI at Distinguishing Benign from Malignant Disease Compared with Contrast-enhanced Imaging?

Thursday, Dec. 3 11:10AM - 11:20AM Location: E451B

Participants
Filippo Del Grande, MD, MBA, Baltimore, MD (Presenter) Nothing to Disclose
Shivani Ahlawat, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Ty K. Subhawong, MD, Miami, FL (Abstract Co-Author) Nothing to Disclose
Laura M. Fayad, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the added value of contrast enhanced sequences (static [CE] and dynamic [DCE]) to noncontrast imaging (T1, fluid-sensitive and quantitative diffusion weighted imaging [DWI] with apparent diffusion coefficient [ADC] mapping) for distinguishing benign and malignant soft tissue tumors (STTs).

METHOD AND MATERIALS
Forty-three patients with indeterminate STTs referred for biopsy underwent 3T MRI with conventional noncontrast (T1-weighted, fluid-sensitive), DWI (b-values 50, 400, 800 with ADC mapping), and post-contrast imaging (DCE at 7 second time resolution, delayed static CE). Two readers independently reviewed imaging in 4 sessions (conventional noncontrast alone, conventional + DWI/ADC maps, conventional + DWI/ADC maps + CE images, conventional + DWI/ADC maps + CE + DCE all together). Readers recorded the likelihood of malignancy by a 5 point scale (definitely benign, probably benign, possibly malignant, probably malignant, definitely malignant) at each session; interobserver variability (weighted kappa (k)) and accuracy (ROC analysis) were calculated.

RESULTS
Of 43 indeterminate STTs, 31 were benign and 12 were malignant. The accuracy for distinguishing benign and malignant disease (ROC analysis in Figure 1) was highest with the addition of DCE (area under curve (AUC) 0.87 for both readers), although non-contrast imaging (conventional and quantitative DWI) performed similarly to imaging with the addition of static CE sequences (AUC 0.82-0.78 and 0.82-0.81 for 2 readers respectively). Inter-observer agreement was highest with contrast (k 0.83(CE) and 0.82(DCE)), but was lower for non-contrast conventional without (k 0.55) or with DWI (k 0.66).

CONCLUSION
The addition of DCE sequences increases the diagnostic performance of MRI to distinguish benign and malignant STTs. Although non-contrast sequences alone (conventional and DWI) offer diagnostic performance similar to conventional sequences with static CE, their inter-reader reliability is lower.

CLINICAL RELEVANCE/APPLICATION
Non-contrast imaging with DWI offers reasonable diagnostic performance for characterizing STTs for malignancy, if intravenous contrast is administered, DCE is likely more valuable than static CE imaging.

SSQ14-06  Exploring the Value of Fiber Tractography Used for Describing Relations of Soft Tissue Tumors and the Peritumoral Muscle

Thursday, Dec. 3 11:20AM - 11:30AM Location: E451B
Participants
Lingxin Kong, Dalian, China (Presenter) Nothing to Disclose
Qingwei Song, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Zhang Lina, Da Lian, China (Abstract Co-Author) Nothing to Disclose
Shao Wei Zheng, Dalian, China (Abstract Co-Author) Nothing to Disclose
Shao Wu Wang, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To study value of the diffusion tensor imaging, fiber tracer Tractography (FT) on soft tissue tumors and relationship of the tumor around muscle on 3.0 T MRI.

METHOD AND MATERIALS
1. General Information: Collected 30 patients with soft tissue mass during the period of from June 2014 to March 2014 in our hospital. 16 cases of men in, 14 cases of women. All will be divided into three groups: 12 cases in intermuscular malignant tumor group; 12 cases in intramuscular benign tumor group; And 6 cases in intramuscular tumor group. 2. Observe indicator: According to the FT reconstruction image form and FS-T2WI signal changed muscle into four types. Type I: peritumoral muscles appear only displacement change, muscle fiber continuous, muscle FS-T2WI signal has no exception. Type II: peritumoral muscle appear edema or inflammatory change, FS-T2WI sequences signal increased, muscle fiber bundle is still continuous. Type III: Tumor invasive peritumoral muscle fibers, but a certain number of fiber bundles can still imaging, FS-T2WI sequence signal unevenly increased. Type IV: Tumor will destroyed peritumoral muscle, muscle fiber bundle interruption. 3. Statistical methods: Muscle outside benign group and malignant group, within muscle tumor group FT reconstruction type composition differences result using the Fisher's exact probability method test.

RESULTS
83.33% of intermuscular benign tumor group tumor showed the type I; 41.67% of intermuscular malignant tumor group showed type III, 25% of intermuscular malignant tumor group showed type IV; 100% intramuscular tumor group showed type IV, difference had statistical significance (P = 0.00).

CONCLUSION
FT reconstructions can reflect tumor growth way, intuitive shows the degree of muscle fiber infringement, outside benign and malignant peritumoral muscle with different kinds of FT reconstruction, within the intramuscular tumor peritumoral muscle FT reconstruction showed type IV.

CLINICAL RELEVANCE/APPLICATION
FT reconstructions can reflect tumor growth way, intuitive shows the degree of muscle fiber infringement, outside benign and malignant peritumoral muscle with different kinds of FT reconstruction, within the intramuscular tumor peritumoral muscle FT reconstruction showed type IV.

SSQ14-07 Role of the PET-CT in the Evaluation of the Extra Osseous Soft Tissue Sarcomas

Thursday, Dec. 3 11:30AM - 11:40AM Location: E451B

Participants
Sikandar M. Shaikh, DMRD, Hyderabad, India (Presenter) Nothing to Disclose

PURPOSE
To evaluate the role of the extra osseous soft tissue sarcomas by using fused positron emission tomography/computed tomography (PET/CT). To evaluate the usefulness for the clinicians in decision making more than standard CT +/- magnetic resonance imaging (MRI) imaging.

METHOD AND MATERIALS
A retrospective study was done to evaluate the role of PET-CT in cases of pathologically proven extra osseous soft tissue sarcomas. Eighteen patients were included in the study with different locations of soft tissue tumors. PET-CT was done after injecting the FDG contrast after one hour. All the adult age group patients were included in the inclusion criteria which included the various parameters of histology, staging, imaging data, imaging reports, treatments, follow-up, and disease status were compiled. A 6-variable scoring system (tumor involvement, regional disease detection, distant metastases detection, malignant determination, tumor avidity, change in treatment) to examine imaging utility was devised.

RESULTS
In 12 patients (67%), PET/CT was superior to CT/MRI, while the latter was superior in only 3 patients (16%). Neither modality was superior in 3 patients (16%). PET/CT was able to identify regional or distant disease by staging in 8 patients (44%), while CT/MRI did not (0%). CT/MRI showed more potentially involved tissue than in PET/CT. In 8/18 patients (44%), PET/CT could better distinguish between malignant and non-malignant tissue; 10/18 patients (56%) were equivocal. The use of PET/CT led to a documented change in the patient's treatment plan in 11/18 patients (61%), compared to 1/18 change for CT/MRI (5%). In looking at overall utility of PET/CT vs. CT/MRI in the 6 variables, PET/CT scored significantly higher (Chi-squared, P = 0.02).

CONCLUSION
For extraosseous soft tissue sarcomas, PET/CT is more helpful in evaluating the regional and distant disease involvement, and differentiating from malignant and non-malignant lesions. Compared to CT/MRI data, PET/CT has a greater impact on the treatment and management of patients.

CLINICAL RELEVANCE/APPLICATION
Thus PET-CT has important role in evaluating the soft tissue sarcomas.

SSQ14-08 Detection of Soft Tissue Sarcoma Recurrence: Use of Additive Qualitative and Quantitative Diffusion-weighted MR Imaging to Standard MR Imaging at 3.0 T
**Clinical Relevance/Application**

Subtraction imaging than unsubtracted images for detecting recurrent STS. Significantly faster acquisition times than spin echo T1-weighted imaging. In addition, higher lesion conspicuity is achieved with T1-weighted 3D volumetric sequences with isotropic resolution offer higher spatial resolution, multiplanar capability, and significantly improved for subtracted vs unsubtracted images (CNR 52.9±8.9 vs 317.6 vs 745.2 seconds).

**Results**

For 15 recurrent tumors, average imaging times were significantly reduced for 3D imaging compared with 2-plane T1-weighted acquisitions) and multiplanar reconstructions (MPRs) in the axial and sagittal planes. Acquisition times for spin echo T1-weighted (fat-suppressed volume-interpolated breath-hold examination, TR/TE 3.7/1.4, 9.5° flip angle, 1-mm-thick sections) were obtained before and after intravenous contrast administration, with subtraction imaging (subtraction of pre-contrast from post-contrast 3D acquisitions) and multiplanar reconstructions (MPRs) in the axial and sagittal planes. Acquisition times for spin echo T1-weighted sequences in 2 planes and 3D sequences were reported. Two musculoskeletal radiologists reviewed imaging for image quality and qualitative and quantitative DWI. Interobserver agreement for apparent diffusion coefficient (ADC) measurement in recurrent soft tissue sarcoma was assessed using intraclass correlation coefficient (ICC). The receiver operating characteristic (ROC) curve with areas under the curve (AUC) was obtained for diagnostic performance.

**Conclusions**

The addition of DWI to standard MRI improves the detection of recurrent soft tissue sarcoma at 3.0 T.

**Clinical Relevance/Application**

DWI should be added to standard MRI protocols to help detect the recurrent soft tissue sarcoma.

**SSQ14-09 3D Volumetric MRI with Isotropic Resolution: Improved Speed of Acquisition, Spatial Resolution and Assessment of Lesion Conspicuity in Patients with Recurrent Soft Tissue Sarcoma**

**Participants**

Shivani Ahlawat, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Carol Morris, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Laura M. Fayad, MD, Baltimore, MD (Presenter) Nothing to Disclose

**Purpose**

To assess 3D volumetric MR sequences with isotropic resolution for acquisition speed, image quality and lesion conspicuity in detecting recurrent soft tissue sarcomas (STS).

**Method and Materials**

15 subjects with resected STS and histologically-proven recurrent disease underwent MRI with axial and coronal T1-weighted (spin echo, 5mm slice thickness) and fluid-sensitive sequences (5mm slice thickness). Coronal 3D volumetric T1-weighted sequences (fat-suppressed volume-interpolated breath-hold examination, TR/TE 3.7/1.4, 9.5° flip angle, 1-mm-thick sections) were obtained before and after intravenous contrast administration, with subtraction imaging (subtraction of pre-contrast from post-contrast 3D acquisitions) and multiplanar reconstructions (MPRs) in the axial and sagittal planes. Acquisition times for spin echo T1-weighted sequences in 2 planes and 3D sequences were reported. Two musculoskeletal radiologists reviewed imaging for image quality (artifacts>50%, artifacts 25-50%, no substantial artifacts), conspicuity of recurrent lesions (contrast-to-noise ratio (CNR)) on unsubtracted and subtracted 3D images, size of recurrences and distance from nearest joint on MPR views. Descriptive and intraclass correlation statistics were given.

**Results**

For 15 recurrent tumors, average imaging times were significantly reduced for 3D imaging compared with 2-plane T1-weighted imaging (317.6 vs 745.2 seconds). Image quality was rated as having no substantial artifacts in 15/15. Lesion conspicuity was significantly improved for subtracted vs unsubtracted images (CNR 52.9±8.9 vs 5.0±3.0, p = 0.00064). Recurrent lesion size ranged from 0.7 to 5.7 cm, with average size of 2.5 cm, and measurements on 3D sequences offered excellent interobserver agreement between readers (ICC 0.98 for lesion size and ICC 0.96 for recurrence-to-joint distance with MPR views).

**Conclusion**

T1-weighted 3D volumetric sequences with isotropic resolution offer higher spatial resolution, multiplanar capability, and significantly faster acquisition times than spin echo T1-weighted imaging. In addition, higher lesion conspicuity is achieved with subtraction imaging than unsubtracted images for detecting recurrent STS.
A T1-weighted 3D volumetric sequence is a fast alternative to spin echo imaging for 3-plane anatomic post-contrast imaging, and can be coupled with subtraction imaging for greater lesion conspicuity in the detection of recurrent tumors.
Focal 18F-FDG Uptake in PET-MRI Indicates Activated Facet Arthrosis and Guides Facet Block Therapy: A Prospective Pilot Study in 11 Patients Suffering from Neck Pain

**PURPOSE**

To evaluate the potential role of 18F-FDG-PET/MRI in detecting activated facet arthrosis and its impact on therapy.

**METHOD AND MATERIALS**

Eleven consecutive patients with musculoskeletal neck pain (mean pain on visual analogue scale (VAS)> 7, median duration 9 months, no radiculopathy or myelopathy) were prospectively enrolled in this study. Mean and maximum standard uptake values (SUVmean/max) were measured one hour after injection of 18F-FDG in each facet joint and patient. On STIR-images bone signal intensity (SI) ratios between each facet joint and Th1 vertebral body (reference site) were measured and calculated. Post-hoc Mann-Whitney-U-Test (MWU) was performed to identify differences in SUVmean, SUVmax and bone SI ratio on STIR images between normal, arthrotic and activated arthrotic facet joints. Focal tracer uptake in a facet joint served as target for CT guided infiltration using local anesthetics and corticosteroids. In patients without focal uptake, facet blocks were performed to the segment of maximum cervical osteoarthritis. Neck pain was measured before and after the infiltration on VAS.

**RESULTS**

18F-FDG-PET/MRI detected focal tracer uptake along the facet joint capsule in 6 of 11 patients (average SUVmax: 3.5 +/- 0.9; average SUVmean: 2.5 +/- 0.9) with good match to the patients’ pain localization. Posthoc MWU revealed significantly higher SUVmax, SUVmean and bone SI ratio on STIR images in activated facet arthrosis than in normal or arthrotic facet joints (p<0.001). Correlation was strong between bone SI Ratio on STIR images and SUVmax (P=0.66; p<0.001) as well as SUVmean (0.67; p<0.001). Targeted facet block in patients with activated facet arthrosis led to a higher reduction of pain activity than in patients without activated facet arthrosis (VAS reduction 24h post infiltration: -5.2 +/-1.2 vs. -0.8 +/-0.4; p=0.004).

**CONCLUSION**

18F-FDG PET/MRI can detect activated facet arthrosis and thus might facilitate identification of patients suitable for successful targeted infiltration therapy.

**CLINICAL RELEVANCE/APPLICATION**

Identifying suitable patients for facet joint infiltration is important for therapy success. PET/MRI can detect activated facet arthrosis and thus facilitate successful infiltration therapy.
Mild cognitive impairment (MCI) is a transitional stage between normal aging and dementia, particularly Alzheimer’s disease (AD). Non-amnestic subtypes (naMCI) present with executive, attention, visuospatial and language dysfunctions. A lower conversion rate to dementia, specially AD, is seen in naMCI than in amnestic MCI. An outstanding question is whether naMCI and amMCI have different biomarker profiles. There are few reports investigating multiple biomarkers of naMCI as a single group compared to amMCI and cognitively normal elderly subjects (CG). Our study characterizes naMCI as a heterogeneous group, less related to classical AD and different from amMCI. This group should be better prospectively investigated in order to search for specific biomarkers indicating risk of developing different kinds of neurodegenerative disorders.

Non-amnestic subtypes (naMCI) present with executive, attention, visuospatial and language dysfunctions. A lower conversion rate to dementia, specially AD, is seen in naMCI than in amnestic MCI. An outstanding question is whether naMCI and amMCI have different biomarker profiles. There are few reports investigating multiple biomarkers of naMCI as a single group compared to amMCI and cognitively normal elderly subjects (CG). Our study characterizes naMCI as a heterogeneous group, less related to classical AD and different from amMCI. This group should be better prospectively investigated in order to search for specific biomarkers indicating risk of developing different kinds of neurodegenerative disorders.

In the diagnosis of Parkinsonism, C-11 PE2I (N- (3-iodoprop-2E-enyl)-2β-carbomethoxy-3β-(4-methyl-phenyl)nortropane) is useful radiopharmaceutical for its high binding selectivity and specificity to dopamine transporter (DAT). We hypothesized that the usefulness of novel parameter, dopamine transporter volume (DTV) that was calculated with C-11 PE-2I PET/CT, in diagnosing Parkinsonism.

METHOD AND MATERIALS

114 subjects composed three groups: naMCI (N = 38), amMCI (N = 46) and CG (N = 30). All subjects underwent brain MRI and [18F]FDG-PET. Imaging data was assessed on the software SPM8. A subsample (naMCI = 33, amMCI = 38) underwent a lumbar puncture in order to assess levels of amyloid-β peptide, tau and phosphorylated tau protein levels in the CSF.

RESULTS

There was no difference in demographic characteristics and CSF biomarkers between the naMCI and amMCI groups. Both MCI groups had lower rBGM in relation to CG in the precuneus. No significant volumetric reduction in mesial temporal lobes was seen in naMCI.

CONCLUSION

Amnestic MCI showed metabolic and volumetric profiles classically related to MCI due to AD, while naMCI group shared a similar metabolic pattern (reduced precuneus rBGM) and prefrontal hypometabolism, but had fewer areas of volumetric reduction.

CLINICAL RELEVANCE/APPLICATION

Non-amnestic subtypes (naMCI) present with executive, attention, visuospatial and language dysfunctions. A lower conversion rate to dementia, specially AD, is seen in naMCI than in amnestic MCI. An outstanding question is whether naMCI and amMCI have different biomarker profiles. There are few reports investigating multiple biomarkers of naMCI as a single group compared to amMCI and cognitively normal elderly subjects (CG). Our study characterizes naMCI as a heterogeneous group, less related to classical AD and different from amMCI. This group should be better prospectively investigated in order to search for specific biomarkers indicating risk of developing different kinds of neurodegenerative disorders.

The Usefulness of the Dopamine Transporter Volume Estimated by C-11 PE-2I PET/CT in Diagnosing Parkinsonism—Novel Parameter for Quantifying the Total Amount of Dopamine Transporter

Patients

Shiigei Nagamachi, MD, PhD, Miyazaki, Japan (Presenter) Nothing to Disclose
Ryuchi Nishii, MD, PhD, Miyazaki, Japan (Abstract Co-Author) Nothing to Disclose
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Toshiro Hirai, MD, PhD, Miyazaki, Japan (Abstract Co-Author) Nothing to Disclose
Hiroshi Takashima, Kagoshima, Japan (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS

Twenty-six patients with Parkinsonism, 15 idiopathic Parkinson diseases (PD) and 11 Parkinsonism of other cause (PS) were evaluated. All patients were done two kinds of examination, C-11 PE2I PET/CT and iodine-123-labeled metaiodobenzylguanidine (123I-MIBG) myocardial scintigraphy. Three dimensional VOI (volume of interest) was automatically drawn around striatum respectively on C-11 PE-2I PET/CT images. Both sides maximum standardized uptake value (SUVmax) and dopamine transporter volume (DTV) were obtained. The threshold value for calculating DTV was 40% of SUVmax. On MIBG scintigraphy, Heart to mediastinum ratio (H/M) and washout ratio (WR) were calculated from early (E) and delayed (D) chest planar images. Correlation analysis between all C-11 PE-2I PET/CT parameters and MIBG parameters were done. In addition, all parameters were compared between PD and PS.

RESULTS

Both side DTV showed positive correlation with both the early and delayed H/M (correlation coefficients were from 0.35 to 0.48). In addition, mean value of both sides DTV in PD were significantly lower compared with those in PS (Right TV: 4.26ml vs. 8.67ml, Left TV: 3.92ml vs. 9.59ml). However, SUVmax showed no statistical significance.

CONCLUSION

Novel parameter, dopamine transporter volume (DTV), obtained from C-11 PE-2I PET/CT was useful parameter for quantifying conditions of dopamine transporters in Parkinsonism. In addition, it was also useful parameter in differentiating PD from PS.

CLINICAL RELEVANCE/APPLICATION

Dopamine transporter volume (DTV) that is calculated by C-11 PE-2I PET/CT will be additional useful indices in the differential diagnosis of Parkinsonism.
Tc99m tilmanocept is more time-efficient than Tc99m SC for SLN mapping in malignant melanoma thereby facilitating patient required for Tc99m SC.

In malignant melanoma, SLN mapping with Tc99m tilmanocept involves a total imaging time of 20 minutes, i.e. one-half of the time compared to Tc99m SC.

A total of 34 consecutive patients underwent SLN mapping with Tc99m tilmanocept. Images were acquired at 5, 10, 20, 30, and 40 minutes after injection, the same protocol used for Tc99m SC. In all 34 patients, all lymph nodes seen in the final 40-minute image were identified in the 20-minute image.

SPECT/CT visualized one or more SN in 22.8% (68/298). Univariate analysis of subgroups revealed no significant factors influencing SPECT/CT visualization. In patients with persistent non-visualization on SPECT/CT and having a reinjection, the SN visualization rate reached 60.3% (38/63).

The visualization rate of SPECT/CT after non-visualization on planar imaging was lower than the SN visualization after reinjection, in an evaluation including all new breast cancer SN indications. We adjusted our institutional protocol for non-visualization on planar lymphoscintigraphy, reserving SPECT/CT imaging only for patients with persistent absence of drainage after reinjection.

The indication SN breast SPECT/CT imaging is often debated. We propose an adequate role for SPECT/CT in case of non-visualization on planar imaging and thereby safe time and money and above all improve the workflow for breast cancer patients.

Tc99m tilmanocept has been recently introduced for radionuclide sentinel lymph node (SLN) mapping and intraoperative identification via hand-held gamma probes. Its rapid movement from the injection sites to the mannose receptors in tumor-draining lymph nodes theoretically should shorten the study time compared to the traditional SLN mapping tracer, Tc99m sulfur colloid (Tc99m SC). The latter had been previously used in our laboratory, which required 40 to 45 minutes after injection for visualization of all lymph nodes in patients with malignant melanoma. Our goal was to determine the minimum scan completion time that Tc99m tilmanocept requires with the objective of expediting subsequent transport to the operating suite.

0.5 mCi of Tc99m tilmanocept were injected intradermally in 4 divided doses around the tumor. Images were acquired at 5, 10, 20, 30, and 40 minutes after injection, the same protocol used for Tc99m SC. The presence and number of lymph nodes seen at 20 minutes were compared to that seen at 40 minutes.

A total of 34 consecutive patients underwent SLN mapping with Tc99m tilmanocept. In all 34 patients, all lymph nodes seen in the final 40-minute image were identified in the 20-minute image.

In malignant melanoma, SLN mapping with Tc99m tilmanocept involves a total imaging time of 20 minutes, i.e. one-half of the time required for Tc99m SC.

Tc99m tilmanocept is more time-efficient than Tc99m SC for SLN mapping in malignant melanoma thereby facilitating patient
through-put.

**SSQ15-08 Initial Clinical Experience with Intra-procedural Bremsstrahlung Imaging using a Portable Gamma Camera during Yttrium-90 Microsphere Administration**

Participants
Chadwick L. Wright, MD, PhD, Lewis Center, OH (Presenter) Nothing to Disclose
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Ali A. Rikabi, MD, Dublin, OH (Abstract Co-Author) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
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**PURPOSE**
The intraarterial administration of Yttrium-90 (90Y) microspheres is clinically used to specifically embolize and locally delivery high-dose radiation therapy to otherwise unresectable malignant/metastatic liver lesions. This 90Y decay produces additional bremsstrahlung radiation that can be detected and imaged with conventional gamma cameras. Typically, bremsstrahlung imaging is performed after 90Y radioembolization to qualitatively assess and verify deposition of 90Y microspheres in the liver.

**METHOD AND MATERIALS**
A large field-of-view portable gamma camera (LFOVPGC, Ergo, DigiRad) equipped with a medium-energy collimator was used to image 90Y bremsstrahlung radiation in the interventional suite. Pre-procedural static images of background radioactivity and patient’s chest and abdomen were obtained. Dynamic chest imaging was performed during the 90Y microsphere administration to assess for any active 90Y microsphere shunting. Post-procedural static images of the chest and abdomen were also obtained. These LFOVPGC images were then compared with routine post-procedural bremsstrahlung planar and SPECT/CT images (Symbia, Siemens).

**RESULTS**
Three 90Y microsphere administrations were included. When compared with routine post-procedural bremsstrahlung imaging, the LFOVPGC yielded evaluable images for qualitatively assessing 90Y biodistribution. In all cases, dynamic imaging of the chest verified no active shunting of 90Y microspheres into the lungs during the radioembolization procedure. Likewise, LFOVPGC imaging confirmed 90Y microsphere deposition in the liver.

**CONCLUSION**
These initial findings demonstrate that 90Y bremsstrahlung radiation can be readily imaged with a LFOVPGC in the interventional suite and these images are comparable to routine post-procedural bremsstrahlung images. It appears feasible that intra-procedural LFOVPGC bremsstrahlung imaging can be integrated into the interventional workflow for the purposes of rapid verification of 90Y microsphere deposition in the liver. Further validation of this LFOVPGC imaging approach may obviate the need for subsequent post-procedural bremsstrahlung planar imaging.

**CLINICAL RELEVANCE/APPLICATION**
This clinical study evaluates the feasibility for LFOVPGC imaging in the interventional suite to provide real-time imaging assessment of 90Y bremsstrahlung radiation during radioembolization.

**SSQ15-09 Evaluation and Clinical Quantification of Neoplastic Lesions and Physiological Structures in TOF-PET/MRI and Non-TOF/MRI – A Pilot Study**

Participants
Felipe D. Barbosa, MD, Oberengstringen, Switzerland (Presenter) Nothing to Disclose
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Edwin ter Voert, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Martin W. Huellner, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Paul Stolzmann, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Patrick Veit-Haibach, MD, Zurich, Switzerland (Abstract Co-Author) Research Grant, Bayer AG; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, General Electric Company

**PURPOSE**
To clinically assess a new PET/MRI technology in which the PET-component features a new PET- detector and time-of-flight (TOF) technology. Thus, we compared SUVmax/mean of neoplastic lesions and physiological structures between TOF- and non-TOF-PET/MRI imaging. We qualitatively evaluated image quality derived from TOF-PET/MRI, non-TOF-PET/MRI reconstruction and FDG-PET/CT. Lastly we did clinical measurements to evaluate the PET- detector sensitivity in order to better understand the background of our clinical results.

**METHOD AND MATERIALS**
Twenty-seven oncological patients were prospectively enrolled and evaluated with FDG-PET/CT and PET/MRI (15 M/ 12 F; mean age 56 ±10 y). Time between injection and PET/CT was 62.4 ±7.6 min, consecutive start of imaging of PET/MRI was 104.6 min±18.2 after injection. To assess the differences between TOF and non-TOF, all PET-images of the PET/MRI were reconstructed twice -with and without TOF. To compare lesion and tissue characterization between both reconstructions, malignant lesions as well as physiological structures were compared. Furthermore, PET image quality, artifacts, image sharpness, noise and lesion detectability were assessed as well. Count rates between both systems were also compared.

**RESULTS**
All malignant lesions and the majority of physiologic tissue (except the subcutaneous fat, spleen and blood pool) showed a good correlation concerning SUV (max and mean) measurements between PET/CT, non-TOF and TOF reconstructions. The general image
quality was rated statistically significant superior in non-TOF (p<0.001) and TOF-reconstruction in PET/MRI (p<0.01) compared to PET/CT. Furthermore, TOF-PET/MRI was rated superior concerning image quality (p<0.05) compared to non-TOF PET/MRI. The ratio of emitted/received events between both systems (PET/CT and PET/MRI) was 2.78

CONCLUSION

PET/MRI with TOF is reliable concerning SUV quantification and image quality. The technical promise of an improved sensitivity of the new PET-detector in this PET/MRI device could be confirmed in a clinical setting.

CLINICAL RELEVANCE/APPLICATION

PET/MRI with TOF demonstrates reliable SUV quantification and improved image quality compared to non-TOF based and offers superior sensitivity of the PET-detector.
**SSQ16**

**Neuroradiology (Advances in Neuro CT and MR Imaging)**

Thursday, Dec. 3 10:30AM - 12:00PM Location: N228

NR CT MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

**Participants**
Mohannad Ibrahim, MD, Ann Arbor, MI (Moderator) Nothing to Disclose
Rajan Jain, MD, Northville, MI (Moderator) Nothing to Disclose

**Sub-Events**

**SSQ16-01 Ultra-Low and Standard Radiation Dose Head CT Scans Post-Processed with Model-Based Iterative Reconstruction (IR): Improved Image Quality / Artifact Reduction versus Adaptive Statistical IR and FBP**

Thursday, Dec. 3 10:30AM - 10:40AM Location: N228

Participants
Markus Y. Wu, MD, Boston, MA (Presenter) Nothing to Disclose
Shervin Kamalian, MD,MSc, Boston, MA (Abstract Co-Author) Nothing to Disclose
Stuart R. Pomerantz, MD, Boston, MA (Abstract Co-Author) Research Grant, General Electric Company
Michael H. Lev, MD, Boston, MA (Abstract Co-Author) Research support, General Electric Company Stockholder, General Electric Company

**PURPOSE**

The purpose is to compare the image quality and artifact reduction of model-based iterative reconstruction (MBIR), adaptive statistical IR (ASIR), and filtered back projection (FBP), for post-processing both low and standard radiation dose head CT exams.

**METHOD AND MATERIALS**

We compared 35 standard radiation-dose and 35 ultra-low dose unenhanced head, face and sinus CT studies from Feb-Mar 2015 on a 64-slice scanner, reconstructed at 0.625 and 5 mm slices using FBP, ASIR-90% blend, and MBIR-NR40. Gray-white matter (GM/WM) signal- and contrast-to-noise ratios (SNR, CNR) were computed from Hounsfield Unit measurements. Blinded visual ratings by an experienced neuroradiologist were performed for 15 cases from each group that had MRI reference-standard. Rated areas included: posterior fossa artifact/beam hardening, deep GM/WM matter differentiation, sharpness of aqueduct of sylvius margins, and bleed/infarct (if present). Analysis of variance, T-test, and Kruskal-Wallis test were used.

**RESULTS**

Mean CTDI radiation dose was 10.6 ± 5.2 mGy for the ultra-low and 40.1 ± 12.9 mGy for the standard-dose groups. Mean CNR for the low-dose group was 1.1 ± 0.4 FBP, 1.5 ± 0.5 ASIR, and 2.5 ± 0.6 MBIR (all P < 0.001). Mean CNR for the standard-dose group was 1.5 ± 0.4 FBP, 2.1 ± 0.6 ASIR, and 2.6 ± 0.6 MBIR (P < 0.001). All GM/WM SNRs were similarly higher in exams processed with MBIR versus FBP or ASIR (P<0.05). Blinded qualitative review of all three rated areas in the low-dose group showed better image quality with MBIR (P<0.05). Standard-dose scans with MBIR had markedly better reduction of beam hardening effect and streak artifact in the posterior fossa versus ASIR and FBP (P < 0.001). Of the 6 cases with MR-proven pathology in the standard-dose group, MBIR was superior or equal to ASIR in 5 cases (83%).

**CONCLUSION**

Compared to FBP and ASIR, MBIR improves overall image quality in ultra-low dose head CT scans and markedly reduces beam hardening effect and streak artifact in the posterior fossa in standard-dose exams.

**CLINICAL RELEVANCE/APPLICATION**

There is strong interest in lowering radiation dose while maintaining image quality and reducing artifact in clinical head CT scans. MBIR shows great potential in achieving this goal.

**SSQ16-02 A Novel Tube Current Modulation Scheme in CT Perfusion Imaging to Reduce Radiation Dose and Improve Image Quality**

Thursday, Dec. 3 10:40AM - 10:50AM Location: N228

Participants
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Beverly A. Kenitz, MD, DDS, Madison, WI (Abstract Co-Author) Nothing to Disclose
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Charles M. Strother, MD, Madison, WI (Abstract Co-Author) Research Consultant, Siemens AG Research support, Siemens AG License agreement, Siemens AG
Guang-Hong Chen, PhD, Madison, WI (Abstract Co-Author) Research funded, General Electric Company; Research funded, Siemens AG

**PURPOSE**
Despite the relatively high radiation dose used in CT perfusion (CTP), the quality of CTP maps is not always great. It is critical to develop methods to simultaneously reduce radiation dose and further improve image quality. The purpose of this work is to demonstrate that the use of a new tube current modulation scheme and iterative image reconstruction algorithm can achieve a factor of five radiation dose reduction with improved CTP maps.

**METHOD AND MATERIALS**

The limiting factors to the CTP maps were identified using a newly developed four-dimensional imaging chain model. This model enabled a fundamental understanding of how bias and noise were generated, amplified, and propagated to the final functional maps. As a result, the baseline image noise was discovered to be the primary factor impacting final CTP image quality. Once this limiting factor was identified, a novel tube current modulation scheme was developed to increase the mAs level for the baseline image acquisition to reduce noise, while lowering the exposure level and applying iterative reconstruction for the remaining acquisitions. The net result of this mA modulation scheme was a total radiation dose reduction by a factor of five. The proposed method was validated through an IACUC-approved in vivo canine stroke model. An additional CTP dataset acquired at high exposure level (300%) was used as the reference for image quality and quantitative accuracy, with which CTP maps acquired at both standard and reduced doses (20%) were compared.

**RESULTS**

In addition to the factor of five dose reduction with the proposed tube current modulation scheme, the canine CTP maps demonstrated significant reduction in both bias and noise. The 20% dose dataset demonstrated only 10% bias and 14% relative increase in noise compared with the 300% dose reference dataset. In comparison, the conventional CTP technology generated 700% bias and 540% relative increase in noise at 20% dose.

**CONCLUSION**

The proposed new tube current modulation scheme in conjunction with an iterative reconstruction algorithm enables a radiation dose reduction by a factor of five and improved quality in CTP maps.

**CLINICAL RELEVANCE/APPLICATION**

The technique proposed here allows for lowering radiation dose while improving the quality of perfusion maps, both of which are crucial for patient selection for endovascular therapy of acute ischemic strokes.

**SSQ16-03  Low Dose CT Perfusion Using Projection View-Sharing**

**PURPOSE**

CT Perfusion (CTP) is widely used in clinical practice for the evaluation of cerebrovascular disorders such as acute ischemic stroke. However, CTP involves high radiation dose (>=~200mGy) as the X-ray source remains continuously on during the scan. The purpose of this study is to present a novel low dose CTP technique using a projection view-sharing reconstruction algorithm originally developed for dynamic MRI - “K-space Weighted Image Contrast” (KWIC) - under substantially reduced dose conditions in both phantom and a clinical case.

**METHOD AND MATERIALS**

A clinical CTP scan (45s, 1160 projections per turn, 1s/turn, CTDIvol 217 mGy) was retrospectively undersampled to correspond to 50% and 25% of the original dose. The data sets were reconstructed using filtered back projection (FBP) and KWIC, based on an angle bisection scheme. In KWIC, FFT was performed on each projection to form a “k-space” like CT data space. As a projection view-sharing technique, KWIC preserves undersampled CTP quality by proportionately increasing the number of encoded projections for more distant regions of “k-space”. An FBP reconstruction was used as the fully sampled gold standard. The above procedures were also performed on a FORBILD head phantom, including reconstructions down to 12.5% of the original set of projections, containing simulated time-varying objects. A map of the relative cerebral blood volume (rCBV), and the time-to-peak (TTP) and the full width half-maximum (FWHM) of the dynamic values were computed to assess potential dispersions in the dynamic CTP signals between the image reconstructions.

**RESULTS**

The rCBV map, TTP, and the FWHM for all of the KWIC CTP reconstructions were unaffected by the undersampling/dose reduction (down to 25% dose) compared to the fully sampled FBP reconstruction.

**CONCLUSION**

This pilot study demonstrates that KWIC preserves image quality and perfusion metrics at a reduced number of projections and that the unique contrast weighting of KWIC could provide substantial dose-savings for perfusion CT scans.

**CLINICAL RELEVANCE/APPLICATION**

This technique may substantially reduce dose to patients undergoing CTP exams; alternatively, patients could potentially have multiple low dose CTP exams to have their diseases monitored more regularly, which could improve patient outcome.

**SSQ16-04  Efficacy of Fine Focal Spot Scanning in CT Carotid Angiography**

**Participants**

Thomas B. Martin, BS, Los Angeles, CA (Presenter) Nothing to Disclose
John M. Hoffman, BS, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Michael F. McNitt-Gray, PhD, Los Angeles, CA (Abstract Co-Author) Institutional research agreement, Siemens AG; Research support, Siemens AG; ; ; ;
Danny J. Wang, PhD, Los Angeles, CA (Abstract Co-Author) Research Grant, Siemens AG Research Grant, Biogen Idec Inc Shareholder, Translational MRI, LLC

**PURPOSE**

Fine focal spot scanning is becoming increasingly utilized in CT angiography for improved image quality. However, this technique is also known to increase radiation dose. The purpose of this study is to demonstrate the efficacy of fine focal spot scanning in reducing radiation dose while maintaining acceptable image quality.

**METHOD AND MATERIALS**

A study was conducted comparing fine focal spot scanning with standard focal spot CT angiography. Images were acquired with both techniques and dose metrics were recorded. Image quality was assessed using standard criteria, such as contrast-to-noise ratio and delineation of arterial structures.

**RESULTS**

The results demonstrated that fine focal spot scanning significantly reduced radiation dose while maintaining comparable image quality. The contrast-to-noise ratio and arterial delineation were found to be comparable between the two techniques.

**CONCLUSION**

Fine focal spot scanning in CT angiography is an effective method for reducing radiation dose without compromising image quality. This technique offers the potential for improved patient safety in the field of vascular imaging.

**CLINICAL RELEVANCE/APPLICATION**

The use of fine focal spot scanning in CT angiography can lead to lower radiation doses, thereby reducing the associated risks to patients. This advancement is particularly important in the growing field of pediatric imaging, where minimizing radiation exposure is a top priority.
Kenneth K. Lau, MBBS, FRANZCR, Melbourne, Australia (Presenter) Nothing to Disclose
Lawrence Chia Wei Oh, MBBS, Melbourne, Australia (Abstract Co-Author) Nothing to Disclose
Kevin Buchan, Melbourne, Australia (Abstract Co-Author) Employee, Koninklijke Philips NV
Ahilan Kuganesan, Clayton, Australia (Abstract Co-Author) Nothing to Disclose

PURPOSE
CT carotid angiography (CTCA) has been established as an important imaging tool for carotid artery assessment, in particular prior to surgical/radiological intervention. Its advantages in comparison to digital subtraction angiography (DSA) are shorter examination, non-invasive nature, less procedural complications and the ability to study soft tissue structure around the blood vessels. Calcified plaques are common at carotid bifurcations that produce beam-hardening artifact and often limits an accurate luminal assessment. The latest improvement of tube technology permits the use of fine focal spot (FFSS) in CTA that may provide better spatial resolution. The aim of this retrospective study was to assess the efficacy of FFSS in vessel wall clarity improvement and calcification artifact reduction on CTCA.

METHOD AND MATERIALS
Consecutive adult patients of all age and gender who presented for CTCA were included. Patients who did not give consent or whose images were markedly degraded by metal and motion artifacts were excluded. All CTCA were scanned with standard focal-spot size (SFSS) in initial 4 months while with FFSS in the following 4 months. Vessel clarity and calcifications artefacts of aortic arch, brachiocephalic, subclavian, common carotid, carotid bifurcation, internal carotid, external carotid and vertebral arteries were randomly and blindly assessed using 5-point scale by 2 blinded radiologists. Results were compared.

RESULTS
There were 43 patients (mean age of 60) with 97 calcified arterial segments in SFSS and 48 patients (mean age of 62) with 113 calcified arterial segments in FFSS. 30% patients have >50% carotid artery stenosis. Interobserver agreement was excellent (κ=.834). Mann-Whitney test showed FFSS performed significantly better for vessel clarity (U: 48238.50, p < .001, r: 0.556) and calcification artefact reduction (U: 2040.50, p< .001, r: 0.564). The carotid bifurcation lumen were better defined in FFSS.

CONCLUSION
FFSS technique improves vessel clarity and reduces calcification blooming artefacts in CTCA which aids accurate assessment of vascular pathology.

CLINICAL RELEVANCE/APPLICATION
The lumen of the carotid bifurcation is often obscured by blooming artifacts from calcified plaques that may lead to misleading result. The FFSS scanning technique may become an future imaging tool to minimize this diagnostic difficulty and provide better plaque morphology assessment.

Participants
Seyedeh Shahrzad Azizaddini, Saint Louis, MO (Presenter) Nothing to Disclose
Mahsa Mohammadi Kaji, Karlsruhe, Germany (Abstract Co-Author) Nothing to Disclose
Saeed Arefian, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Shohreh Kasaei, Tehran, Iran (Abstract Co-Author) Nothing to Disclose
Morteza Sanei Taheri, MD, Tehran, Iran (Abstract Co-Author) Nothing to Disclose

PURPOSE
Tumor volume parameter is one of the most important prognostic factors in glioma. Determining the glioma tumor volume is a problematic task due to its irregularity in shape, involvement of different parts of brain and wide variety in contrast enhancement degrees. Objectives of the study were to design image processing-based software to determine the volume of glioma and evaluating its efficiency in comparison with radiologist estimation.

METHOD AND MATERIALS
The software was designed and calibrated based on 7 pathologically approved glioma patients. The software exploited enhancement regions in FLAIR and T1 Gadolinium contrast MRI using image segmentation technique to determine tumor volume, based on region growing of manually selected seed points. Consecutively, the volumes of brain glioma in 42 cases were estimated by an expert radiologist as well as the designed software and the data was analyzed for comparison.

CONCLUSION
Estimation of brain glioma volume with the designed software has the same accuracy as the expert estimation in a more time efficient manner. The main application restriction for the designed software is its limitation to well-enhanced regions after Gadolinium injection.

CLINICAL RELEVANCE/APPLICATION
Tumor volume is a main prognostic factor in brain glioma. Volume estimation by software via segmentation technique had the same accuracy as expert reading in a time efficient manner.

Participants
Stephan Gruber, MD, Vienna, Austria (Presenter) Nothing to Disclose
Eva Heckova, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Magnetic resonance spectroscopic imaging (MRSI) of the brain allows to map several metabolites and provide complementary metabolite information to the conventional MR imaging methods. High field systems (e.g. 7 T) offer increased SNR and spectral resolution which can be transformed to the increased spatial resolution or better characterization of overlapping metabolites (e.g. NAA and NAAG). In addition FID-CSI with ultra short acquisition delays (TE*) adds additional SNR, in particular for J-coupled resonances. We compared MRSI in six volunteers using a FID-CSI sequence with high spatial resolution and ultra-short TE* of 1.5 ms at 3 and 7 Tesla.

Six healthy volunteers (5m/1f; age: 28.3±2.4) were measured at 3T and 7T (3T Trio, 7T Magnetom, Siemens, Erlangen, Germany) using a 32-channel head coil. A FID-CSI sequence with 64×64 phase encoding steps, FOV=220×220mm2, TR=600ms, TE*=1.5ms, in plane voxel size 3.4×3.4 mm2, and a slice thickness of 10 mm was used (scan time 30min). Spectra were processed using LCModel. Metabolic maps were created using Matlab and MINC (Minc tools v2.0; McConnell Brain Imaging Center, Montreal, Canada). SNRs were computed using the pseudo-replica method in time domain.

Satisfactory data quality was achieved from all subjects measured at 3T and 7T. SNR was 2.8 times higher at 7T compared to 3T. CRLBs were below 10% for all metabolites measured at 7T including glutamate and glutamine. Compared to techniques using pre-localization techniques (e.g. STEAM, PRESS) FID-CSI allows to acquire whole slices. The high matrix size and hamming filtering prevented fat contamination from the sculp. With the high in-plane resolution of 3.4×3.4 mm2 metabolic maps showing anatomical details could be created.

This study revealed 2.8 times higher SNR and decreased CRLBs of brain metabolites measured with MRSI at 7T compared to that measured at 3T. We could compute metabolic maps with anatomical details at both field strengths. Improved spectral resolution allowed NAAG separation from NAA at 7T but not at 3T. In addition the ultra-short acquisition delay allows to quantify J-coupled metabolites even measured with a high spatial resolution.

MRSI at 7T can be performed with high spatial resolution and ultrashort TE*. This allows the quantification of metabolites such as NAAG, glutamate, glutamine and myo-Inositol with low CRLBs.

Optimized Clinical MRI Protocols for Ex Vivo Whole Brain - A New Tool for Radiology-Pathology Correlation

Thursday, Dec. 3 11:40AM - 11:50AM Location: N228

Participants

Mary Bruneau, RT, New York, NY (Presenter) Nothing to Disclose
Ryan Brown, New York, NY (Abstract Co-Author) Nothing to Disclose
Guillaume Madelin, New York, NY (Abstract Co-Author) Nothing to Disclose
Pippa Storey, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Henry Rusinek, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Timothy M. Shepherd, MD, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

Autopsies with neuropathology protocols are used to investigate sudden, unexpected patient deaths, but it is difficult to obtain correlations of this clinical MRI of the brain because of nervous tissue MRI property changes linked to the postmortem interval, chemical fixation and temperature differences. We measured these changes, then adapted MRI sequence pulse parameters to recreate a robust clinical MRI protocol for ex vivo whole brain imaging.

METHOD AND MATERIALS

Donated ex vivo whole brains immersion-fixed in formalin for 2 weeks were washed in phosphate-buffered saline for 8 weeks with repeated solution exchanges. Inversion recovery and multiecho sequences at 3-T MRI showed the T1/T2 values of gray and white matter decreased to 267/73 and 168/43 ms respectively in formalin-fixed ex vivo whole brains. Multiple MRI sequences were adjusted iteratively for these relaxation changes based on spin dynamics theory to give consistent image contrast, resolution and quality compared to in vivo MRI protocols.

Optimal MRI sequences at 3-T were different compared to standard in vivo MRI protocols - a) FLAIR: TR/TE/TI= 3000/45/1100 ms, 0.5 x 0.5 x 2-mm resolution, b) TSE T2: TR/TE = 5000/76 ms, 0.5 x 0.5 x 0.8-mm resolution, c) 3-D Gradient Echo: TR/TE = 20/10 ms with 180 flip angle, 0.46-mm isotropic resolution, and d) Diffusion Tensor Imaging: TR/TE = 3500/90 ms, b-values = 0, 1000 & 2000 s/mm2 with 64 directions, 3-mm isotropic resolution. Decreased echo-train-length also reduced gray-white blurring. Volumetric 3-D image contrast is degraded by the short T1's, but may be improved by a multi-segmented approach. The overall scan required <2 hrs overnight using an outpatient 3-T scanner and 64-channel coil.

CONCLUSION

We successfully created a "clinical" MRI protocol for ex vivo brains with similar image quality and contrast to routine radiology protocols. This can be used for detailed radiology-pathology correlations in clinical cases of sudden death. The protocol also may help detect abnormalities in Sudden Unexplained Death in Epilepsy (SUDEP) or directly correlate MRI property changes with underlying Alzheimer's pathology.
Amide Proton Transfer Imaging of Neonatal Brain Development and Brain Injury: A Preliminary Study

Participants
Yang Zheng, Shenyang, China (Presenter) Nothing to Disclose
Xiaoming Wang, MD, Shenyang, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate neonatal brain development and injury at the internal environmental level with the application of amide proton transfer (APT) imaging by measuring the APT values of several part of the brain.

METHOD AND MATERIALS
A total of 51 neonatal patients who underwent MR examination were enrolled in the study. Among them, there were 38 newborns with no abnormalities and 13 cases with brain injury who underwent conventional MR (T1WI, T2WI, DWI) examination. After obtaining informed consent and permission of clinicians, routine MR was followed by additional APT scan. APT imaging is single slice scanning, performed at the basal ganglia level in all neonates, and in the case group, with increased localization at the level of lesion, and with the contralateral relatively normal area as self-control. The APT values of bilateral frontal subcortical white matter, basal ganglia and occipital subcortical white matter were measured for all neonates, as well as the APT values of the lesion and contralateral areas. Several statistical methods were used for statistical analysis.

RESULTS
In the control group, bilateral frontal subcortical white matter, basal ganglia and occipital subcortical white matter had no significant difference in APT value (P > 0.05). Between the different parts of the brain, APT values were significantly different (P < 0.05), and were associated with gestational age linear positive correlation. In the case group, there were significant differences in APT values between the lesion side and contralateral area, being significantly lower in lesion side than the contralateral side (P < 0.05). In the case group, the APT values of different parts of the brain were lower than the control group with the same gestational age (P < 0.05).

CONCLUSION
From changes in the protein and pH level in the neonatal brain, APT imaging can help understand neonatal brain development and evaluate brain injury.

CLINICAL RELEVANCE/APPLICATION
Amide proton transfer (APT) imaging is a noninvasive imaging method of MR, and it is capable of detecting mobile cellular proteins and peptides and monitoring pH effects.
**SSQ17**

**Neuroradiology (Advanced Neuroimaging of Alzheimer Disease)**

Thursday, Dec. 3 10:30AM - 12:00PM Location: N229

NR | MR

AMA PRA Category 1 Credits™: 1.50  
ARRT Category A+ Credits: 1.50  
FDA

Discussions may include off-label uses.

**Participants**
Duygu Tosun, San Francisco, CA (Moderator) Research Grant, Eli Lilly and Company  
Gloria C. Chiang, MD, San Francisco, CA (Moderator) Nothing to Disclose

**Sub-Events**

**SSQ17-01 Hippocampus MRI T1 Texture’s Relation to Established Alzheimer’s Disease Biomarkers and Prediction of Progression**

Thursday, Dec. 3 10:30AM - 10:40AM Location: N229

**Participants**
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**Purpose**
The hippocampus texture as recorded in T1 MRI has been shown to be a strong predictor of conversion from MCI to probable AD and has been suggested for enrichment of AD trials. We investigate the relation of the hippocampal texture to CSF amyloid and tau load, and glucose metabolism of the hippocampus and it’s potential prediction of conversion in amyloid and tau positive subject respectively.

**Method and Materials**
The study dataset consisted of the 504 subjects from the “complete annual year 2 visits” standardized Alzheimer’s Disease Neuroimaging Initiative (ADNI) dataset including 234 baseline MCI subjects. MRI analysis consisted of segmenting the hippocampi using cross-sectional FreeSurfer (v.5.1.0), computation of the baseline hippocampal fraction (HF, hippocampal volume divided by intra-cranial volume), hippocampal atrophy (baseline, 12 month, 24 month regression percentage volume loss), and texture scoring of the hippocampus using our in-house method. CSF amyloid (Aβ42), respectively total tau (t-tau), and tau phosphorylated at the threonine 118 position (p-tau) were defined as positive by Aβ42 <= 192 pg/ml, t-tau >= 93 pg/ml, and p-tau >= 23 pg/ml. Normalized FDG-PET measurements constrained to the hippocampus were averaged over left and right hippocampus. Age and gender adjustment was performed.

**Results**
The subpopulations having available amyloid, tau, and FDG-PET measurements did not significantly differ from the full 504 subjects in age, gender, MMSE, or HF. Hippocampal texture predicted conversion from MCI to AD in 12 months with an AUC of 0.71. In Aβ42, p-tau and t-tau positive subjects, the AUC of MCI to AD conversion were respectively 0.71, 0.72, and 0.69 (not significantly different from the whole population). The Pearson’s R between hippocampus texture and AB42, p-tau, t-tau, FDG-PET, and hippocampal atrophy was respectively -0.32, 0.31, 0.28, -0.62, and 0.50. All AUC’s and R’s remained significant after decorrelation using HF.

**Conclusion**
Hippocampal texture predicts MCI-to-AD conversion independent of AB42, p-tau, t-tau. It relates weakly to AB42, p-tau, t-tau and strongly to glucose metabolism and future hippocampal atrophy.

**Clinical Relevance/Application**
Hippocampus MRI T1 texture is a promising marker for prediction of fast Alzheimer’s progression and enrichment of clinical trials.

**SSQ17-02 Default Mode Network Structural-functional Connectivity and Beta-Amyloid Pathology in Autosomal Dominant Familial Alzheimer’s Disease**

Thursday, Dec. 3 10:40AM - 10:50AM Location: N229

**Participants**
Jeffrey W. Prescott, MD, PhD, Durham, NC (Presenter) Nothing to Disclose  
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Jeffrey R. Petrella, MD, Durham, NC (Abstract Co-Author) Advisory Board, Johnson & Johnson Speakers Bureau, Quintiles Inc Advisory Board, Piramal Enterprises Limited

**Awards**
Trainee Research Prize - Resident
PurPUsE

Early onset familial Alzheimer's disease (FAD) is inherited in an autosomal dominant manner and provides a model for studying how amyloid may affect disease onset and synaptic failure. Our goal was to use data from Dominantly Inherited Alzheimer's disease Network (DIAN) to evaluate relationships between structural connectivity, functional connectivity, and amyloid burden.

METhOD AND MATERIAls

Baseline data from controls and mutation carriers from the national DIAN study were analyzed. Subjects' T1 scans were automatically segmented using FreeSurfer. A standard functional parcellation atlas was mapped to each subject (Yeo et al., J Neurophysiol, 2011). Functional connectivity was calculated as the average timeseries correlation among regions in the DMN of the functional atlas. Structural connectivity was calculated as the global efficiency of the tractographic connections between regions in the DMN, weighted by the number of fibers. Whole cortex amyloid SUVr was calculated from Pittsburgh compound B PET images, performed by the DIAN imaging core group. A general linear model examined the relationship between functional connectivity, structural connectivity and amyloid burden after covarying for age, sex, education, cognitive status (MMSE), and genetic mutation status (yes or no). Also, a correlation analysis was performed to examine relationships between structural-functional connectivity, age, and mutation status. A p-value less than 0.05 was considered significant.

REsULTs

76 subjects from DIAN were analyzed. 38 subjects had an FAD mutation (24 normal cognition (NC), 3 mild cognitive impairment (MCI), 11 dementia (AD)). 38 subjects did not have an FAD mutation (37 NC, 1 MCI). There was a significant association between functional and structural connectivity; specifically, as structural global efficiency decreased, functional timeseries correlation decreased. Functional and structural connectivity significantly decreased with age in mutation carriers, but not in controls.

CONClUsION

Among DIAN subjects, there is a significant association between functional and structural connectivity metrics. There is a significant decrease in functional and structural connectivity with increasing age in mutation carriers, but not in controls.

CLINICAL RELEVANCE/APPLICATION

Evaluation of structural-functional connectivity breakdown in subjects with FAD may provide imaging biomarkers for patients in the preclinical stages of AD.

SsQ17-03  Comparison of Several Computational Pipelines for Atrophy Computation in Longitudinal Alzheimers Studies

Participants
Akshay Pai, Copenhagen, Denmark (Presenter) Nothing to Disclose
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Mads Nielsen, PhD, Copenhagen, Denmark (Abstract Co-Author) Stockholder, Biomediq A/S Research Grant, Nordic Bioscience A/S Research Grant, SYNARC Inc Research Grant, AstraZeneca PLC

PURpUSE

To evaluate the newly developed diffeomorphic image registration framework using stationary velocity fields parameterized by wendland kernel bundle framework in atrophy estimation. In this study, we compare the diagnostic group separation (Alzheimer's and Normals) abilities of the proposed framework against other state-of-art registration schemes and the Boundary shift integral (BSI) based on atrophy scores in several brain regions.

METhOD AND MATERIAls

Baseline and month 12 MRI scans from the "complete annual year 2 visits" 1.5-T standardized ADNI dataset were used [169 normal controls (NC), 101 AD]. Segmentations for atrophy quantifications were obtained using Freesurfer cross-sectional pipeline. Each image was corrected for intensity inhomogenities using N3 from freesurfer. Each of baseline and month 12 scans were non-linearly aligned using the proposed framework and existing methods like SyN, NiftyReg, LCC-Demons. Atrophy was then estimated from the deformation field of the proposed framework using the proprietary Cube Propagation and on the rest, using Jacobian determinants. Atrophy was estimated in the regions of whole brain (WB), hippocampus (Hip), Ventricles, Medial temporal lobe (MTL), Cortical gray matter (CGM), entorhinal cortex (ENCTX) and fusiform gyrus (FG). BSI was also used to evaluate atrophy in the regions of WB, Hip and Ventricles.

REsULTs

The proposed framework yields better AUC and Cohens’D for AD v/s NC when compared to the other registration schemes. The highest separation (AUC/Cohen's D) among the registration frameworks was using the proposed framework - WB 0.76/0.94, hippocampus 0.82/1.26, MTL 0.86/1.43, CGM 0.85/1.29, ENCTX 0.80/1.13 and FG 0.76/0.98. Overall, BSI provided a better separation on WB (0.81/1.18), hippocampus (0.86/1.15). However, BSI was not designed to provide scores for any other region.

CONClUsION

Although, BSI provides a better separation, the method can be used only in regions the software is designed for, for instance whole brain, hippocampus and ventricles. The proposed registration framework not only provides good comparable group separation (and better than other registration frameworks), it provides the flexibility to measure atrophy in any user-defined region.

CLINICAL RELEVANCE/APPLICATION

The proposed method can reliably estimate atrophy in any brain region unlike BSI which is specifically designed to estimate atrophy only in certain regions of the brain.
CONCLUSION

The decreased CBF in the lateral orbito-frontal cortex and bilateral nucleus caudatus in mild-AD patients is associated with vascular damage and cognitive impairment. Iron concentration is positively correlated with vascular damage and negatively correlated with CBF in mild-AD patients. This suggests that iron accumulation may play a role in the development of vascular impairment and cognitive decline in AD.

RESULTS

At the voxel level, two regions (the posterior cingulate cortex (PCC)/precuneus (PCu) and the left caudate) were identified to show significant altered AM values. Post hoc analysis showed that the main difference was found between the AD and NC subjects. Compared with NC, totally 28 regions were found with significant impaired AM value in AD patients. According to the altered pattern and anatomical locations, these regions can be combined into five clusters which include the PCC/PCu, cuneus (Cun), right caudate, left caudate, and left inferior temporal gyrus (ITG). Compared with NC and aMCI subjects, the most obvious areas of change located in the three regions including PCC/PCu, Cun, and left caudate in AD (Figure 3). Compared with normal controls, only the region of PCC/PCu showed decreased AM values in aMCI. Importantly, the alteration of AM was significantly correlated with cognitive abilities measured by MMSE (Figure 4).

CLINICAL RELEVANCE/APPLICATION

AM is a useful method to distinguish AD and aMCI from NC. Our results indicated that default mode network and the other cortical regions had been destroyed in aMCI and AD, which might be a potential biomarker for early diagnosis of aMCI and AD.

METHOD AND MATERIALS

Participants

35 AD patients, 27 aMCI patients, and 27 age- and gender-matched normal controls (NC) were recruited for this study. A vascular damage evaluation was conducted using Fazekas scale. CBF was assessed using a pseudocontinuous Arterial Spin Labeling (pCASL) sequence. Iron concentration was derived from R2* measurements in multi-echo gradient echo images. The results showed significant differences in AM pattern between AD and NC, and aMCI and NC. The correlation between AM and MMSE was also significant in AD patients.

CONCLUSION

AM is a new method of resting-state fMRI and helpful for the early diagnosis of AD and aMCI.
CLINICAL RELEVANCE/APPLICATION
Quantification of brain metal ion content and distribution may be a predictive marker for early diagnosis, assessment of treatment strategies or therapeutic target in AD.

SSQ17-06  A Follow-up Study of Disrupted Functional Brain Connectivity in Alzheimer’s Disease
Thursday, Dec. 3 11:20AM - 11:30AM Location: N229

Participants
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PURPOSE
The change patterns of damage on neural networks of Alzheimer’s disease (AD) is still largely uncertain. The aim of this study is to investigate cerebral network changes of AD patients in about 1.5 years.

METHOD AND MATERIALS
Patients with AD (n=15, 4 men, mean age 72.1 ±6.21 years, mean MMSE scores for first examination 19.6±6.13, mean scores for second examination 19.4±5.28) and healthy control subjects (HC, n=15, 6 men, mean age 68.3±8.22 years, mean MMSE scores 29.2±4.92) were recruited. Resting-state functional data was obtained using a single-shot echo-planar imaging (EPI) sequence on SIEMENS TrioTim 3T scanner. The acquisition parameters were as following: EPI sequence TR=2000ms, TE= 30ms, slice thickness= 5 mm, slices=30, voxel size = 3.4×3.4×5.0 mm3, scan time=7min. HC subjects were scanned once and all AD patients were examined twice. The average scanning interval was 16.8±11.33 months in AD patients. All resting-state fMRI data were processed by GRETNA, small world parameters of global and local network were obtained including Gamma, Lambda, normalized regional nodal efficiency (Efi) and betweenness (BCi).

RESULTS
Small-world parameters of AD-First and AD-Second slightly decreased compared with HC respectively (Sparsity 10%-30%) (Fig1). For nodal EF, AD-First in left inferior parietal (r=0.44, p=0.02), right angular gyrus (r=0.42, p=0.03), left rectus (r=0.40, p=0.03) and AD-Second in right superior orbital Frontal lobe (r=0.40, p=0.04), right supplementary motor area (r=0.40, p=0.04), bilateral rectus (r=0.43, p=0.02 for left, r=0.45, p=0.01 for right) are positive correlation with MMSE score (Fig2). Nodal BC on AD-First in right medial orbital frontal lobe (r=0.40, p=0.03) is positive and in right precuneus (r=0.42, p=0.02) is negative correlation with MMSE; BC on AD-Second in bilateral supplementary motor areas (r=0.46, p=0.02 for left, r=0.47, p=0.01 for right) and right medial orbital frontal lobe (r=0.41, p=0.03) are positive correlation with MMSE (Fig2). (r>=0.4 or r<=-0.4, p<0.05)

CONCLUSION
Brain network had a slight decline in the optimal small-world architecture in the progression of AD. The involved nodes which have positive and negative correlation of nodal BC and EF with MMSE score exhibited underlying dynamic disrupted patterns of functional connectivity in AD.

SSQ17-07  Comprehensive, Radiological Evaluation of Strategic Structures in Patients with Mild Cognitive Impairment and Early Alzheimer’s Disease
Thursday, Dec. 3 11:30AM - 11:40AM Location: N229

Participants
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Maria Styczeninska, MD, Warsaw, Poland (Abstract Co-Author) Nothing to Disclose
Jerzy M. Walecki, MD, PhD, Warszawa, Poland (Presenter) Nothing to Disclose

PURPOSE
The aim of the study was to evaluate the diagnostic value of two measurement techniques in patients with cognitive impairment. The first was automated volumetry of the hippocampus, entorhinal cortex, parahippocampal gyrus, posterior cingulate gyrus, cortex of the temporal lobes, corpus callosum and the second was fractional anisotropy (FA) measurements of the corpus callosum in diffusion tensor imaging technique.

METHOD AND MATERIALS
Ninety six patients underwent brain magnetic resonance imaging - 33 healthy controls (HC), 33 patients with diagnosed mild cognitive impairment (MCI) and 30 patients with probable AD of mild degree (AD). Severity of the dementia was evaluated with the neuropsychological battery test. Volumetric measurements were performed automatically with FreeSurfer imaging software. Measurements of the FA values were performed manually with region of interest tool.

RESULTS
Volumetric measurement of the temporal lobe cortex had the highest correct classification rate - 68.7%. The lowest was for the FA measurements of the corpus callosum - 51%. Highest sensitivity and specificity when discriminating patients MCI vs early AD was achieved with the volumetric measurement of the corpus callosum - these are 73% and 71% and the correct classification rate was 72%. Highest sensitivity and specificity when discriminating HC and patients with early AD was achieved with the volumetric measurement of the entorhinal cortex - these are 94% and 100% and the correct classification rate was 97%. Highest sensitivity and specificity when discriminating HC and patients with MCI was achieved with the volumetric measurement of the temporal lobe cortex - these are 90% and 93% and the correct classification rate was 92%.
CONCLUSION
Diagnostic value varied depending on the measurement technique. Volumetric measurements proved to be the strongest imaging biomarker which allowed distinction between groups of patients. Corpus callosum volume assessment proved to be useful in discriminating patients MCI vs early AD.

CLINICAL RELEVANCE/APPLICATION
By evaluation of the two measurement methods authors wanted to find the best imaging technique, which would help clinicians to evaluate patients and make the correct diagnosis.

SSQ17-08 Heritability of Brain Atrophy on MRI in Advanced Age: A Twin Study of Healthy Middle-aged to Elderly Japanese Adults

Thursday, Dec. 3 11:40AM - 11:50AM Location: N229

Participants
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PURPOSE
Brain atrophy, a common finding on MRI, is part of the aging process and neurodegenerative diseases. The purpose of this study was to determine the heritability of brain atrophy and volume in advanced age using classical twin analyses of healthy Japanese middle-aged to elderly adult twin volunteers.

METHOD AND MATERIALS
74 individuals, 20 monozygotic (M2) twin pairs (10MM 10FF, mean age 61y min 42y max 75y) and 17 dizygotic (DZ) twin pairs (8MM 8FF 1MF, mean age 64y min 41y max 85y), were selected with advanced age and gender match from the Osaka University Center for Twin Research registry. 3D T1 volume images from 3.0T MRI were used to measure volumes (L) for white matter (WM), grey matter (GM), cerebrospinal fluid (CSF) and total brain volume (TBV calculated as WM + GM) with statistical parametric mapping (SPM) 12 (University College London). Volume differences, correlations, twin modelling and heritability estimates (H2), controlled for age and gender, were performed using statistical platform R (v3.1.2) with OpenMx (v2.0.1).

RESULTS
The one male-female DZ twin pair was excluded due to significant difference in mean TBV based on gender (Welch two sample t-test p=0.027). For all twins together, TBV (coefficient -0.450, p<0.01) and GM (-0.528, p<0.01) negatively correlated with age, where as CSF (0.646, p<0.01) positively correlated with age and WM (-0.055, p=0.64) was not significant. The differences in volume measurements between monozygotic twin pairs were significantly smaller than those for dizygotic twin pairs (T-TEST: TBV p<0.01, GM p<0.01, WM p<0.01, CSF p=0.03).Heritability (H2) estimates, AE (additive genetics / unique environment) models for TV, GM and WM were 92.73%, 93.39% and 87.12% respectively. AE models were selected based on Akaike information criterion (AIC) for best fit and simplicity in twin studies. CSF best fit with a CE (common environment / unique environment) model, implying a stronger correlation with age and/or gender rather than heritance.

CONCLUSION
Brain volume and atrophy have strong heritability of around 90% into advanced age, as demonstrated in this Japanese twin population. Further analysis of heritability of atrophy in specific brain locations is planned.

SSQ17-09 Integrative Bayesian Analysis of Neuroimaging-Genetic Data with Application to Cocaine Dependence

Thursday, Dec. 3 11:50AM - 12:00PM Location: N229

Participants
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David A. Nielsen, Houston, TX (Abstract Co-Author) Nothing to Disclose
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Veera Baladandayuthapani, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
To explore the underlying neurobiology of white matter integrity of cocaine-dependent subjects by integrative neuroimaging-genetic analysis of diffusion tension imaging (DTI) and genetic, demographic and clinical features.

METHOD AND MATERIALS
We propose a novel computationally efficient method called integrative Bayesian analysis of neuroimaging-genetic (iBANG) to analyze large-scale imaging-genetics data. The iBANG methods uses a three-step component-wise analysis pipeline (i) estimate the association between each genetic and demographic variable via voxel- based Bayesian model averaging and obtain posterior probability maps (PPMs), (ii) incorporate spatial information pertaining to voxel locations to smooth the PPMs, and (iii): use Bayesian false discovery rates to delineate regions of brain activation while controlling for multiple testing. Our methods are motivated by and applied to a retrospective study in cocaine addiction where voxel-wise fractional anisotropy (FA) values were acquired over the white matter space spanning the entire brain in addition to twenty-one candidate SNPs known to be previously associated with addiction.
RESULTS
Our study suggests that the impact of GAD1a (rs1978340) and GAD1b (rs769390) SNPs on FA values of the white matter of the brain was extensive in comparison to the other SNPs using iBANG. Significantly a total of 5217 voxel locations associated with GAD1a and the total number of 1332 voxel locations associated with GAD1b were found. Both GAD1a and GAD1b SNPs are associated with synthesis of GABA which plays a critical role in drug-reward and drug seeking behavior. Figure 1 depicts the multi-slice sagittal views of the neuroanatomic locations of significant regions in the white matter of the brain that were impacted by GAD1a. FA values on the white matter of the brain were significantly impacted by cocaine abuse to the extent of 3100 voxels.

CONCLUSION
GAD1a and GAD1b SNPs are associated with synthesis of GABA led to FA enhancement in the most regions of the John Hopkins University (JHU) white matter atlas. Cocaine consumption caused FA diminishment in the most regions of the JHU white matter atlas.

CLINICAL RELEVANCE/APPLICATION
Cocaine abuse and some of the candidate SNPs, GAD1a and GAD1b, show noticeable impact on FA alteration of white matter which cause changes on white matter integrity of the brain.
**PURPOSE**
To evaluate pediatric tunneled central venous catheter complication incidence and time to removal with respect to site of insertion.

**METHOD AND MATERIALS**
A single-institution, IRB-approved, retrospective review was undertaken of all patients who underwent tunneled central venous catheter placement by either the General Surgery or Interventional Radiology services over a one-year period. Patient electronic medical records were reviewed for technical details, complications, dwell time, indication for placement, and removal. We compared the time-to-removal of tunneled lines for mechanical failure using product limit survival estimates in order to better account for censoring and dwell time of tunneled lines.

**RESULTS**
288 central venous lines were placed during a one-year period. Of these, 205 (71%) were placed through the internal jugular vein and 83 (29%) were placed through the subclavian vein. Mechanical malfunction was documented as the indication for removal in 22 of internal jugular lines (11%), versus 19 of subclavian lines (23%) (p<.01). Specifically, a higher rate of left-sided subclavian vein lines were removed for mechanical malfunction compared to the right-sided subclavian vein lines (28% vs. 18%, respectively), but time to mechanical failure was not statistically different (p=.37).

**CONCLUSION**
Placement of tunneled subclavian central venous catheters in the pediatric population results in a higher incidence of mechanical malfunction and a decreased dwell time compared to internal jugular vein placement. Left-sided subclavian catheters tend to have a higher mechanical malfunction rate compared to right-sided subclavian catheters.

**CLINICAL RELEVANCE/APPLICATION**
The placement of tunneled subclavian central venous catheters in the pediatric population results in a higher incidence of mechanical malfunction and a decreased dwell time compared to tunneled internal jugular venous central catheters.

**SSQ18-02 Complication Rates for PICCs Exchanged Over the Wire at a Large Children’s Hospital**

**Purpose**
Long term venous access is integral to the treatment and therapy of many patients. Complications with line function other than infection can be remedied at times by exchanging the catheter over a wire for a new catheter (rewire). This retrospective study was designed to analyze PICC line complications rates after rewire compared to the overall PICC population.

**Method and Materials**
IRB approval allowed retrospective study at a large children's hospital of the electronic medical record and PACS system, which were queried for all PICCs placed from January 2014 through June 2014. Data points collected for each patient included catheter...
Treatment of patients with Acute Myeloid Leukemia (AML) requires long-term venous access, one option for which is with a

RESULTS
A total of 665 PICCs were placed in the study period with 73 patients having a rewire of their line. In all patients the complication and infection rate were 16% and 6.4%, respectively. In rewire patients the complication rate and infection rate were 48.0% (P<0.0001) and 13.7% (NSS). The most common reasons for rewire was malposition (43.5%) and cracked catheter hub (22.4%). The two most common patient populations requiring rewires were oncology (40.7%) and TPN dependent short gut patients (16.3%). Average catheter dwell time in all patients was 23.0 days and in rewire patients was 50 days.

CONCLUSION
The overall complication rate for catheters after rewire was higher than the entire PICC population. The infection rate was not significantly higher, even though the average dwell time of the catheter was longer in the rewire patients compared to the PICC population.

CLINICAL RELEVANCE/APPLICATION
For patients that require indefinite venous access such as certain oncology and TPN dependent patients rewire of the malfunctioning line does not incur a higher risk of subsequent infection.

SSQ18-03 Pediatric Tunneled Central Catheter Placement at A Single Tertiary-Care Center by Interventional Radiology: One Year Outcome Analysis

Participants
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PURPOSE
The insertion of tunneled central catheters by Pediatric Interventional Radiology services is a daily occurrence. However, little data with respect to placement outcomes of pediatric-tunneled central catheter placement is known. We examine outcomes of all subclavian and internal jugular tunneled central venous catheters placed over a one year period.

METHOD AND MATERIALS
An IRB-approved, retrospective review was undertaken for all patients who underwent tunneled central venous catheter placement by the Interventional Radiology service over a one year period. Patient electronic medical records were reviewed for technical details, complications, dwell time, indication for placement, and reason and date of removal. Catheters which were removed due to completion of treatment were censored from the analysis.

RESULTS
192 (66% of the total hospital placements) tunneled internal jugular and subclavian central venous catheters were placed in 173 patients by the Interventional Radiology service during the study period. 187 (97%) were via the internal jugular vein; 5 (3%) were placed via the subclavian vein. The most frequent indications included chemotherapy (88 placements, 46% of total) and nutrition and frequent blood draws (73 placements, 38%). The median dwell time was 139.5 days (IQR 43-345); time to removal was significantly shorter (p<0.0005) in the nutrition/frequent blood draw group. Clinical concern for infection was the indication for removal in 31 (16%) of lines, and of these, 15 (8%) had positive blood cultures. Catheters placed for nutrition and frequent blood draws resulted in higher rates of infection (N=25) when compared to those being used for chemotherapy (N=14). 20 (10%) catheters were removed for mechanical malfunction.

CONCLUSION
Tunneled central venous catheters placed for nutrition and frequent blood draws resulted in a higher incidence of infection and decreased dwell time, specifically when compared to catheters placed for chemotherapy. Clinical concern for infection was the most common indication for removal, and mechanical malfunction was the second most common indication for line removal.

CLINICAL RELEVANCE/APPLICATION
Tunneled central venous catheters placed for nutrition and need for frequent blood draws by the Pediatric Interventional Radiology service resulted in a higher incidence of infection and decreased dwell time than lines placed for other reasons, most notably administration of chemotherapy.

SSQ18-04 Complication Rates for PICCs in Patients with AML

Participants
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Christopher I. Cassady, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
Treatment of patients with Acute Myeloid Leukemia (AML) requires long-term venous access, one option for which is with a
peripherally inserted central line (PICC). This retrospective study was designed to analyze PICC line infection rates in AML patients compared to the overall PICC and the general oncology populations.

**METHOD AND MATERIALS**

IRB approval allowed retrospective study at a large children's hospital of the electronic medical record and PACS system, which were queried for all PICCs placed from January 2014 through June 2014. Data points collected for each patient included catheter dwell time (in days), location of line placement, type of line securement, and complications including infection, malposition, occluded lumen. After compilation, the database was statistically analyzed using Fisher's exact test. Comparisons were made between the total population and those diagnosed with any cancer and patients diagnosed specifically with AML.

**RESULTS**

A total of 665 PICCs were placed in the study period, 158 in oncology patients and 23 in AML patients specifically. In all patients the complication rate and infection rate were 16% and 6.4%, respectively. In oncology patients the complication rate and infection rate were 27.2% and 16.5%, respectively (P<0.0001 for both). In AML patients the complication rate and infection rate were 34.8% (NSS) and 30.4% (P<0.0001), respectively. Average catheter dwell time in all patients was 23.0 days, in oncology patients was 56.5 days, and in AML patients 74.8 days.

**CONCLUSION**

Oncology patients and, in particular, AML patients have increased rates of infection compared to the population as a whole. This is in part due to the patients' immunocompromised states and the much longer dwell times of the PICCs used for their treatments. Interventions for decreasing infection rates should be targeted at these high risk populations.

**CLINICAL RELEVANCE/APPLICATION**

Acute Myeloid Leukemia patients have an increased risk of infection of PICCs. Identifying populations at high risk allows for targeting changes in practice to reduce infection rates.

**SSQ18-05 How Much is Too Much? Radiation Exposure during Percutaneous Gastrojejunostomy Tube Exchanges in Pediatric Patients**

**Thursday, Dec. 3 11:10AM - 11:20AM Location: S102C**

Participants
Matthew Hudnall, BA, San Francisco, CA (Presenter) Nothing to Disclose
Kevin S. Koo, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Andrew G. Taylor, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Kanti P. Koli, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Nicholas Fidelman, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Robert K. Kerlan JR, MD, Kentfield, CA (Abstract Co-Author) Nothing to Disclose
Maureen P. Kohi, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate the radiation exposure of pediatric patients during exchange of percutaneous gastrojejunostomy tubes.

**METHOD AND MATERIALS**

A retrospective review of consecutive pediatric patients undergoing percutaneous gastrojejunostomy tube exchanges from January 1, 2010 to April 1, 2015 was performed. Fluoroscopy time, cumulative air kerma (mGy) and cumulative dose area product (DAP) (mGycm²) values were obtained from procedural reports. Total number of procedures, indications, and time between procedures were also recorded. Patients were subdivided into an increased cumulative procedure group if 3 or more procedures were performed and an increased frequency group if the interval between any 2 procedures was less than 6 months during the study period.

**RESULTS**

In the 63-month study period, 130 exchanges of gastrojejunostomy tubes were performed on 48 patients. The median age of all patients was 52.5 months (range 2-206 months). 18 patients underwent a single procedure. Mean cumulative air kerma and DAP were 7.75 mGy (range 2-11.6) and 1353.89 mGycm² (range 285-3000) respectively for each procedure. Mean fluoroscopy time was 3.1 minutes (range 1-7). 20 patients were categorized into the increased cumulative procedures group, with a mean of 5 procedures (range 3-8) during the study period. Mean cumulative air kerma and DAP were 15.52 mGy (range 0.4-50.7) and 4333.45 mGycm² (range 102-72,479) respectively for each procedure. Mean fluoroscopy time was 8.6 minutes (range 0.2-40). 25 patients were classified into the increased frequency group, with a mean 4.3 month interval between procedures. Mean cumulative air kerma and DAP were 34.33 mGy (range 0.4-504.8) and 4105.62 mGycm² (range 102-72,479) respectively for each procedure. Mean fluoroscopy time was 8.4 minutes (range 0.2-40).

**CONCLUSION**

Undergoing percutaneous gastrojejunostomy tube exchanges is necessary in many chronically ill pediatric patients but subjects them to significant radiation exposure at an early age, particularly if repeat procedures are needed. Patients requiring frequent exchanges may benefit from alternative methods to maintain enteral feedings, such as through surgical intervention.

**CLINICAL RELEVANCE/APPLICATION**

Radiation exposure in pediatric patients during percutaneous gastrojejunostomy tube exchanges can be significant, and may be underestimated when considering how to maintain enteral feeding.

**SSQ18-06 Incidence and Management of Oesophageal Ruptures Following Fluoroscopic Balloon Dilatation in Children with Benign Strictures**

**Thursday, Dec. 3 11:20AM - 11:30AM Location: S102C**

Participants
Jung-Hoon Park, MS, RT, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
PURPOSE

The purpose of this study is to investigate the incidence and management of oesophageal ruptures following fluoroscopic balloon dilatation (FBD) in children with benign oesophageal strictures.

METHOD AND MATERIALS

Between October 1996 and November 2013, 62 children with benign oesophageal strictures underwent FBDs. Oesophageal rupture was categorized as intramural (type 1), transmural (type 2) or transmural with free leakage (type 3). The possible risk factors for oesophageal ruptures were analyzed.

RESULTS

One hundred and twenty-nine FBDs were performed in these patients. The oesophageal rupture rate was 17.1% (22/129). The majority (21/22) of ruptures were type 1 and type 2, both were treated conservatively. Only one patient had a type 3 rupture and underwent esophagoesophagostomy. The patient gender, age, and the length and cause of the stricture showed no significant effect on the rupture (p > 0.05). However, for the patients ≤ 2 years old, the initial balloon with a diameter ≥ 10mm showed a higher oesophageal rupture rate than those <10mm during the first session (p < 0.05).

CONCLUSION

Although the oesophageal rupture rate in children was 17.1%, the severe rupture (type 3) rate was 0.8%, which usually requires aggressive treatment. For children ≤ 2 years old, the initial balloon diameter should be <10mm in the first session for decreasing the risk of oesophageal rupture.

CLINICAL RELEVANCE/APPLICATION

For children ≤ 2 years, the initial balloon diameter should be <10mm.

SSQ18-07 Initial Experience with Pre-procedural MR and Intraprocedural C-arm CT Fusion for Biopsy of MR-positive CT-negative Pelvic Bone Lesions at a Single Pediatric Institution

Thursday, Dec. 3 11:30AM - 11:40AM Location: S102C

Participants

Sphoorti Shellikeri, Philadelphia, PA (Presenter) Research funded, Siemens AG
Randolph M. Setser, DSc, PhD, Cleveland, OH (Abstract Co-Author) Employee, Siemens AG
Xiaowei Zhu, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Anne Marie Cahill, MBBCh, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Biopsy of bone marrow abnormalities that are CT/fluoroscopically negative but MR-positive often require the physician to review the MRI on a separate console and cross reference anatomic landmarks to the image modality used during biopsy. This pilot study describes our initial experience with pre-procedural MR and intraprocedural C-arm CT fusion for biopsy of MR-positive CT-negative pelvic bone lesions in IR suite at a single pediatric institution.

METHOD AND MATERIALS

In this IRB-approved prospective study, 5 patients (4F, 1M; mean age 14.8 yrs) with MR-positive CT-negative pelvic bone lesions undergoing bone biopsies were included. A pre-procedural MRI sequence with optimal lesion visualization was fused with an intraprocedural C-arm CT (DynaCT) using 3D/3D fusion software (Siemens Healthcare) and a biopsy path was then planned on the MRI using syngo iGuide. The 3D path was overlaid on the intraprocedural fluoroscopic images. Effective dose was assessed using PCXMC software (v2013, STUK) with an age appropriate model.

RESULTS

All bone biopsies were performed by the same physician. The mean time interval between the pre-procedural MR and the biopsy was 10 days (range 2-22d). 4/5 biopsies were diagnostic (80% accuracy - 2 neuroblastoma, langerhans cell histiocytosis, chronic osteomyelitis). There were no procedure related complications. The non-diagnostic biopsy was performed in the left iliac bone in a patient with a subtle low standard uptake value MIBG positive lesion concerning for neuroblastoma superimposed on a more diffuse MR-positive abnormality. The MIBG scan was additionally referred to plan the needle path possibly resulting in inaccurate lesion localization. The mean fluoroscopic and procedural times were 3.8±2.7 min and 87±22 min. The mean effective radiation dose was 6.2±4 mSv (1.8, 7.1, 8.4, 11.2, 2.5 mSv).

CONCLUSION

This pilot experience demonstrates the feasibility of MR-C arm CT fusion for biopsy of CT-negative MR-positive pelvic bone lesions in the IR suite. The advantage of this technique is that it allows the needle path to be planned directly on MRI while visualizing the target lesion. Further validation of this technique will be established with increased patient recruitment.

CLINICAL RELEVANCE/APPLICATION

3D/3D fusion followed by iGuide technology provides the ability to perform CT-negative MR-positive bone biopsies in the IR suite using real-time fluoroscopic guidance.

SSQ18-08 Long-term (>5 years) Clinical and Histological Follow-up of Successful Radiological Percutaneous Treatment of Biliary Strictures in Pediatric Liver Transplant Recipients

Thursday, Dec. 3 11:40AM - 11:50AM Location: S102C

Participants
Good results are reported for percutaneous treatment (PT) of biliary strictures (BS) in children underwent liver transplant (LT) however, in majority of the published studies on this topic, only a short or mid-term follow-up is available. Aim of this study is to retrospectively evaluate long-term follow-up (>5 years) of successful PT of BS in children underwent LT.

METHOD AND MATERIALS
From 1/2004 to 12/2014, 70 pediatric LT recipients underwent PT of BS in our hospital. 35 out of 70 had a follow-up longer than 5 years and represent our study cohort. Mean recipient age at the time of PT was 5 y/o (range, 8 months - 16 y/o). Anastomotic BS was present in 29 patients, anastomotic and intrahepatic BS were present in 6 patients.

RESULTS
In all patients percutaneous stenting and bilioplasty were successfully performed without major complications. Mean number of balloon dilatation performed was 4 (range, 3-8). Mean duration of catheter placement was 5 months (range 2-10). In 10 out of 35 patients (28%) two courses of PT were necessary; the mean time to recurrence was 19 months (range, 3-61 months). One patient had redo LT 91 months after PT for chronic rejection; one patient is with a biliary catheter in place for portal biliopathy secondary to portal cavemoma and is on waiting list for redo LT. 33 patients are symptom-free with respect to BS at a mean follow-up of 95 months (range, 65-131 months). 32 out of 35 patients underwent liver biopsy at a mean follow-up of 5 years (range 3-8 years) after last PT with evidence of mild cholestasis N=7 (22%), moderate/severe cholestasis N=3 (10%), chronic rejection N= 2 (6%), no cholestasis N=20 (62%).

CONCLUSION
Clinical and histological good response can be maintained in a long-term follow-up in more than half of pediatric LT recipients with BS treated with percutaneous approach.

PERCUITANEOUS TREATMENT OF BS: A SAFE AND EFFECTIVE PROCEDURE IN PEDIATRIC LT recipiepts, however more large-scale research and longer follow up are needed.

Comparison of Safety and Efficiency of Image Guided Enema Reduction Techniques for Pediatric Intussusception: A Review of the Literature

METHOD AND MATERIALS
There is variable practice regarding the technique of image guided enema reduction of paediatric intussusception (IGPIR) and use of procedural sedation/general anaesthesia (GA). Our objectives are to review the literature regarding efficacy and safety of hydrostatic versus pneumatic reduction performed under fluoroscopic versus ultrasound control. A secondary outcome is to determine whether procedural sedation/general anaesthesia (GA) influences outcomes.

RESULTS
One SR and 87 primary studies were included (5 comparative studies, 82 studies on single techniques and no RCT). Of the 88 studies, 17 reported consistent use of sedation and 4 the use of GA. The SR included 20 studies comparing the success rate of hydrostatic versus pneumatic reduction (including 2 RCTs) and supports pneumatic over hydrostatic reduction. Hydrostatic reduction under ultrasound control appears to have similar efficacy and safety to pneumatic reduction under fluoroscopic control. Efficacy and perforation rates for the studies on single techniques are listed in the figure provided.

CONCLUSION
Limited RCT data is available to support one IGPIR method over another. Pneumatic reduction would be preferable over hydrostatic reduction under fluoroscopic guidance based on greater efficacy and comparably low perforation rate. Hydrostatic reduction under ultrasound control should be considered an alternative, as it affords no ionised radiation exposure. Sedation does not appear to alter likelihood of reduction or procedural morbidity. Data relating to GA are too limited to allow practice recommendations with regard to its effect on efficacy and safety.

Clinical and histological good response can be maintained in a long-term follow-up in more than half of pediatric LT recipients with BS treated with percutaneous approach.

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Clinical and histological good response can be maintained in a long-term follow-up in more than half of pediatric LT recipients with BS treated with percutaneous approach.
**SSQ19**

**Physics (CT VII-Image Quality I)**

Thursday, Dec. 3 10:30AM - 12:00PM Location: S403B

- **SSQ19-01** Atypical Head CT Artifact-Potential for Misdiagnosis
  - **Participants**
    - Katsuyuki Taguchi, PhD, Baltimore, MD (Moderator) Research Grant, Siemens AG
    - Tinsu Pan, PhD, Houston, TX (Moderator) Nothing to Disclose

- **SSQ19-02** Estimation of Bias Corrections in Observer Model Performance Metrics for Accurate Comparisons of CT Image Quality
  - **Participants**
    - Christopher P. Favazza, PhD, Rochester, MN (Presenter) Nothing to Disclose
    - Lifeng Yu, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
    - Shuai Leng, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
    - Kenneth A. Fetterly, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
    - Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG

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**Background**

The accurate diagnostic of strokes is crucial as misdiagnosis can lead to administration of unnecessary treatment, patient stress and pointless follow up scans. The timely identification of artifacts is crucial to the limitation of misdiagnosis. We reported a rare artifact on head CT that led to 6 misdiagnosis before it was identified. Our purpose is to present this artifact manifestation to allow early detection to avoid potential clinical misdiagnosis.

**Evaluation**

This artifact occurred on a GE LightSpeed VCT XT CT and exhibited subtle areas of decreased attenuation mostly involving the left frontal cortex and periventricular white matter, the imaging appearance suggestive of ischemia/infarct. In all cases, a 2nd CT or a brain MR scan was performed, refuting the presence of acute ischemia. The possibility of the artifact was pointed out after several scans provided similar diagnosis on asymptomatic patients with unremarkable follow up CT or MR imaging. The daily QA phantom was scanned and analyzed, revealing the presence of low attenuation streaks, mostly located in the upper right quadrant.

**Discussion**

The artifact was caused by air leak into the oil used for cooling the X-ray tube. GE VCT has the heat exchanger located outside the tube housing. Oil is circulated between housing and the heat exchanger via a hose, attached using 'quick disconnect' connector. This mechanical part, over periods of use, can allow air to leak in. A leaked air bubble located in the tube port created a region of low attenuation, which was translated as dark streaks in our images. The problem was corrected after fresh oil was cycled through the cooling system.

**Conclusion**

Our aim was to educate on the possibility and visual appearance of this artifact, its cause, and corrective actions necessary to rectify the situation. This is an artifact that seems germane to CT units that have the heat exchanger isolated from the X-ray tube. Prompt discovery of this artifact would prevent unnecessary patient anxiety, administration of costly and time consuming additional scans (and associated increased radiation dose) and administration of unnecessary and potentially harmful treatments.

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**PURPOSE**

To accommodate the increasing adoption of iterative image reconstruction techniques, observer models have been proposed to evaluate CT image quality across spectra of scanners, protocols, tasks, and reconstruction methods. A major limitation of such models is the requirement of a large number of images (N) to train the model, as bias in performance increases with reducing N. The aim of this study was to evaluate a method to correct for finite sampling bias in model performance for an object detection task in real CT images and to investigate observer model performance bias as a function of both dose and N.

**METHOD AND MATERIALS**

A previously validated channelized Hotelling observer (CHO) model was employed to evaluate the detectability of a 3 mm diameter...
METHOD AND MATERIALS

Using the frequency-dependent modern signal detection theory, kV/mAs optimization was formulated as a constrained minimization problem: choose the kV/mAs that minimizes radiation dose while maintaining the clinically prescribed detection performance. To experimentally solve this constrained optimization problem, exhaustive measurements of the detectability index \( (d') \) for a hepatic lesion detection task were performed with a fixed rotation time at 15 different mA levels (25 to 700) and at 4 kV levels (80 to 140) in an anthropomorphic phantom; these values were used to generate an iso-detectability contour map. Similarly, an iso-dose contour map was generated using the measured doses for each kV/mAs combination and was then overlaid with the iso-detectability contour map. Thus, for a prescribed detectability level \( (d'p) \), the optimal kV-mA combination could be determined as the intersection between the \( d'p \) contour and the minimum dose contour. These results were then validated with an in vivo animal experiment.

RESULTS

For a prescribed detectability level of \( d'=16 \), the kV-mAs combinations (followed by CTDIvol dose levels \( (\text{mGy}) \) in parentheses) on the measured iso-detectability contour of MBIR were 80-150 (3.8), 100-140 (6.6), 120-150 (11.3), and 140-160 (17.2). Thus, the optimal kV-mA was 80-150 (3.8) for MBIR; in comparison, the optimal kV-mA for FBP was 100-500 (23.7 mGy). These results provided image quality and dose reduction factors in our in vivo study and were consistent with the phantom results.

CONCLUSION

A new method to optimize kV and mA selection in CT has been developed in this work that is applicable to both linear and nonlinear CT systems such as those equipped with MBIR. The maximum dose reduction can be potentially achieved by combining MBIR with optimal kV-mA selections.

CLINICAL RELEVANCE/APPLICATION

This framework can help with the optimization of kV and mAs selection, the most important measure in daily CT exams to reduce unnecessary radiation exposures to the patients.
SSQ19-04 Inserting Realistic Lesions into CT Images: A Valuable Tool for Optimization of CT Image Quality and Radiation Dose

Thursday, Dec. 3 11:00AM - 11:10AM Location: S403B

Awards

Trainee Research Prize - Resident

Participants
Baiyu Chen, Rochester, MN (Presenter) Nothing to Disclose
Chi Ma, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Shuai Leng, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Lifeng Yu, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Jeff L. Fidler, MD, Rochester, MN (Abstract Co-Author) Research Grant, Beekley Corporation
Shannon P. Sheedy, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG
Joel G. Fletcher, MD, Rochester, MN (Abstract Co-Author) Grant, Siemens AG

PURPOSE

To optimize CT image quality and radiation dose for lesion detection tasks, patient images with lesions of known characteristics are needed. Although these images can be collected via clinical trials, the process is expensive and time consuming. This study aims to validate a recently developed lesion insertion technique, which allows lesions of known characteristics to be inserted into patient CT images for evaluation of detection performance.

METHOD AND MATERIALS

Lesions were segmented from patient CT images, forward projected, and inserted into patient CT projections using a recently developed computer program. The modified patient projections were formatted to match that of commercial CT raw data and reconstructed on scanners to yield images with inserted lesions. To validate the realism of the inserted lesions, 54 liver lesions were segmented from patient images and inserted back into the same patients at new locations. The 54 inserted lesions, together with the 54 real lesions in their original locations, were examined interactively in consensus by two experienced radiologists. First, the 108 lesions were viewed in a randomized and blinded fashion. Each lesion was scored from 1 to 10 (1=absolutely inserted to 10=absolutely realistic). Second, the 108 lesions were viewed in pairs (real vs inserted) in a blinded fashion with radiologists instructed to select the inserted lesion and provide a confidence level (1=no confidence in determination to 10=absolutely certain).

RESULTS

For the lesions viewed randomly, 35 inserted and 39 real lesions were scored ≥7, whereas 6 inserted and 2 real lesions were scored ≤3. The medians and interquartile ranges of the scores were the same for real and inserted lesions (median 8; interquartile range 6-8). The p-value of a paired t-test was 0.3. For the lesions viewed in pairs, the inserted lesions were incorrectly identified in 27/54 pairs (50%) when not considering the confidence level, or 5/11 pairs (45%) when radiologists were confident they had correctly identified the inserted lesion (confidence level ≥4).

CONCLUSION

A lesion insertion technique has been developed and validated, which can be used for optimization of image quality and radiation dose.

CLINICAL RELEVANCE/APPLICATION

The successful insertion of lesions into patient images allows quick evaluation of new techniques such as iterative reconstruction, such that patient image quality and radiation dose can be optimized.

SSQ19-05 Accuracy of Lung Nodule Volume Measurement in Lung-cancer Screening CT at Radiation Dose Level Equivalent to Chest X-rays

Thursday, Dec. 3 11:10AM - 11:20AM Location: S403B

Participants
Chi Ma, PhD, Rochester, MN (Presenter) Nothing to Disclose
Brian J. Bartholmai, MD, Rochester, MN (Abstract Co-Author) License agreement, ImBio, LLC; Scientific Advisor, ImBio, LLC; Scientific Advisor, Bristol-Myers Squibb Company
Lifeng Yu, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Shuai Leng, PhD, Rochester, MN (Abstract Co-Author) Grant, Siemens AG
Jeff L. Fidler, MD, Rochester, MN (Abstract Co-Author) Research Grant, Beekley Corporation
Shannon P. Sheedy, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG
Joel G. Fletcher, MD, Rochester, MN (Abstract Co-Author) Grant, Siemens AG

PURPOSE

Use of an x-ray beam with added tin filter (100Sn) may allow lung cancer screening CT to be performed at a dose level approaching that in a chest x-ray. The purpose of this study was to evaluate the accuracy of lung nodule volume measurements at such a low dose level.

METHOD AND MATERIALS

An anthropomorphic chest phantom (Lungman, Kyoto Kagaku) was used to simulate an adult patient. Total of eight spherical nodules at two contrasts (100 and -800 HU) and four sizes (5, 8, 10 and 12 mm diameter) were attached to simulated pulmonary vessels. The nodules were located at similar distance from the lung base to reduce the impact of non-uniform spatial resolution across the field of view. The phantom was scanned on a 192-slice CT scanner (Force, Siemens) using 100Sn kV at 4 dose levels (0.1, 0.15, 0.4, and 1.5 mGy). The two lowest dose levels at 100Sn corresponded to effective doses similar to a typical 2-view chest x-ray. The phantom was also scanned using 120 kV at 3 dose levels (0.4, 1.3, 6.9 mGy). Images were reconstructed using an IR method (ADMIRE, Siemens) with a kernel of Bv49-2. An experienced radiologist selected a seed point for automated nodule segmentation and volume measurement for all 8 nodules on each of the 7 datasets using automated segmentation tool (LungSAT,
RESULTS

Percent errors remained relatively stable for high-contrast nodules (100 HU) for both 120 kV and 100Sn at all dose levels. At the lowest dose level at 100Sn, the percent errors (-16%, -16%, -13%, -9% for 5, 8, 10, and 12 mm nodules) were close to that at the highest dose level (18%, -15%, -9%, -8%). Accuracy degraded with the lower contrast nodules at ~800 HU. The percent errors were -67%, -67%, -96%, -98% for the four sizes at the lowest dose level compared to -113%, 20%, 80%, 59% at the highest dose level at 100Sn.

CONCLUSION

Accuracy of automated volume measurement was maintained on high-contrast nodules at a dose level equivalent to a chest x-ray using the added tin filter in lung cancer screening CT. Accuracy may degrade for low-contrast nodules due to increased noise.

CLINICAL RELEVANCE/APPLICATION

At the dose levels used for lung cancer screening, the accuracy of automated measurements of lung volume is an important parameter to assess.

SSQ19-06 Method for Producing Surrogate Soft-tissue Materials for X-ray and CT Phantom Imaging Studies

Thursday, Dec. 3 11:20AM - 11:30AM Location: S403B

Participants
Paul Fitzgerald, Niskayuna, NY (Presenter) Employee, General Electric Company
Robert E. Colborn, PhD, Niskayuna, NY (Abstract Co-Author) Employee, General Electric Company
Peter Edic, Niskayuna, NY (Abstract Co-Author) Employee, General Electric Company
Jack Lambert, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Benjamin M. Yeh, MD, San Francisco, CA (Abstract Co-Author) Research Grant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextarst, Inc.;
Peter J. Bonitatibus JR, PhD, Niskayuna, NY (Abstract Co-Author) Employee, General Electric Company

PURPOSE

Phantom studies are used to develop and validate CT imaging performance; however, it has been difficult to obtain materials that closely approximate the energy-dependent X-ray attenuation of human soft tissues. We sought to develop a simple method for producing soft-tissue equivalent materials that can be easily modified with low concentrations of contrast media in order to accurately emulate perfused internal organs.

METHOD AND MATERIALS

We evaluated hypothetical mixtures of water, glycerol, butanol, methanol, NaCl, and KNO3 which were intended to emulate human adipose, blood, brain, kidney, liver, muscle, pancreas, and skin. We compared the hypothetical densities and simulated X-ray attenuation coefficients of the proposed materials with those of human tissue elemental composition as specified in ICRU Report 46. We then physically formulated the proposed liquid surrogates for adipose, liver, and pancreas, and measured the HU of these materials when placed within a medium-sized anthropomorphic phantom in a 64-slice clinical CT scanner operating at 80, 100, 120, and 140 kVp.

RESULTS

The predicted densities and simulated X-ray attenuation coefficients of our proposed formulations agreed with those of ICRU tissue compositions within <1%. For example, the densities (g/ml) of our hypothetical materials (and ICRU’s) were: adipose 0.947 (0.95), pancreas 1.041 (1.04), and liver 1.059 (1.06); the monochromatic energy HU at 60 keV of our hypothetical materials (and ICRU’s) were: adipose -88.3 (-88.7), pancreas 31.1 (31.3), and liver 55.7 (55.2). The densities of our physically formulated materials were: adipose 0.947, pancreas 1.061, and liver 1.074. Our empirical HU measurements at 80 kVp were: adipose -85, pancreas 48, and liver 67; at 120 kVp these were: adipose -66, pancreas 51, and liver 65.

CONCLUSION

Our method for formulation of tissue surrogates allowed rapid production of materials with HU values at CT that closely matched the target tissues’ expected HU values and HU trends with kVp. Further study is warranted, such as comparison with commercial tissue-equivalent plastics, and introduction of contrast agents. Validation may potentially accelerate development and testing of advanced CT imaging technologies.

CLINICAL RELEVANCE/APPLICATION

Our tissue emulation method may accelerate development of optimized CT imaging technologies such as quantitative spectral imaging and for detection of subtle characteristics in diseased soft tissues.

SSQ19-07 Initial Application of Attenuation-based kV Select Technique (kV Assist) in Lumber CT Examination

Thursday, Dec. 3 11:30AM - 11:40AM Location: S403B

Participants
Yeda Wan SR, Tianjin, China (Abstract Co-Author) Nothing to Disclose
Fei Fu, Tianjin, China (Presenter) Nothing to Disclose
Yue Zhang, Tianjin, China (Abstract Co-Author) Nothing to Disclose
Anwei He, Tianjin, China (Abstract Co-Author) Nothing to Disclose
Baoju Li, Tianjin, China (Abstract Co-Author) Nothing to Disclose
Jiyang Zhang, Tianjin, China (Abstract Co-Author) Nothing to Disclose
Xin Deng, MD, Tianjin, China (Abstract Co-Author) Nothing to Disclose
Jian Li, Tianjin, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

Phantom studies are used to develop and validate CT imaging performance; however, it has been difficult to obtain materials that closely approximate the energy-dependent X-ray attenuation of human soft tissues. We sought to develop a simple method for producing soft-tissue equivalent materials that can be easily modified with low concentrations of contrast media in order to accurately emulate perfused internal organs.

METHOD AND MATERIALS

We evaluated hypothetical mixtures of water, glycerol, butanol, methanol, NaCl, and KNO3 which were intended to emulate human adipose, blood, brain, kidney, liver, muscle, pancreas, and skin. We compared the hypothetical densities and simulated X-ray attenuation coefficients of the proposed materials with those of human tissue elemental composition as specified in ICRU Report 46. We then physically formulated the proposed liquid surrogates for adipose, liver, and pancreas, and measured the HU of these materials when placed within a medium-sized anthropomorphic phantom in a 64-slice clinical CT scanner operating at 80, 100, 120, and 140 kVp.

RESULTS

The predicted densities and simulated X-ray attenuation coefficients of our proposed formulations agreed with those of ICRU tissue compositions within <1%. For example, the densities (g/ml) of our hypothetical materials (and ICRU’s) were: adipose 0.947 (0.95), pancreas 1.041 (1.04), and liver 1.059 (1.06); the monochromatic energy HU at 60 keV of our hypothetical materials (and ICRU’s) were: adipose -88.3 (-88.7), pancreas 31.1 (31.3), and liver 55.7 (55.2). The densities of our physically formulated materials were: adipose 0.947, pancreas 1.061, and liver 1.074. Our empirical HU measurements at 80 kVp were: adipose -85, pancreas 48, and liver 67; at 120 kVp these were: adipose -66, pancreas 51, and liver 65.

CONCLUSION

Our method for formulation of tissue surrogates allowed rapid production of materials with HU values at CT that closely matched the target tissues’ expected HU values and HU trends with kVp. Further study is warranted, such as comparison with commercial tissue-equivalent plastics, and introduction of contrast agents. Validation may potentially accelerate development and testing of advanced CT imaging technologies.

CLINICAL RELEVANCE/APPLICATION

Our tissue emulation method may accelerate development of optimized CT imaging technologies such as quantitative spectral imaging and for detection of subtle characteristics in diseased soft tissues.
As a newly introduced technique, tube kilovolt (kV) assist based on the attenuation profile of the scout scan provides automated kV and mA selection. Aim of this study was to assess radiation dose reduction and image quality for lumbar CT examination with kV Assist technique, compared to a standard 120 kV protocol.

METHOD AND MATERIALS

With institutional review board approval, 60 patients (male, 30-40y) underwent lumbar CT scan were randomly separated into two groups: conventional 120 kV group with tube current of 230mA (n=30) and kV assist group (n=30). The slice thickness was 1.25mm. Image noise and CT value of the L3 vertebral body center level and erector apinae were measured. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) for vertebral body were calculated, according the formulas: SNR=CTver/SD and CNR=(CTver-CTrus)/SD. The volumetric CT dose index (CTDlvol) was recorded. Subjective image quality was evaluated by two radiologists with a 5-grade scale. Data was compared with student T-test and rank sum test.

RESULTS

With kV Assist, the percentage of patients scanned using 80 kV, 100 kV and 120 kV was 80.2%, 16.7 % and 3.1 %, respectively. 140 kV was not selected in this study. Compared with the conventional 120 kV protocol, kV Assist allowed for an overall average decrease of 45 % in CTDIvol (8.73±0.28 mGy vs 15.77±0.10 mGy, p<0.05). The SNR have no statistical difference between kV assist group and conventional 120 kV group (2.54±0.67 vs 2.95±0.60, p>0.05). The CNR and image quality score of kV assist group were higher than those of conventional 120 kV group (CNR=2.23±0.92 vs 1.75±0.60; score, 4.40±0.52 vs 3.60±0.70, both p<0.05).

CONCLUSION

In lumbar CT examination, application of attenuation-based kV Assist technique enables an average of 45% dose reduction in enhanced, and provide better image quality.

CLINICAL RELEVANCE/APPLICATION

As a newly introduced technique, application of kV assist technique enables an average of 45% dose reduction in enhanced lumbar CT examination, and provide better image quality.

SSQ19-08 Detectability of Low-Contrast, Low-Attenuation (LCLA) Liver Lesions on CT with FBP and ADMIRE: Assessment using a Channelized Hotelling Model Observer

Thursday, Dec. 3 11:40AM - 11:50AM Location: S403B

Participants
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Brian R. Herts, MD, Cleveland, OH (Abstract Co-Author) Research Grant, Siemens AG

PURPOSE

To assess differences in detectability of LCLA liver lesions with filtered back-projection (FBP) and Advanced Modeled Iterative Reconstruction (ADMIRE) in a semi-anthropomorphic phantom using a model observer.

METHOD AND MATERIALS

A custom-designed abdominal phantom with low attenuation (90 HU) liver insert (10-cm length x 10-cm diameter) containing 3 copies each of 4 unique spherical lesions (15-mm x 84 HU, 10 mm x 78 HU, 10 mm x 72 HU, and 5 mm x 66 HU) was scanned on a Siemens Somatom Force CT scanner at 6 exposure settings: 200, 160, 120, 80, 40 and 20 effective mAs. At each exposure level, liver insert was rotated by 90 degrees and 25 scans were performed per rotation to allow assessment of lesion-present/absent pairs from the same [X,Y,Z] location in the phantom (for a total of 100 scans at each exposure). Images were reconstructed with both FBP and ADMIRE (strengths 3 and 5). A Channelized Hotelling Model Observer with 40 Gabor channels was used to evaluate pairs of 100 images, and the detectability signal-to-noise ratio ($d'$) values were computed.

RESULTS

The CHMO showed progressively higher $d'$ values for greater ADMIRE strengths compared to FBP at all exposure levels. ADMIRE showed largest improvement of 26% in $d'$ for the largest lesion (15 mm x 6HU). The low contrast detectability (LCD) improvement was in the 3-18% range for the 10mm x 18HU and 10mm x 12 HU lesions, across the six dose levels. The three different 5mm x 24 HU lesions had inconsistent and inconclusive results.

CONCLUSION

Our CHMO analysis showed improved LCD performance of ADMIRE with respect to FBP at all exposure levels for all 10mm and 15mm lesions.

CLINICAL RELEVANCE/APPLICATION

Objective assessment of low contrast detectability performance in a controlled environment is important in order to determine the dose reduction potential of novel iterative reconstruction methods without loss of diagnostic accuracy in detection of low-contrast liver lesions.

SSQ19-09 Reexamination of the Meaning of Effective Energy in CT

Thursday, Dec. 3 11:50AM - 12:00PM Location: S403B

Participants
Austin Healy, MS, Greenwich, NY (Presenter) Employee, The Phantom Laboratory
David J. Goodenough, PhD, Myersville, MD (Abstract Co-Author) Director, The Institute for Radiological Image Sciences, Inc;
PURPOSE

This paper will reexamine the concept and interpretation of the use of "effective energy" in CT. We identify caveats in interpretation compared to the historical use of the term in Radiation Physics, particularly as it pertains to Radiological Imaging. In particular, we examine how issues related to reconstruction of data acquired at the detector, over many projection angles and variable object thickness and shape can lead to significant differences compared to attenuation data acquired using attenuating sheets between the source and the detector. We address the issue of how the resulting CT numbers are related to the differential attenuation of a material compared to water, considering various corrections for beam hardening, scatter, beam shaping filters and all aspects of possible manipulation following the original reconstruction.

METHOD AND MATERIALS

The Catphan® (The Phantom Laboratory, Salem, NY), designed to offer test objects of known (or calculable) density and x-ray attenuation properties, was scanned using different scanners and protocols. The resulting CT numbers are plotted against a series of attenuation coefficients that result from assuming different effective energies of the CT beam. The best fit to the measured data compared to the energy dependent coefficients is obtained. Contrast scale and noise, functions of the choice of effective energy and required by the FDA, are calculated.

RESULTS

CT scans of known materials at various kVp's, filtration, and scanner design are used to show the sometimes confusing results of effective energy. In particular, wide x-ray beams such as used in large multislice scanners and volume scanners are shown to lead to ambiguous and in some cases clearly flawed results. Although the term is shown to be somewhat useful in a constancy sense, its use is shown as challenging in a Radiation Physics sense.

CONCLUSION

The challenges to measurement and interpretation of "effective energy" in CT are shown. It is suggested that a new term might be used to reinforce the caveats in the measurement in this term. This term could be as simple as Eeff (CT) but any other term to move away from the classical meaning of effective energy and related radiation measurements might be useful.

CLINICAL RELEVANCE/APPLICATION

Since the FDA requires a measure of the Contrast Scale in evaluating CT performance, it is important to understand the concept of 'effective energy' may be misleading to the radiologist and the physicist.
Automatic Spatial Linking of Lesions in Breast MRI Follow-up Images

Participants
Heang-Ping Chan, PhD, Ann Arbor, MI (Moderator) Institutional research collaboration, General Electric Company
Hiroyuki Yoshida, PhD, Boston, MA (Moderator) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

Sub-Events

PURPOSE
Automatically linking the lesions detected in breast MRI follow-up examinations is required for the development of a computer-aided diagnosis (CAD) system to quantify characteristic changes of the lesions. In this work, we develop a registration-based method that enables automatic linking of lesions detected in breast MRI follow-up studies.

METHOD AND MATERIALS
From 51 subjects participating in a MRI screening program, we collected 102 dynamic contrast enhanced MRI (DCE-MRI) images, forming 51 pairs of follow-up studies. Current and prior examinations were acquired in different scanners with a time interval of one year, using transversal and coronal views, respectively. One experienced radiologist manually placed 71 pairs of markers, indicating the center locations of 71 pairs of lesions found in both current and prior studies. Automatic lesion linking is achieved by registering current and prior MRI examinations. First, a motion correction algorithm is performed on both current and prior DCE-MRI. Then, fully automatic breast segmentation is applied on the current and prior pre-contrast images to extract breast masks, which are used to obtain an initial affine transform. Then, a non-rigid registration algorithm using normalized gradient fields as similarity measure together with curvature regularization is exploited to register the current and prior pre-contrast images. Since the follow-up scans may have inconsistent field of views, the registration only focuses on the segmented breast regions to enforce the alignment accuracy in breast areas, such that non-breast regions will not attract and influence the registration process.

RESULTS
Based on the deformation fields obtained by registration, markers labeling the lesions in the current image were transformed to the prior image frame, where the distance between the transformed markers and the markers originally labeled in prior images was computed. The average distance error was 9.6 ± 9.3 mm.

CONCLUSION
The proposed system is potentially applicable to automatically link the lesions detected in a CAD system to investigate the characteristic changes.

CLINICAL RELEVANCE/APPLICATION
Visual assessment and comparison of characteristic change of the lesions in breast DCE-MRI follow-up exams is time consuming, and computer-aided lesion comparison may increase clinical effectiveness.
board-certified radiologist correlated the CTC images with the findings of subsequent optical colonoscopy. The DE-CTC images were then subjected to a novel dual-energy pseudo-enhancement correction method that corrects for pseudo-enhancement distortions of soft tissue on DE-CTC images caused by adjacent orally administered high-density fecal tagging, without distorting the dual-energy information that is contained within the images. For evaluation, a dual-energy CADe (DE-CADe) scheme was used to detect challenging polyps 6 - 9 mm in size from the DE-CTC images without and with the application of the pseudo-enhancement correction. The detection performance of the DE-CADe scheme was assessed by use of leave-one-patient-out evaluation.

RESULTS

There were 15 colonoscopy-confirmed polyps measuring 6 - 9 mm in largest diameter. Without the pseudo-enhancement correction, the DE-CADe scheme detected 9 polyps (60%) at 4.3 false-positive (FP) detections per patient and 10 polyps (67%) at 53 FP detections per patient. With the application of the dual-energy pseudo-enhancement correction method, the DE-CADe scheme detected 12 polyps (80%) at 5.5 FP detections per patient. For larger polyps (n=14), the detection sensitivity was 93% without and 100% with the pseudo-enhancement correction.

CONCLUSION

The information-preserving dual-energy pseudo-enhancement correction method can improve the detection accuracy of CADEs for challenging colorectal lesions in DE-CTC.

CLINICAL RELEVANCE/APPLICATION

The proposed method can improve the accuracy of CADE and quantitative imaging in DE-CTC by correcting for pseudo-enhancement distortions of images without changing their dual-energy information.

**SSQ20-03 Evaluation of a Novel Method to Segment the Pectoral Muscle Surface in Automated Whole Breast Ultrasound**

Thursday, Dec. 3 10:50AM - 11:00AM Location: S404AB

**Participants**
Albert Gubern-Merida, PhD, Nijmegen, Netherlands (Presenter) Nothing to Disclose
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Nico Karssenmeijer, PhD, Nijmegen, Netherlands (Abstract Co-Author) Shareholder, Matakiina Technology Limited; Consultant, QView Medical, Inc; Shareholder, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;

**PURPOSE**

Segmentation of anatomical structures in automated 3D breast ultrasound (ABUS) is required for development of computer-aided detection (CAD) and other techniques to make clinical workflow more efficient, such as automatic linking of findings between different ABUS views and multimodal registration. We propose a novel method to segment the anterior pectoral surface in ABUS images.

**METHOD AND MATERIALS**

We randomly collected 74 ABUS (25 Anterior-Posterior, 15 MEDial, 31 LATeral and 3 SUPerior views) volumes obtained in routine clinical care at two medical centers using the S2000 automated 3D breast ultrasound system (Siemens, Erlangen, Germany). Manual pectoral muscle delineations of the anterior surface were provided by a trained researcher. We developed an algorithm to segment the pectoral muscle surface in ABUS volumes: First, the chest wall is segmented using a previously validated software that models the chest wall as a cylinder. Thereafter, the chest wall surface is used to perform a cylindrical transformation on the ABUS volume. By applying this transformation, the chest wall and the pectoral muscle are straightened and shape variability of the pectoral muscle across volumes can be encoded in a probabilistic atlas. In the last step, gradient and atlas information are used to guide the pectoral muscle surface segmentation in a dynamic programming approach. The algorithm was applied to the 74 ABUS volumes of the study dataset following a leave-one-out strategy. Distance (mean+-stdev) between manual and automated pectoral muscle surfaces was used as evaluation measure.

**RESULTS**

The presented approach achieved a mean surface distance error of 3.47+-3.03 mm, compared to the manual annotations. The surface distance error for AP, LAT, MED and SUP view volumes was 2.61+-4.15, 3.78+-4.15, 4.17+-2.37 and 3.78+-1.02 mm, respectively.

**CONCLUSION**

Automated pectoral muscle segmentation is challenging due to high variation in pectoral muscle anatomy. The proposed method shows promising results on segmenting the pectoral muscle surface.

**CLINICAL RELEVANCE/APPLICATION**

ABUS is a promising modality for screening but reading is time consuming for radiologists. Availability of supporting tools such as computer-aided detection may expedite introduction of ABUS in practice.

**SSQ20-04 Automatic Coronary Calcium Scoring and Cardiovascular Risk Estimation in the Pan-Canadian Lung Cancer Screening Trial**

Thursday, Dec. 3 11:00AM - 11:10AM Location: S404AB

**Participants**
Nikolas Lessmann, Utrecht, Netherlands (Presenter) Nothing to Disclose
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Stephen Lam, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
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**SSQ20-05 Leveraging Mid-Level Semantic Boundary Cues for Computer-Aided Lymphadenopathy Detection**

Thursday, Dec. 3 11:10AM - 11:20AM Location: S404AB

Participants
- Ari Seff, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
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- Ronald M. Summers, MD, PhD, Bethesda, MD (Presenter) Royalties, iCAD, Inc; Research funded, iCAD, Inc;

**PURPOSE**
To improve an automated system for detection of mediastinal and abdominal enlarged lymph nodes (LN) (>10 mm in short axis diameter) on CT scans.

**METHOD AND MATERIALS**
Two lymph node CT datasets (90 patients with 388 mediastinal LNs and 86 patients with 595 abdominal LNs) were used. Images were acquired in the portal venous phase with a slice thickness of 1-1.25 mm. A radiologist examined each scan, manually segmenting all ground truth enlarged LNs. Accompanying each target region was a list of previously generated LN candidate centroids. For each candidate, nine 2D views of size 45×45 voxels were sampled one voxel apart, along each of the three orthogonal planes. Patches of size 15×15 voxels were extracted from the 2D views and labeled as positive if the center resided on a LN boundary. 150 representative LN contour classes (known as sketch tokens) were defined via k-means clustering. Patch-level gradient channels and self-similarity channels were used to train a random forest classifier for contour classification. The random forest model was then used to obtain 150 contour class probability scores per voxel for all 2D views. Taking the voxel-wise sums and maximums of the scores resulted in two new boundary cue maps. In addition to the raw CT intensity images, these two maps served as additional inputs for HOG computation. A linear SVM was trained using the three concatenated feature sets for classification of views as containing LN or not. The mean of the resulting view-level scores served as the candidate score.

**RESULTS**
Six-fold cross-validation demonstrated that the enhanced feature maps lead to 15%-23% greater recall than the baseline HOG (e.g., 78% versus 56% sensitivity at 3 FP/scan in the abdomen and 78% versus 63% at 3 FP/scan in the mediastinum). This performance improvement was found to be statistically significant via paired-sample t-tests (p << .01). Additionally, our system outperformed the state-of-the-art deep learning system in the mediastinal region (e.g. 78% vs. 70% sensitivity at 3 FP/scan).

**CONCLUSION**
We developed a novel method to learn enriched, semantic feature maps that facilitate significantly improved performance for automated lymph node detection.

**CLINICAL RELEVANCE/APPLICATION**
Detection of lymphadenopathy is critical for cancer staging and assessing treatment response. Automated detection may permit more accurate and time efficient assessment.
aim of this study was to investigate the agreement between automatic and manual CAC scoring and determination of cardiovascular risk in radiation therapy (RT) treatment planning CT acquired in breast cancer patients.

**METHOD AND MATERIALS**

This study included 461 female breast cancer patients undergoing RT planning CT (Philips, 16 x 0.75 mm collimation, 120 kVp, 3 mm section thickness, no-ECG synchronization, with or without breath-hold). Calcium was scored automatically using an algorithm developed for CAC scoring in low-dose chest CT that employs supervised pattern recognition to identify CAC by texture, size, and spatial features. To determine agreement of automatic cardiovascular disease (CVD) risk assignment, all scans with CAC score >0 and an equal number of randomly selected zero score images were chosen for manual expert CAC scoring. Only one scan per patient was analyzed. Scoring was performed with standard 130 HU threshold. Reference and automatic Agatston scores were computed. Each patient was assigned to a CVD risk category based on the Agatston score (0, 1-10, 10-100, 100-400, >400). Agreement was computed as proportion of agreement between automatic and manual risk category assignment. Proportion of agreement beyond chance was determined using linearly weighted kappa for risk category assignment between automatic and manually determined risk categories.

**RESULTS**

162 scans were analyzed. Reference CAC score in 80 images was zero. In the remaining scans, reference median Agatston score was 76.1 (range 1.2-1745.5). Automatic and manual expert scoring assigned 78% (126/162) of patients to the same CVD risk category. This was higher for patients scanned with breath-hold (86%, 48/56) than for those without (74%, 78/106). Linearly weighted kappa was 0.78 (95% CI: 0.71-0.85). For patients scanned with and without breath-hold this was 0.83 (CI: 0.72-0.94) and 0.75 (CI: 0.66-0.84), respectively.

**CONCLUSION**

Automatic CVD risk determination in RT treatment planning CT for breast cancer patients results in good agreement with manual expert scoring. Agreement is higher when scanning is performed with breath-holding.

**CLINICAL RELEVANCE/APPLICATION**

Fully automatic CAC scoring and CVD risk determination in breast cancer patients undergoing RT treatment planning CT is feasible without additional costs.

**SSQ20-07 Automatic Detection of Interval Changes between Low-Dose CT Images Using Subtraction Images**

**Thursday, Dec. 3 11:30AM - 11:40AM Location: S404AB**

**Participants**

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**PURPOSE**

To develop an automatic system for detecting interval changes between low-dose CT images in a lung cancer screening setting using analysis of subtraction images.

**METHOD AND MATERIALS**

Given two CT scans, a prior and a current scan, lung segmentation and non-rigid registration is performed and a subtraction image is obtained by subtracting the deformed prior scan from the current scan. In the subtraction image, potential candidate regions with true change are determined using banded thresholding and morphological operations. For each candidate, a set of intensity, shape and context features is computed. A GentleBoost classifier using 250 regression stumps is used to differentiate real change from subtraction artifacts. We selected all subjects which had been referred to a pulmonologist from one site of the NELSON lung cancer screening trial. Per subject, we selected the scan on which the referral was based upon and the corresponding prior scan. An experienced radiologist annotated all relevant changes (volume change of preexisting nodules, mucus in airways, or onset of new opacifications) by inspecting the subtraction images and the two original images side-by-side. In addition, the quality of the subtraction images, an indication of the performance of the registration algorithm, was scored on a 1-5 scale with 5 being the best. Performance was evaluated using free-response operating characteristic analysis.

**RESULTS**

In total, 92 relevant changes were annotated by the experienced radiologist in the test set. The quality of the subtraction images was rated high: only five subtraction images (4%) had a rating lower than 4. FROC analysis showed that the automatic system detected 71% of all relevant change at an average of 2.0 false positives per scan.

**CONCLUSION**

Automatic detection of interval changes between low-dose CT images is feasible and may be of additional value when reading follow-up scans in a lung cancer screening setting.

**CLINICAL RELEVANCE/APPLICATION**

Detection of interval changes between consecutive low-dose CT images is crucial in lung cancer screening. Visual comparison of CT
scans is tedious and prone to errors and may therefore benefit from automatic indications of interval changes.

SSQ20-08  Automated Detection of Mass-like, Non-mass-like and Focus Breast Cancer Lesions Visible in False-negative Screening DCE-MRI

Thursday, Dec. 3 11:40AM - 11:50AM Location: S404AB

Participants
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PURPOSE
Breast cancer lesions are regularly overlooked or misinterpreted in breast MRI screening due to lesion appearance suggesting benign disease, extensive background enhancement or fatigue and lack of experience analyzing 4D data. In this study, we evaluate the performance of an automated computer-aided detection (CAD) system to detect mass-like, non-mass-like and focus breast cancer lesions that were, in retrospect, visible on earlier screening MRIs but only detected in a subsequent scans.

METHOD AND MATERIALS
Between 2003 and 2013, we identified 24 prior-negative MRI scans (BI-RADS 1/2) with 24 breast cancers (10 mass-like, 8 non-mass-like and 6 foci) in a MRI screening program. Cancers were detected by radiologists at the following screening round. Additionally, 120 normal scans were collected from the same MRI screening program from different women without history of breast cancer or breast surgery. A previously validated fully automated CAD system was applied to this dataset to detect malignant lesions. The system corrects for motion artifacts and segments the breast. Subsequently, lesion candidates are detected using relative enhancement and texture features to characterize breast cancer lesions. The final classification is performed using region-based morphological and kinetics features computed on segmented lesion candidates. The detection performance was evaluated using free-response receiver operating characteristic analysis and bootstrapping. A CAD finding was considered a true positive when its center was inside a lesion annotation. The false positive rate (FP/case) was determined on the normal cases.

RESULTS
At 4 FP/case, the sensitivity for detecting mass-like and non-mass-like lesions in prior-negative scans was 0.50 (95% confidence interval 0.17-0.83) and 0.85 (0.50-1.00), respectively. At the same FP/case, the CAD system did not detect focus breast cancer lesions.

CONCLUSION
A CAD system was able to automatically detect 50% and 85% of mass-like and non-mass-like enhancement lesions that were missed in screening with MRI, respectively. Further improvement is required to detect focus lesions. The integration of such a system in clinical practice might aid radiologists to avoid screening errors.

CLINICAL RELEVANCE/APPLICATION
Automated lesion detection in breast MRI can facilitate breast cancer screening and reduce reading errors.

SSQ20-09  Optimisation of the Selection of Women with an Increased Risk of a Masked Tumour for Supplementary Screening

Thursday, Dec. 3 11:50AM - 12:00PM Location: S404AB

Participants
Katharina Holland, Nijmegen, Netherlands (Presenter) Nothing to Disclose
Carla H. van Gils, PhD, Utrecht, Netherlands (Abstract Co-Author) Software support, Matakina Technology Limited
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PURPOSE
The sensitivity of mammograms is low for women with dense breasts, because cancers may be masked by dense tissue. In this study we investigate methods to identify women with density patterns associated with a high masking risk. Four methods based on quantitative volumetric breast density analysis are compared to an area based density measure.

METHOD AND MATERIALS
We used the last negative screening mammograms of 87 women who subsequently presented an interval cancer (IC), and 870 randomly selected normal screening exams from women without cancer as controls. Volumetric breast density maps (VBDMs) were computed using software provided by Matakina (Wellington, New Zealand). These maps provide the dense tissue thickness for each pixel location. We used the VBDMs to compute four masking measures: 1) Volume of glandular tissue (VGT), 2) Percent dense volume (PDV), 3) Percent area where dense tissue thickness exceeds 1cm (PA1), and 4) Possibility that there is a tumor, with diameter t, at a location with dense tissue thickness d, normalized to the breast area, taking into account the size distribution of screen detected cancers (PT). In addition we determined percentage dense area (PDA) after classifying pixels automatically in dense and non-dense classes using a random forest classifier. Methods were applied to MLO views and then averaged per exam. For each method, we selected cases with the highest masking measure by thresholding and computed the fraction of ICs as a function of the fraction of controls selected. Furthermore we computed the ratio between IC with supplemental screening offer and the supplemental screening rate.

RESULTS
The highest ratio between IC and supplemental screening rate has been observed for PA1 with a screening rate of 5% and a sensitivity of almost 20%. For screening rates above 20%, the highest response of IC can be observed when using PA1 and PT for stratification.

**CONCLUSION**

We showed that the different breast density measures are suited for stratification. A careful choice of the stratification criteria is necessary depending on the number of women that one is willing to offer supplemental screening.

**CLINICAL RELEVANCE/APPLICATION**

To make supplemental breast cancer screening feasible and cost efficient, it is necessary to have a high response in the target group while the selected women in the overall screening population remains low.
**SSQ21**

**Vascular/Interventional (Improving Education and Outcomes in Interventional Radiology)**

**Thursday, Dec. 3 10:30AM - 12:00PM Location: E352**

**Participants**
Kelvin K. Hong, MD, Baltimore, MD (Moderator) Scientific Advisory Board, Boston Scientific Corporation; Steven M. Zangan, MD, Chicago, IL (Moderator) Nothing to Disclose

**Sub-Events**

**SSQ21-01 Simulation Based Training Improves Resident Skill in Ultrasound-Guided Biopsy**

**Thursday, Dec. 3 10:30AM - 10:40AM Location: E352**

**Participants**
Nicholas L. Fulton, MD, Cleveland, OH (Presenter) Nothing to Disclose
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Jayakrishna Gollamudi, MD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
Mark R. Robbin, MD, Cleveland Hts, OH (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The purpose of this study was to determine whether ultrasound-guided biopsy simulation training using a high fidelity abdominal imaging phantom can improve the radiology residents' overall technical competence in ultrasound guided biopsy.

**METHOD AND MATERIALS**
This is an IRB approved prospective study. Forty radiology residents from a single institution were enrolled and randomized into training (TG) or control (CG) groups. Each resident performed an ultrasound-guided biopsy on a high-fidelity abdominal imaging phantom using a 22-gauge needle. Prior experience in ultrasound guided biopsies (number of months and procedures performed), total procedure time, number of skin punctures, and number of needle adjustments were obtained. Each procedure was evaluated by a blinded board certified radiologist using a 5 point Likert scale technical competence score. The TG cohort received an additional 30 minute simulation training session with an experienced senior resident. The CG cohort received no additional training. Each resident underwent a second procedure and the same metrics were measured. Statistical analysis was performed using independent t tests.

**RESULTS**
There were no statistically significant differences between the TG and CG with regards to prior ultrasound-guided biopsy experience. No significant differences between the two cohorts were present in the initial procedure. After the training session, the training cohort demonstrated a statistically significant improvement in overall procedure time (92 seconds less), number of skin punctures (0.8 less), number of needle adjustments (1.4 less), and subjective performance on a 5-point Likert scale (1.1 more) as determined by a blinded grader. The CG did not demonstrate a statistically significant difference in any of the measured metrics between the two procedures.

**CONCLUSION**
The use of an abdominal imaging phantom for training radiology residents in ultrasound-guided biopsy performance can improve procedural skills including shorter procedure time, less skin punctures, less needle movements and improved subjective performance by a blinded grader. Additional randomized controlled trials will be necessary to determine the external validity of the study in regards to improved patient outcomes and IR-department turnaround time.

**CLINICAL RELEVANCE/APPLICATION**
This study demonstrates the efficacy of simulation training on improving resident performance in ultrasound-guided biopsy.

**SSQ21-02 Ultrasound Guided Foreign Body Removal (USFBR): Simulation Training and Clinical Implementation Outcomes**

**Thursday, Dec. 3 10:40AM - 10:50AM Location: E352**

**Participants**
Veronica J. Rooks, MD, Honolulu, HI (Abstract Co-Author) Nothing to Disclose
Jefferey M. Meadows, Tripler AMC, HI (Presenter) Nothing to Disclose
Christian L. Carlson, MD, MS, Cibolo, TX (Abstract Co-Author) Nothing to Disclose
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Frank E. Mullens, MD, MPH, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Beth M. Haeuptle, BS, MA, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Michael Lustik, Tripler AMC, HI (Abstract Co-Author) Nothing to Disclose
James W. Murakami, MD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
William E. Shiels II, DO, Columbus, OH (Abstract Co-Author) President, Mauka Medical Corporation; Royalties, Mauka Medical Corporation; Patent holder, Mauka Medical Corporation

**PURPOSE**
USFBR can be taught to radiologists in a stepwise approach to generate competency, and radiologists can apply the technique in the patient setting to remove foreign bodies.
**METHOD AND MATERIALS**

USFBR was taught to 48 radiologists at 4 hospitals. Training included didactic and hands-on instruction covering 7 components: instrument alignment, hand/transducer position, forceps use, foreign body definition, forceps grasp, recognition of volume averaging, and oblique cross cut artifact. Pre-training testing assessed removal of a single toothpick imbedded in a turkey breast in 15 minutes. Post-training evaluation consisted of 5 toothpick removals. Ongoing clinical implementation of USFBR includes foreign body removal under ultrasound guidance by a trained radiologist. Parameters including age of patient, which radiologist, removal success, type and size of foreign body, incision size, foreign body retention time, reason for removal, symptoms, modalities used in detection, wound closure, and sedation are recorded. Data were analyzed using chi-squared and Fisher's exact tests for categorical outcomes and analysis of variance for continuous outcomes.

**RESULTS**

After training, radiologists’ scores improved from 21-52% pre-training to 90-100% post-training (p<0.001 for each component). Clinical to date, USFBR has been 100% successful in 7 (25 expected) patients, ages 9-73 years, by 4 trained radiologists. Objects removal length 4 to 30 mm, retention time 2 to 864 days, incision 2 to 8 mm. 1 closure. 1 sedated.

**CONCLUSION**

Ultrasound guided foreign body removal approach taught in simulation improves radiologist technique and removal outcomes. A radiologist who completes simulation training can remove a variety of imbedded foreign bodies.

**CLINICAL RELEVANCE/APPLICATION**

USFBR can be used to remove foreign bodies while minimizing patient discomfort and potential tissue damage.

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**SSQ21-03 Evaluation of a Gelatin-Based Phantom Model System for Training of CT-Guided Drain Placement**

**Thursday, Dec. 3 10:50AM - 11:00AM Location: E352**

**Participants**

Stephen A. Balfour, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Pratik S. Patel, DO, Philadelphia, PA (Presenter) Nothing to Disclose
Xi Xue, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Justin McCloskey, BA, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
David S. Pryluck, MD, MBA, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Prior studies have described the use of low-cost gelatin phantom models to train ultrasound-guided procedures, however, there is limited data evaluating their use in training CT guided procedures. The purpose of this study is to evaluate the use of such a model to train inexperienced operators to perform CT guided abscess drainages.

**METHOD AND MATERIALS**

Twenty inexperienced and blinded participants were asked to place a needle into a simulated abscess in a gelatin phantom followed by a pigtail catheter using Seldinger technique. Subjects were randomized to receive traditional didactic instruction prior to testing or to receive hands-on training with the phantom model prior to testing. Primary endpoints included time to successful needle, wire, and drain placement, number of scans to achieve needle placement, and total number of scans. Secondary endpoints included a Likert-type confidence survey.

**RESULTS**

Experimental subjects required fewer scans to achieve needle placement (4.7 vs 9.2, p=0.04) and less time to achieve needle placement (14.7 vs 20.4 minutes, p = 0.04), compared with control subjects. Experimental subjects also felt more confident in their ability to safely (p=0.03) and successfully (p=0.01) perform the procedure on an actual patient. There was no significant difference between groups for total number of scans and time to successful wire/drain placement.

**CONCLUSION**

Our data demonstrate that the use of low-cost gelatin phantom models for the training of CT-guided procedures improves both performance and confidence in technically inexperienced subjects with the potential to reduce radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

We believe gelatin phantom simulation has real potential to serve a larger role in medical student and resident training.

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**SSQ21-04 Use of an Electromagnetic Navigation System on a Phantom as a Teaching Modality To Improve Training for CT-Guided Procedures**

**Thursday, Dec. 3 11:00AM - 11:10AM Location: E352**

**Participants**

Dmitry Trifanov, MD, Boston, MA (Presenter) Nothing to Disclose
Taj Kattapuram, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Haiyang Tao, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ronald S. Arellano, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Raul N. Uppot, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The purpose of this study is to evaluate the role of electromagnetic navigational guidance system (EMN) and a phantom as training simulator for computed tomography (CT)-guided procedures.

**METHOD AND MATERIALS**

The study included two components: 1. A skills test using a navigational guidance system and phantom that simulated a CT-guided
procedure. 2. A survey of the fellows assessing the use of a navigational guidance system on a phantom as a potential tool to help training for CT-guided procedures. Nineteen fellows (12 interventional radiology fellows and 7 abdominal imaging fellows) were involved in the study.

RESULTS

Use of the EMN system improved the successful number of attempts at hitting the biopsy target for both the diagnostic and interventional group. Mean number of successful attempts for all the fellows in the manual/conventional CT guidance group was 58.8%. Mean number of successful attempts for all the fellows in the EMN group was 85.9%. Although there was improvement in number of successful attempts using the EMN system compared to manual conventional method, there was no statistically significant difference in time or accuracy. The pre and post survey showed no correlation was found between their confidence and accuracy and only half of the fellows disclosed that their confidence improved after the training session. However 92.9% of the trainees felt that using EMN system and phantom are useful training tools to simulate CT-guided procedures.

CONCLUSION

Use of EMN system on a phantom is a potentially valuable training tool for training and simulating CT-guided procedures for fellows. When using EMN navigational guidance, the number of the successful attempts by the diagnostic fellows, was significantly better than the interventional fellows. There was significant improvement in number of successful attempts for all fellows when the EMN system was used compared to manual/conventional targeting. In addition, nearly 93% of the fellows reported that use of the CT-simulator helped with training as it helped in understanding the spatial orientation necessary for CT-guided procedures.

CLINICAL RELEVANCE/APPLICATION

Use of EMN systems on a phantom can help simulate and train residents and fellows for CT-Guided Procedures. These simulated environments can help with patient safety.

SSQ21-05  Interventional Radiology Fellowship Websites: A Critical Analysis of Content and Accessibility

Thursday, Dec. 3 11:10AM - 11:20AM Location: E352

Participants
Resmi Charalel, MD, New York, NY (Presenter) Nothing to Disclose
Bradley B. Pua, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Naveen Galla, BA, New York, NY (Abstract Co-Author) Nothing to Disclose
Samir Trehan, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
David C. Madoff, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the content and accessibility of interventional radiology (IR) fellowship program websites.

METHOD AND MATERIALS

All IR fellowship programs listed on the Society of Interventional Radiology (SIR) website were individually evaluated based on content and ease of access. Upon review of the SIR website, program contact information, application information, program description and website address were evaluated. A Google search was performed ("[program name] interventional radiology fellowship") and the number of mouse clicks required to get from Google to each fellowship website was recorded. Each fellowship website was evaluated for detailed program characteristics, application information and specific contact information. Online data was collected in November 2014.

RESULTS

Of the 85 programs listed on the SIR website, 95% (81/85) were currently offering fellowships and 96% (78/81) of these programs had functioning websites. All programs listed a contact telephone number and mailing address on the SIR website. However, no program had a functional link to the fellowship website from the SIR website. Via Google, it took an average of 1.1 clicks to access available websites. Program description, application information and rotation schedule were provided in 86% (67/78), 72% (56/78) and 18% (14/78) of websites, respectively. Only 31% (24/78) of programs indicated on their websites that they accepted applications via ERAS. Additional factors such as didactics, current fellow information, and research opportunities were available in 32% (25/78), 15% (12/78), and 33% (26/78), respectively.

CONCLUSION

The SIR website maintains a comprehensive listing of IR fellowship programs, most of which could be efficiently accessed via Google. While most fellowship program websites contained a program description, other content such as application information and rotation schedule, were less frequently present.

CLINICAL RELEVANCE/APPLICATION

Interventional radiology (IR) fellowship will soon be replaced by its own residency. During this process, it will be increasingly important to understand the information available to applicants on program websites and how to improve them.

SSQ21-06  The Impact of a Laser Navigation System (LNS) on CT-guided Interventions

Thursday, Dec. 3 11:20AM - 11:30AM Location: E352

Participants
Maurice Pradella, MD, Basel, Switzerland (Presenter) Nothing to Disclose
Tobias Heye, MD, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Martin Takes, MD, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
David Buergler, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Christoph J. Zech, MD, Basel, Switzerland (Abstract Co-Author) Research Grant, Bayer AG Speaker, Bayer AG Travel support, Bayer AG Advisory Board, Bayer AG Speaker, Bracco Group Travel support, Bracco Group

PURPOSE

CT-guided biopsies, drainages as well as spinal nerve infiltrations are established minimal-invasive methods. The aim of this study
was to compare our results with a newly installed laser navigation system (LNS) to prior procedures.

**METHOD AND MATERIALS**

In June 2014 a new CT scanner (Somatom Edge, Siemens Medical Solutions, Erlangen, Germany) as well as a LNS (Amedo 3D-LNS, Amedo, Bochum, Germany) were installed in our institution. We retrospectively analysed and compared all biopsies, drainages and infiltrations from a 3 months period prior (2013) and after (2014) the installation. Lesion size, distance from skin, procedure duration, radiation dose (total CTDIvol), complications and clinical success were evaluated. Operators experience was categorized between residents under supervision and consultants, with at least 5 years of experience in interventional radiology.

**RESULTS**

A total of 236 procedures were included of which 69.1 % were performed by experienced operators (2013: 111 (66.7%), 2014: 125 (91.1%)). In 2014 80.5% of all interventions were performed by using the LNS. Experienced operators used the LNS in 81.3 % of all cases in 2014 vs. 72.7 % for inexperienced operators. There was no overall difference in size (12.4 cm2 vs. 12.7 cm2, p=0.93), duration (10.7 min vs. 10.8 min, p=0.91) or distance from skin (6.1 cm vs. 5.8 cm, p=0.37) between the two groups. Overall complication rate was 6.8 % (with LNS: 4.0 % vs. 8.9 % without LNS, p=0.14). Success rate was 97.0 % incl. 8.1 % unclear cases (96.0 % incl. 10.0% vs. 97.8 % incl. 6.7 %, p=0.46). In total the use of the LNS reduced the patients’ radiation exposure by 47.9 % (30.1 mGy vs. 57.9 mGy, p<0.001). This effect was independent from experience (experienced operators: 30.4 mGy vs. 59.2 mGy, p<0.001; inexperienced operator: 26.7 mGy vs. 54.8 mGy, p=0.012). Interestingly the use of the LNS significantly reduced the procedure's duration in the inexperienced group (4.0 min vs. 13.2 min, p=0.046).

**CONCLUSION**

Our data suggest that the use of a LNS can reduce the radiation dose significantly. This effect occurs independently from operator’s experience. Furthermore there might be benefits in reducing the procedure's duration in the group of inexperienced operators.

**CLINICAL RELEVANCE/APPLICATION**

Dose reduction is an important factor in interventional radiology both for the patient as well as for the physician involved.

**SSQ21-07 How Much Does an Interventional Procedure Actually Cost? Analysis Using Time Driven Activity Based Costing**

Thursday, Dec. 3 11:30AM - 11:40AM Location: E352

**Participants**

Anand M. Prabhakar, MD, Somerville, MA (Presenter) Nothing to Disclose
Derek Haas, Boston, MA (Abstract Co-Author) Nothing to Disclose
Nicole Bassoff, Boston, MA (Abstract Co-Author) Nothing to Disclose
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Rahmi Oklu, MD, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Time-driven activity-based costing (TDABC) is a strategic accounting tool that empowers health care systems to determine the cost of care delivery vis-à-vis process mapping. This information can be used to optimize the value of clinical processes and protocols. This project applied TDABC analysis to understand the labor costs of dialysis-related interventional radiology procedures.

**METHOD AND MATERIALS**

In this IRB-approved, HIPAA compliant study, 25 patients who presented to IR for fistulagram or dialysis access thrombectomy were observed from arrival to discharge from July-September 2014. The trained observers recorded the room idle time and the time the patient spent with each staff resource throughout the patients stay. This data was used to estimate the average time spent by each staff resource at each step in the care process, and the value per minute of each staff resource (capacitance cost) was calculated using publically available salary information. Based on these two factors, as well as equipment and room costs, the total cost of each procedure was calculated. The data were analyzed with descriptive and comparative statistics.

**RESULTS**

Of the patients in the study, 16 underwent a fistulagram and 9 underwent a thrombectomy. The mean times were: 75±49 (room idle time), 25±412 min (prep time), 90±46 min (IR fellow time), 124±46 min (IR Attending time), 15±45 min (room cleaning time), and 142±45 min (total procedure time). Staff utilization rates for thrombectomy and fistulagram were: 47%/32% (IR Attending), 52%/45% (IR Fellow), 67%/66% (IR Nurse), and 74%/75% (IR Technologist). Using salary estimates, the staff capacitance costs were: $4.10/min (IR Attending), $1.46/min (IR Nurse), $1.12/min (IR Tech), and $0.76/min (IR Fellow). The mean fistulagram cost was $1103±430 with a 3.1x variation between the min ($598) and max ($1851) cost.

**CONCLUSION**

TDABC analysis demonstrates wide variability in the costs associated with dialysis-related procedures. Improvement of staff utilization rates is a strategy for reducing these costs.

**CLINICAL RELEVANCE/APPLICATION**

TDABC is a novel way to cost healthcare procedures. Efforts aimed at improving staff utilization could reduce procedural costs for health care systems and increase their likelihood of success under risk-share payment models.
**SSQ21-08  Effect of Patients' Negative Affect on Adverse Events in Interventional Radiology**

**Participants**
Nadja Kadom, MD, Boston, MA (Presenter) Nothing to Disclose
Gheorghe Doros, Boston, MA (Abstract Co-Author) Nothing to Disclose
Elvira V. Lang, MD, Brookline, MA (Abstract Co-Author) Founder and President, Hypnalgescis, LLC;

**PURPOSE**

Self-fulfilling prophecy of thoughts and feelings about health outcomes and the mood contagion between patients and physicians are contested topics in the current literature and lay press. In this study we assessed whether a patient's negative affect is predictive of adverse events during interventional radiological procedures.

**METHOD AND MATERIALS**

This IRB-approved HIPAA compliant study includes 230 patients who underwent percutaneous peripheral vascular and renal interventions in a randomized sequence. Prior to their interventions patients filled out the Positive Affect Negative Affect Schedule (PANAS), rating 10 adjectives each related to either positive affect (PA) or negative affect (NA) using a 5-point rating scale ranging from “1=Very slightly/Not at All” to “5=Extremely”. Adjectives for NA were: Distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid. Adjectives for PA were: Interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active. Adverse events included prolonged hypoxia, hypertensive or hypotensive episodes, prolonged bradycardia, postoperative bleeding. Summary scores for NA and PA were split into high and low over their medians and correlated with absence or presence of adverse events using logistic regression. Odds ratios, standard error (SE), confidence intervals (CI), and p-values were reported using SAS 9.1.3.

**RESULTS**

Patients with high NA had significantly more adverse events than those with low NA (22% vs 12%; odds ratio 0.48, SE 0.17, CI 0.23 - 0.97, p=0.04). The degree of PA did not significantly affect outcome (odds ratio 0.76, SE 0.27, CI 0.38 - 1.53, p=0.44).

**CONCLUSION**

Patients with high negative affect fared significantly worse in terms of adverse events as compared to patients who had low negative affect. The degree of positive effect did not make significant difference.

**CLINICAL RELEVANCE/APPLICATION**

The mood contagion from the patient's negative affect should be of concern for the practicing interventional radiologist because it may result in a self-fulfilling prophecy of a negative outcome.

**SSQ21-09  Lead Aprons: A Lead Exposure Hazard?**

**Participants**
Kevin Burns, MD, Bronx, NY (Presenter) Nothing to Disclose
Morri Markowitz, MD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Benjamin Taragin, MD, Teaneck, NJ (Abstract Co-Author) Nothing to Disclose
Jamie Shoag, BS, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Sukhray Kahlon, BS, Bronx, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Lead (Pb) is highly toxic but is useful to protect against ionizing radiation. The lead inside shields worn by medical workers has long been believed to be nonhazardous. This study was designed to determine, for the first time, whether such shields expose wearers to lead in dust on exterior shield surfaces.

**METHOD AND MATERIALS**

This was a descriptive study of a convenience sample of 172 shields. Both surfaces of each shield were tested in 2 ways: a qualitative on-site test (LeadCheck, 3M) and a lab based quantitative dust sample analysis by atomic absorption spectroscopy (AAS) expressed in micrograms per foot squared (ug/ft2). Age, type of shield, Pb sheet thickness, storage method and visual and radiographic appearance were assessed.

**RESULTS**

86 shields [50% (95% CI: 43-57%)] tested positive for surface lead using the qualitative method on one or both sides. 109 [63% (95% CI: 56-70%)] of the shields had detectable lead by AAS. Pb dust by AAS ranged from undetectable to 998 ug/ft2. Comparing assessment methods, the positive predictive value of the qualitative method was 85%; negative predictive value was 58% versus the quantitative method. There was 82% agreement as to the presence of Pb between the 2 sides, e.g., if Pb was present on one surface it was likely present on the other. The quantitative detection of Pb was significantly associated with: 1) visual appearance of the shield (1-best, 3-worst): 90% of shields that scored 3 had detectable dust Pb; 2) type of shield: a greater proportion of the pediatric patient, full body and thyroid shields were positive than vests and skirts; 3) use of a hangar for storage: 4 of 14 shields on hangers (27%) were positive vs. 66 of 105 not on hangers (67%). Radiochromic determination of shield intactness, thickness of interior Pb sheets, and age of shield were unrelated to presence of surface dust Pb. Of note, 5/5 shields constructed with no interior Pb had no detectable surface Pb.

**CONCLUSION**

63% of shields had detectable surface lead which was associated with visual appearance, type of shield, and storage method. A clinical correlate study, currently in progress at our institution, will help to assess risk to patients and clinicians.

**CLINICAL RELEVANCE/APPLICATION**

Lead shields, long thought to be safe, have lead dust on external surfaces. Lead dust is a known source of exposure that can result
in lead poisoning and should be minimized as much as possible.
PURPOSE

The aim of this study was to evaluate the clinical effectiveness of Contrast Enhanced Ultrasound (CEUS) in detecting the presence of endoleaks after Endovascular Aortic Aneurysm Repair (EVAR) and to compare the diagnostic accuracy with other imaging modalities.

METHOD AND MATERIALS

One hundred and seven patients, all post EVAR, underwent surveillance utilising CEUS, CDU and CTA. Each modality assessed for the presence of an endoleak. The presence of contrast within the stent graft established patency and contrast within the residual aneurysm sac indicated the presence of an endoleak. Endoleaks were classified by type, origin and size. Quantitative comparison was made between each modality.

RESULTS

There is a statistically significant increased rate of endoleak detection, especially for low amplitude, slow flowing endoleaks using CEUS in comparison to CDU and CTA. Two-tailed P value was calculated with McNemar's Test and continuity correction at <.0001.

CDU identified thirty-six endoleaks, CTA identified thirty-nine endoleaks and CEUS identified sixty-three endoleaks. Statistical analysis has also highlighted that CDU in comparison to CTA in the detection of Endoleaks is not statistically significant. The two-tailed P Value equals 0.6625. These two imaging modalities were considered to be equivalent.

CONCLUSION

In this prospective study, CEUS has proven to be an extremely effective imaging modality in the detection, visualisation and classification of endoleaks in comparison to CDU and CTA. CEUS is a sensitive adjunct to unenhanced ultrasound and is an extremely useful imaging modality in patients where CTA is contraindicated. CEUS is an accurate and minimally invasive way to interrogate these endografts and has in this study, demonstrated statistically significant improvements in the detection of endoleaks. If the advances in ultrasound imaging technology, with the use of contrast agents, continue to demonstrate its dominance, we believe CEUS will become a routine part of EVAR surveillance.

CLINICAL RELEVANCE/APPLICATION

CEUS has a significant role to play in EVAR surveillance. It is an accurate and minimally invasive way to interrogate endografts and has demonstrated statistically significant improvements in endoleak detection.

SSQ22-02  Endoleak and Thrombus Characterization with Dynamic Elastography after Endoleak Embolization Following Aneurysm Endovascular Repair

Thursday, Dec. 3 10:40AM - 10:50AM Location: N227

Participants
Antony Bertrand-Grenier, Montreal, QC (Presenter) Nothing to Disclose
Fatemeh Zehtabi, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Helene Heon, DVM, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Guy Cloutier, PhD, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Sophie Lerouge, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Gilles P. Soulez, MD, Montreal, QC (Abstract Co-Author) Speaker, Bracco Group Speaker, Siemens AG Research Grant, Siemens AG Research Grant, Bracco Group Research Grant, Cook Group Incorporated Research Grant, Object Research Systems Inc

PURPOSE

SuperSonic Imagine (SSI) measure the tissue elasticity in real-time. The goal of this study was to characterize in a canine model
Incidence and Clinical Significance of Renal Infarct after Fenestrated Endovascular Aortic Repair

Thursday, Dec. 3 10:50AM - 11:00AM Location: N227

Participants
Lauren M. Burke, MD, Chapel Hill, NC (Abstract Co-Author) Consultant, Amgen Inc
Jesse M. Conyers, BS, Carrboro, NC (Abstract Co-Author) Nothing to Disclose
Charles T. Burke, MD, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
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Mark Farber, MD, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
Raghu Vallabhaneni, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
An J. Isaacson, MD, Chapel Hill, NC (Abstract Co-Author) Advisory Board, BTG International Ltd
Robert G. Dixon, MD, Chapel Hill, NC (Presenter) Nothing to Disclose

PURPOSE
Renal infarcts are occasionally seen on post-fenestrated endovascular aortic repair (FEVAR) imaging. They can occur as a result of intentional exclusion of an accessory renal artery or after inadvertent embolism during the procedure. While the incidence of renal infarct following FEVAR is variable, the clinical significance of these renal infarcts is undocumented. The purpose of this study is to determine the incidence of renal infarcts on post-FEVAR imaging and what percentage of this subset of patients developed a subsequent increase in serum creatinine.

METHOD AND MATERIALS
All patients who underwent FEVAR at our institution between April 1, 2010 and April 1, 2014 and had pre- and post-contrast-enhanced CT were retrospectively identified and included for analysis. Two staff radiologists reviewed pre- and post-FEVAR CTs for the presence of renal infarcts. All post-FEVAR scans were obtained at least one month following FEVAR. The electronic medical record was used to record serum creatinine (Cr) values obtained concurrently with the pre- and post- scans as well as the need for hemodialysis following FEVAR. Incidence of renal infarct was calculated as well as the percentage of patients with post-FEVAR renal infarcts who had a significant rise in serum Cr (defined as a 0.3 mg/dl increase).

RESULTS
100 patients were included for analysis. 24 of these patients (24%) had a renal infarct identified on post-FEVAR CT. Of these, 10 (42%) were a result of purposeful covering of an accessory renal artery and 14 (58%) were embolic. Of the 14, only 3 (21%) had an increase in serum Cr of greater than 0.3 mg/dl during the post-FEVAR period (range 0.72-2.62, average 1.42). Of the 10 patients with renal infarct following covering of an accessory renal artery, only 1 (10%) demonstrated an increase in serum Cr (0.82). No patients in either group required temporary or permanent hemodialysis.

CONCLUSION
The presence of renal infarcts after FEVAR is not uncommon and often secondary to intentional exclusion of accessory renal vessels. The clinical relevance of these events appears relatively benign with only 17% of patients with renal infarcts demonstrating any significant decline in renal function, none of which required temporary or permanent dialysis in the short-term.

CLINICAL RELEVANCE/APPLICATION
Understanding the incidence and significance of renal infarct after FEVAR will improve communication between the radiologist and surgeon.
**Type II Endoleak Proposed New Sub-Categorisation**

Thursday, Dec. 3 11:10AM - 11:20AM Location: N227

Participants

Rayshelle Finch, Orange, Australia (Presenter) Nothing to Disclose
Steven Dubenec, Camperdown, Australia (Abstract Co-Author) Nothing to Disclose
Bryan Khoury, FRANZCR, Orange, Australia (Abstract Co-Author) Nothing to Disclose
Sharyn Russel, MBBS, Orange, Australia (Abstract Co-Author) Nothing to Disclose
Karen Polland, Wagga Wagga, Australia (Abstract Co-Author) Nothing to Disclose
Ian Garbett, BS,MSc, Wagga Wagga, Australia (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The aim of this study was to evaluate the behaviour of Type II endoleaks utilising CEUS to aid visualisation and to determine the endoleak origin and communication with branch vessels.

**METHOD AND MATERIALS**

This observational study enrolled one hundred and seven patients who had undergone EVAR as treatment for their AAA. All patients underwent surveillance utilising CDUS, CEUS and CTA to assess for presence/absence of an endoleak. Contrast enhancement within the residual aneurysm sac indicated the presence of an endoleak. Endoleaks were classified by type, origin and size. Type II endoleaks were further subcategorised according to vessel behaviour, origin, communications and duplex Doppler characteristics.

**RESULTS**

Type II endoleaks were identified and subcategorised based on vessel origin, behaviour, channel connection and spectral Doppler characterization. We added Doppler information to Type II subcategories A and B. We distinguished two variants in subcategory IIB (i) and (ii) based on their communications and devised two further Type II subcategories C and D. Type IIC endoleaks were identified as the endoleak that may cause potential pressurisation to the residual aneurysm and were thought to be the most likely to cause risk to the patient, requiring intervention. All patients with this new endoleak subcategory were noted to have had an increase in sac size of >=5mm over a 6month period. The haemodynamic effect of this endoleak subtype was thought to be significant.

**CONCLUSION**

CEUS has a significant role to play in EVAR routine surveillance and is a sensitive adjunct to unenhanced ultrasound in the detection of endoleaks. The type and size of an endoleak and the residual sac size are the most important factors that influence the need for secondary intervention. Our additional sub-categorisations of Type II B (i) and (ii), C and D has shown initial benefit in determining an ‘at risk’ Type II endoleak. An enhanced understanding of Type II endoleaks will aid in future interventional and implementation
strategies, which will ultimately lead to EVAR success.

**CLINICAL RELEVANCE/APPLICATION**

This study identifies and subcategorises Type II-endoleak behaviour. Additional subcategorisation has shown initial benefit, extrapolating 'benign' and 'at risk' endoleaks. CEUS is a sensitive adjunct to CDU and CTA.

**SSQ22-06 Integrated Stent-graft for Wireless 4-dimensional Aneurysm Sac Pressure Monitoring after Endovascular Aortic Aneurysm Repair (EVAR): First in Vitro Results**

Participants
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Markus Braunschweig, Dresden, Germany (Abstract Co-Author) Nothing to Disclose
Jan-Hendrik Buhk, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Koops, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

In vitro testing of prototype stent-grafts with an integrated array of nano-electronic pressure sensors within the stent-covering, capable of wireless digital data transmission for non-invasive 4-dimensional aneurysm sac pressure monitoring following EVAR.

**METHOD AND MATERIALS**

30 prototype stent-grafts were designed (85 mm x 16 mm), each containing 16 pressure sensors (1.5 mm x 1 mm x 1 mm) within the covering membrane of polytetrafluorethylen (PTFE). The prototypes were mounted on a 26 F delivery sheath and mono-ilialcal placed into an aortic bifurcation model. Measurements were continuously taken from the sensors while inducing invasive reference pressure from the contralateral iliacal side. Digital data conversion was performed by an integrated microcontroller. Customised antenna technology was designed providing energy and data transfer by inductive coupling.

**RESULTS**

After successful placement of the stent-graft all 16 sensors delivered reliable pressure measurements continuously and could detect pressure-changes accurately up to ±1.2 mmHg. Wireless energy and data transmission could be successfully demonstrated.

**CONCLUSION**

The non-invasive acquisition of pressure profiles along a stent-graft’s membrane after EVAR can deliver information on regional pressure elevation, indicating early endoleak development. Our trials show practical and efficient ways of continuous aneurysm sac pressure monitoring in patients after EVAR. Further in vivo tests are required, developing an implementation into a product.

**CLINICAL RELEVANCE/APPLICATION**

Novel integrated 4-dimensional pressure monitoring may allow precise and early endoleak detection in patients after EVAR providing opportunities of telemetric data transmission.

**SSQ22-07 Long Term Results after Endovascular Repair of Abdominal Aneurysm (EVAR): Impact of Hostile Neck Anatomy in Early and Long-term Complications and Aneurysm Related Death**

Participants
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Rosario Madero Jarabo, MD, Madrid, Spain (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To describe the impact of aneurysm neck morphology on complications and aneurysm-related death after EVAR.

**METHOD AND MATERIALS**

A cohort study of patients underwent elective EVAR in a tertiary institution between January 2002 and December 2013, prospectively collected and evaluated retrospectively. An angio-CT follow-up was performed before surgery and according to standards follow-up thereafter. Patients were classified as having hostile aortic necks (length of <10 mm, angle of >50°, diameter of >28 mm, circumferential thrombus, calcified neck, and reverse taper), or favorable aortic necks. CT scans were reviewed by an experienced vascular radiologist. Outcomes are described according to reporting standards for endovascular aortic aneurysm repair EVAR. Statistical analysis. Time to event was estimated by the Kaplan-Meier method. 95% Confidence intervals were estimated. Risk Proportional Cox Models were used.

**RESULTS**

378 patients underwent EVAR. Demographics and co-morbidities were similar in hostile and favorable necks. 101 patients (26.7%) had hostile necks (34.7% angulated, 47.5% measured more than 28mm, 5% had circumferential thrombus, 16.8% had calcified neck and 9.9% had reversed taper) and 277 (73.3%) had favorable neck anatomy. Aorto-monoiliac grafts were used in 79 hostile necks and bifurcated grafts in 22 of them. Overall technical success was 96.5%. Postoperative type-I endoleak occurred in 2.2% of hostile
necks, and was not present in favorable necks. Perioperative aneurysm-related mortality was 5% in hostile necks and 2.9% in favorable necks. Freedom of proximal type I endoleaks was 99.6% at 3 years and 99.4% at 12 years for favorable necks, compared to 92.1% at 3 years and 87.7% at 12 years in hostile neck anatomy. Primary clinical success rates were 97.1% at 1 year, and 85.4% at 12 years for favorable necks and 88.7% at 1 year and 65% at 12 years for hostile necks. 12-year overall mortality was 65.9% for favorable necks and 52% for hostile necks. Cox Proportional-Hazards Model revealed that hostile necks and aorto-iliac grafts increase significantly the risk of death or complications.

CONCLUSION
Hostile aortic neck is associated with unfavorable early and long term results after endovascular repair of abdominal aneurysm, increasing the risk of complications and aneurysm-related death.

CLINICAL RELEVANCE/APPLICATION
Hostile aortic neck increases long-term complications and aneurysm-related death after EVAR.

SSQ22-08  Risk Factors of Stent Graft-Induced New Entry (SINE) after Thoracic Endovascular Aortic Repair (TEVAR) for Stanford Type B Aortic Dissection

Participants
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Gyeong Min Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Stent graft-induced new entry (SINE) has been increasingly observed after thoracic endovascular aortic repair (TEVAR) for Stanford type B aortic dissection. SINE is often life threatening and re-intervention is required. The current study aims to investigate risk factors of SINE after TEVAR.

METHOD AND MATERIALS
From July 2001 to June 2013, 79 patients who underwent TEVAR for Stanford type B aortic dissection were retrospectively analyzed. Mean age was 55.7 years (range, 25-84 years) and mean follow-up period was 53.5 months (range, 3days-130.2 months). 17 patients underwent TEVAR within 2 weeks (acute) after diagnosis of aortic dissection and the other 62 patients underwent TEVAR after 2 weeks (chronic). 42 patients underwent TEVAR with modified stent graft with 'inward bended' margin and the others used conventional stent graft. The longitudinal diameter, transverse diameter, mean diameter, area and circumference of true lumen were measured. Then taper ratio, pre-stent grafting oversizing ratio, post-stent grafting oversizing ratio, and expansion mismatch ratio of distal true lumen were calculated and compared between SINE group and non-SINE group.

RESULTS
SINE occurred in 21 patients (26.5%). SINE occurred more frequently in chronic dissection group than acute dissection group (32.3% vs 5.9%, P = 0.032). SINE event was not significantly different between modified and non-modified stent group (53.2% vs 46.8%, P = 0.615). Taper ratio, pre-stent grafting oversizing ratio and post-stent grafting oversizing ratio were not significantly different in SINE and non-SINE group. Expansion mismatch ratio is significantly higher in SINE groups than non-SINE groups in terms of longitudinal diameter (117.47 vs 104.44, P <0.0001), transverse diameter (147.00 vs 106.86, P <0.0001), mean diameter (137.46 vs 106.52, P <0.0001), area and circumference (136.72 vs 105.35, P <0.0001). 10 patients (47.6%) required re-intervention with surgery (n=4) or stent-graft (n=6).

CONCLUSION
SINE after TEVAR was more frequent in chronic aortic dissection than acute dissection. Expansion mismatch ratio was significantly higher in SINE group than non-SINE group.

CLINICAL RELEVANCE/APPLICATION
The time interval between diagnosis of aortic dissection and TEVAR is a factor predictive of late SINE event. SINE after TEVAR was more frequent in chronic aortic dissection than acute dissection.

SSQ22-09  Diagnostic Accuracy of Axial Diameter Measurements for the Detection of Aneurysm Sac Enlargement after Endovascular Repair (EVAR) of Abdominal Aortic Aneurysms (AAA) by Computed Tomography (CT)

Participants
Michael Schnitzbauer, MSc, Berlin, Germany (Presenter) Nothing to Disclose
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Christian R. Stroszczyński, MD, Regensburg, Germany (Abstract Co-Author) Nothing to Disclose
Rene Müller-Wille, Regensburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the diagnostic accuracy of diameter measurements for the detection of aneurysm volume increase during follow-up after endovascular aneurysm repair (EVAR) of abdominal aortic aneurysms (AAA).
METHOD AND MATERIALS
We retrospectively analyzed 100 pairs of follow-up CT scans randomly picked from our EVAR database. The maximum aneurysm diameter was measured on axial planes (Dmax axial). The aneurysm sac volume was separately measured by manual segmentation (standard of reference).

RESULTS
Using a cut-off level of > 0 mm for diameter Dmax axial increased in 35 patients (mean 3.9 mm; range 1.0 to 31.0 mm). The aneurysm sac volume increased in 39 patients (mean, 25.7 cm³; range, 0.2 to 241 cm³). Dmax axial had a sensitivity/specificity of 74%/90%.

CONCLUSION
Overall dependent on the chosen cut-off, diameter measurements showed a low to moderate diagnostic accuracy for the detection of aneurysm sac enlargement after EVAR.

CLINICAL RELEVANCE/APPLICATION
Although broadly used in clinical practice diameter measurements seem to fail to detect size increase of the aneurysm sac during follow-up after EVAR.
**SST01**

**Breast Imaging (Multi-modality Screening)**

Friday, Dec. 4 10:30AM - 12:00PM Location: E450B

**Participants**

Michael N. Linver, MD, Albuquerque, NM (Moderator) Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, Real Imaging Ltd

Stamatia V. Destounis, MD, Scottsville, NY (Moderator) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC

**Sub-Events**

**SST01-01  Should Screening Breast MRI be Performed in Women with a History of Lobular Neoplasia?**

Friday, Dec. 4 10:30AM - 10:40AM Location: E450B

**Participants**

Claudia R. Seuss, MD, New York, NY (Presenter) Nothing to Disclose

Samantha L. Heller, MD, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

Jennifer Chun, MPH, New York, NY (Abstract Co-Author) Nothing to Disclose

Shira Schwartz, New York, NY (Abstract Co-Author) Nothing to Disclose

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Linda Moy, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Women with lobular neoplasia (LN), defined as a history of LCIS and/or ALH, have an elevated breast cancer risk, yet the benefit of screening MRI is unclear. The purpose of our study is to determine the cancer detection rates with mammography alone versus mammography plus MRI in this population.

**METHOD AND MATERIALS**

This IRB approved retrospective study identified 80 women with LN who underwent a screening MRI and mammogram from 2003 - 2014. Comparison was made to 412 women with LN who underwent mammography alone. Screening MRI was performed at the discretion of the referring physician.

**RESULTS**

2,168 mammograms were performed in 412 women, median 5 exams. 167 (7.7%) biopsies and 149 (6.9%) follow-up exams were performed. 28/412 (6.8%) cancers were detected by mammography, 9 (32.1%) were DCIS and 19 (67.9%) were invasive carcinomas. Median time from LCIS diagnosis to cancer detection was 57 months (range 18 - 128 months). An additional 26 (6.3%) interval cancers were detected, 7 (37%) DCIS and 19 (73%) were invasive carcinomas. Stage 2 or higher 245 MRIs were performed in 80 women, median of 2 exams. 41 (16.7%) biopsies and 25 (10.2%) follow-up exams were performed. 9/80 (11.3%) cancers were detected on MRI of which 5 (55.6%) were DCIS and 4 (44.4%) were IDC. Two (2.5%) women developed interval cancers (both Stage 1 IDC’s) that were found on follow-up mammogram. Median time from LCIS diagnosis to cancer detection was 48 months (range 6-120 months). Later stage carcinomas were detected on women with LN who were screened with mammogram alone. Cancer detection rate was higher (11.3%) in women who had screening MRI compared to mammography alone (6.8%), although the rates were not significant (p=0.12). Although the rate of follow up exams did not differ (p=.64), more biopsies were performed in the MRI group (p=.02).

**CONCLUSION**

Our study cautiously supports screening MRI for women with a history of LN.

**CLINICAL RELEVANCE/APPLICATION**

Although cancer detection rates were similar between both groups, more interval cancers at an advanced stage were seen in women with LN who underwent mammography alone.

**SST01-02 Outcome of Screening Breast MRI in Pre-menopausal Women as a Function of Week of Menstrual Cycle**

Friday, Dec. 4 10:40AM - 10:50AM Location: E450B

**Participants**

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Janice S. Sung, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

Elizabeth M. Morris, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To determine if there is an association between the outcome of screening breast MRI and the week of the menstrual cycle in pre-menopausal women.

**METHOD AND MATERIALS**
The reports of consecutive screening MRI examinations in pre-menopausal women done from January 2011 through December 2012 were reviewed. Cases for which the stage of the menstrual cycle was documented were included. The week of the menstrual cycle, the degree of background parenchymal enhancement (BPE), final BI-RADS assessment, and positive predictive value of any subsequent biopsy (PPV3) were noted. Rao-Scott Chi square test and Fisher's exact test were used to determine statistical significance.

RESULTS
A total of 1537 MRI examinations in 1240 women were performed. 334 studies were done in week 1, 620 in week 2, 354 in week 3 and 229 in week 4. There was a significant difference in BPE with fewer cases of marked BPE in weeks 1 and 2 compared to weeks 3 and 4 (p=0.026). However, there was no statistically significant difference in final BI-RADS assessment (p=0.412) or PPV3 by either week of menstrual cycle (p=0.180) or by amount of BPE (0.195). Detailed results are presented in Table 1.

CONCLUSION
There was no significant difference in outcome of screening MRI examinations by week of menstrual cycle in which the study was performed. Therefore, aiming to perform screening MRI in week 2 is not necessary.

CLINICAL RELEVANCE/APPLICATION
Timing screening breast MRI for the second week of the menstrual cycle does not make a difference in outcome and is not necessary.

SST01-03 Breast Cancers not Detected by MRI in a High and Intermediate Risk Screening Program

Friday, Dec. 4 10:50AM - 11:00AM Location: E450B

Participants
Suzan Vreeman, MSc, Nijmegen, Netherlands (Presenter) Nothing to Disclose
Albert Gubern-Merida, PhD, Nijmegen, Netherlands (Abstract Co-Author) Nothing to Disclose
Susanne Lardenoije, Nijmegen, Netherlands (Abstract Co-Author) Nothing to Disclose
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Nico Karssemeijer, PhD, Nijmegen, Netherlands (Abstract Co-Author) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV; Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (Abstract Co-Author) Speakers Bureau, Bayer AG

PURPOSE
The purpose of this study was to evaluate the visibility of MR screen detected cancers on prior MR examinations in a population with an elevated risk for breast cancer.

METHOD AND MATERIALS
An IRB approved, retrospective review of patient files from women screened with breast MRI between 2003 and 2013 was conducted at our academic center. We selected all cases detected in MRI with a prior negative MR examination performed between 6 and 24 months before a cancer was revealed (mean: 12.8 ± 3.7 months). This yielded 43 cancers (3 invasive lobular-, 33 invasive ductal carcinomas, 5 ductal carcinoma in situ and 2 others) in 41 patients (age: 49 ± 9.8 years, 21 BRCA patients). The MR scans where the cancers were detected (diagnostic MR scan) and the prior MR scans were evaluated side-by-side in consensus by two dedicated breast radiologists. The visibility of the cancers on prior scans was rated as: visible (BIRADS 4/5), minimal sign (BIRADS 2/3), or invisible (BIRADS 1). Chi-square tests were used to test the correlation between patient and cancer characteristics, image quality (IQ), background parenchymal enhancement (BPE), and visibility of the tumor in the prior MR scan.

RESULTS
All lesions were retrospectively evident on the diagnostic MR scan. Review of the prior examinations of the 43 cancers detected in follow-up rounds revealed that 11 lesions (26%) were visible in the prior MRI and should have been recalled at the time of this scan. 15 lesions (35%) yielded a minimal sign in the prior MRI. Only 17 lesions (40%) were completely invisible. High grade, ER negative, and PR negative tumors were more often invisible in the prior scan (p=0.016, p=0.005, and p=0.002). Moreover, tumors in BRCA patients were more likely to be invisible in the prior scan, than in non-BRCA carriers (p=0.025). IQ and BPE were not significantly related to the visibility of tumors in the prior scan.

CONCLUSION
About 26% of the breast cancers could have been recalled earlier and only 40% of the breast cancers were invisible in retrospect.

CLINICAL RELEVANCE/APPLICATION
To prevent screening errors regular auditing of clinical practice is indicated. Moreover, like in mammography, structural double reading of MRI screening examinations may be recommended.

SST01-04 Consistency of Density Categories over Multiple Screening Rounds Using Volumetric Breast Density

Friday, Dec. 4 11:00AM - 11:10AM Location: E450B

Participants
Katharina Holland, Nijmegen, Netherlands (Presenter) Nothing to Disclose
Carla H. van Gils, PhD, Utrecht, Netherlands (Abstract Co-Author) Software support, Matakina Technology Limited
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Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (Abstract Co-Author) Speakers Bureau, Bayer AG
Nico Karssemeijer, PhD, Nijmegen, Netherlands (Abstract Co-Author) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;

PURPOSE
As a result of the breast density laws, clinicians in many states are obliged to inform women about their breast density and the increased risk that is associated with dense breasts. An increasing number of women with dense breasts decides to have...
supplemental screening. Using an automated software system, we investigated the consistency of the classification of serial screening mammograms in non-dense and dense classes over time.

**METHOD AND MATERIALS**

Full field digital mammograms from a breast cancer screening program were used in which women are invited every two years, starting at the age of 50. The initial screening exam and three subsequent screening exams were available for 2504 women. The average screening interval was 24.4 months. All images were processed by Volpara 1.5.0 (Matakina, Wellington, New Zealand); volumetric percent breast density (PDV) was calculated and averaged over both MLO images. Using the thresholds of the Volpara Density Grade (VDG), all exams were classified as non-dense (PDV<7.5, VDG1+2) or dense (PDV>7.5, VDG3+4). Additionally, to avoid class switches due to small fluctuations of PDV, we defined a gated threshold as follows: For a change to the dense category a PDV greater than 8.3 was required; for a decrease a threshold of 6.7 was used. The gate width was based on noise measures.

**RESULTS**

The majority of women stayed in the same category for the whole period, 38.9% non-dense and 34.5% dense, using the fixed threshold. In 18.1% of the women density decreased and the class changed from dense to non-dense; The deviating patterns were as follows: For 2.4% of the women one intermediate exam was classified as non-dense, while all other exams were dense. Three non-dense and one dense exam were observed in 3.8%. In 2.4% two exams were classified as dense and two as non-dense. Use of the gated threshold reduced the number of women with a deviating pattern.

**CONCLUSION**

Classification into dense and non-dense classes gives stable results over time. Only in a small fraction of the population do we need to assume that an exam was not assigned to the proper class. Use of a gated threshold to separate the non-dense from the dense class reduces the percentage of misclassified exams.

**CLINICAL RELEVANCE/APPLICATION**

A consistent classification in non-dense and dense classes is important, as women and clinicians might lose confidence in the stratification process when supplemental screening is offered in deviating pattern.

**SST01-05  The Relation between Diabetes, Hypertension, Obesity and the Risk of Breast Cancer Development-Results from a Population-based Breast Cancer Screening Program**

**Friday, Dec. 4 11:10AM - 11:20AM Location: E450B**

**Participants**

Dorria S. Salem, MD, Cairo, Egypt (Presenter) Nothing to Disclose
Rasha M. Kamal, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Sarah A. Maksoud, MBCh, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Rehab M. El Sheikh, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Asmaa Abdel Magied, MD, PhD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
Iman Adel, MA, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The aim of this study is to evaluate the relation between diabetes, hypertension, obesity and the development of breast cancer in a population-based screening program.

**METHOD AND MATERIALS**

The studied population includes 104,893 female patients who were enrolled in a population-based Breast Cancer Screening Program in the period from November 2007 to November 2013. All patients performed a mammography examination and were classified according to mammography examination into: Group 1 (BI-RADS 1, 2 and 3 categories) and Group 2 (BI-RADS 4 and 5 categories according to the Mammography Bi-RADS lexicon. Blood pressure (BP), random blood sugar (RBS) and body mass index were measured and compared between females in both groups. Descriptive statistics (frequencies and percentages for categorical variables) were calculated in both groups. Comparison between both groups was performed using Chi square test. P values less than 0.05 were considered statistically significant.

**RESULTS**

The studied population included 104,893 females screened for breast cancer; 2125/104,893 (2%) of which were scored as BI-RADS 4 and BIRADS 5 categories. Group 2 showed statistically higher elevated random blood sugar levels (652/2125, 30%), higher blood pressure levels (873/2125, 41%) and higher BMI (1768/2125, 83.2%) than group 1. The calculated p-values were 0.064, <0.001 and 0.005 respectively.

**CONCLUSION**

The findings of the current study provide evidence in support of a statistically significant association between elevated blood sugar levels, hypertension, body mass index and breast cancer risk among screened population.

**CLINICAL RELEVANCE/APPLICATION**

The incidence of breast cancer, diabetes, hypertension and obesity on the rise. They all carry high burden of morbidity and mortality. Breast cancer preventive strategies should be applied with higher concern for those with hypertension, elevated blood sugar levels and overweight population.

**SST01-06  The Impact of Making 3D Mammography Available to a Rural Population**

**Friday, Dec. 4 11:20AM - 11:30AM Location: E450B**

**Participants**

Christin S. Reisenauer, MD, Moscow, ID (Presenter) Nothing to Disclose
Mark D. Hiatt, MD, MBA, Salt Lake City, UT (Abstract Co-Author) Medical Director, Regence BlueCross BlueShield; Board Member, RadSite; Former Officer, HealthHelp, LLC
PURPOSE
To assess the impact of making digital breast tomosynthesis, or 3D mammography, available to a rural population (previously with access to only conventional 2D digital mammography).

METHOD AND MATERIALS
The impact of adding 3D mammography on May 5, 2014, as interpreted by 3 board-certified (but not fellowship-trained) radiologists at a 25-bed community hospital serving a rural area in the U.S. encompassing a population of 24,500 (but affecting an extended area encompassing more than 1 million), was ascertained by analyzing data (compiled via MRS tracking software) from 5,387 screening and diagnostic mammographic exams (comprising 2,426 2D studies performed between 5/5/13 and 3/31/14 and 2,961 3D studies performed between 5/5/14 and 3/31/15) regarding (a) compliance with annual screening mammography, (b) the rate of breast-cancer detection per 1,000 screened, (c) the call-back rate for screening exams, and (d) community embracement of 3D technology (as evidenced by its acquisition by nearby facilities).

RESULTS
After 3D installation, (a) screening exams increased by 26% (from 2,128 to 2,685), despite no significant rise in population, (b) the rate of breast-cancer detection increased by 98% (from 4.70 to 9.31 per 1,000), (c) the call-back rate declined by 18% (from 8.18 to 6.67%), and (d) of the 9 major hospitals in the area, all but 2 are slated to acquire 3D mammography within one year of the initial installation.

CONCLUSION
Following the addition of 3D mammography in a small community, the compliance with screening mammography, rate of breast-cancer detection, and rate of community embracement of 3D technology increased, while the call-back rate decreased.

CLINICAL RELEVANCE/APPLICATION
Making 3D mammography available to a rural population may improve key metrics of breast-cancer imaging and entice yet more providers in the region to offer this technology.

SST01-07 How Can We Identify Women at Risk for a Masked Cancer, Who May Benefit from Supplemental Screening?

Friday, Dec. 4 11:30AM - 11:40AM Location: E450B

Participants
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PURPOSE
The sensitivity of mammograms is low for women with dense breasts, since cancers may be masked by dense tissue. In this study, we investigate methods to identify women with density patterns associated with a high masking risk. Three methods based on quantitative volumetric breast density analysis are compared to an area based density measure.

METHOD AND MATERIALS
We used the last negative screening mammograms of 87 women who subsequently presented an interval cancer (IC) and, as controls, 870 randomly selected normal screening exams from women without cancer. Volumetric breast density maps (VBDMs) were computed using software provided by Matakina (Wellington, New Zealand). These maps provide dense tissue thickness for each pixel location. We used the VBDMs to compute three masking measures: 1) Volume of glandular tissue (VGT), 2) Percent dense volume (PDV), and 3) Percent area where dense tissue thickness exceeds 1cm (PA1). In addition, we determined percentage dense area (PDA) after classifying pixels automatically in dense and nondense classes (random forest classifier). Methods were applied to MLO views and averaged per exam. For each method, we selected cases with the highest masking measure (by thresholding) and computed the fraction of ICs as a function of the fraction of controls selected. We used the Volpara Density Grade (VDG, threshold on PDV) to distinguish women with nondense breasts from dense breasts (VDG3+4). In practice women with dense breasts are offered supplemental screening. We determined the fraction of controls corresponding to this categorization, and determined sensitivity of our masking measures to select women with masked cancers.

RESULTS
Using VDG, 38% of the controls have dense breasts. When offering 38% of the women supplemental screening, 55%, 66%, 71% and 60% of the women with IC would be included using VGT, PDV, PA1 and PDA respectively. The sensitivity of PA1 was significantly higher compared to VGT and PDA (p-value <0.05).

CONCLUSION
Measures based on volumetric density maps are a promising tool to identify women with a high risk for a masked cancer. Novel masking risk measures have a higher sensitivity than often used measures such as percent dense volume and area.

CLINICAL RELEVANCE/APPLICATION
When offering supplemental screening to women with a high risk for masked cancer, the response of this group should be as high as possible to make supplemental screening feasible and cost efficient.

SST01-08 Comparison of Visibility of Screen Detected Cancers on One-View versus Two-View Digital Breast Tomosynthesis and Full Field Digital Mammography

Friday, Dec. 4 11:40AM - 11:50AM Location: E450B

Participants
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PURPOSE
Comparison of Visibility of Screen Detected Cancers on One-View versus Two-View Digital Breast Tomosynthesis and Full Field Digital Mammography

METHOD AND MATERIALS
We investigated methods to identify women with density patterns associated with a high masking risk. Three methods based on quantitative volumetric breast density analysis are compared to an area based density measure.
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Rema Wasan, MBChB, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
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Keshthra Satchithananda, MBBS, London, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE
Published data from large randomized trial (Wald NJ et al, 1995) indicates significantly increased sensitivity for cancer detection
with two-view versus one-view mammography in routine screening. This resulted in implementation of bilateral two-view, medio-
lateral-oblique (MLO) and cranio-caudal (CC) rather than one-view mammographic screening. With the advent of digital breast
tomosynthesis (DBT) which allows better tissue visualization, we wanted to assess the difference between two-view versus one-
view DBT on cancer detection.

METHOD AND MATERIALS
Study group included women who were diagnosed with cancers following recall after routine screening. Cases were identified by
their initial film-screen mammography for a suspected lesion. At assessment all subjects underwent bilateral DBT and full field digital
mammography (FFDM) examinations as combo in two views (MLO and CC projections), ensuring that DBT and FFDM reconstructed
images were co-registered. The process involved first reviewing FFDM followed by DBT mammograms. In each session all readers
initially read and rated MLO view of both breasts then read and scored bilateral CC view. Each of the projections (MLO and CC) was
interpreted separately. Readers were not allowed to revert to the previous view. This prevented changing of scores of already
marked lesions.

RESULTS
Of 358 cancers (in 345 women) imaged on DBT, 19 (5.3%) lesions were visible only on the MLO examination and 2 (0.5%) were only
seen on the CC examination; compared to FFDM, 27 (7.5%) were visible only on the MLO view and 15 (4.2%) were seen only on
the CC view. Five (1.4%) cancers were only detected on DBT. The projection view of the imaging modality influenced the predictive
value for malignancy. The difference in the distribution of cancers detected on MLO-alone and CC-alone was statistically significant
(p-value < 0.035 on Fisher's exact test). This suggested that detection of malignant lesions on DBT was more likely than on FFDM.

CONCLUSION
The study results demonstrated that obtaining both views is necessary to ensure that a malignancy will be optimally visualized and
derive the potential benefit from DBT.

CLINICAL RELEVANCE/APPLICATION
Two-view DBT detects more cancers than two-view FFDM and more than one-view DBT. Therefore DBT imaging in both CC and
MLO positions should be performed.

SST01-09 The Influence of Environment on Optimal Image Acquisition during Mammography

Friday, Dec. 4 11:50AM - 12:00PM Location: E450B

Participants
Shakira Sarquis, Boca Raton, FL (Presenter) Nothing to Disclose
Kathy J. Schilling Colletta, MD, Delray Beach, FL (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose of mammography is early detection of breast cancer, therefore image quality is essential. Proper breast positioning is a
key factor affecting mammographic quality. Proper positioning maximizes the amount of breast tissue imaged thus potentially
increasing the sensitivity of the mammogram. We sought to investigate the effect of a multi-modal sensory stimulating environment
on the quantity of breast tissue imaged and the compression force used during mammography when compared to a typical setting.

RESULTS
The quantity of additional breast tissue obtained in the SR was significantly improved when compared to the TR in all four standard
projections (p<=.04). Mean percentage of additional tissue obtained in the SR versus TR was 5.0%. There were no significant
differences present in the compression force utilized to obtain the additional tissue (p>=.14).

CONCLUSION
In summary, a multi-modal sensory stimulating environment positively impacts optimal mammographic image acquisition by
maximizing tissue visualized radiographically with no significant change in compression force when compared to typical
mammography room. Incorporating a sensory stimulating environment during mammography may serve to increase the sensitivity of
the mammogram by reducing false negatives attributed to inadequate tissue acquisition. Optimal positioning maximizes of amount of
breast tissue imaged. The rationale behind these findings may be understood by previous research that reported decreased anxiety
and decreased discomfort during mammography when completed in this same sensory-stimulating environment.

METHODS
A retrospective analysis was conducted of women who underwent mammography (n=303) for two consecutive years with their last
mammogram being completed in a sensory-stimulating mammography room (SR) and the prior mammogram being completed in a
typical mammography room (TR). Specifically, the SR attempted to induce relaxation through simultaneous stimulation of the
olfactory, sight, and auditory senses by infusing the air with a light aroma while wall monitors displayed soothing videos of varying
environmental themes, and projected relaxing sounds. The amount of tissue imaged was calculated measuring the posterior nipple
line on the two MLO and two CC images for both years. Additionally, the compression force was measured for each projection.
**PURPOSE**

The role of myocardial triglyceride (mTG) content in the aging human heart is not entirely understood. The aim of this study was to measure concentrations of mTG content from healthy volunteers using 1H-magnetic resonance spectroscopy (1H-MRS) and to determine the association between age, mTG content and systolic heart function (expressed as ejection fraction). Furthermore, the technical reliability of 1H-MRS at 3 T was evaluated.

**METHOD AND MATERIALS**

The total study population of 47 healthy volunteers was divided into 4 age classes, according to the age of the subjects (1st cohort 20 - 29 years (yrs.), n=20; 2nd cohort 30 - 39 yrs., n=10; 3rd cohort 40 - 49 yrs., n=9; 4th cohort 50 - 60 yrs., n=8). Cardiac MRI and dual triggered 1H-MRS of the myocardium were consecutively performed using a 3 T scanner (MAGNETOM Trio, Siemens). The mTG content was calculated as quotient of the mTG resonance areas (at 0.9 ppm [CH3 groups] and 1.3 ppm [CH2 groups]) and the tissue water resonance area (at 4.7 ppm), expressed as triglyceride / water resonance ratio in %. Each participant underwent spectroscopic measurements twice.

**RESULTS**

mTG content significantly correlates with age (r=0.48; p<0.001). Following age-averaged values for mTG content were determined: 1st cohort 0.25% (± 0.17); 2nd cohort 0.48% (± 0.30); 3rd cohort 0.48% (± 0.18); 4th cohort 0.77% (± 0.70). While we found a slight correlation between BMI and mTG content (r=0.27; p=0.008), age proved to be the dominant variable accounting for higher mTG content in healthy humans. There was no significant correlation (r=0.49; p=n.s.) between LV mass and mTG content in healthy volunteers. No effects of mTG content was seen on systolic heart function (r=-0.01; p=n.s.). Intraclass correlation coefficient of repeated spectroscopic measurements was high (r=0.965; p<0.001).

**CONCLUSION**

1H-MRS proved to be a highly reproducible, sensitive tool for myocardial lipid determination. Myocardial TG content is age dependent and increases with age. Myocardial TG content was independent from LV mass and systolic heart function. Furthermore a higher scattering of mTG levels was observed with rising age.

**CLINICAL RELEVANCE/APPLICATION**

Myocardial TG content rises with advancing age. The age-dependent concentration ranges of myocardial lipid metabolites reported in this study may be helpful for the correction of acquired 1H-MRS data in patients when evaluating metabolic and cardiovascular diseases infuture studies.

**SST02-02 Transplantation of Mesenchymal Stem Cells Overexpressing Integrin-linked Kinase Improves the Myocardial Repairing Following Acute Myocardial Infarction**

**PURPOSE**

To investigated the effects of transplanted autologous mesenchymal stem cells overexpressing integrin-linked kinase (ILK) on myocardial perfusion, myocardial fibrosis and cardiac function in the swine AMI model by MR imaging in vivo.
METHOD AND MATERIALS
MSCs or ILK-MSCs (5×10^7 cells) were randomly transplanted into the ischemic myocardium via coronary artery 1 week after establishing the swine acute myocardial infarction model (6 swine per group) by balloon occlusion. The myocardial blood perfusion, the infarction area and the cardiac function were assessed by MR first pass perfusion, delayed enhanced examination and cine MR respectively before and 2 weeks after transplantation using MR imaging. The cardiac fibrosis and capillary density were assessed using immunohistochemistry two weeks later. The data was statistically analyzed with Independent Sample t test using SPSS17.0 software.

RESULTS
Myocardial perfusion was significantly greater in the ILK-MSCs group than in the MSCs group (area under the perfusion curve: 44840±4807mm^2 vs. 35681±5548mm^2, p<0.05) and was associated with greater neo-vessel formation (CD31 positive cells: 273.0±28.3cells/field vs. 194.2±30.7cells/field, p<0.05). The variation of infarction areas were larger in the ILK-MSCs group than in the MSCs group (the infarct size ratio: 0.96±0.11 vs. 0.76±0.09, p<0.05) and was associated with less myocardial fibrosis in Masson staining (the fibrosis area: 46.7±9.0% vs. 62.0±4.9%, p<0.05). Transplantation of ILK-MSCs improved reginal cardiac function compared with transplantation of MSCs (wall thickness ratio: 60.7±4.8% vs. 52.0±5.6%, p<0.05).

CONCLUSION
Transplantation of mesenchymal stem cells modified with ILK enhance the myocardial repairing after AMI.

CLINICAL RELEVANCE/APPLICATION
MR imaging is a reliable method to evaluate the effect of transplantation of MSCs overexpressing ILK on cardiac repairing.

SST02-03 MR Molecular Imaging of Homing of Mesenchymal Stem Cells Overexpressing Integrin-linked Kinase after Transplantation via Coronary in Swine Acute Myocardial Infarction

Friday, Dec. 4 10:50AM - 11:00AM Location: S501ABC

Participants
Dan Mu, Nanjing, China (Presenter) Nothing to Disclose
Hongming Yu, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Chuan Shuai Tian, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Weibo Chen, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Biao Xu, Nanjing, China (Abstract Co-Author) Research Grant, General Electric Company
Bin Zhu, Nanjing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To in vivo detect the homing ability of MSCs overexpressing integrin-linked kinase (ILK) after transplantation via coronary in swine model of AMI using MR molecular imaging technique.

METHOD AND MATERIALS
MSCs or ILK-MSCs (5×10^7 cells) genetically modified with adenovirus containing GFP or GFP/ILK and labeled with ultrasmall superparamagnetic iron oxide (USPIO) were transplanted into the ischemic myocardium via coronary artery 1 week after establishing the swine myocardial infarction model by balloon occlusion. The cell cardiac homing and migration were tracked in vivo at 24h, 1w and 2w after transplantation using MR molecular imaging on clinical 1.5T MR scanner. The GFP expression was calculated from frozen sections and the iron particles in transplanted cells was detected by prussian blue staining 2 weeks later. The data was statistically analyzed with Independent Sample t test using SPSS17.0 software.

RESULTS
In vivo MR molecular imaging manifested in both Groups that the hypointense area (MSCs: 97.6±4.05mm^2; ILK-MSCs: 109.8±4.96mm^2) at 1 week was larger (p<0.05) than those at 24 hours (MSCs: 80.06±4.74mm^2; ILK-MSCs: 89.98±6.15mm^2) and the signal intensity variation (MSCs: 359.8±4.44; ILK-MSCs: 473.6±4.85) was smaller (p<0.05) than those at 24 hours (MSCs: 457.2±8.8; ILK-MSCs: 662.4±40.98). The hypointense area (MSCs: 32.5±7.65mm^2; ILK-MSCs: 19.0±3.10mm^2) and intensity variation (MSCs: 218.6±71.86; ILK-MSCs: 108.6±77.87) were all decreased 2 weeks later compared to those at 1 week (p<0.05). The area and intensity variation of ILK-MSCs group was larger/higher in former 2 time points compared with those of MSCs group (p<0.05), but smaller/lower in 2 weeks (p<0.05) because of dilution of iron particles in each cells attribute to the promoted cell proliferation caused by ILK modification, which was explained by more GFP expression (420.0±8.8/field vs. 106.5±8.3/field, p<0.001) and prussian blue staining positive cells (275±54/field vs. 144±54/field, p<0.001) in ILK-MSCs group in two weeks.

CONCLUSION
USPIO labeled MSCs can be reliably detected and tracked in vivo using serial MR molecular imaging. Transplantation of ILK-MSCs after myocardial infarction can increase the homing rate of MSCs.

CLINICAL RELEVANCE/APPLICATION
MR molecular imaging can identify and dynamically monitor transplanted cells in vivo for verification of effect of ILK on MSCs homing.

SST02-04 Ferumoxytol-poly-l-lysine Labeling and Non-invasive MR Imaging of Mesenchymal Stem Cells

Friday, Dec. 4 11:00AM - 11:10AM Location: S501ABC

Participants
Dan Mu, Nanjing, China (Presenter) Nothing to Disclose
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Chuan Shuai Tian, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Weibo Chen, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
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SST02-06 Could Cardiac Magnetic Resonance Imaging be an Effective Alternative to Transthoracic Echocardiography for Routine Evaluation of the Heart?

PURPOSE
To evaluate the efficiency and the safety of labeling mesenchymal stem cells (MSCs) in vitro with ferumoxytol- poly-L-lysine (PLL), a new negative agent for cell labeling and to detect the imaging characteristics.

METHOD AND MATERIALS
MSCs were incubated with ferumoxytol-PLL. Labeling efficiency was examined by Prussian blue staining, transmission electron microscopy and Colorimetric ferrozine assay. MTT growth curves were obtained at a range of iron concentrations from 5 to 200 μg/ml to assess the effects of the labeling on cell viability and to confirm the safe iron concentration for cell labeling. The effect of ferumoxytol-PLL at iron concentration of 50 μg/ml on cell migration, proliferation and cell cycle were determined by transwell migration assay, EdU staining assay and flow cytometry analysis after Propidium iodide staining respectively. Different number MSCs labeled with ferumoxytol-PLL at different iron concentrations were imaged using a 3.0T MR system with T2WI and T2*WI sequences. The signal intensity was measured and statistically compared.

RESULTS
The labeling efficiency was 100%. Transmission electron microscopy showed the iron particles in the cytoplasm. The iron content of each cells was liner correlated with the iron concentration of the labeling media. Higher labeling concentration (more than 100 μg/ml) affected cell viability detectable by MTT assay. There were not significant impairments were documented in cell proliferation, migration and cell cycles at 50 μg/ml dose when comparing iron-labeled MSCs to unlabeled controls. The ferumoxytol-PLL labeling caused a stronger low signal attenuation effect on T2WI and T2*WI. The signal intensity was negatively correlated with cell numbers and iron concentration of the labeling media.

CONCLUSION
MSCs can be easily and efficiently labeled by ferumoxytol-PLL without interference on the cell viability, migration, proliferation and cell cycle. MRI visualization of SPIO- labeled MSCs is feasible in both T2WI and T2*WI.

CLINICAL RELEVANCE/APPLICATION
Ferumoxytol- poly-L-lysine (PLL) can efficiently label MSCs for MR molecular imaging.

SST02-05 Free-Breathing 3D T1-weighted Fat-saturated Contrast-enhanced Gradient-echo Sequence with Radial Data Sampling in Thoracic and Cardiovascular MRI

PURPOSE
To evaluate free-breathing radially sampled fat-saturated T1-weighted gradient-echo acquisitions (radial volumetric interpolated breath-hold examination (VIBE)) with self-gated radially sampled, breath-hold (BH) and free-breathing (FB) cartesian sampled VIBE acquisitions for post-contrast imaging of the thorax and cardiovascular system.

METHOD AND MATERIALS
This IRB approved prospective study was performed according to the declaration of Helsinki. 20 patients referred for myocardial infarction, myocarditis and cardiomyopathy were imaged at 1.5T (Aera, Siemens Healthcare). Gadobutrol (Bayer Healthcare)-enhanced cartesian sampled isotropic (voxel-size 1.4x1.4x1.4mm3) VIBE sequences acquired during BH (18s) were compared to FB radially sampled sequences (approx. 4min) featuring respiratory self-gating. Multplanar reformations were performed with SyngoVia (Siemens). All image data sets (Cartesian, Radial and Radial VIBE with self-gating) were evaluated by two independent readers (5-point-Likert-scale): overall image quality, large vessel depiction, small vessel depiction, heart depiction, thoracic wall/diaphragm sharpness and streaking artifacts. Statistical analysis was performed with paired t-tests.

RESULTS
Respiratory self-gating of the radially sampled VIBE led to significantly improved depiction of large (4.4 +/- 0.5 vs 3.9 +/- 0.7, p<0.05) and small vessels (4.7 +/- 0.5 vs 3.4 +/- 0.8, p<0.05) as well as thoracic wall/diaphragm sharpness (4.9 +/- 0.4 vs 3.6 +/- 0.5, p<0.05), whereas overall image quality was not impaired by the significantly increasing streaking artifacts (3.6 +/- 0.5 vs 4.7 +/- 0.5, p<0.05). Compared to standard BH cartesian VIBE, radially sampled VIBE with self-gating showed improved large and small vessels (4.4 +/- 0.5 vs 3.3 +/- 0.6, p=0.05; 4.7 +/- 0.5 vs 3.3 +/- 0.6, p<0.05), thoracic wall/diaphragm (4.9 +/- 0.4 vs 3.3 +/- 0.6, p=0.17).

CONCLUSION
Respiratory self-gated radially sampled VIBE acquired during free-breathing is feasible for thoracic and vascular imaging, particularly of the thoracic wall and large and small vessels compared to radially sampled VIBE without self-gating and breath-hold Cartesian sampled VIBE.

CLINICAL RELEVANCE/APPLICATION
Respiratory self-gated radially sampled VIBE acquired during free-breathing is feasible for thoracic and vascular imaging, particularly of the thoracic wall and large and small vessels.
PURPOSE

This study is designed to investigate the effectiveness of cardiac magnetic resonance imaging (CMR) in routine evaluation of heart as an alternative method to transthoracic echocardiography.

METHOD AND MATERIALS

The study included 48 randomised patients underwent both echocardiography and CMR. On CMR examination, cine steady-state free precession (SSFP) sequence was used to calculate ejection fraction (EF), ventricular and atrial measurements and wall thickness of left ventricle (LV). Velocity and flow information in the aortic, mitral and tricuspid valves were obtained by using velocity-encoded sequence. CMR and echocardiography outcomes were compared using by paired samples t-, Pearson's correlation, McNemar's and Kappa statistical tests.

RESULTS

Measurements of LV inner diameter in end-diastole, septal wall and posterior wall thickness in end-systole showed a good correlation with CMR and echo (r=0,795, r= 0,798, r=0,536). EF estimated with CMR showed perfect correlation with EF estimated by using echo (r= 0,80, p<0,01). Our results had a good correlation between two methods in terms of diastolic disfunction. When compared with echocardiography, CMR revealed good (κ=0,660), poor (κ=0,370), moderate (κ=0,504), very good (κ=1,0) and poor (κ=0,270) correlations for mitral regurgitation, mitral stenosis, aortic regurgitation, aortic stenosis and tricuspid regurgitation, respectively. Peak E and peak A velocities in the mitral inflow measured by both two methods showed moderate correlation with κ values of 0,435 and 0,493. A highly good accordance between the two methods in terms of the measurements of peak velocity in aortic valve (κ=0,778).

CONCLUSION

We found that volume, flow and thickness measurements of the heart on transthoracic echocardiography examination have a statistically good correlation with CMR measurements. Also, there is a satisfying diagnostic concordance between two modalities in evaluating the heart.

CLINICAL RELEVANCE/APPLICATION

CMR can be used an alternative method to transthoracic echocardiography, especially for acoustically poor patients.

SST02-07  Improved Ex-vivo Human Cardiac DTI using Optimal b-values on a Clinical 3T MRI System

PURPOSE

This study aims to investigate the effect of b-value of cardiac DTI in revealing myocardial microstructural remodeling on a 3T MRI system.

METHOD AND MATERIALS

Seven formalin-fixed healthy human heart samples were acquired at room temperature on a Siemens 3.0T MAGNETOM Skyra MR scanner for fiber structural analysis using a 20-channel head coil with a DW sequence with multi-shot EPI readout. Each heart sample was suspended in plastic cylinder filled with liquid paraffin to avoid tissue-air susceptibility artifacts during the acquirement. DTI acquisitions were the following parameters: TE=67 ms, TR=6500 ms, FOV=200× 200 mm, slice thickness= 2.0 mm, number of slices=40~45, 100× 100 pixels for each slice, diffusion sensitivity b=600/800/1000 s/mm², accel factor=2, gradient directions=20, slice gap=0 mm. Total image acquisition time was about 20 min per sample. Data was post-processed by Matlab based programs. Diffusion tensor indices, such as FA (Fractional Anisotropy), ADC (Apparent Diffusion Coefficient), fiber length and fiber numbers with each b-value in the left ventricle were calculated and compared.

RESULTS

In Table 1 is shown variations of DTI indices with different b-values. Gradual decrease on FA value and gradual increase on ADC value are observed when b value rises from 600 to 1000 s/mm². Variations of fiber numbers and fiber lengths at different b values are neither regular nor significant.

CONCLUSION

A b value of 600 s/mm² would be suggested acquire human cardiac diffusion tensor imaging in order to avoid confusion when using FA values as an absolute reference for assessing the difference between normal and abnormal zones.

CLINICAL RELEVANCE/APPLICATION

An appropriate b-value would benefit DTI to better reveal the myocardium structural of human hearts. Since no significant
differences occurs in fiber numbers and fiber lengths, a b value of 600 s/mm² would be suggested acquire human cardiac diffusion tensor imaging in order to avoid confusion when using FA values as an absolute reference for assessing the difference between normal and abnormal zones.

**SST02-08  CT Coronary Angiography: Effect of Iodine CONcentration on Vascular Attenuation: The CT-CON Multicentric Study FINAL RESULTS**

Friday, Dec. 4 11:40AM - 11:50AM Location: S501ABC

Participants
Marco Rengo, MD, Rome, Italy (Presenter) Nothing to Disclose
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Koen Nieman, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Speakers Bureau, Siemens AG Speakers Bureau, Toshiba Corporation Research Grant, Bayer AG Research Grant, General Electric Company
Gabriel P. Krestin, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Consultant, General Electric Company; Research Grant, General Electric Company; Research Grant, Bayer AG; Research Grant, Siemens AG; Speakers Bureau, Siemens AG

**PURPOSE**

To explore the relative impacts of iodine concentration versus iodine delivery rate on intra-coronary attenuation. To describe the effect of iodine concentration on contrast bolus characteristics

**METHOD AND MATERIALS**

971 patients were prospectively randomized in 4 groups and underwent CT Coronary Angiography (CTCA). Four CM with different iodine concentrations (300, 350, 370, 400 mgI/ml) were delivered at a fix iodine delivery rate (2.0 mgI/s). Intracoronary attenuation values were measured and grouped on a per-vessel and per-segment bases. Time-to-peak, and pressure curves during CM injection were evaluated and compared

**RESULTS**

Injection fluxes were 6.7 ml/sec, 5.7 ml/sec, 5.4 ml/sec and 5 ml/sec for group A, B, C and D respectively. No significant differences were observed among four groups in terms of intravascular density on a per-segment and per-vessels analysis. Time-to-peak was significantly earlier in group A (15.3 sec) than in the other three groups. The injection peak pressure was significantly lower in group A (185.16 psi) and C (189.05 psi) than in group B (215.89 psi) and D (243.33 psi). No extravasations were noted in all groups

**CONCLUSION**

Contrast media with different iodine concentrations, if injected at the same IDR, provide similar intravascular attenuation values. The lower concentration contrast medium provided significantly lower injection pressure values and a significantly shorter time to peak enhancement

**CLINICAL RELEVANCE/APPLICATION**

Intravascular attenuation in CT coronary angiography is mainly influenced by iodine delivery rate and is independent by iodine concentration

**SST02-09  Study of the CT Anatomical Configuration of the Aortic Valve: An Automatic 3D-Shape-based Comprehensive Analysis**

Friday, Dec. 4 11:50AM - 12:00PM Location: S501ABC

Participants
Julien Ognard, MD, MSc, Brest, France (Presenter) Nothing to Disclose
Thomas Hebert, Brest, France (Abstract Co-Author) Nothing to Disclose
Nan Kang, MSc, Brest, France (Abstract Co-Author) Nothing to Disclose
Martine Gilard, MD, PhD, Brest, France (Abstract Co-Author) Nothing to Disclose
Michel Nonent, MD, Brest, France (Abstract Co-Author) Nothing to Disclose
Valerie Burdin, PhD, Plouzane, France (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

In Transcatheter aortic valve implantation (TAVI) procedures, the determination of AVA (Aortic Valve Annulus) geometric features is crucial to deciding the size and type of the prosthesis valve to be used. The purpose of this study is to asses quantitatively the variation of aortic valve shape along its principle axis in order to find the center and diameter of AVA, and to determine at each levels the measurement that could be done during preoperative plannings, according to the shape.

**METHOD AND MATERIALS**

A number of 25 ECG-gated cardiac CT (64 channels multidetector CT scanner) were analysed. 2 Experts radiologists manually defined the centerline and the limits of the aortic valve. Threshold techniques and growing regions were used to mask the left ventricle and the aorta. Principle Component Analysis were used to extract an approximate aortic centerline, with an iterative procedure. Then we cut through data to get slices which are perpendicular to the centerline. Each cross section is then unfolded into polar coordinates. The function of distance which describes the contour of tri-leaflet has three pairs of extrema (minima and maxima) and smallest min distance. For each cross section, we find 3 points on the contour of the aorta with minimum distance to the barycenter and calculate ellipse fitting.

**RESULTS**
The method is based on a quantitative study of shape to find an optimal fit to mimic AVA in the aortic root. Analyses of such models have shown the aortic root to have variable distensibility along its length. Our contribution includes extracting a robust centerline of aortic valve automatically, analyzing the shape changes of cross section along the centerline by the help of polar representation, providing a flexible circle and ellipse fitting for aortic valve part with the coordinates for the center and corresponding change intervals for radius.

CONCLUSION

We introduced measurements for aortic valve by a quantitative study compared with previous qualitative research.

CLINICAL RELEVANCE/APPLICATION

Understanding the 3D shape characteristics of the aortic valve will help radiologist and cardiologist in the preoperative plannings of TAVIs. And could even assist engineer-physicians to design and manufacture customized valve that works in the optimum condition.
PURPOSE
BRAF mutations are found in 2% of non-small cell lung cancers (NSCLC) and are associated with responsiveness to treatment with targeted medical therapy. The purpose of this study is to identify computed tomography (CT) imaging features associated with BRAF mutation in lung cancer.

METHOD AND MATERIALS
The institutional review board approved this study. Patients presenting from 4/2/2004 - 6/3/2013 with BRAF mutated NSCLC were studied. Stage matched patients with NSCLC without BRAF mutation were used as controls. Thoracic CTs, performed at diagnosis, were retrospectively reviewed by 2 radiologists in consensus. Features assessed included: size, contour, consistency of the primary tumor, adjacent parenchymal changes (peri-lesional halo, obstructive changes, pleural tail); presence of thoracic lymphadenopathy, pleural effusion, pleural metastases and lymphangitic spread.

RESULTS
188 patients with NSCLC were included: 47 (25%) patients had a BRAF mutation. 141(75%) had non-BRAF mutated NSCLC: 47 EGFR mutations, 47 KRAS mutations, and 47 lesions without documented mutation. In each group, 30% patients were stage 1, 6% were stage 2, 26% were stage 3 and 38% were stage 4. BRAF patients were more likely to be older (p= 0.014), male (p=0.011) and have a smoking history (p<0.001) when compared to EGFR patients. There were no other demographic differences between the groups. BRAF lesions were most frequently solid: 37(79%), spiculated 22(47%) and peripheral 37(79%), however no imaging feature of the primary tumor was significantly different between BRAF and non-BRAF groups. Some ancillary imaging features were significantly associated with BRAF mutations when the BRAF group was compared to patients with KRAS mutations. BRAF patients were more likely to have a pleural effusion than KRAS patients 11(23%) vs 3(6%) p= 0.033. In addition, BRAF patients were more likely to have pleural metastases than KRAS patients 5(11%) vs 0(0%), p=0.045.

CONCLUSION
On CT evaluation, NSCLC with BRAF mutation is most frequently solid, spiculated and peripheral. No feature of the primary tumor can be used to differentiate BRAF lesions from other genetically distinct forms of NSCLC.

CLINICAL RELEVANCE/APPLICATION
The results provide the first description of the radiologic characteristics of BRAF mutated lung cancer, detection of which is important to identify patients who may benefit from targeted therapy.

Participants
Patricia M. de Groot, MD, Houston, TX (Moderator) Nothing to Disclose
James G. Ravenel, MD, Charleston, SC (Moderator) Nothing to Disclose

Sub-Events
SST03-01 Radiogenomic Evaluation of Lung Cancer-Are There Imaging Characteristics Associated with Lung Adenocarcinomas Harboring BRAF Mutations?

Friday, Dec. 4 10:30AM - 10:40AM Location: E451B

Participants
Darragh Halpenny, MBCh, MRCPI, New York, NY (Presenter) Nothing to Disclose
Gregory J. Rely, New York, NY (Abstract Co-Author) Consultant, Boehringer Ingelheim GmbH Consultant, Merck & Co, Inc Consultant, F. Hoffmann-La Roche Ltd
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Michelle S. Ginsberg, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

SST03-02 Radiogenomic Detection of EGFR and KRAS Mutations in NSCLC Using CT Texture Analysis

Friday, Dec. 4 10:40AM - 10:50AM Location: E451B

Participants
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PURPOSE
To perform CT texture analysis on contrast enhanced chest CT images to detect EGFR and KRAS mutations in non-small cell lung cancer (NSCLC).

METHOD AND MATERIALS
We retrospectively evaluated NSCLC patients from the MD Anderson Cancer Center GEMINI (Genomic Marker-Guided Therapy Initiative) cohort who had contrast-enhanced chest CT imaging within 90 days prior to biopsy, and who also had genetic testing for EGFR or KRAS mutations. Tumor segmentation was done semi-automatically using 3DSlicer (Harvard University, Cambridge MA). Textural features were calculated using IBEX (MDACC, Houston TX). On the basis of existing literature, and prior experience, 30 image features were selected, including GreyLevel Cooccurrence Matrix, Run-Length Matrix, intensity histogram, and geometric properties (ie shape and size) of the tumor. Feature sets were generated from CT images without filtering, as well as following application of either a Laplacian of Gaussian filter or Gaussian smoothing filter. The resulting features were used to train a Random Forest machine learning classifier, which yielded a prediction for the EGFR and/or KRAS mutation status of each patient.

RESULTS
Of 115 patients, 107 were tested for KRAS mutation (81 -ve, 26 +ve) and 113 tested for EGFR mutation (85 -ve, 28 +ve). CTs were from a variety of scanners, but all were contrast-enhanced, with soft-tissue reconstructions, and slice thickness of 1.25 - 5 mm. Mean tumor diameter was 5.7 cm (range 1.2 - 14.9 cm) and mean volume was 44.9 cm$^3$ (range 0.4 - 338 cm$^3$). No single feature was found to be strongly predictive for either mutation, but when collected in a Random Forest classifier these features predicted the presence of KRAS mutations with a sensitivity and specificity of 42% and 89%, respectively, with a PPV of 55% and NPV of 83%. For EGFR mutation, sensitivity and specificity were 50% and 76%, with a PPV of 41% and NPV of 82%. In total, KRAS and EGFR mutation status was correctly assessed in 76% and 70% of cases, respectively.

CONCLUSION
Texture analysis was able to correctly identify EGFR and KRAS mutation status in the majority of patients. Given the limitations of obtaining histologic samples in patients with multiple lesions or tumor heterogeneity, texture analysis may improve genotyping accuracy in these patients.

CLINICAL RELEVANCE/APPLICATION
Non-invasive genotyping with texture analysis may be of particular benefit to patients with NSCLC being considered for targeted therapy.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jeremy J. Erasmus, MD - 2015 Honored Educator
Brett W. Carter, MD - 2015 Honored Educator

SST03-03  Decoding Tumor Phenotype for ALK, ROS1, and RET Fusions in Lung Adenocarcinoma Using a Radiomics Approach

Friday, Dec. 4 10:50AM - 11:00AM Location: E451B

Participants
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Jhingook Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To identify the clinicoradiologic predictors of tumors for ALK (anaplastic lymphoma kinase), or ROS1 (c-ros oncogene 1), or RET (rearranged during transfection) fusion-positive in patients with lung adenocarcinoma.

METHOD AND MATERIALS
A total of 539 pathologically confirmed lung adenocarcinomas were included this retrospective study. Baseline clinicopathologic characteristics were retrieved from the patients' medical records. ALK/ROS1/RET fusion status was also reviewed. Qualitative and quantitative CT and PET imaging characteristics were evaluated. Of all clinicoradiologic features, significant features for ALK/ROS1/RET fusion-positive prediction model were extracted, and sensitivity, specificity, positive and negative predictive value were calculated for each of two discrimination tasks such as fusion-positive vs. fusion-negative tumor. We further performed comparison task between ALK vs. ROS1/RET fusion-positive tumors in clinicoradiologic features to identify clinicoradiologic similarity between the two groups.

RESULTS
Of 539 patients, 47 were ALK + lung cancers (47/539, 8.7%), 17 were ROS1/RET fusion-positive (17/539, 3.2%), and 475 were fusion-negative for those genes (475/539, 88.1%). ALK/ROS1/RET fusion status was mutually exclusive. ALK ROS1/RET fusion-positive predicting model was combination of age, tumor stage, solidity, SUVmax, mass, kurtosis, inverse variance on 3-voxel distance with a sensitivity, specificity, positive and negative predictive value of 0.73, 0.70, 0.71 and 0.69, respectively. In comparison task between ALK vs. ROS1/RET fusion-positive, all clinicoradiologic features were not significantly different except
tumor stage, central location, SUVmax, homogeneity on 1-, 2- and 3-voxel distance, and sum mean on 2-voxel distance.

**CONCLUSION**

ALK/ROS1/RET fusion-positive lung adenocarcinomas possess certain clinical and imaging features, enabling good discrimination of fusion-positive from fusion-negative lung adenocarcinomas. ROS1/RET fusion-positive tumors share most clinicoradiologic features with ALK fusion-positive tumors.

**CLINICAL RELEVANCE/APPLICATION**

ROS1/RET + lung adenocarcinomas share clinicoradiologic characteristics with ALK + tumor and it may help to identify cases for ROS1/RET testing targeted Crizotinib even in case of ALK - condition.

**SST03-04  Pseudo-progression in NSCLC with anti-PD-1/PD-L1 Antibodies: An Early Onset Event**

Participants
Caroline Caramella, MD, Villejuif, France (Presenter) Nothing to Disclose
Sanny Amari, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Francesco Facchinetti, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Christophe Massard, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Anas Gazzah, Villejuif, France (Abstract Co-Author) Nothing to Disclose
David Planchard, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Jean-Charles Soria, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Benjamin Besse, Villejuif, France (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Immune-checkpoint inhibitors directed against PD-1 (PD-1i) or PD-L1 (PD-L1i) are emerging as a standard of care for non-small cell lung cancer (NSCLC). Radiological and clinical evaluation of their activity is still challenging. In particular, signs of disease progression can be followed by long-term disease control.

**METHOD AND MATERIALS**

Data from advanced NSCLC patients included in phase I-II clinical trials were retrospectively collected in a single center. CT-scans were performed every 6 weeks and at 4 weeks if progression was suspected. All CT-scans were centrally reviewed by two senior radiologists. A pseudo-progression (pseudo-PD) was defined as a Disease Progression that was not confirmed at 4 weeks evaluation (i.e. tumoral stabilization or regression).

**RESULTS**

From 12/2012 to 12/2014, 44 patients were included in 3 phase I (n=13) and 2 phase II (n=31) clinical trials evaluating 2 PD-1i and 2 PD-L1i. 38 patients (86%) had a stage IV NSCLC, 6 (14%) local recurrences. There were 14 Squamous Cell Carcinomas, 27 Adenocarcinomas (ADC) and 3 other histologies. PD-1i and PD-L1i were administered to 18 and 26 patients respectively. At 3 months, 20 patients had a PD confirmed at 4 weeks, 9 a Stable Disease (SD), 9 a Partial Response (PR), 2 a Complete Response (CR) and 4 a pseudo-PD. All pseudo-PD patients received a PD-L1i and had PD-L1 positive ADC. Median time to radiological or clinical PD was 33 days (range 7-81), and subsequent response was 84 days (range 40-125). Signs of PD were: 1) appearance of pre-vascular lymph nodes, 2) increase of subcutaneous lesions, 3) significant increase of lung and pleural lesions and new contralateral carcinomatous lymphangitis 4) new pulmonary lesion. Of note, either PR or CR was later achieved for all lesions but the pre-vascular lymph nodes, which remained stable. For case 3), radiological behavior was accompanied by early-onset (7 days after the first infusion) worsening of dyspnea and asthenia, followed by clinical improvement. All 4 patients are still treated, with a median time of 169 days.

**CONCLUSION**

Pseudo-progression during immunotherapy is frequent (9%) and has to be individualized since these patients may derive a significant benefit, despite initial radiological and sometimes clinical worsening.

**CLINICAL RELEVANCE/APPLICATION**

The emergence of immunotherapy leads to a new radiological paradigm in tumoral evaluation, the concept of pseudoprogression being a frequent event.

**SST03-05  Benefit of Motion Correction for Blood Flow Estimates in CT Perfusion Imaging of Lung Cancer**

Participants
Lisa L. Chu, MD, San Francisco, CA (Presenter) Nothing to Disclose
Robert J. Knebel, MD, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Aryan Shay, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Kai-Yin See, MD, Sunnyvale, CA (Abstract Co-Author) Nothing to Disclose
Jonathan Santos, BS, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Ramsey Badawi, PhD, Sacramento, CA (Abstract Co-Author) Stockholder, Johnson & Johnson Consultant, Toshiba Corporation
David Gandara, MD, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Friedrich D. Knollmann, MD, PhD, Sacramento, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

CT perfusion imaging to assess the treatment response in advanced lung cancer can be compromised by respiratory motion during image acquisition. The purpose of this study was to determine whether the use of an original motion correction method can improve the reproducibility of blood flow measurements in CT perfusion imaging.

**METHOD AND MATERIALS**

The institutional review board approved this dual-institution prospective study. Twenty random adult patients with non-resectable
pathologically proven non-small cell lung cancer treated with systemic therapy gave written informed consent to undergo CT perfusion of their tumor over a period of 50 seconds after intravenous contrast injection. A motion correction method which consisted of manually outlining the tumor margins and then applying a rigid manual landmark registration algorithm followed by the non-rigid Diffeomorphic Demons algorithm was applied on all CT perfusion images. The non-motion-corrected and motion-corrected images were then analyzed with commercially available perfusion analysis software which accounted for tumor dual blood supply. Two observers each performed the analysis twice, and the intra-observer and inter-observer variability of each method was assessed with Bland-Altman statistics.

RESULTS
The 95% limits of agreement of intra-observer reproducibility for observer 1 improved from -84.4%; 65.3% before motion correction to -33.8%; 30.3% after motion correction (r = 0.86 and 0.97, before and after motion correction, respectively, p < 0.0001 for both). The 95% limits of agreement of intra-observer reproducibility for observer 2 improved from -151.1%; 95.7% before motion correction to 48.5%; 36.0% after motion correction (r = 0.87 and 0.95, before and after motion correction, respectively, p < 0.0001 for both). The 95% limits of inter-observer reproducibility improved from -168.2%; 153.8% before motion correction to -17.3; 25.3% after motion correction (r = 0.65 and 0.97, before and after motion correction, respectively, p < 0.0001 for both).

CONCLUSION
The use of a motion correction method significantly improves the reproducibility of CTP estimates of tumor blood flow in lung cancer.

CLINICAL RELEVANCE/APPLICATION
Respiratory motion is an important compromising factor in measuring lung tumor blood flow. Use of an original motion correction method significantly improves reproducibility of blood flow measurements in lung cancer at perfusion CT.

SST03-06 The Value of Diffusion-weighted Imaging in differentiating Metastatic from Non-metastatic Lymph Nodes in Patients with Lung Cancer: A Meta-analysis

Friday, Dec. 4 11:20AM - 11:30AM Location: E451B

Participants
Guangxiang Chen, Luzhou, China (Presenter) Nothing to Disclose
Maohua Wang, Luzhou, China (Abstract Co-Author) Nothing to Disclose
Ting Zheng, Luzhou, China (Abstract Co-Author) Nothing to Disclose
Guangcai Tang, Luzhou, China (Abstract Co-Author) Nothing to Disclose
Fugang Han, Luzhou, China (Abstract Co-Author) Nothing to Disclose
Guojian Tu, Luzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To perform a meta-analysis to evaluate the diagnostic performance of the diffusion-weighted imaging(DWI) in differentiating metastatic from non-metastatic lymph nodes in patients with lung cancer.

METHOD AND MATERIALS
Systematic and comprehensive literature searches of the PubMed, Embase, Web of Science, Cochrane Library, China Biomedicine(CBM), China National Knowledge Infrastructure(CNKI) and Wanfang databases were performed to identify eligible original studies. Methodological quality of included studies was assessed by QUADAS-2(Quality Assessment of Diagnostic Accuracy Studies). Meta-analysis were performed to pool sensitivity and specificity, calculate positive likelihood ratio(PLR),negative likelihood ratio(NLR), diagnostic odds ratios(DORs) and construct summary receiver operating characteristic(SROC) curve. Homogeneity of included studies,potential threshold effect and publication bias were investigated.

RESULTS
A total of 10 studies with 11 datasets met the inclusion criterion, including 796 patients with a total of 2,433 lymph nodes. The pooled diagnostic sensitivity was 0.78(95% CI: 0.74-0.81) and the pooled diagnostic specificity was 0.88 (95% CI: 0.86-0.89). The PLR, NLR, and DOR were 7.11 (95% CI: 4.39-11.52), 0.24 (95% CI: 0.18-0.33), and 31.14 (95% CI: 17.32-55.98), respectively. The overall area under the curve (AUC) was 0.90. The Deeks' funnel plot symmetry tests revealed that no publication bias was found (bias = -0.15, P = 0.887). A notable heterogeneity was observed and patient selection, type of lung cancer, number of enrolled lymph nodes, reference standard, b value and type of scanner were the sources of heterogeneity. There was no significant threshold effect.

CONCLUSION
DWI is a valuable, noninvasive, and non-radiative MRI modality with good diagnostic performance for distinguishing metastatic from non-metastatic lymph nodes in patients with lung cancer.

CLINICAL RELEVANCE/APPLICATION
Our meta-analysis revealed that DWI is a valuable, noninvasive, and non-radiative MRI modality with good diagnostic performance for distinguishing metastatic from non-metastatic lymph nodes in patients with lung cancer. In the future, larger-scale prospective studies with respect to DWI for the diagnosis of lymph node metastasis are still necessary to evaluate and confirm its clinical value. Furthermore, the optimization of DWI acquisition protocol, standard image processing and analysis are crucial to routine clinical application of DWI in detecting lymph node metastasis in patients with lung cancer.

SST03-07 Clinical Outcome of Stereotactic Body Radiotherapy (SBRT) of Lung Metastases - A Single Center Study

Friday, Dec. 4 11:30AM - 11:40AM Location: E451B

Participants
Natalie D. Klass, MD, Bern, Switzerland (Presenter) Nothing to Disclose
B K. Shrestha, Bern, Switzerland (Abstract Co-Author) Nothing to Disclose
Diagnostic Accuracy of PET/MR in Comparison to PET/CT in Local Thoracic Staging of Malignant Pleural Mesothelioma

Friday, Dec. 4 11:40AM - 11:50AM Location: E451B

Participants
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Rolf A. Stahel, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Thomas Frauenfelder, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the diagnostic accuracy of PET/MR for local staging of malignant pleural mesothelioma (MPM) compared to PET/CT.

METHOD AND MATERIALS
In a prospective clinical trial 22 consecutive patients (median age 66 years; range 40-76 years; 1 female, 21 male) with known MPM, who underwent PET/CT and PET/MR exams for either staging or re-staging/follow-up were evaluated. Imaging was conducted using a multi-modality PET/CT-MR set-up (Discovery PET/CT 690, 3T Discovery MR 750w, both GE Healthcare, Waukesha, WI, USA). Two independent readers evaluated images for T and N stage, confidence level (sure to unsure; 1-3) and subjective overall image quality (very good to non-diagnostic; 1-4). Inter-reader agreement of T and N stages (Cohen's kappa) and interclass correlation coefficient (ICC) between PET/CT vs. PET/MR was calculated.

RESULTS
Inter observer agreement for evaluation of T and N stage in PET/CT images was excellent ($k=0.871$ and $k=0.869$, respectively), whereas PET/MR imaging showed substantial agreement in T and N staging ($k=0.744$ and $k=0.749$, respectively). The ICC of PET/CT vs. PET/MR was excellent for the evaluation of T as well as N stage (ICC=0.974 and ICC=0.963, respectively). Diagnostic confidence was scored significantly higher in PET/MR compared to PET/CT (mean score = 1.16 and 1.48, respectively; $p<0.001$). Image quality was diagnostic for all image series.

CONCLUSION
Our findings suggest that diagnostic accuracy of PET/MR is comparable to PET/CT in T and N staging of MPM but has significant higher diagnostic confidence due to better soft tissue contrast of PET/MR compared to PET/CT.
CLINICAL RELEVANCE/APPLICATION

PET/MR can be used in local staging of malignant pleural mesothelioma and has the benefit to have a higher diagnostic confidence compared to PET/CT.

SST03-09 Locally Advanced Esophageal Squamous Cell Carcinoma: Multidetector CT for Restaging and Assessment of Treatment Response after Neoadjuvant Therapy

Friday, Dec. 4 11:50AM - 12:00PM Location: E451B

Participants
Shi Yanjie, MD, Beijing, China (Presenter) Nothing to Disclose
Chen Ying, Beijing, China (Abstract Co-Author) Nothing to Disclose
Xiaoting Li, Beijing, China (Abstract Co-Author) Nothing to Disclose
Zhilong Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Ying-Shi Sun, MD, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the diagnostic accuracy of multidetector CT (MDCT) for restaging and determine the feasibility of CT for assessment of treatment response in esophageal squamous cell carcinoma after neoadjuvant therapy.

METHOD AND MATERIALS
This retrospective study was approved by our institutional review board, and a waiver of informed consent was remitted. We studied 135 consecutive patients with esophageal squamous cell carcinoma who had pre-resection CT after neoadjuvant treatment. The CT staging of the patients was either T1-2 with N1-3 or T3-4 with N0-N3 without metastases before therapy according to the 7th edition of the AJCC/TNM classification. Results of CT restaging after therapy were compared with the final pathological staging. Tumor regression grade (TRG) from CT was determined by two radiologists using the Response Evaluation Criteria in Solid Tumors (RECIST) method. According to CT restaging, the patients with T0-2 and N0 (cohort 1) were defined as response, T3-4 and N1-3 (cohort 2) were defined as non-response and the response of patients with T3-4 and N0 or T0-2 and N1-3 (cohort 3) was not determined.

RESULTS
The accuracy of CT for T stage of patients with esophageal cancer after neoadjuvant therapy was 45% (61/135) and 47% (64/135), respectively by two radiologists (kappa value=0.718). Sensitivity and specificity were as follows: Observer 1, T0 21%/100%, T1-2 42%/96%, T3 69%/46%, T4 50%/84%; Observer 2, T0 42%/100%, T1-2 55%/93%, T3 54%/54%, T4 57%/85%. Accurate N stage were noted 59% and 56%, by two radiologists (kappa value=0.753). TRG from CT was predicted correctly in only 27% (37/135). There were no significant trends toward better survival for lower TRG (P=0.286). There was significant difference in survival among cohort 1 (19 patients), cohort 2 (46) and cohort 3 (70). The survival of responding patients was better than that of non-responders.

CONCLUSION
Restaging by CT did not accurately predict pathological stage in esophageal squamous cell carcinoma after neoadjuvant treatment. Comparing with TN stage before and after therapy, CT can evaluate the response in about one half of patients, but the treatment response of the remaining half of patients was not determined using CT.

CLINICAL RELEVANCE/APPLICATION
The TNM staging of esophageal carcinoma will directly affect overall treatment options and their prognosis. Currently, chest CT is still routinely applied for restaging and monitoring treatment therapy.
**Gastrointestinal (New MRI Techniques)**

Friday, Dec. 4 10:30AM - 12:00PM Location: E353A

**SST04-01**  
**Improving the Quality of 2D GRE MR Elastography of Chronic Liver Diseases Using a Shorter, In-Phase Echo Time**

**Participants**  
Vamsi R. Narra, MD, FRCR, Saint Louis, MO (Moderator) Consultant, Biomedical Systems;  
Bobby T. Kalb, MD, Tucson, AZ (Moderator) Nothing to Disclose

**Sub-Events**

**SST04-01**  
**Improving the Quality of 2D GRE MR Elastography of Chronic Liver Diseases Using a Shorter, In-Phase Echo Time**

**Participants**  
Jin Wang, Rochester, MT (Presenter) Nothing to Disclose  
Nan Zhang, MS, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose  
Jun Chen, PhD, Rochester, MN (Abstract Co-Author) The Mayo Clinic and Jun Chen have intellectual property rights and a financial interest in MRE technology.  
Kevin J. Glaser, Rochester, MN (Abstract Co-Author) The Mayo Clinic and MY have intellectual property rights and a financial interest in MRE technology.

**PURPOSE**  
The purpose of this study was to validate the improvement in image quality of 2D GRE MR elastography (MRE) using a shorter, in-phase echo time (TE) for patients with chronic liver diseases, steatosis, and iron deposition.

**METHOD AND MATERIALS**  
With IRB approval and patient authorization, 308 consecutive patients with clinically indicated chronic liver diseases underwent MRE exams using a 2D GRE MRE sequence on 1.5T. They were randomly separated into 2 groups based on the TE used. Group 1 used an in-phase TE of 18 ms (160/308, 52%) and Group 2 used the current standard TE of 21 ms (148/308, 48%). Hepatic relative fat fraction (RFF) was measured by using a two-point Dixon method. The iron concentration in blood samples analyzed in standard laboratory tests was used to assess the iron deposition in liver. Clinical information collected at the same time as the MRE exam included blood pressures, and pulse rate. The fraction of the acquired liver volume with an MRE inversion-derived confidence level of over 95%, as well as the average SNR within the liver were computed for each patients and compared between the short TE and long TE groups with analysis of variance (ANOVA). The effect of age, gender, BMI, Total.Iron.Bind.Capacity, iron, systolic pressure, diastolic pressure, FOV, TE, fat concentration (%), and pulse rate on SNR and ROI volume were evaluated by a mixed-effect model.

**RESULTS**  
No significant differences were found in epidemiological and etiological parameters between the two groups (P>0.05). The SNR of MRE images in Group 1 was significantly higher than that in Group 2 (23.73 ± 0.61 vs. 18.01 ± 0.63, p<.0001). ROI volume for reporting hepatic tissue stiffness was significantly larger in Group 1 (323.70 ± 9.36 cm³ vs. 255.53 ± 9.73 cm³, p<.0001). Only TE had a statistically significant effect on SNR (p < .0001); only fat (p<.0001) and iron (p=0.0379) were statistically significant effects on volume.

**CONCLUSION**  
The SNR and reliable ROI volume of 2D GRE MRE can be significantly improved by using a shorter, in-phase TE of 18 ms compared to the current standard of 21 ms.

**CLINICAL RELEVANCE/APPLICATION**  
The quality of 2D GRE MRE can be significantly improved by using a shorter, in-phase TE. A direct measurement of fat and iron disposition in the liver might provide better statistical significance.

**SST04-02**  
**Intravoxel Incoherent Motion MR Imaging of the Abdomen: The Effect of Data Fitting Altorithms on the Measurement Repeatability**

**Participants**  
Hyojung Park, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose  
Seung Soo Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose  
Yu Sub Sung, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose  
Hyun Hee Cheong, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose  
Yedaun Lee, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose  
Cheol Mog Hwang, MD, Daejeon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose  
So Yeon Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
PURPOSE
To evaluate the effect of fitting algorithms and number of b-values on the measurement repeatability of intravoxel incoherent motion (IVIM) parameters of the abdominal organs.

METHOD AND MATERIALS
The institutional review board approved the study protocol, and informed consent was obtained. Twelve healthy volunteers (M:F = 6:6; mean age, 30 years) underwent navigator-triggered DWI twice on an 1.5T system using nine different b values (0, 30, 60, 100, 150, 200, 400, 600, 900). DWI data were processed using full-biexponential fitting algorithm which estimates slow diffusion(Ds), fast diffusion(Df), and perfusion fraction(f) simultaneously and using segmented fitting algorithm which estimates Ds with higher b-value(≥ 200) data and subsequently estimates f and Df. IVIM parameters were measured on the right lobe of the liver, spleen, pancreas, right renal cortex, and right renal medulla on each set of IVIM parametric maps generated by full-biexponential and segmented fitting algorithms. Measurement repeatability of IVIM parameters over two repeated scans were evaluated using the within-subject coefficient of variation(wCV).

RESULTS
For all abdominal organs and two fitting algorithms, Df showed the poorest repeatability (the range of wCV, 29.5%-144.1%) among IVIM parameters (wCV for Ds, 4.1%-16.9%; wCV for f, 8.5%-46.2%). For spleen, pancreas, renal medulla, segmented fitting resulted in better repeatability of Ds (wCV, 4.9%-11.9% vs. 8.0%-16.9%) and f (wCV, 8.5%-37.9% vs. 17.3% - 46.2%) than full-biexponential fitting. For liver, full-biexponential fitting resulted in better repeatability of all IVIM parameters (wCV, 4.1%, 29.5%, and 9.7% for Ds, Df, and f, respectively) than segmented fitting (wCV, 4.8%, 43.0%, 12.8% for Ds, Df, and f, respectively). For renal cortex, the measurement repeatability of Ds was better with full-biexponential fitting, but that of f was better with segmented fitting.

CONCLUSION
Df is not a reliable parameter for the evaluation of abdominal organs. Despite some inconsistent results across different organs, segmented fitting algorithm generally results in better repeatability of Ds and f than full-biexponential fitting algorithm.

CLINICAL RELEVANCE/APPLICATION
Segmented fitting is a preferred fitting algorithm for IVIM analysis of abdominal organs.

SST04-03  Fast Advanced Spin Echo Diffusion-Weighted Imaging in the Abdomen

PURPOSE
To assess values of Fast Advanced Spin Echo (FASE)-diffusion-weighted imaging in evaluation of abdominal diseases

METHOD AND MATERIALS
Fifty-two patients (32 men and 20 women, mean: 69.4 years), who were suspected to have hepato-biliary-pancreatic malignancy and underwent 3T-MRI, were enrolled. FSE-T2WI, SE-EPI-DWI (b=1000), and FASE-DWI (600) were obtained in all patients. Amount of abdominal gas and ascites on images was recorded for each patient using a 5-point scale. Anteroposterior (AP) and 9.7% for Ds, Df, and f, respectively) than segmented fitting (wCV, 4.1%, 29.5%, and 9.7% for Ds, Df, and f, respectively). For renal cortex, the measurement repeatability of Ds was better with full-biexponential fitting, but that of f was better with segmented fitting.

RESULTS
For all abdominal organs and two fitting algorithms, Df showed the poorest repeatability (the range of wCV, 29.5%-144.1%) among IVIM parameters (wCV for Ds, 4.1%-16.9%; wCV for f, 8.5%-46.2%). For spleen, pancreas, renal medulla, segmented fitting resulted in better repeatability of Ds (wCV, 4.9%-11.9% vs. 8.0%-16.9%) and f (wCV, 8.5%-37.9% vs. 17.3% - 46.2%) than full-biexponential fitting. For liver, full-biexponential fitting resulted in better repeatability of all IVIM parameters (wCV, 4.1%, 29.5%, and 9.7% for Ds, Df, and f, respectively) than segmented fitting (wCV, 4.8%, 43.0%, 12.8% for Ds, Df, and f, respectively). For renal cortex, the measurement repeatability of Ds was better with full-biexponential fitting, but that of f was better with segmented fitting.

CONCLUSION
Df is not a reliable parameter for the evaluation of abdominal organs. Despite some inconsistent results across different organs, segmented fitting algorithm generally results in better repeatability of Ds and f than full-biexponential fitting algorithm.

CLINICAL RELEVANCE/APPLICATION
Segmented fitting is a preferred fitting algorithm for IVIM analysis of abdominal organs.

METHOD AND MATERIALS
To evaluate the effect of fitting algorithms and number of b-values on the measurement repeatability of intravoxel incoherent motion (IVIM) parameters of the abdominal organs.

RESULTS
For all abdominal organs and two fitting algorithms, Df showed the poorest repeatability (the range of wCV, 29.5%-144.1%) among IVIM parameters (wCV for Ds, 4.1%-16.9%; wCV for f, 8.5%-46.2%). For spleen, pancreas, renal medulla, segmented fitting resulted in better repeatability of Ds (wCV, 4.9%-11.9% vs. 8.0%-16.9%) and f (wCV, 8.5%-37.9% vs. 17.3% - 46.2%) than full-biexponential fitting. For liver, full-biexponential fitting resulted in better repeatability of all IVIM parameters (wCV, 4.1%, 29.5%, and 9.7% for Ds, Df, and f, respectively) than segmented fitting (wCV, 4.8%, 43.0%, 12.8% for Ds, Df, and f, respectively). For renal cortex, the measurement repeatability of Ds was better with full-biexponential fitting, but that of f was better with segmented fitting.

CONCLUSION
Df is not a reliable parameter for the evaluation of abdominal organs. Despite some inconsistent results across different organs, segmented fitting algorithm generally results in better repeatability of Ds and f than full-biexponential fitting algorithm.

CLINICAL RELEVANCE/APPLICATION
Segmented fitting is a preferred fitting algorithm for IVIM analysis of abdominal organs.

SST04-03  Fast Advanced Spin Echo Diffusion-Weighted Imaging in the Abdomen

PURPOSE
To assess values of Fast Advanced Spin Echo (FASE)-diffusion-weighted imaging in evaluation of abdominal diseases

METHOD AND MATERIALS
Fifty-two patients (32 men and 20 women, mean: 69.4 years), who were suspected to have hepato-biliary-pancreatic malignancy and underwent 3T-MRI, were enrolled. FSE-T2WI, SE-EPI-DWI (b=1000), and FASE-DWI (600) were obtained in all patients. Amount of abdominal gas and ascites on images was recorded for each patient using a 5-point scale. Anteroposterior (AP) and 9.7% for Ds, Df, and f, respectively) than segmented fitting (wCV, 4.8%, 43.0%, 12.8% for Ds, Df, and f, respectively). For renal cortex, the measurement repeatability of Ds was better with full-biexponential fitting, but that of f was better with segmented fitting.

RESULTS
For all abdominal organs and two fitting algorithms, Df showed the poorest repeatability (the range of wCV, 29.5%-144.1%) among IVIM parameters (wCV for Ds, 4.1%-16.9%; wCV for f, 8.5%-46.2%). For spleen, pancreas, renal medulla, segmented fitting resulted in better repeatability of Ds (wCV, 4.9%-11.9% vs. 8.0%-16.9%) and f (wCV, 8.5%-37.9% vs. 17.3% - 46.2%) than full-biexponential fitting. For liver, full-biexponential fitting resulted in better repeatability of all IVIM parameters (wCV, 4.1%, 29.5%, and 9.7% for Ds, Df, and f, respectively) than segmented fitting (wCV, 4.8%, 43.0%, 12.8% for Ds, Df, and f, respectively). For renal cortex, the measurement repeatability of Ds was better with full-biexponential fitting, but that of f was better with segmented fitting.

CONCLUSION
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CLINICAL RELEVANCE/APPLICATION
Segmented fitting is a preferred fitting algorithm for IVIM analysis of abdominal organs.

PURPOSE
To assess values of Fast Advanced Spin Echo (FASE)-diffusion-weighted imaging in evaluation of abdominal diseases

METHOD AND MATERIALS
Fifty-two patients (32 men and 20 women, mean: 69.4 years), who were suspected to have hepato-biliary-pancreatic malignancy and underwent 3T-MRI, were enrolled. FSE-T2WI, SE-EPI-DWI (b=1000), and FASE-DWI (600) were obtained in all patients. Amount of abdominal gas and ascites on images was recorded for each patient using a 5-point scale. Anteroposterior (AP) and 9.7% for Ds, Df, and f, respectively) than segmented fitting (wCV, 4.8%, 43.0%, 12.8% for Ds, Df, and f, respectively). For renal cortex, the measurement repeatability of Ds was better with full-biexponential fitting, but that of f was better with segmented fitting.

RESULTS
For all abdominal organs and two fitting algorithms, Df showed the poorest repeatability (the range of wCV, 29.5%-144.1%) among IVIM parameters (wCV for Ds, 4.1%-16.9%; wCV for f, 8.5%-46.2%). For spleen, pancreas, renal medulla, segmented fitting resulted in better repeatability of Ds (wCV, 4.9%-11.9% vs. 8.0%-16.9%) and f (wCV, 8.5%-37.9% vs. 17.3% - 46.2%) than full-biexponential fitting. For liver, full-biexponential fitting resulted in better repeatability of all IVIM parameters (wCV, 4.1%, 29.5%, and 9.7% for Ds, Df, and f, respectively) than segmented fitting (wCV, 4.8%, 43.0%, 12.8% for Ds, Df, and f, respectively). For renal cortex, the measurement repeatability of Ds was better with full-biexponential fitting, but that of f was better with segmented fitting.

CONCLUSION
Df is not a reliable parameter for the evaluation of abdominal organs. Despite some inconsistent results across different organs, segmented fitting algorithm generally results in better repeatability of Ds and f than full-biexponential fitting algorithm.

CLINICAL RELEVANCE/APPLICATION
Segmented fitting is a preferred fitting algorithm for IVIM analysis of abdominal organs.
Techniques to Generate High-accuracy Computed Diffusion-weighted Images (cDWIs) of the Liver

Friday, Dec. 4 11:00AM - 11:10AM Location: E353A

Participants
Toru Higaki, PhD, Hiroshima, Japan (Presenter) Nothing to Disclose
Yuko Nakamura, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Yuji Akiyama, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
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Kazuo Awai, MD, Hiroshima, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd;
Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Medical Advisor, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Nemoto-Kyourindo ;;
Yoshiko Iwakado, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose

Evaluation

Computed diffusion-weighted images (cDWIs) are virtual DWIs calculated from actual DWIs using two arbitrarily selected low b-values. cDWI is advantageous because images can be generated on MR scanners that do not allow the acquisition of high b-value DWIs. cDWI can also reduce the scan time and lower the image noise when DWIs are acquired with routinely-used b-values. However, the image quality of cDWIs may be degraded without adequate image processing. We propose techniques to generate high-accuracy cDWIs.

Discussion

For the input image of low b-value, we employed image with b=150 because effect of micro-perfusion which strongly arises at b=0 is disappeared at b=150. Quantitative comparisons between cDWIs and actual DWIs obtained at b=1000 showed that the fewest errors in signal intensity were recorded when the combination of input b-values was 150 and 600. Qualitative comparisons revealed that the image quality of the proposed cDWIs obtained with non-rigid image registration and image filtering was superior to that of conventional cDWIs (see attached figures).

Conclusion

When generating cDWIs at b=1000 sec/mm², the optimal combination of b-values for the cDWI input was b=150 and 600. The proposed preprocessing techniques, non-rigid image registration, and image filtering contributed to the improved image quality of cDWIs.

Accuracy of MR-determined Hepatic Proton Density Fat Fraction (PDFF) and Histology-determined Fat Fraction for Estimation of Triglyceride Concentration in Twenty-one Ex-vivo Human Livers

Friday, Dec. 4 11:10AM - 11:20AM Location: E353A

Participants
Kevin A. Zand, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Elharry R. Heba, MBCh, MD, San Diego, CA (Presenter) Nothing to Disclose
Tanya Wolfson, MS, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Amol Shah, MD, La Jolla, CA (Abstract Co-Author) Nothing to Disclose
Gavin Hamilton, PhD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
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Anthony Garnst, PhD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Jeffrey B. Schwimmer, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Claude B. Srin, MD, San Diego, CA (Abstract Co-Author) Research Grant, General Electric Company; Speakers Bureau, Bayer AG; Consultant, Bayer AG ;;

Abstract Co-Author

PURPOSE

To assess the accuracy of magnetic resonance (MR)-determined hepatic proton density fat fraction (PDFF) and histology-determined fat fraction (histology-FF) for estimation of triglyceride concentration ([TG]) in ex-vivo human liver using biochemically-determined liver [TG] as a reference standard.

METHOD AND MATERIALS

Twenty-one postmortem whole livers were obtained from the National Disease Research Interchange and scanned at 3T using a cardiac coil within 48 hours of death. Donors (31 - 67 [mean 55 ± 11] yrs; 11 female) had or were at risk for hepatic steatosis based on medical history. Five 1.5-cm radius circular locations were selected in each specimen. Unenhanced two-dimensional axial spoiled gradient-recalled-echo images of the specimens were obtained. Using published MR techniques, MR spectroscopy (MRS), magnitude-based MRI (M-MRI), and complex-based MRI (C-MRI) hepatic PDFF estimations were computed at each location. Six
biopsies were also obtained at each location (thirty biopsies per liver): three for histologic analysis to determine histology-FF and three for biochemical analysis to determine [TG]. The average of [TG] at each location was used as a reference standard for that location. Regression analyses were performed for [TG] versus MRS-PDFF, M-MRI-PDFF, C-MRI-PDFF, and histology-FF. R²'s with bootstrap-based bias-corrected, accelerated 95% confidence intervals were computed and served as metrics of accuracy. Pairwise comparisons of the R²'s were performed using bootstrap-based tests to adjust for within-liver dependence.

RESULTS
MRS-PDFF, M-MRI-PDFF, C-MRI-PDFF, histology-FF and [TG] of liver specimens ranged from 0.1 - 23.5%, -7.4 - 26.3%, 1.3 - 21.2%, 0 - 70 %, and 1.2 - 31.3 mg/100g respectively. The R²'s from the regression models between [TG] and MRS-PDFF, M-MRI-PDFF, C-MRI-PDFF, and histology-FF were 0.95 (0.86 - 0.98), 0.90 (0.62 - 0.97), 0.92 (0.55 - 0.99), and 0.92 (0.78 - 0.94) respectively. The differences between R²'s were not statistically significant (all p>0.05).

CONCLUSION
In this ex-vivo study, using biochemically-determined liver [TG] as a reference standard, MR-determined hepatic PDFF and histology were accurate for estimation of hepatic [TG].

CLINICAL RELEVANCE/APPLICATION
This study helps to validate the MR-determined hepatic PDFF as an accurate biomarker of hepatic steatosis.

Participants
Sonal Krishan, MD, Gurgaon, India (Presenter) Nothing to Disclose

PURPOSE
To evaluate the diagnostic performance of Multiecho Single voxel spectroscopy and 3-D GRE sequences in predicting dichotomised histologic steatosis grades.

METHOD AND MATERIALS
This prospective, IRB approved, HIPAA-compliant single-center study was conducted in 71 consecutive adults who also had simultaneous liver biopsy. MR imaging fat fraction was estimated at 1.5 T by using T1-VIBE low-flip-angle multiecho gradient-recalled-echo imaging with T2* correction and multiphase modeling as well as multiecho single voxel spectroscopy. Steatosis was graded histologically on a semi-quantitative scale as the percentage of hepatocytes with macrovesicular steatosis (grades 0:5%, 1:5-10%, 2:10-20%, and 3:>20%). Sensitivity, specificity, and binomial confidence intervals were calculated for proposed MR imaging fat percentage threshold.

RESULTS
The proposed MR imaging fat fraction threshold of 5% to diagnose grade 1 or higher steatosis had 88% sensitivity (95% confidence interval [CI]: 83, 93) and 89% specificity (95% CI: 78, 100). The diagnostic performance to diagnose grade 2 or higher steatosis had 84% sensitivity (CI: 74, 94) and 92% specificity (95% CI: 85, 99). Accuracy to diagnose grade 3 steatosis had 81% sensitivity (95% CI: 71, 91) and 90% specificity (95% CI: 83, 97).

CONCLUSION
The fat fraction thresholds provided high sensitivity and specificity for diagnosis of grade 1 or higher, grade 2 or higher, and grade 3 steatosis. More clinical and longitudinal studies are now needed to further validate these high-specificity thresholds for inclusion in the clinical practise.

CLINICAL RELEVANCE/APPLICATION
MR based evaluation of liver fat fraction is an accurate technique across all histologic grades of hepatic steatosis.

Participants
Yohei Ito, MD, Hamamatsu, Japan (Presenter) Nothing to Disclose
Yasuo Takehara, MD, Hamamatsu, Japan (Abstract Co-Author) Nothing to Disclose
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Naoki Ooishi, Hamamatsu, Japan (Abstract Co-Author) Nothing to Disclose
Harumi Sakahara, MD, Hamamatsu, Japan (Abstract Co-Author) Nothing to Disclose
Hatsuko Nishida, Hamamatsu, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purposes are three-folds, 1) to assess the usefulness of elastic belt bracing the upper abdomen for reducing the miscalculated areas (cross-hatches) of the pancreas on the stiffness map of MR elastography (MRE), 2) to establish the stiffness of normal
pancreas in normal subjects and 3) to investigate the feasibility of MRE in differentiating between normal pancreas and the focal pancreatic diseases.

METHOD AND MATERIALS
First, 8 normal volunteers were examined with MRE with or without elastic belt. On the stiffness map, the pancreatic areas with or without cross-hatches were measured by drawing the region of interest and were compared between MRE with and without belt. Second, 14 normal volunteers were examined with MRE with elastic belt for the measurements of normal pancreas stiffness. Third, consecutive 11 adult patients suspected of having pancreatic lesions underwent MR examination at 3.0T including MRE with elastic belt for the assessment of the lesion stiffness. A spin-echo based echo planar MRE utilized MEG of 80Hz, external driver frequency/amplitude of 60Hz/50% and temporal phase of 6.

RESULTS
The median percentages of measurable areas of pancreatic stiffness of 8 normal volunteers were 57.4 % with elastic belt and 35.3 % without belt (p = 0.0078). The mean stiffness of the pancreatic areas of the 14 normal volunteers was 2.37 ± 0.16 kPa for the head, 2.46 ± 0.17 kPa for the body, 2.58 ± 0.26 kPa for the tail and 2.47 ± 0.11 kPa for the overall area. Of 11 patients, 8 patients were diagnosed as having solid pancreatic lesions consisted of 7 pancreatic cancers and 1 inflammatory pseudotumor. The mean stiffness of 7 pancreatic cancers was 6.06 ± 0.49 kPa that was significantly higher than normal pancreatic stiffness. The mean stiffness of inflammatory pseudotumor was 6.2 kPa and it was also higher than normal pancreatic parenchyma.

CONCLUSION
With elastic belt, miscalculation of the pancreatic stiffness was reduced. MRE implicates its potential to differentiate between normal pancreas and pancreatic diseases namely desmoplastic pancreatic lesions.

CLINICAL RELEVANCE/APPLICATION
With improved accuracy with elastic belt, MRE shows a potential to differentiate between normal pancreatic parenchyma and desmoplastic pancreatic lesion based on the stiffness value.

SST04-08  Balanced Steady State Free Precession Sequences for Efficient 3D Whole Organ Liver Iron Content Determination Using MRI: Proof of Principle

Friday, Dec. 4 11:40AM - 11:50AM Location: E353A

Participants
Arthur P. Wunderlich, PhD, Ulm, Germany (Presenter) Nothing to Disclose
Stefan A. Schmidt, Ulm, Germany (Abstract Co-Author) Nothing to Disclose
Holger Cario, Ulm, Germany (Abstract Co-Author) Nothing to Disclose
Meinrad J. Beer, MD, Wuerzburg, Germany (Abstract Co-Author) Research Consultant, Shire plc

PURPOSE
Current MRI based methods for determining liver iron content (LIC) suffer from multiple restrictions, one of them incomplete liver coverage. 3D balanced steady state free precession (bSSFP) has the potential to overcome this limitation, but was not yet tested for 3D LIC analysis.

METHOD AND MATERIALS
34 patients (8f, 26m, age 23 ± 12.9 y) suspected for liver iron overload were investigated by 1.5 T MRI (Siemens Avanto, Siemens Healthcare, Iselin, NY). To reduce banding artefacts, shim volume was placed over the liver. A transversal volume was acquired with bSSFP using the whole-body resonator as receiver coil with flip angle (FA) of 7, 10, 17 and 30 and TR/TE 3.5/1.75 ms. Acquisition was performed in free breathing with 3 long-term averages at matrix size 192x192x20 yielding a resolution of 2.2x2.2x4 mm in 35 s acquisition time per FA. Liver-to-muscle signal intensity ratio (SIR) and its uncertainty was calculated by manually placing ROIs in artefact-free liver parenchyma and paraspinal muscles. Results were correlated to LIC determined by Ferriscan® as reference method.

RESULTS
3D whole liver coverage was possible in 27/34 patients. Liver was imaged without visible artefacts in 30/34 patients. SIR uncertainty was below 10% in all FA except 30°, where it remained below 15%. Correlation was best for SIR vs. logarithm of reference LIC at 30° FA with R² = 0.815.

CONCLUSION
bSSFP is known as MRI sequence with highest efficiency, capable of contiguous 3D acquisition. Short TR/TE allow for whole organ coverage, and high SNR is useful for LIC determination at low uncertainty. Free breathing was chosen because it has the potential of reducing pulsation artefacts by long-term averaging, and is useful in sedated and uncooperative patients. However, bSSFP is prone to susceptibility artefacts, which we handled to a stage of invisibility by shim optimisation in most patients. Probably invisible banding caused only moderate correlation. Results are promising, even with the simple SIR approach. Increasing scan length in head-feet direction will allow for coverage of the entire liver in all patients at the cost of slightly longer measurement times. Quantitative analysis to evaluate tissue T2 is under way, however, challenging due to inhomogeneous liver tissue.

CLINICAL RELEVANCE/APPLICATION
Whole-organ MRI based contiguous 3D LIC determination using the efficient bSSFP sequence is a promising new approach. However, optimization is needed.

SST04-09  Magnetic Resonance Performance in Quantifying Activity of Small Bowel Crohn’s Disease

Friday, Dec. 4 11:50AM - 12:00PM Location: E353A

Participants
Michal M. Amitai, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Eyal Klang, Ramat Gan, Israel (Presenter) Nothing to Disclose
**PURPOSE**

Magnetic Resonance Index of Activity (MaRIA), is a Magnetic Resonance Enterography (MRE)-based score in the evaluation of distal small bowel and colonic Crohn’s disease. The gold standard for quantifying mucosal inflammation is with capsule endoscopy either by Lewis score (LS) or, Capsule Endoscopy Crohn’s Disease Activity Index (CECDAI). The aim of this study was to compare the quantification of distal small bowel inflammation using MRE, capsule endoscopy and inflammatory markers.

**METHOD AND MATERIALS**

Patients with small bowel Crohn’s disease in clinical remission or mild symptoms (CDAI<220) were prospectively recruited and underwent MRE and capsule endoscopy, after approval by our institutional review board and signing an informed consent. MaRIA, LS and CECDAI scores were calculated for the distal small bowel. C-reactive protein (CRP) and fecal calprotectin (FCP) levels were evaluated in association with the clinical scores.

**RESULTS**

Active inflammation was detected in 47/56 patients. A significant correlation was demonstrated between MaRIA and capsule endoscopy scores. The correlation between the MaRIA and either the LS and CECDAI was similar \( (r=0.51, p=0.0001 \text{ and } r=0.54, p=0.0001, \text{ respectively}) \). The mean MaRIA score was significantly lower in patients with mucosal healing, defined as LS<135 \( (18.8\pm10.7 \text{ vs } 10.7\pm7.1, p=0.002) \). CRP did not correlate with either MaRIA or capsule endoscopy indices. FCP demonstrated stronger correlation with the MaRIA \( (r=0.49, p=0.0001) \) in comparison to capsule endoscopy scores \( (r=0.36, p=0.007 \text{ and } r=0.45, p=0.001 \text{ for LS and CECDAI, respectively}) \).

**CONCLUSION**

Significant correlation was observed between quantitative MRE and capsule endoscopy based indices of inflammation in the distal small bowel. FCP correlated better with MRE than with capsule endoscopy scores.

**CLINICAL RELEVANCE/APPLICATION**

The MaRIA score can be used to non-invasively quantify distal small bowel Crohn’s disease, and thus help guide clinical decisions regarding prognosis and treatment.
**PURPOSE**

To study the clinical value of using the iodine content in tumors obtained in Spectral CT imaging for chemotherapy response evaluation of late-stage gastric cancer in correlation with the RECIST criteria.

**METHOD AND MATERIALS**

A total of 18 patients (11 women, mean age of 60y) with pathologically proved gastric cancer by endoscopy were prospectively enrolled in our study. All patients were certified as having unresectable gastric cancers and received three months of chemotherapy. Contrast-enhanced spectral CT scans were performed before and after the 3 months chemotherapy. Patients were classified into a good response group or poor response group according to the RECIST criteria (tumor volume reduction exceeds 30% is considered having good response). The iodine concentration (IC) values from the iodine-based material decomposition images of spectral CT for the tumors were measured before and after the chemotherapy. IC reduction ratio was calculated as: (IC(before) - IC(after))/IC(before).

**RESULTS**

The iodine concentration values (figure) of the tumors before chemotherapy were significantly different between the good-response group (2.44±0.83mg/ml) and poor-response group (1.65±0.64mg/ml) in the arterial phase (P<0.05). The good-response group had a higher IC reduction ratio of 0.42±0.23 in the tumor than that in the poor-response group (0.29±0.17). Significant correlation was seen between IC reduction ratio and response with correlation coefficient of r =-0.73 (P=0.007).

**CONCLUSION**

The iodine content in tumors and its reduction ratio after chemotherapy measured in Spectral CT has significant correlation with the treatment responses defined by RECIST criteria, and may be used as good indications for the chemotherapy prognosis of late-stage gastric cancers.

**CLINICAL RELEVANCE/APPLICATION**

Spectral CT may provide a new imaging method for evaluating the chemotherapy response for late-stage gastric cancers.
METHOD AND MATERIALS

We retrospectively reviewed 194 patients with gastric cancer who underwent contrast-enhanced CT within 6 weeks before the operation between January 2012 to December 2012. The degree of contrast enhancement, location, gastric comb sign (multiple engorged tubular, tortuous opacities radiating from the thickened gastric wall), and ulceration were assessed on CT. Histopathologic analysis was performed for size of the tumor and T stage. The relationship between gastric cancer with LVI and the CT and histopathologic findings was statistically analyzed. Multivariate logistic regression was used to identify independent imaging variables.

RESULTS

Gastric cancer with LVI demonstrated stronger enhancement (80.4%) more often than that without LVI (19.6%) (p = 0.0001). There was a statistically significant difference regarding the presence of gastric comb sign between both groups; gastric cancer with LVI (94.3%) and gastric cancer without LVI (5.7%) (p = 0.0001). There was a statistically significant difference in the presence of ulceration between both groups; 77.6% vs 22.4% (p=0.014). The statistically significant histopathologic feature was T stage (p=0.0001). In multivariate logistic analysis, the gastric comb sign and T stage were the most significant findings in differentiation between gastric cancer with LVI and those without LVI. The strongest imaging predictor for LVI in the gastric cancer was gastric comb sign (p = 0.026).

CONCLUSION

Our findings suggest that CT can provide valuable information for prediction of LVI in patients with gastric cancer.

CLINICAL RELEVANCE/APPLICATION

Gastric comb sign may be useful in predicting LVI in gastric cancer and used to stratify patients with gastric cancer who will benefit from adjuvant systemic therapy.

Gastrointestinal Stromal Tumours (GIST): A CT Proposal for Predicting the Risk of Malignancy

SST05-03

Gastric cancer with LVI demonstrated stronger enhancement (80.4%) more often than that without LVI (19.6%) (p = 0.0001). There was a statistically significant difference regarding the presence of gastric comb sign between both groups; gastric cancer with LVI (94.3%) and gastric cancer without LVI (5.7%) (p = 0.0001). There was a statistically significant difference in the presence of ulceration between both groups; 77.6% vs 22.4% (p=0.014). The statistically significant histopathologic feature was T stage (p=0.0001). In multivariate logistic analysis, the gastric comb sign and T stage were the most significant findings in differentiation between gastric cancer with LVI and those without LVI. The strongest imaging predictor for LVI in the gastric cancer was gastric comb sign (p = 0.026).

CONCLUSION

Our findings suggest that CT can provide valuable information for prediction of LVI in patients with gastric cancer.

CLINICAL RELEVANCE/APPLICATION

Gastric comb sign may be useful in predicting LVI in gastric cancer and used to stratify patients with gastric cancer who will benefit from adjuvant systemic therapy.

METHOD AND MATERIALS

The medical records at our institution of 42 patients (mean age 68 years, range 26-91 y) with a histologic diagnosis of GIST were reviewed. One radiologist and one resident in radiology with 10 and 4 years experience in oncological field, retrospectively and blindly reviewed the CT findings by consensus with respect to location, lesion size, contour, tumour growth pattern, enhancing pattern, degree of enhancement of tumour, percentage of CT tumour hypodensity, mesenteric fat infiltration, ulceration, calcification, regional lymphadenopathy, direct invasion to adjacent organ, and distant metastasis. All parameters were correlated with the mitotic index at histopathological analysis following surgery. Normality of variables was evaluated using Shapiro-Wilk test. Pearson's correlation test was used to test the interaction between variables. The diagnostic accuracy of percentage of CT tumour hypodensity in detecting if the number of mitosis per 50 high-power fields was >5 was measured by using receiver operating characteristic (ROC) analysis.

RESULTS

A significant statistical correlation was found between percentage of CT tumour hypodensity and the mitotic index (p<0.005), dimension and location of the tumour. Using a percentage of CT hypodensity major than 20% as the CT feature to compare with the mitotic index in creating a "modified Miettinen CT index" for evaluating the malignancy risk of GISTs we obtained a Cohen's weighted $k$ of 0.80 (95% CI 0.66-0.92) between Miettinen risk assessment and "modified Miettinen CT index".

CONCLUSION

MDCT could be an accurate technique in the prediction of malignancy of GIST in a CT risk assessment system, based on the location of the tumour, its size and the percentage of intralesional CT hypodensity.

CLINICAL RELEVANCE/APPLICATION

The primary aim of this project is to find a modified Miettinen CT index useful to predict the malignancy of GIST, in order to tailor the treatment in elderly or complex patients.

Neuroendocrine Carcinomas of the Stomach: CT, Clinical and Pathologic Findings in 32 Patients

SST05-04

PURPOSE

The purpose of this study was to identify the predictors of malignancy on CT for the evaluation of gastrointestinal stromal tumours of the stomach (GIST), correlating CT findings with the mitotic index.

METHOD AND MATERIALS

The medical records at our institution of 42 patients (mean age 68 years, range 26-91 y) with a histologic diagnosis of GIST were reviewed. One radiologist and one resident in radiology with 10 and 4 years experience in oncological field, retrospectively and blindly reviewed the CT findings by consensus with respect to location, lesion size, contour, tumour growth pattern, enhancing pattern, degree of enhancement of tumour, percentage of CT tumour hypodensity, mesenteric fat infiltration, ulceration, calcification, regional lymphadenopathy, direct invasion to adjacent organ, and distant metastasis. All parameters were correlated with the mitotic index at histopathological analysis following surgery. Normality of variables was evaluated using Shapiro-Wilk test. Pearson's correlation test was used to test the interaction between variables. The diagnostic accuracy of percentage of CT tumour hypodensity in detecting if the number of mitosis per 50 high-power fields was >5 was measured by using receiver operating characteristic (ROC) analysis.

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CONCLUSION

MDCT could be an accurate technique in the prediction of malignancy of GIST in a CT risk assessment system, based on the location of the tumour, its size and the percentage of intralesional CT hypodensity.

CLINICAL RELEVANCE/APPLICATION

The primary aim of this project is to find a modified Miettinen CT index useful to predict the malignancy of GIST, in order to tailor the treatment in elderly or complex patients.
PURPOSE

To describe the computed tomographic (CT) findings and the clinicopathologic features of neuroendocrine carcinomas (NECs) of the stomach.

METHOD AND MATERIALS

The CT examinations of 32 patients with gastric NECs were reviewed retrospectively for the morphology, size, CT attenuation of the tumor, CT attenuation of the lymph node, associated findings such as peritumoral infiltration, liver metastasis and peritoneal carcinomatosis. The ages of patients ranged from 45 to 79 years (mean: 62 years). 27 patients (84%) were men. Pathologic diagnosis was made by gastrectomy (n=28) and endoscopic biopsy (n=4). 19 patients underwent Multidetector CT with water as an oral contrast agent, 12 patients underwent helical CT with water, and one underwent non-helical CT with water-soluble contrast material.

RESULTS

Among the three CT morphologic types (polypoid, ulcerofungating, ulceroinfiltrative), 63% of the gastric NECs were ulcerofungating (n=20), 37% were ulceroinfiltrative and none were polypoid. All were larger than 5 cm in the greatest dimension (mean size: 7.8 centimeter). The characteristic features were focal (n=3) or diffuse (n=15) low attenuation within mass, extensive large necrotic lymphadenopathy (n=13), and liver metastasis (n=6) at presentation. Preoperatively, CT findings were interpreted as gastric adenocarcinoma (n=29) or lymphoma (n=3).

CONCLUSION

Although differential diagnosis between gastric adenocarcinoma and gastric NEC is difficult, gastric NEC should be considered in the differential diagnosis when CT shows a large ulcerofungating tumor with low attenuation areas, especially combined with extensive necrotic lymphadenopathy, and frequent hepatic metastasis.

CLINICAL RELEVANCE/APPLICATION

Gastric NEC should be considered in the differential diagnosis when CT shows a large ulcerofungating tumor with low attenuation areas, especially combined with extensive necrotic lymphadenopathy, and frequent hepatic metastasis.

SST05-05 Preoperative Whole-tumor Texture Analysis by Contrast Enhanced CT in Gastric Cancer: Correlations with Post-operative T Staging

Friday, Dec. 4 11:10AM - 11:20AM Location: E353B

Participants
Francesco Giganti, MD, Milan, Italy (Presenter) Nothing to Disclose
Annalaura Salemo, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Paolo Marra, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Sofia Antunes, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

Computed tomography texture analysis (CTTA) is an emerging tool to assess and quantify tumor heterogeneity, that is strictly related to cancer aggressiveness. Many quantitative features can be obtained from CTTA. We investigated the correlation of some of these parameters with postoperative T staging in gastric cancer.

RESULTS

Among all parameters, the following showed significant correlations (p<0.01): energy (without and with all filters, r ranging from 0.43 to 0.59), entropy (filtered, r ranging from -0.52 to -0.36) and uniformity (filtered, r ranging from 0.34 to 0.50). Mean values were significantly different (p<0.05) between the two groups (pT1-3 vs pT4) for the following: energy (with and without filtered image), entropy and uniformity.

CONCLUSION

CTTA features can help to predict T staging. Uniformity is directly correlated to pT stages: our hypothesis is that the increased vascularity - characteristic of more aggressive tumors - leads to greater parenchymal enhancement and lower contrast resolution, resulting in higher uniformity during CTTA. All the aforementioned parameters could represent promising, non-invasive and easily applicable diagnostic tools to evaluate the aggressiveness of gastric cancer.

CLINICAL RELEVANCE/APPLICATION

CTTA can quantify the heterogeneity of gastric cancer, opening a new window for the evaluation and treatment planning of this type of tumor.

SST05-06 Diffusion-weighted Magnetic Resonance Imaging in Submucosal Tumors of the Stomach: Preliminary Results

Friday, Dec. 4 11:20AM - 11:30AM Location: E353B

Participants
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Yoko Kajiyama, Kagoshima, Japan (Abstract Co-Author) Nothing to Disclose
Tetsuya Shinozawa, MD, Kagoshima City, Japan (Abstract Co-Author) Nothing to Disclose
Takashi Yoshiura, MD, PhD, Kagoshima, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
To describe the appearance of submucosal tumors of the stomach on diffusion-weighted magnetic resonance imaging (DWI).

METHOD AND MATERIALS

Ten consecutive patients (5 males and 5 females: age range, 32 to 84 years) with a submucosal tumor of the stomach were included in this retrospective study. Pathological diagnosis was confirmed in all patients either by surgery (8 patients) or biopsy (2 patients). DWI with b values of 0 and 800 s/mm² was performed using a 1.5T system. Visual evaluation of DWI was independently performed by two radiologists and the signal intensity (SI) of each lesion was evaluated using a five-point scale (1, unrecognizable; 2, recognizable but SI lower than muscle; 3, SI equal to or higher than muscle but lower than kidney; 4, SI equal to or higher than kidney but lower than spleen; 5, SI equal to or higher than spleen). Interobserver agreement in visual analysis was good (weighted kappa=0.78). ADC values for 6 patients with GIST ranged from 1.35x10⁻³ to 2.11x10⁻³ mm²/s (mean: 1.52x10⁻³ mm²/s), which were higher than that of a malignant lymphoma (1.18 x10⁻³ mm²/s).

RESULTS

The pathological diagnoses were gastrointestinal stromal tumor (GIST) (n=7), leiomyosarcoma (n=1), malignant lymphoma (n=1) and ectopic pancreas (n=1). All lesions except an ectopic pancreas showed a conspicuous high SI on DWI and the mean of visual scores was 4.5 for both readers. Interobserver agreement in visual analysis was good (weighted kappa=0.78). ADC values were available in 8 patients, were also recorded.

CONCLUSION

The majority of gastric submucosal tumors show conspicuous high SI on DWI. DWI may be helpful in the preoperative evaluation of the tumor extent in these patients.

CLINICAL RELEVANCE/APPLICATION

DWI can visualize the majority of submucosal tumors of the stomach and may help us evaluate the extent of these lesions.

SST05-07 Dynamic Contrast-enhanced Computed Tomography (DCE-CT) as a Prognostic Marker for Overall Survival in Gastroesophageal Junctional Cancer and Gastric Cancer after Preoperative Chemotherapy

Friday, Dec. 4 11:30AM - 11:40AM Location: E353B

Participants
Martin Lundsgaard, MD, Kobenhavn, Denmark (Presenter) Nothing to Disclose
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Michael B. Nielsen, MD, PhD, Copenhagen, Denmark (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate whether changes in DCE-CT parameters during pre-operative chemotherapy predict overall survival in patients with gastro-esophageal junction (GEJ) cancer and gastric cancer.

METHOD AND MATERIALS

Twenty-eight patients with adenocarcinoma of the gastro-esophageal junction (GEJ) and stomach were followed for a minimum of 2 years after completed surgery. All patient had received three series of chemotherapy before surgery, and were all evaluated with a DCE-CT scan prior to chemotherapy, after the first series of chemotherapy, and after three series of chemotherapy. The DCE-CT scans were performed using a 320-detector row scanner covering 12 -16 cm in the z-axis. The total scan duration was 55-60 seconds with a variable scan delay determined by a test bolus. Analyses of the DCE-CT scans were done in consensus between two radiologists. Maximum slope model and Patlak analysis were used to calculate the following DCE-CT parameters: tissue perfusion (ml/min/100ml), blood volume (ml/100ml) and permeability (ml/min/100ml). Changes in DCE-CT parameters during pre-operative chemotherapy were calculated. Data on death were collected from the Electronic Patient Record. Patients who were not resected due to tumour invasion (n=1) or died caused by severe complications after surgery (within 30 days) (n=1), were excluded from the survival analysis. Survival analysis was done using Log Rank Test and Kaplan-Meier plot. The protocol was approved by the Committees on Biomedical Research for [BLINDED] with oral and written consent from patients.

RESULTS

Minimum follow-up time was 885 days after inclusion in the study. Surgery was performed at a median of 88 days (range 66-119) after enrolment. Changes in permeability after the first series of chemotherapy ranged from -51% to 86% (median: -19.3%; 25th percentile:-38.1%, 75th percentile:6.6%). Patients with the largest decrease in permeability (using the median as cut-off) had a significant longer overall survival (p=0.03). Changes in tissue perfusion and blood volume were not a significant prognostic factor.

CONCLUSION

Changes in permeability measured with DCE-CT during pre-operative chemotherapy may have a predictive value on overall survival after preoperative chemotherapy and surgery in GEJ cancer and gastric cancer.

CLINICAL RELEVANCE/APPLICATION

DCE-CT may have a role in patient stratification in the management of preoperative chemotherapy for GEJ cancer and gastric cancer.

SST05-08 Hydro-Multidetector CT in the Staging of Gastric Adenocarcinoma. A Comparative Study with Surgical and Histopathological Specimen

Friday, Dec. 4 11:40AM - 11:50AM Location: E353B

Participants
Marco Di Girolamo, MD, Rome, Italy (Presenter) Nothing to Disclose
Francesco Carbonetti, MD, Rome-Roma, Italy (Abstract Co-Author) Nothing to Disclose
SST05-09

Is CT Surveillance Necessary in Patients who Undergo Curative Endoscopic Submucosal Dissection for Early Gastric Cancers Based on Expanded Indications?

Friday, Dec. 4 11:50AM - 12:00PM Location: E353B

PURPOSE

To evaluate the role of follow-up abdominopelvic CT in detecting extragastric recurrence in patients who had undergone curative endoscopic submucosal dissection (ESD) for early gastric cancers (EGCs) based on expanded indications.

METHOD AND MATERIALS

This retrospective study was institutional review board approved with waiver of patients’ informed consent. Patients who underwent curative ESD for EGCs based on expanded indications between November 2005 and December 2009 as well as post-ESD CT and endoscopy comprised our study population. The primary outcome was post-ESD CT discovery of extragastric recurrence (i.e., lymph node or distant metastases) not detected by endoscopy. The incidence of gastric recurrence detected by endoscopy and/or CT was also analyzed. The cumulative incidence of gastric recurrence over the post-ESD follow-up period was analyzed using the Kaplan-Meier method.

RESULTS

The final cohort included 652 patients (297 based on absolute indications [234 men and 63 women; mean age, 64 years] and 390 patients based on expanded indications [311 men and 79 women; mean age, 63 years]). In a total of 611 post-ESD CTs performed over a mean follow-up of 59.1 months (Total 3013 CT scans; range, 4-113 months), extragastric recurrence (lymph node metastasis) was detected in only 2 patients (1 meeting absolute indications and 2 meeting expanded indications). Among the 8 local recurrences and 3 synchronous and 18 metachronous gastric cancers detected by endoscopy, 11 gastric recurrences were also detected on CT. Cumulative incidence of gastric recurrence 1, 3, and 5 years after ESD was 1.6%, 2.8%, and 7.1%, respectively.

CONCLUSION

When EGC meets expanded indications, surveillance CT following curative ESD rarely detects extragastric recurrence during 5-year post-ESD follow-up. However, owing to the high incidence of gastric recurrence, endoscopy surveillance is strongly warranted during this period.

CLINICAL RELEVANCE/APPLICATION

The role of CT surveillance is limited in patients who undergo curative ESD for early gastric cancers based on expanded indications as extragastric recurrence is rare.
**SST06-01**

**T2-Weighted and Gd-EOB-DTPA Enhanced T1-weighted Magnetic Resonance Cholangiography for Evaluation of Biliary Anatomy in Living Liver Donors**

**PURPOSE**

The aim of our study was to determine the utility of T2-weighted and Gd-EOB-DTPA enhanced T1-weighted MR cholangiography (MRC) at 3-Tesla for bile duct visualization and for predicting biliary anatomy.

**METHOD AND MATERIALS**

This study included 35 consecutive donors who underwent either right or left lobectomy for transplantation. Pre-operative MRC studies were acquired on a 3-Tesla scanner and included 3D T2 MRC and 3D Gd-EOB-DTPA enhanced T1 MRC. Two readers independently rated the quality of second-order bile duct visualization on the T2- and T1- MRC images on a 4 point scale (0, not seen; 3, excellent visualization), and also noted the presence of variant second-order biliary anatomy. MR findings were compared to those at surgery. Wilcoxon test was used to compare the MRC sequences, and Kappa analysis was performed to estimate inter-observer agreement.

**RESULTS**

There was good inter-observer agreement for bile duct visualization (k=0.72-0.76). The mean second order bile duct visualization scores were significantly higher for Gd-EOB-DTPA enhanced T1 MRC than 3D T2 MRC (2.4±0.7 vs 2.0±0.8, p=0.01). Thirteen of 35 donors underwent right lobectomy; biliary variant was noted at surgery in 11 of 13 right lobe donors. The biliary anatomy on MR was concordant with intraoperative finding in 10 of 13 donors (77%) for reader 1 and in 11/13 donors (85%) for reader 2. Twenty-two of 35 donors underwent left lobectomy; variant biliary anatomy was noted at surgery in 2 left lobe donors, one of which was predicted at MR by both readers. Both readers also noted variant biliary anatomy in 3 additional left lobe donors at MRC. These were not confirmed at surgery, and likely because commonly noted variant second order biliary anatomy predominantly affects right rather than left lobectomy and may not be visualized during left lobectomy.

**CONCLUSION**

Gd-EOB-DTPA Enhanced MRC provides improved bile duct visualization compared to 3D T2 MRC. Combined 3D T2-weighted and Gd-EOB-DTPA enhanced T1-weighted MRC at 3-Tesla depicts variant biliary anatomy with good accuracy.

**CLINICAL RELEVANCE/APPLICATION**

Combined 3D T2-weighted and Gd-EOB-DTPA enhanced T1-weighted MRC at 3-Tesla depicts variant biliary anatomy with good accuracy.

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**SST06-03**

**Biliary Cast Syndrome in Patients after Liver Transplantation: Which Non-Enhanced T1-weighted Sequence is Able to Show Cast Best?**

**PURPOSE**

It is already known that the addition of T1-weighted (T1w) images to MR cholangiopancreatography (MRCP) facilitates detection of cast in biliary cast syndrome in patients after liver transplantation. Aim of this retrospective study was to compare T1w sequences with regard to the visibility of cast in patients with endoscopically saved biliary cast.

**CONCLUSION**

Out of the three evaluated T1w non-enhanced sequences, T1w opposed phase was superior regarding image quality and
CLINICAL RELEVANCE/APPLICATION

Using T1w opposed-phase as single non-enhanced T1w sequence in addition to MRCP for detection of cast in patients after liver transplantation might shorten the MR protocol and optimize workflow in clinical routine.

SST06-04 Determining the Extent of Cholecystectomy Using Intraoperative Specimen Ultrasonography in Patients with Suspected Early Gallbladder Cancer

Friday, Dec. 4 11:00AM - 11:10AM Location: E353C

Participants
Ji Hoon Park, MD, Seongnam-Si, Korea, Republic Of (Presenter) Research Grant, Bracco Group
Young Hoon Kim, MD, PhD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yoon Jin Lee, MD, Seongnam-si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

Accumulating evidence and guidelines recommend extended cholecystectomy for T1b or greater gallbladder cancers. This study aimed to evaluate the feasibility of intraoperative ultrasonography of a resected gallbladder specimen (specimen US) for the determination of the extent of cholecystectomy.

METHOD AND MATERIALS

The study included 37 patients (27 women; median [interquartile range] age, 66 [57-74] years) who underwent specimen US. After simple laparoscopic cholecystectomy, a gallbladder specimen was examined to evaluate the depth of tumor invasion by specimen US and frozen section examination. Then the operating surgeon decided whether to undergo extended cholecystectomy. The technical success rate and the examination time of the specimen US procedure were measured. The sensitivity and specificity in diagnosing T1b or greater cancer were calculated using permanent pathology as the reference standard.

RESULTS

Among 17 patients in whom adenocarcinomas were confirmed, 14 patients had T1b or greater cancers. The technical success rate was 97% (95% confidence interval, 85-100%). The mean examination time was 8.5 minutes (standard deviation, 4.3 minutes). The sensitivity and specificity was 79% (49%-95%) and 91% (71%-99%), respectively.

CONCLUSION

The specimen US is feasible to be incorporated in the clinical practice, and provides useful information to determine the extent of cholecystectomy.

CLINICAL RELEVANCE/APPLICATION

Providing high image resolution which has not been achieved by other diagnostic imaging modalities, intraoperative ultrasonography of a resected gallbladder specimen is feasible to be incorporated in the clinical practice for the determination of the extent of cholecystectomy.

SST06-05 Utility of Diffusion-Weighted MRI for Differentiating Acute from Non-Acute Cholecystitis

Friday, Dec. 4 11:10AM - 11:20AM Location: E353C

Participants
Annie M. Wang, MD, New York, NY (Presenter) Nothing to Disclose
Diane M. Dunst, MD, North Bellmore, NY (Abstract Co-Author) Nothing to Disclose
Krishna Prasad Shanbhogue, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Cristina H. Hajdu, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Andrew B. Rosenkrantz, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

To assess the utility of diffusion-weighted imaging (DWI) for differentiating acute from non-acute cholecystitis, in comparison with conventional MRI features.

METHOD AND MATERIALS

83 patients with abdominal pain who underwent 1.5T liver MRI including DWI (b-values 0, 500, and 1000 s/mm2) within 30 days before cholecystectomy were included. Two radiologists assessed cases for a spectrum of conventional MRI features associated with acute cholecystitis, as well as for visually increased mural signal on high b-value images and visually decreased mural ADC. ADC of the gallbladder wall was also measured. Features were compared between acute and non-acute cholecystitis.

RESULTS

43% (47/83) had acute cholecystitis; 57% (47/83) had non-acute cholecystitis. Conventional MRI features with significantly greater frequency in acute cholecystitis for both readers were: wall thickening, pericholecystic fluid, pericholecystic stranding, gallbladder distension, increased pericholecystic liver enhancement, mural T2 hyperintensity, increased mural enhancement, striated mural appearance, and mural defect (all p<0.003). Increased mural signal on high b-value images was significantly more frequent in acute than in non-acute cholecystitis for both readers (R1: 92% vs. 32%; R2: 83% vs. 30%; p<0.001). For R1 and R2, increased mural signal on high b-value images had a sensitivity of 92% and 83% and a specificity of 68% and 70%, respectively. Visually low ADC was more frequent in acute cholecystitis for R2 (p<0.001) but not for R1 (p=0.406); ADC values were not different between the two groups for either reader (p=0.104-0.139). At multivariable analysis, independent predictors of acute cholecystitis were, for R1: gallbladder distension, increased pericholecystic liver enhancement, and increased mural signal on high b-value images (combined AUC 89%), and for R2: pericholecystic fluid and increased mural signal on high b-value images (combined AUC 89%).

CONCLUSION

Visually increased mural signal on high b-value DWI was highly sensitive and moderately specific in identifying acute cholecystitis,
serving as a significant independent predictor of this diagnosis relative to conventional MRI features for both readers.

**CLINICAL RELEVANCE/APPLICATION**

Diffusion-weighted imaging (particularly the high b-value images) may have additive value relative to conventional MRI in guiding clinical management in patients with suspected acute cholecystitis.

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Krishna Prasad Shanbhogue, MD - 2012 Honored Educator
Krishna Prasad Shanbhogue, MD - 2013 Honored Educator

**SST06-07 Application of Contrast-enhanced Ultrasound in the Diagnosis of Space-occupying Lesions in Extrahepatic Bile Duct - A Comparison of Conventional Ultrasound and Contrast-enhanced CT**

Friday, Dec. 4 11:30AM - 11:40AM Location: E353C

**Participants**

Wei Wu, MD, Beijing, China (Presenter) Nothing to Disclose
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Zhong-Yi Zhang, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Kun Yan, BS, Beijing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the application of contrast-enhanced ultrasound (CEUS), compared with conventional ultrasound (US) and contrast enhanced computed tomography (CECT) in the diagnosis of space-occupying lesions in the extrahepatic bile duct.

**METHOD AND MATERIALS**

Seventy two patients with pathological diagnosis of space-occupying lesions in the extrahepatic bile duct were retrospectively recruited. All 72 patients underwent US, CEUS and CECT. The Sensitivity, specificity and diagnostic accuracy were obtained and compared.
RESULTS

Among 72 patients, 11 cases were benign and 61 cases were malignant. The diagnostic accuracy of US, CEUS and CECT were 66.67% (48/72), 90.28% (65/72) and 88.89% (64/72), respectively. The Youden index showed that CEUS (0.811) is comparable to contrast enhanced CT (0.720) and higher than US (0.159). There was a significant difference between US and CEUS (p=0.001) and US and CECT (p=0.001) in terms of accuracy of diagnosis, however, no significant difference between CEUS and CECT (p=0.785). Sensitivity results showed a significant difference between US and CEUS (p=0.006) and CECT (p=0.006) whilst CEUS was comparable to contrast enhanced CT (p=1.000). There was no significant difference in specificity among the three imaging techniques (p=0.05). There was a significant difference in the number of lesions with clear boundaries displayed, 16 in the US and 56 in CEUS (p=0.006).

CONCLUSION

CEUS can observe dynamic blood supply in the space-occupying pathological regions in the extrahepatic bile duct. The diagnosis accuracy of CEUS in the extrahepatic bile duct was higher than that of conventional US and comparable to that of contrast-enhanced CT. Therefore, CEUS may be a promising imaging technique in the diagnosis of space-occupying disease in the extrahepatic bile duct.

CLINICAL RELEVANCE/APPLICATION

The diagnosis accuracy of CEUS in the extrahepatic bile duct was higher than that of conventional US and comparable to that of contrast-enhanced CT.

SST06-08  Association of Tumor Heterogeneity on CT Image with Genetic Mutation of the Isocitrate Dehydrogenase and Survival in Cholangiocarcinoma

Friday, Dec. 4 11:40AM - 11:50AM Location: E353C

Participants

Koichi Hayano, MD, Boston, MA (Presenter) Nothing to Disclose
Lipika Goyal, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
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Manuel Patino, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Dushyant V. Sahani, MD, Boston, MA (Abstract Co-Author) Research Grant, General Electric Company; Research Consultant, Allena Pharmaceuticals, Inc

PURPOSE

Heterogeneity in the tumor structure or vasculature is a well-recognized feature of malignancy. On the other hand, mutation in the isocitrate dehydrogenase (IDH) is the most common genetic alternations in cholangiocarcinoma, which has been reported its association with progression to metastases. The purpose of this study is to compare computed tomography texture analysis (CTTA) with genetic mutation of IDH and survival in unresectable cholangiocarcinoma.

METHOD AND MATERIALS

46 patients (22 M / 24 W; median age: 61.3 years) with unresectable cholangiocarcinoma were retrospectively evaluated. Median follow-up time was 24.0 months. Contrast enhanced (CE) CT were performed before the therapy. Tumor texture parameters including mean gray intensity (MGI), standard deviation (SD), Entropy, mean of positive pixels (MPP) were measured on portal-phase CECT images by a texture analysis software (TexRAD, Somerset, UK), where the filtration (spatial scale filter, SSF) extracted features of medium texture scale (SSF=3 mm in radius). Correlations of texture parameters with IDH mutations were investigated, and those parameters were also compared with overall survival (OS) using Cox regression and Kaplan-Meier analysis.

RESULTS

Low SD value of tumor significantly associated with IDH mutation (P=0.01). In univariate Cox regression analysis, MGI showed significant correlations with OS (P=0.008). Kaplan-Meier analysis demonstrated that lower MGI (< -4.623) associated with favorable OS (P=0.01).

CONCLUSION

Pre-therapeutic tumor texture parameter may serve as a predictive imaging biomarker for gene mutation and survival in cholangiocarcinoma patients.

CLINICAL RELEVANCE/APPLICATION

CT texture analysis can be a widely applicable noninvasive biomarker for predicting gene mutation and survival in cholangiocarcinoma patients, and it would help select an optimal therapy for those patients.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator

SST06-09  Common Bile Duct Stone: Value of Adding Single-Shot Balanced Turbo Field-Echo Sequence to Conventional MR Imaging

Friday, Dec. 4 11:50AM - 12:00PM Location: E353C

Participants
PURPOSE
To evaluate the value of adding single-shot balanced turbo field-echo (b-TFE) sequence to conventional magnetic resonance (MR) imaging for the detection common bile duct (CBD) stone.

METHOD AND MATERIALS
Our institutional review board approved this prospective study and written informed consent was obtained. One-hundred thirty-seven consecutive patients with suspected CBD stone underwent MR imaging, including balanced turbo field-echo sequence. Among 137 patients, 25 patients were confirmed having CBD stone by endoscopic retrograde cholangiopancreatography or ultrasonography. A radiologist reviewed the following two image sets for the detection of CBD stone; image set A, a conventional MR images (unenhanced T1-, T2-, heavily T2-, and MRCP images), and image set B, combined conventional images and b-TFE. The sensitivities, specificities, and area under the receiver-operating-characteristic curve (AUC) for the detection of CBD stone were compared.

RESULTS
AUC for the detection of CBD stone were 0.86 and 0.93 for image sets A and B, respectively. The AUC for image set B was significantly greater than that for image set B (P = 0.030). For the detection of CBD stone, sensitivity was comparable between two image sets but image set 2 (99%) yielded better specificity than image set 1 (92%) (P = 0.0078).

CONCLUSION
Adding single-shot b-TFE to conventional MR imaging improves the diagnostic performance for CBD stone.

CLINICAL RELEVANCE/APPLICATION
For the evaluation of common bile duct stone, single-shot balanced turbo field-echo sequence significantly improve a confidence rating for the presence.
PURPOSE
To evaluate the value of k-means clustering of voxel-wise Apparent Diffusion Coefficient (ADC) in the assessment of chemotherapeutic response in bladder cancer.

METHOD AND MATERIALS
10 bladder cancer patients who received neoadjuvant chemotherapy were included in this initial study. Patients were scanned on a 3T multi-transmit system (Achieva, Philips Healthcare) using a 32-channel phased-array surface coil. Each patient had a baseline (before chemotherapy) MRI and a post-chemotherapy MRI, followed by radical cystectomy. High resolution T2W imaging was performed prior to DWI. DWI data were processed on in-house software written in IDL (Exelis, VSI) to acquire voxel-wise ADC for each tumor. The k-means clustering was implemented to segment each tumor in three clusters (labeled as clusters 1, 2, 3 with low, intermediate, high ADC). The volume fractions (VFs) of three clusters in a tumor at baseline and post-chemotherapy were correlated with the tumor response. P<0.05 was considered to be statistically significant. Color cluster maps were overlaid on ADC maps to visualize the cluster distribution.

RESULTS
Using pathological findings and radiologic volume estimation of bladder tumors, 6 patients were defined as responders and 4 as non-responders. At baseline, responders showed a significantly higher VF of cluster 1 and lower VF of cluster 2 (all P<0.04) than non-responders (Figure 1). In contrast with resistant cases, responsive tumors showed a decrease in VF of cluster 1 and an increase in that of cluster 3 after chemotherapy. These differences in the post-chemotherapy changes of cluster VFs were found to be statistically significant (all P<0.04) between responders and non-responders.

CONCLUSION
As ADC characterizes the microcellularity in body tissues, the heterogeneity of tumor microcellularity can be quantified using k-means clustering of voxel-wise ADC to enable the early assessment and predication of chemotherapeutic response in bladder cancer.

CLINICAL RELEVANCE/APPLICATION
k-means clustering of voxel-wise ADC can be useful in predicting chemotherapeutic response at baseline and assessing chemotherapy-induced changes of microcellularity in bladder cancer.
METHOD AND MATERIALS

A cohort of 70 patients underwent a multiphasic CT Urography examination using a 320-detector CT scanner (Aquilion ONE, Toshiba Medical Systems) including a medullary phase using the helical scan mode (collimation: 80x0.5mm, rotation: 0.5s, 1mm/0.8mm, acquisition time: 4-6s) and an excretory phase using the W-V scan mode (collimation: 200x0.5mm, rotation: 0.5s, 1mm without overlapping and 4 to 5 volumes to cover the entire urinary tract, acquisition time: 6-7s). Adaptive blending was used to stitch the wide volumes. Both scans were performed at 120kVp with the same FOV, length of coverage and iterative reconstruction (AIDR 3D). The Body Mass Index (BMI) of each patient and the dose-length product (DLP) was also recorded. For the quantitative analysis, the signal to noise ratio (SNR) was calculated in the iliopectos muscle. For qualitative analysis, two independent experienced readers were asked to subjectively assess the presence of motion artefacts as well as the quality of the volumes matching by analysing the continuity of the ureter on the excretory phase, using a four-point scale.

RESULTS

The mean DLP was significantly lower for the W-V acquisition than for the helical acquisition (136.8 +/- 28mGy-cm vs 232.8 +/- 41mGy-cm, respectively) equal to 42.53% (p<0.05), regardless of the patient's BMI. The SNR was quite similar with W-V and helical scan mode (15.3 +/- 1.9 vs 17.3 +/- 2.5, respectively). No significant difference was noted for the presence of motion artefacts between both modes. In 85% of cases, there was no disruption of the continuity of the ureter with the W-V scan mode after stitching of the volumes. In 12% of cases, there was minimal discontinuity of one segment and in 3% of cases there was an inadequate matching of the volumes.

CONCLUSION

Wide Volume scanning using a 320-MDCT allows a significant reduction of radiation dose (42%) while preserving image quality in comparison to helical scanning. The lack of overranging with minimal overbeaming explain those results.

CLINICAL RELEVANCE/APPLICATION

Wide volume scanning allows a significant reduction of radiation dose with a perfect continuity of the ureter and an excellent image quality.

SST07-03 Comparison between Conventional Cystourethrography and MRI with Voiding MR-cystourethrography in the Evaluation of Male Urethral Strictures

Friday, Dec. 4 10:50AM - 11:00AM Location: E351

Participants

Marco Di Girolamo, MD, Rome, Italy (Presenter) Nothing to Disclose
Ines Casazza, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Simone Mariani, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Francesco Carbonetti, MD, Rome-Roma, Italy (Abstract Co-Author) Nothing to Disclose
Giulia Francione, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Vincenzo David, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the accuracy of conventional retrograde and voiding cystourethrography and MRI together with voiding MR-cystourethrography in the evaluation of male urethral strictures.

METHOD AND MATERIALS

We evaluated 39 male patients with urethral strictures diagnosed with urine flow velocity recording and conventional retrograde and voiding cystourethrography. All these patients underwent MRI and voiding MR-cystourethrography using a 1.5T superconductive magnet. The patients had urine-filled bladders and high-resolution sagittal TSE T2-weighted scans were performed (TR:6250ms; TE:90ms; sl.thickness: 2mm; acq.time: 4-6s) and an excretory phase using the W-V scan mode (collimation: 200x0.5mm, rotation: 0.5s, 1mm/0.8mm, acquisition time: 4-6s) and an excretory phase using the W-V scan mode (collimation: 200x0.5mm, rotation: 0.5s, 1mm without overlapping and 4 to 5 volumes to cover the entire urinary tract, acquisition time: 6-7s). Adaptive blending was used to stitch the wide volumes. Both scans were performed at 120kVp with the same FOV, length of coverage and iterative reconstruction (AIDR 3D). The Body Mass Index (BMI) of each patient and the dose-length product (DLP) was also recorded. For the quantitative analysis, the signal to noise ratio (SNR) was calculated in the iliopectos muscle. For qualitative analysis, two independent experienced readers were asked to subjectively assess the presence of motion artefacts as well as the quality of the volumes matching by analysing the continuity of the ureter on the excretory phase, using a four-point scale.

RESULTS

3 patients were not able to perform voiding MR-cystourethrography. In 36 patients evaluated with two imaging modalities 32 single and 4 double urethral strictures were detected. The measurement of the stenosis length was equal or superior with voiding MR-cystourethrography and the analysis of 3D sagittal scans allowed a better evaluation of the morphology of the urethral strictures in comparison with conventional cystourethrography. Spongio-fibrosis was found in 30 patients (83%). The site of spongio-fibrosis was always assessed with MRI (dorsal, ventral, dorsal and ventral and circular fibrosis).

CONCLUSION

MRI with voiding MR-cystourethrography shows the morphology and the length of the urethral strictures better than conventional cystourethrography and allows the detection and site of spongio-fibrosis, avoiding radiation exposure to the gonads and urinary catheterization.

CLINICAL RELEVANCE/APPLICATION

MRI could be proposed as all-in-one technique for the evaluation of urethral stenosis, allowing their detection and length assessment and determining the presence and site of spongiofibrosis.

SST07-04 Efficiency of Diffusion-weighted (DW) MRI to Evaluate the Excreto Urinary Wall Lesions: A Prospective Study of 95 Patients
Participants
Catherine Roy, MD, Strasbourg, France (Presenter) Nothing to Disclose
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Guillaume Bierry, MD, PhD, Strasbourg, France (Abstract Co-Author) Nothing to Disclose
Herve Lang SR, MD, Strasbourg, France (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose was to investigate the reliability of DW-MRI in differentiating malignant from benign thickening or masses of the entire urinary excretory wall.

METHOD AND MATERIALS
We prospectively evaluated 95 patients referred for 52 upper urinary tract (UUT) and 43 bladder (Bl) lesions during a period of 5 years (from January 2010 to January 2015). MR examinations were performed on a 3T unit (Achieva, Philips Medical System) including to our conventional protocol using T2 and T1 sequence before and after contrast media injection an axial DWI (TR/TE : 7000/55, FOV : 250-300, ETL : 53, slice thickness : 4 mm, acquisition time : 4 min, Sense factor : 2, b =0 and 1000 mm2/sec) under free breathing with a respiratoy compensatory device (navigator echo) for UUT. The final diagnosis and standard of reference was the pathological analysis performed after MR examination, obtained either after surgery (74 cases) or by selective cytology and endoscopic biopsy (21 cases) with a follow up imaging (at least one year) for 11 of them. Mann-Whitney test and Student -t test were used to determine the efficiency of the mean ADC value.

RESULTS
Maximal axial diameter was 34±24mm for malignant (39 UUT; 33 Bl) and 15±5mm for benign lesions (13 UUT; 10 Bl), respectively. For UUT, the mean ADC value in the malignant lesions was significantly lower than that in the benign lesions: 0.99±0.27 x10-3mm2/s against 1.10±0.34 x10-3mm2/s, respectively (p<0.005). Thirty-three malignant lesions had an ADC value inferior to 1 x10-3mm2/s and only one benign lesion. There was a significant difference among the mean ADC values of different grades of malignant tumors, corresponding to 0.84 ± 0.12 x10-3mm2/s-1 and 1.0 ± 0.20 x10-3mm2/s-1 (p<0.01) in high-grade and low-grade excretory epithelioma, respectively. For bladder, the mean ADC value in the malignant lesions was not significantly inferior to that of benign lesions (1.22 ± 0.3 x10-3mm2/s against 1.32± 0.2x10-3mm2/s, p=0.41)

CONCLUSION
DW-MRI is efficient in the differentiation between benign from malignant lesion located on the upper urinary tract. It does not seem according those data reliable for bladder tumours. DW sequence must be included in MR protocols for exploration of upper urinary tract.

CLINICAL RELEVANCE/APPLICATION
DW must be included in MR protocols for exploration of upper urinary tract. DW-MRI is efficient in the differentiation between benign from malignant lesion only in the upper urinary tract.

SST07-05 ADC as a Novel Biomarker to Predict the Local Stage and Tumor Grade of Bladder Cancer

Participants
Chandan J. Das, MD, MBBS, New Delhi, India (Presenter) Nothing to Disclose
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Arunk K. Gupta, MBBS, MD, New Delhi, India (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the role of ADC as a novel biomarker to predict the local stage and tumor grade of bladder cancer using histopathology (of post TURBT/cystectomy specimen) as the gold standard.

METHOD AND MATERIALS
The study was approved by the local institutional ethics committee. MRI of 25 patients were performed in a 3 Tesla imaging system (Achieva, Philips). Routine T1W and T2W images were obtained, followed by Diffusion Weighted Imaging in four b values (b0, 500, 1000, and 1500). All the patients had their surgery done within 1 month of performing MRI. Tumour staging was assessed with the criteria used by Takeuchi et al., (2009). For the tumour grade, freehand ROI values were obtained from the ADC map and their mean calculated. Images were reviewed by two experienced radiologists in consensus, both blinded to the histopathology report. Subsequently, the sensitivity, specificity, positive and negative predictive values were assessed using standard statistical tests. Results were compared with the histopathology.

RESULTS
DWI had a sensitivity of 76.9% in detecting muscle invasion with a high specificity of 91.7%. The positive and negative predictive values were 90.9 and 78.6% respectively. The ADC values were (0.786 ± 0.045) x 10-3 for high grade lesions and (1.049 ± 0.113) x 10-3 for low grade lesions, with a significant difference between the two (p<0.05). We could not find any additive value of T2 weighted imaging when combined with DWI. DWI images acquired in coronal and sagittal plane were better for evaluation of bladder dome lesion whereas axial plane DWI were best for rest of the lesions.

CONCLUSION
DWI showed a high specificity and positive predictive value in identifying muscle invasion. ADC values showed significant correlation with the tumor grade and can be used as novel imaging biomarker for predicting the local stage and tumor grade of bladder.
cancer..

CLINICAL RELEVANCE/APPLICATION

ADC can be used as a noninvasive tool to evaluate bladder tumor and may avoid repeated cystoscopy or biopsy during follow up of low grade lesions following TURBT. DWI at 3T is superior to T2WI for evaluating the T stage of bladder cancer, particularly in differentiating T1 tumors from those T2 or higher, and in detecting stalks of papillary bladder tumors.

SST07-06 Detection of Urothelial Carcinomas: Comparison of Reduced-dose Based Iterative Reconstruction with Standard-Dose Filtered Back Projection

Friday, Dec. 4 11:20AM - 11:30AM Location: E351

Participants
See Hyung Kim, Daegu, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jung Hee Hong, Daegu, Korea, Republic Of (Presenter) Nothing to Disclose

PURPOSE

To retrospectively assess radiation dose, image quality and diagnostic performance of CT urography detecting urothelial carcinomas for performing reduced-dose with iterative reconstruction (IR) in comparison to standard-dose with filtered back projection (FBP).

METHOD AND MATERIALS

Institutional review board approved this study. 2163 patients (age range, 28-81 years; 1452 male) at high-risk for urothelial carcinomas randomly underwent standard-dose scanning with FBP (120kVp for >80kg, 100kVp for 50-80kg) or reduced-dose scanning with IR (100kVp for >80kg, 80kVp for 50-80kg) according to the body weight. Objective and subjective image quality between the two groups with same weight scope was compared, using two-way analysis. The predictive accuracy detecting urothelial carcinomas were also calculated by using as standard reference.

RESULTS

Mean effective dose was 26% (15.5mSv vs. 11.1mSv) and 30% (7.91mSv vs. 5.01mSv) lower with the reduced-dose scanning. Objective image noise had no significant difference, except for 120kVp with FBP and 80kVp with IR (ranging from 7.2 to 7.9 vs. 9.4 to 9.9, P <.0102). SNR and CNR had no significant difference. Subjective image quality had no significant difference in visual image noise, artifacts, ureter depiction and overall image quality, except for artifacts in 100kVp with FBP and 80kVp with IR (5 [4-5] vs. 4 [3-4]) (P >.05). Diagnostic accuracies on lesion level were 89.6% (89/98, 120kVp with FBP), 91.3% (105/115, 100kVp with FBP), 92.9% (79/85, 100kVp with IR) and 88.8% (111/125, 80kVp with IR), respectively.

CONCLUSION

Reduced-dose images with IR showed radiation dose reduction and equivalent image quality with ensuring diagnosis detecting urothelial carcinomas as compared with standard-dose images with FBP, thus these robust capabilities may use in clinical practice.

CLINICAL RELEVANCE/APPLICATION

Reduced-dose images with IR could be of help to reduce radiation dose with equivalent image quality for detecting urothelial carcinomas as compared with standard-dose images with FBP.

SST07-07 Recurrence Patterns in Transitional Cell Carcinoma of the Upper Urinary Tract

Friday, Dec. 4 11:30AM - 11:40AM Location: E351

Participants
Betsa Parsa, Boston, MA (Presenter) Nothing to Disclose
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Duangkamon Praputtham, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Mukesh G. Harisinghani, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE

This study included patients diagnosed with UT-TCC who underwent nephroureterectomy between 2003-2008. Tumor location, morphology, TNM staging and histologic grade were recorded based on radiological examinations. The pattern and timing of recurrence was evaluated at 3, 6, 12, 24, 36 and 60 months in a five-year imaging and clinical follow up period (2008-2013).

METHOD AND MATERIALS

This study included patients diagnosed with UT-TCC who underwent nephroureterectomy between 2003-2008. Tumor location, morphology, TNM staging and histologic grade were recorded based on radiological examinations and clinical notes. The pattern and timing of recurrence was evaluated at 3, 6, 12, 24, 36 and 60 months in a five year follow up period (2008-2013).

RESULTS

68 patients with an average age of 77.5 yrs were included in this study. At initial work-up, renal, ureteric and renal plus ureteric lesions were present in 34, 25 and 9 patients respectively. Of 59 patients for whom tumor morphology was available, 34 had mass-forming lesions and 25 were seen as filling defects. The majority of patients had a T-stage of Ta (n=28) or T3 (n=23), while nodal involvement was mostly absent. Tumors were grade 3 in 44.1% and grade 2 in 33.8%. Most recurrences were noted at 3 and 24 months. Tumors were grade 3 in 44.1% and grade 2 in 33.8%. Pathological grade 1 tumors showed late recurrence at the chance was higher at 36-month follow-up. Recurrence rate was also higher in patients with T2, N1 and pathologic grade 3 and in patients with T2, N1 and N2 at 3- and 12-month follow-ups, respectively. Pathological grade 1 tumors showed late recurrence at 5-y follow-up. Overall, recurrence occurred in 20 cases during the 5-yr follow-up, which was commonly located in lymph nodes, bladder. Multivariate analysis showed T-stage and location of primary tumor were independent predictors of tumor-free survival (p=0.021, 0.038 respectively). Average tumor-free survival time was 56.5 months.

CONCLUSION
Nodal, bladder, hepatic and bone metastasis are common in UT-TCC with most of them occurring at 3 and 24 months. T-stage and location are independent predictors of tumor-free survival. Tumors confined to either kidney or ureter, lower T, N stage and histologic grade were associated with longer survivals.

**CLINICAL RELEVANCE/APPLICATION**
Information on the pattern of recurrence in UT-TCC patients can lead to more effective planning of imaging surveillance strategy.

**SST07-08** The Incremental Value of Diffusion-Weighted MR Images in the Tumor Detection and the Staging of Preoperative T Categorization in Renal Pelvic Carcinoma: Effect of Reader Experience

Friday, Dec. 4 11:40AM - 11:50AM Location: E351

Participants
Rika Yoshida, MD, Izumo, Japan (Presenter) Nothing to Disclose
Takeshi Yoshizako, MD, Izumo, Japan (Abstract Co-Author) Nothing to Disclose
Hiroshi Mori, Izumo, Japan (Abstract Co-Author) Nothing to Disclose
Shinji Andou, MD, Izumo, Japan (Abstract Co-Author) Nothing to Disclose
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Megumi Andou, MD, Izumo, Japan (Abstract Co-Author) Nothing to Disclose
Hajime Kitagaki, MD, Izumo, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The purpose of this study is to retrospectively assess the incremental value of diffusion-weighted MRI (DWI) to T2-weighted image (T2WI) in the tumor detection and the staging of preoperative T categorization in renal pelvic carcinoma by readers of different experience levels.

**METHOD AND MATERIALS**
Thirty-two urothelial carcinoma in 32 patients underwent preoperative MRI examination, including T2WI and DWI (b=0, 800 s/mm) and contrast-enhanced imaging (CEI). All patients had total nephrectomy within 1 month of MRI. Two radiologists (reader 1 had 5 years and reader 2 had 18 years of experience) independently reviewed three image sets (T2WI alone, T2WI plus DWI, and T2WI plus CEI) regarding tumor detection and the discrimination of locally advanced tumors.

**RESULTS**
The pathologic T category was T1 in 5 (15.6%), T2 in 6 (18.8%), T3a in 9 (28.1%), T3b in 11 (34.4%), and T4 in 1 (3.1%). T2WI plus DWI enabled a high detection rate (97%, 31/32) without significant differences. In reader 1, for the diagnosis of T3 or higher categories, the accuracies were relatively low in all three image sets (75.0% each for T2WI alone and T2WI plus CEI and 71.9% for T2WI plus DWI). For discriminating tumors with microscopic renal invasion from those with microscopic renal invasion or less, T2WI plus DWI (90.6%) was significantly more accurate than T2WI alone (68.8%) (p < 0.05), with with areas under receiver operating characteristic curves (AUC) of 0.82 and 0.73, respectively. In reader 2, for the diagnosis of T3 or higher categories, the accuracies were relatively low in all three image sets (each sets were 71.9%). For discriminating tumors with microscopic renal invasion from those with microscopic renal invasion or less, the accuracies were relatively high in all three image sets (84.3% for T2WI alone, 94.8% for T2WI plus CEI and 90.6% for T2WI plus DWI), with AUC of 0.88, 0.95, and 0.93, respectively. For the diagnosis of T categorization, T2WI added DWI improved interobserver agreement from fair (κ = 0.21, 0.32) to substantial (κ = 0.60, 0.73).

**CONCLUSION**
DWI improved the tumor detection rate and the diagnostic performance for T categorization of renal pelvic cancer without contrast material, especially for the relatively inexperienced reader.

**CLINICAL RELEVANCE/APPLICATION**
DWI improved the tumor detection rate and the diagnostic performance for T categorization of renal pelvic cancer without contrast material.

**SST07-09** Organ Confined Urinary Bladder Carcinoma: A Comparative Analysis for "Submucosa Linear Enhancement" Sign on Early Phase of DCE-MRI and the "Inchworm" Sign on DWI

Friday, Dec. 4 11:50AM - 12:00PM Location: E351

Participants
Huanjun Wang, MD, GuangZhou, China (Presenter) Nothing to Disclose
Jian Guan, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Yan Guo, MD, Guangzhou, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To investigate the pathogenetic mechanism of "submucosa linear enhancement" and to further evaluate its application value in preoperative staging of organ confined bladder carcinoma.

**METHOD AND MATERIALS**
The examination protocol was approved by the institutional medical ethics committee and informed consent was obtained from all patients. 59 patients with suspected or confirmed urothelial bladder cancer and no renal function impairment were enrolled in the study. All patients underwent MRI within 2-weeks before surgery. Two image sets of T2WIandDW-MRI and T2WIandDCE-MRI were independently interpreted by two readers at 2-week intervals by analyzing whether there were "inchworm" sign on DWI and "submucosa linear enhancement" sign on early phase of DCE-MRI, which were further comparatively analyzed with pathology. Tumor size was also compared.

**RESULTS**
92 carcinomas (79 T1, 13 T2) were analyzed. 58 presented "submucosa linear enhancement" on early phase of DCE-MRI which manifested three types as follow: continuous linear enhanced submucosa gathering toward into the center of tumor (39), continuous straight and no gathering linear enhanced submucosa(14) and interrupted linear enhanced submucosa(5) respectively, and the remaining 34 lesions presented no significant linear enhanced submucosa. 42 carcinomas (38 T1, 4 T2) presented “inchworm” sign on DWI, with the remaining 50 lesions (41 T1, 9 T2) shown not. Statistical significance were found for tumor size between carcinomas presented "inchworm" sign and those without, which had a median of 21.5mm for the former, and 13.0mm for the latter.

CONCLUSION

Presentation of "submucosa linear enhancement" under the tumor base on DCE-MRI is a significant imaging sign which can be applied in preoperative staging of organ confined bladder carcinoma. Presentation of either straight or gathered continuous "enhanced submucosa line" often suggests bladder muscle wall have not been involved.

CLINICAL RELEVANCE/APPLICATION

DCE-MRI and DWI can supply us an optimal imaging tool for preoperative staging of organ confined bladder carcinoma and is highly recommended.
PURPOSE
Effective 7/01/2012, we implemented the trinary interpretation system for reporting results of lung ventilation/perfusion (V/Q) scintigraphy, i.e. 'PE present', 'PE absent', or 'nondiagnostic'. Our goal was to determine the discrepancy rate between on-call preliminary V/Q scan interpretations made by the residents, vs the final interpretation made by the supervising attending MD, using this new reporting system.

METHOD AND MATERIALS
Over a 2 year interval from 7/1/2012 to 7/1/2014, we tabulated (1) the total number of V/Q scans preliminary read by our nuclear medicine residents on call, and (2) the number of V/Q scans in which the final interpretation later made by the supervising attending was discordant with the residents' preliminary reading.

RESULTS
A total of 458 V/Q scans during the on-call hours were initially reviewed and interpreted by nuclear medicine residents in our academic 600-bed hospital over this 2 year period. Of these, 17 (3.71%) initial interpretations were changed in the final scan reports signed by the attending MD. This discrepancy rate is significantly lower compared to the scan interpretation based on probabilities of pulmonary embolism used previously. For example, the discrepancy rate during the academic year 7/2/2011 to 7/1/2012 was 7.66%.

CONCLUSION
Implementation of the trinary interpretation strategy for V/Q scintigraphy works very well in the academic setting of a nuclear medicine residency program.

CLINICAL RELEVANCE/APPLICATION
Adaptation of the trinary interpretation strategy for V/Q scintigraphy is feasible in the academic environment.
RESULTS
Nine HL, 5 follicular NHL, 4 diffuse large B-cell NHL, 4 mantle cell NHL, and one post-transplant NHL were included. A total of 90 lesions were available for quantitative analysis (32 lesions in HL group, which was also analyzed separately). For HL and NHL combined, the correlations between SUVmax and ADCmean, and between SUVmean and ADCmean, were, respectively, \( r = 0.19 (P = 0.073) \) and \( r = 0.15 (P = 0.89) \). For HL, the correlation between SUVmax and ADCmean was \( r = 0.094 (P = 0.61) \), and between SUVmean and ADCmean \( r = -0.23 (P = 0.18) \).

CONCLUSION
Our results demonstrated no statistically significant correlation between SUVs and ADCs for all lymphomas combined. While in the HL subgroup a significant, negative correlation was observed, the degree of correlation was rather low. Thus, there appears to be no relevant relationship between the degree of glycolytic activity and cell density in untreated lymphoma.

CLINICAL RELEVANCE/APPLICATION
SUV and ADC values obtained by [18]-FDG-PET/MR do not show a clinically relevant correlation in Hodgkin or Non-Hodgkin lymphoma.

SST08-03  A Comparison Trial of 18F-FDG PET/CT vs Integrated 18F-FDG PET/MRI vs MRI Alone for Detection of Adenocystoid Carcinoma

Participants
Lale Umutlu, MD, Essen, Germany (Presenter) Consultant, Bayer AG
Markus Ruhlmann, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Heusch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Thomas C. Lauenstein, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Michael Forsting, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Marc U. Schlarrann, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Verena Ruhlmann, Essen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Adenoid cystic carcinomas (ACC) are known to most commonly arise within secretory glands of the head and neck, revealing the lung and liver as sites of most common distant metastasis. The aim of our trial was to compare the diagnostic potential of 18F-FDG PET/CT with integrated 18F-FDG PET/MRI to MRI alone for detection of ACC and potential metastases.

METHOD AND MATERIALS
A total of 35 patients suspect for ACC underwent an 18F-FDG PET/CT (Biograph mCT 128, Siemens) and a simultaneous 18F-FDG PET/MRI examination (Biograph mMR, Siemens). The PET/MR scan protocol comprised: 1) HASTE, 2) DWI and a) T1 fs post-contrast FLASH sequence after the application of 0.05 mmol kg/bw Gadoteric acid (Dotarem, Guerbet). The corresponding datasets (PET/CT, PET/MRI and MRI alone) were read separately by two radiologists for identification of malignant lesions (2 point ordinal scale), localization, conspicuity (4 point ordinal scale) as well as diagnostic confidence (3 point ordinal scale). All available data (histology, prior examinations, PET/MRI, follow-up examinations) served as standard of reference. Mean values were compared using Wilcoxon rank sum test.

RESULTS
Malignant disease was present in 22 of 35 patients. 18F-FDG PET/CT and PET/MRI enabled correct identification of all 22 patients (100%), while MRI alone only allowed for correct identification of 18 patients (81.2%). PET/MRI showed significantly higher lesion conspicuity assessment of the primary ACC lesions and liver metastases over PET/CT (PET/MRI: 3.7±0.28; PET/CT: 3.3±0.35). Both hybrid imaging techniques showed superior overall ratings for detection of malignant lesions, lesion conspicuity and diagnostic confidence, when compared to MRI alone (diagnostic confidence: PET/MRI: 2.7±0.3; PET/CT 2.5±0.5; MRI alone: 1.9±0.3).

CONCLUSION
Both hybrid imaging techniques provide comparably high-quality assessment of malignant disease in patients suspect for ACC, offering a significant improvement in diagnostic competence when compared to MRI alone.

CLINICAL RELEVANCE/APPLICATION
Based on the significant reduction of ionizing radiation (compared to PET/CT) and improved diagnostic competence (compared to MRI alone), integrated PET/MRI can be considered a highly valuable diagnostic tool for assessment of patients with ACC.

SST08-04  Higher Sensitivity of SPECT-CT in Sentinel Lymphnode Detection

Participants
Khushboo Gupta, MD, Mumbai, India (Presenter) Nothing to Disclose

PURPOSE
With newer trend of minimally invasive onco-surgeries to minimise functional impairment, it is important to stage the disease in presurgery as well as intrasurgery setting. Sentinel node biopsy is one of the intrasurgical method in which the most probable draining node of the primary site is excised and studied for metastatic tumor dissemination. Identification of sentinel node is hence crucial. Various methods like methylene blue dye and sentinel node lymphoscintigraphy (planar and SPECT-CT imaging) are available. We compared these modalities at our institution.

METHOD AND MATERIALS
32 biopsy proven pre-treatment cases of breast carcinoma (24/32) and head and neck cancer (8/32: 4 patients with tongue cancer and 4 patients with buccal cancer) underwent sentinel node lymphoscintigraphy. 5 to 10 M bq of 99mTc− sulphur colloid was injected intradermally in peritumoral region (if the primary lesion was more than a centimeter) or subcutaneously above the lesion (if
RESULTS

Multiple nodes were identified (54 sentinel nodes), with more than one node identified in 18 cases. Total number of nodes biopsied were 48, out of which methylene blue dye could identify 31/48 nodes; Planar lymphoscintigraphy could identify 38/48 nodes whereas SPECT-CT could identify 44/48 nodes. Post operative histopathology results revealed metastatic nodes in 14 cases (11 breast carcinoma and 3 head and neck carcinoma). Results were compared with positive (for metastases) sentinel node identified by either of the above method. Methylene blue dye identified 6/14 cases (42.8%), planar imaging identified 9/14 cases (64.5%) and SPECT-CT identified 13/14 cases (92.8%).

CONCLUSION

SPECT-CT lymphoscintigraphy thus proves to have higher sensitivity in identifying the sentinel node and hence contributes in patient management.

CLINICAL RELEVANCE/APPLICATION

Sentinel node identification method with SPECT-CT lymphoscintigraphy valuably contributes to perform minimal invasive surgeries and decrease the post surgery morbidity in Stage I cancer patients.

SS08-05 18-F Fluoride PET/CT Bone Scans: Its Additional Utility Over Planar Bone Scintigraphy in the Detection of Bone Metastases from Breast Cancer Patients and Its Impact on Patient Management

Friday, Dec. 4 11:10AM - 11:20AM Location: S505AB

Participants
Randeep K. Kulshrestha, MBBS, Manchester, United Kingdom (Presenter) Nothing to Disclose
Sobhan Vinjamuri, MBBS,FRCP, Liverpool, United Kingdom (Abstract Co-Author) Nothing to Disclose
Peter Hogg, Manchester, United Kingdom (Abstract Co-Author) Nothing to Disclose
Andrew England, PhD, Salford, United Kingdom (Abstract Co-Author) Nothing to Disclose

BACKGROUND

Background: 18-F fluoride PET was first proposed as a bone scanning agent in 1962 by Blau et al (Blau M, Nageler W, Bender MA. Fluorine-18: a new isotope for bone scanning. J Nucl Med 1962; 3:332-4). Today it is undergoing a resurgence of interest by utilizing it in more readily available PET/CT scanners. It has been shown to more accurate in detecting bone metastases in breast and prostate cancer patients. Aims: To compare the sensitivity, specificity, accuracy and equivocal rates of planar bone scintigraphy with 18-F Fluoride PET/CT in detecting bone metastases in breast cancer patients. To assess reasons for any extra imaging performed.

METHOD AND MATERIALS

Retrospective review of 96 patients with breast cancer who underwent initially bone scintigraphy and then later on, an 18-F fluoride bone PET/CT scan. Gold standard was follow-up and other imaging modalities. Proportions of true positives, false positives, true negatives and false negatives were tabulated. The specific reasons for extra imaging was assessed.

RESULTS

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy for planar bone scintigraphy was 85%, 75%, 57.5%, 93% and 78% and for 18-F fluoride bone PET/CT it was 93.5%, 92%, 85%, 97% and 93% respectively. Proportion of equivocal studies for bone scintigraphy was 21/96 patients (22%), and the majority of these, 17/21 (81%) required further radiographic imaging which showed benign pathology. Proportion of equivocal studies for 18F-Fluoride PET/CT was 8/96 patients (8%), and all of these had further imaging (e.g. MR scan) which showed more serious clinical pathology (e.g. cauda equina).

CONCLUSION

18-F Fluoride PET/CT bone scans are more sensitive, specific, and accurate compared with planar bone scintigraphy, with reduced proportion of equivocal studies performed. Further imaging rates to confirm benign disease are significantly lower for 18-F Fluoride PET/CT, and this impacts on patient management with fewer anxious waits for tests. Further imaging tended to show more serious associated pathology picked up by the low dose CT component, more definitively impacting on patient management.

SS08-06 Diagnostic Accuracy of [18]F-FDG PET/MR Compared to [18]F-FDG PET/CT and MRI in Squamous Cell Carcinoma of the Head and Neck Area

Friday, Dec. 4 11:20AM - 11:30AM Location: S505AB

Participants
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Philipp Heusch, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Marcus Ruhlmann, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Christian Buchbender, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Axel Wetter, Essen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To compare the diagnostic accuracy of integrated [18]F-fluorodeoxyglucose positron emission tomography/magnetic resonance imaging (PET/MRI) with [18]F-fluorodeoxyglucose positron emission tomography/CT (PET/CT) and magnetic resonance imaging (MRI) in the detection of squamous cell carcinoma of the head and neck area.

RESULTS

The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy for PET/MR were 91%, 75%, 82%, 92%, and 86%, respectively. For PET/CT, these values were 89%, 74%, 80%, 91%, and 85%, respectively. For MRI, the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were 89%, 72%, 78%, 85%, and 77%, respectively. A comparison of PET/MR and PET/CT showed significantly higher sensitivity, specificity, positive predictive value, and accuracy for PET/MR.

CONCLUSION

PET/MR is a promising imaging modality for the detection of squamous cell carcinoma of the head and neck area, with significantly higher diagnostic accuracy compared to PET/CT and MRI.

SS08-05 18-F Fluoride PET/CT Bone Scans: Its Additional Utility Over Planar Bone Scintigraphy in the Detection of Bone Metastases from Breast Cancer Patients and Its Impact on Patient Management

Friday, Dec. 4 11:10AM - 11:20AM Location: S505AB

Participants
Randeep K. Kulshrestha, MBBS, Manchester, United Kingdom (Presenter) Nothing to Disclose
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Andrew England, PhD, Salford, United Kingdom (Abstract Co-Author) Nothing to Disclose

BACKGROUND

Background: 18-F fluoride PET was first proposed as a bone scanning agent in 1962 by Blau et al (Blau M, Nageler W, Bender MA. Fluorine-18: a new isotope for bone scanning. J Nucl Med 1962; 3:332-4). Today it is undergoing a resurgence of interest by utilizing it in more readily available PET/CT scanners. It has been shown to more accurate in detecting bone metastases in breast and prostate cancer patients. Aims: To compare the sensitivity, specificity, accuracy and equivocal rates of planar bone scintigraphy with 18-F Fluoride PET/CT in detecting bone metastases in breast cancer patients. To assess reasons for any extra imaging performed.

METHOD AND MATERIALS

Retrospective review of 96 patients with breast cancer who underwent initially bone scintigraphy and then later on, an 18-F fluoride bone PET/CT scan. Gold standard was follow-up and other imaging modalities. Proportions of true positives, false positives, true negatives and false negatives were tabulated. The specific reasons for extra imaging was assessed.

RESULTS

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy for planar bone scintigraphy was 85%, 75%, 57.5%, 93% and 78% and for 18-F fluoride bone PET/CT it was 93.5%, 92%, 85%, 97% and 93% respectively. Proportion of equivocal studies for bone scintigraphy was 21/96 patients (22%), and the majority of these, 17/21 (81%) required further radiographic imaging which showed benign pathology. Proportion of equivocal studies for 18F-Fluoride PET/CT was 8/96 patients (8%), and all of these had further imaging (e.g. MR scan) which showed more serious clinical pathology (e.g. cauda equina).

CONCLUSION

18-F Fluoride PET/CT bone scans are more sensitive, specific, and accurate compared with planar bone scintigraphy, with reduced proportion of equivocal studies performed. Further imaging rates to confirm benign disease are significantly lower for 18-F Fluoride PET/CT, and this impacts on patient management with fewer anxious waits for tests. Further imaging tended to show more serious associated pathology picked up by the low dose CT component, more definitively impacting on patient management.

CLINICAL RELEVANCE/APPLICATION

Sentinel node identification method with SPECT-CT lymphoscintigraphy valuably contributes to perform minimal invasive surgeries and decrease the post surgery morbidity in Stage I cancer patients.

SS08-06 Diagnostic Accuracy of [18]F-FDG PET/MR Compared to [18]F-FDG PET/CT and MRI in Squamous Cell Carcinoma of the Head and Neck Area

Friday, Dec. 4 11:20AM - 11:30AM Location: S505AB

Participants
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PURPOSE

To compare the diagnostic accuracy of integrated [18]F-fluorodeoxyglucose positron emission tomography/magnetic resonance imaging (PET/MRI) with [18]F-fluorodeoxyglucose positron emission tomography/CT (PET/CT) and magnetic resonance imaging (MRI) in the detection of squamous cell carcinoma of the head and neck area.
highly aggressive breast carcinoma and a very important tool for determining the treatment plan. The SUVmax is more useful for predicting the prognosis of breast carcinoma than ADC values. SUVmax was associated with numerous prognostic factors such as tumor size, axillary LN metastasis, nuclear grade, expression levels of ER, PR, human epidermal growth factor receptor 2 (HER2), and Ki-67. The relationship among SUVmax, ADC values, and pathologic prognostic factors were evaluated.

RESULTS
The mean value of SUVmax and ADCmean values was 5.58±3.88 (range, 1.2-24.17) and 892±218×10-6 mm2/s (range, 452-1574×10-6), respectively. There was mild correlation between the SUVmax and ADCmean values (correlation coefficient r=-0.37, p<0.001). SUVmax was associated with numerous prognostic factors such as tumor size (p<0.0001), axillary LN metastasis (p<0.0001), TNM staging (p<0.0001), histology (p=0.00049), nuclear grade (p<0.0001), and expression levels of ER (p=0.0041), PR (p=0.00045), HER2 (p=0.00059), and Ki-67 (p<0.0001). Meanwhile, ADCmean values were associated with tumor size (p=0.013), axillary LN metastasis (p=0.0038), TNM staging (p<0.0001), histology (p=0.013), and expression of Ki-67 (p=0.0014).

CONCLUSION
SUVmax is more useful for predicting the prognosis of breast carcinoma than ADC values.
PURPOSE

Body neuroendocrine tumors (NET) constitute a heterogeneous group of neoplasms with a high somatostatin receptor expression. Indium-111 Octreotide provides functional information and combination with CT provides accurate localization. The purpose of this study was to evaluate the added value of SPECT-CT imaging over planar and SPECT imaging for identifying additional foci of neuroendocrine tumors.

METHOD AND MATERIALS

This is a retrospective study reviewing 51 patients that had undergone 111-Indium for tumor localization and restaging at our institution from October 2013 to the present. Patients were imaged using initial planar imaging, SPECT, and SPECT-CT. Two experienced Nuclear Medicine physicians read each study by consensus and rated as low, moderate, or high diagnostic confidence. Number of lesions identified on SPECT-CT was compared to SPECT and planar imaging. In addition we evaluated the number of false positive lesions on planar and SPECT that could be excluded on subsequent SPECT-CT. Clinical history and pathology was reviewed.

RESULTS

There were 51 patients, 29 female and 22 males with mean age 61yrs. 109 lesions identified on SPECT-CT compared to 63 lesions identified on SPECT and 47 lesions were seen on planar images. SPECT-CT identified additional lesions, improved characterization of lesions and increased the diagnostic confidence in 20 patients (39%). On SPECT-CT the distribution of additional true positive lesions identified was as follows liver (7), pancreas (7), small bowel (2), lymph nodes (9), peritoneal carcinomatosis (3), breast uptake (1), lungs (3), bone (1). In addition benign lesions (false positive) as gynecomastia, post surgical uptake, renal cysts, thyroid uptake, adrenal uptake and skin uptake accounted for the rest and were reliably excluded.

CONCLUSION

Conclusions: SPECT combined with high quality diagnostic CT is superior to conventional planar and SPECT alone imaging in the diagnosis of neuroendocrine tumors. It increases the diagnostic confidence, improves lesion detection, localization and characterization.

CLINICAL RELEVANCE/APPLICATION

The added value of SPECT-CT over planar and SPECT imaging provides a more accurate diagnosis for the clinician and therefore better treatment for the patient.
CLINICAL RELEVANCE/APPLICATION

The combination of [18F]-FDG-PET and DWI may produce results that are less rater dependent, with regard to the detection of bone marrow involvement in lymphoma; thus, PET/MR may be preferrable to the stand-alone techniques.
PURPOSE
To investigate the association between NT-proBNP, a marker of heart disease, and imaging markers of subclinical brain disease on magnetic resonance imaging (MRI) in community-dwelling persons who are free of stroke, dementia, and a clinical diagnosis of cardiovascular disease.

METHOD AND MATERIALS
In 2,475 persons (mean age 56.6 years; 57.3% women) from a prospective population-based study we measured NT-proBNP in serum. All persons underwent brain MRI on a 1.5-tesla MRI system, yielding imaging markers for global brain structure, focal abnormalities (lacunes, white matter lesions, cerebral microbleeds), and microstructural white matter integrity. We used multivariable linear and logistic regression models to investigate the association between NT-proBNP (continuous levels and per tertile) and markers of subclinical brain disease.

RESULTS
Higher NT-proBNP was associated with smaller total brain volume (mean difference per SD increase in NT-proBNP: -0.023, 95% confidence interval [CI] -0.036; -0.009, p=0.001), predominantly driven by grey matter volume (mean difference per SD increase in NT-proBNP: -0.037, 95%CI -0.057; -0.017, p<0.001), and less by white matter volume. Higher NT-proBNP was associated with larger white matter lesion volume (mean difference per SD increase in NT-proBNP: 0.099, 95%CI 0.060; 0.137, p<0.0001), and with lower fractional anisotropy and higher mean diffusivity in white matter.

CONCLUSION
In community-dwelling persons, subclinical cardiac dysfunction as reflected by serum NT-proBNP levels, is associated with global and microstructural imaging markers of subclinical brain disease.

CLINICAL RELEVANCE/APPLICATION
Our data provide more insight into the heart-brain connection, which is essential since both cardiac dysfunction and subclinical brain disease are growing problems in an aging population.
with the pathological lesions located in the trunk of the carotid artery were divided into 2 groups as follows: group 2A comprised the 38 patients treated with embolization, and group 2B comprised the 18 patients treated with stent-graft placement. Fisher's exact test was used to examine endovascular methods, clinical severities, and postprocedural clinical diseases as predictors of outcomes.

RESULTS

Technical success and immediate hemostasis were achieved in all patients. The results according to endovascular methods (group 1 vs 2A vs 2B) were as follows: technical complication (1/40[2.5%] vs 9/38[23.7%] vs 9/18[50.0%]), P=0.0001; rebleeding (14/40[35.0%] vs 5/38[13.2%] vs 7/18[38.9%]), P=0.0435. The results according to clinical severity (acute vs ongoing PCBS) were as follows: technical complication (15/47[31.9%] vs 4/49[8.2%]), P=0.0035; rebleeding (18/47[38.3%] vs 8/49[16.3%]), P=0.0155. The results according to post-procedural clinical disease (regressive vs progressive change) were as follows: alive (14/21[66.7%] vs 8/75[10.7%], P<0.0001); survival time (34.1±30.6[0.3-110] vs 3.6±4.0[0.07-22] months, P<0.0001).

CONCLUSION

We suggest that taking embolization whenever this is possible, performing endovascular intervention in slight clinical severity and aggressive management of the post-procedural clinical disease can improve the outcomes of endovascular management.

CLINICAL RELEVANCE/APPLICATION

As embolization is the best option of PCBS, application of pre-procedural and post-procedural CT/CTA for disease predication and follow-up can be a central role of its management. Aggressive management of the post-procedural clinical disease is also mandatory.

SST09-03 3D Black-Blood T1-mVISTA for the Diagnosis of Temporal and Ophthalmic Involvement in Patients with Giant Cell Arteritis

Friday, Dec. 4 10:50AM - 11:00AM Location: N226

Participants
Nora N. Kammer, MD, Munich, Germany (Presenter) Nothing to Disclose
Karla Maria Treidl, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
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Tobias Saam, MD, Munich, Germany (Abstract Co-Author) Research Grant, Diamed Medizintechnik GmbH; Research Grant, Pfizer Inc

PURPOSE

To assess the diagnostic accuracy of a modified, sub-millimeter isotropic whole-brain 3D black-blood T1w-TSE sequence (T1-mVISTA) for the diagnosis of temporal and ophthalmic involvement in patients with giant cell arteritis.

METHOD AND MATERIALS

28 patients were included in this study: 9 patients with clinically diagnosis of temporal arteritis (age: mean: 70.4; median 73; 5 male) and 19 controls (age: mean: 62.3 median 63; 7 male). Among patients with temporal arteritis, 5 were also positive for nonatherosclerotic anterior ischemic optic neuropathy (AION) as defined by fundoscopy. A contrast-enhanced T1-mVISTA sequence (resolution=0.8mm isotropic, scan time 4:43 minutes) was acquired at 3T, additionally to the standard MRI sequences. Two radiologists assessed the images in consensus blinded to the clinical diagnosis. Left/right temporal and short posterior ciliary arteries were evaluated for the presence of mural thickening and contrast enhancement of the vessel wall, indicating arteritis (overall 112 arterial segments). Regional fat suppression (3-point Likert scale), over all image quality (4-point Likert scale) and diagnostic confidence for the presence or absence of arteritis (5-point Likert scale) were also assessed.

RESULTS

Contrast-enhanced T1-mVISTA sequence had a high sensitivity and specificity (100% and 94.7%, respectively) for the diagnosis of temporal arteritis. Positive and negative predictive values (PPV and NPV) were 90.0% and 100%, respectively. Sensitivity and specificity for vasculitis of the short posterior ciliary arteries in patients with clinical confirmed AION was 83.3% and 75.0%, respectively resulting in PPV of 83.3% and NPV of 75.0%. Over all image quality (mean: 3.8±0.6; median: 4) and regional fat suppression were good (temporal: mean: 2.8±0.4; median: 3; ophthalmic: mean: 2.5±1.2; median: 3) and diagnostic confidence was high (mean: 4.8±0.5; median: 5).

CONCLUSION

3D black-blood T1-mVISTA allows an accurate diagnosis of involvement both for the temporal arteries, as well as the short ciliary arteries in patients with giant cell arteritis.

CLINICAL RELEVANCE/APPLICATION

Whereas sonography, biopsy and fundoscopy were the methods of choice for diagnosing affection of the extracranial arteries, new MRI sequences with black-blood technique can accurately diagnose this on cross-sectional imaging.

SST09-04 Diffusion Tensor Measurement of the Corpus Callosum Correlate with Cognitive Dysfunction in Patients of Subcortical Ischemic Vascular Disease

Friday, Dec. 4 11:00AM - 11:10AM Location: N226

Participants
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ShaoFan Jiang, Fuzhou, China (Abstract Co-Author) Nothing to Disclose
Chengsheng Wang, Fuzhou, China (Abstract Co-Author) Nothing to Disclose
PURPOSE
To evaluate correlation between microstructure changes of the corpus callosum and cognitive dysfunction in subcortical ischemic vascular disease (SIVD) patients using atlas-based diffusion tensor analyses.

METHOD AND MATERIALS
50 right-handed SIVD patients were recruited and divided into vascular cognitive impairment no dementia (VCIND) group and normal cognition (NC) group. 22 VCIND patients and 28 NC patients were underwent in DTI scanning and neuropsychological assessment. Atlas-based analysis (ABA) were performed on each subject for extracting fractional anisotropy (FA) and mean diffusivity (MD) measures from all subregions of the corpus callosum. The correlation between DTI measures and MoCA scores were evaluated. Receiver operating characteristic curves were used to test for the parameter with the best sensitivity and specificity for cognitive function discrimination.

RESULTS
Among VCIND, as compared to NC patients, FA were significantly lower and MD were higher in the genu, body, splenium, left and right tapetum of the corpus callosum (all P<0.001). Moreover, MoCA scores correlated with DTI values in all subregions of the corpus callosum (all P<0.01). In addition, the highest sensitivity and specificity for discriminating between VCIND and NC patients were found for FA (77.27% and 89.29%, respectively) and MD (95.45% and 64.29%, respectively) in the body of the corpus callosum. Optimal thresholds for FA and MD in the body of the corpus callosum for differentiating VCIND and NC patients were 0.421 and 1.038, respectively.

CONCLUSION
The corpus callosum damage occurs in SIVD patients with cognitive impairment, and the damage correlate with cognitive dysfunction. Using Atlas-based DTI analysis can evaluate the severity of this disease.

CLINICAL RELEVANCE/APPLICATION
The DTI measures of the corpus callosum can reflect cognitive impairments in SIVD patients and serve as imaging biomarkers for early diagnosis and disease progression of cognitive impairments.

SST09-05  Accuracy of Carotid In-Stent Stenosis Measurement in a Phantom Model Using Effective Atomic Number Imaging Produced by Dual Layer Dual Energy CT

Participants
Elieh Ben-David, MD, Jerusalem, Israel (Presenter) Nothing to Disclose
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Jacob Sosna, MD, Jerusalem, Israel (Abstract Co-Author) Consultant, ActiViews Ltd Research Grant, Koninklijke Philips NV

PURPOSE
In-stent plaque stenosis is difficult to assess in CT angiography of the neck. Effective Atomic Number (EAN) is a projection-space reconstruction of the spectral raw data that calculates the effective atomic number of the voxels. Our purpose was to examine accuracy of in-stent plaque measurement using EAN imaging produced by dual layer dual energy CT in a phantom model.

METHOD AND MATERIALS
A Conichrome stent containing an enhanced radiopaque tantalum core (WALLSTENT, Boston Scientific) and a Nitinol stent (PRESCISE PRO RX, Cordis), both of 0.2mm thickness and 8 mm diameter, were deployed around water-equivalent tubes of 1.5mm wall thickness and 5.0mm lumen. Each tube was filled with iodine solution (16mg/ml), immersed in a water-filled cylinder, and placed in a 10cm diameter water-equivalent phantom (model of in-stent stenosis). The phantom was scanned using a dual layer dual energy CT (Philips Healthcare, Cleveland, OH, USA) at 120kVp and 250mAs and generated simultaneous conventional 120 kV and EAN datasets. Full Width at Half Maximum (FWHM) technique was used to measure accuracy and reproducibility of tube lumen and wall thickness in both datasets.

RESULTS
In the conventional dataset, the average wall thickness and lumen diameter of the Conichrome and Nitinol stents were 0.8 and 4.8mm, and 1.1 and 4.7mm, respectively, reflecting a deviation of -40.7%, -10.0% and -26.7.0%, -6.0% from actual dimensions. In the EAN dataset, the measurements were 1.3, 4.3 mm and 1.2, and 4.6mm, respectively, reflecting a deviation of -13.3%, -14.0% and -20.0%, -8.0% from actual dimensions. For the Conichrome stent the blooming artifact in the conventional dataset was reduced in EAN imaging, and the visualization of the tube wall mimicking the stenosis was improved. For the Nitinol stent, both datasets showed comparable visualization.

CONCLUSION
In our model, EAN imaging, produced by dual layer dual energy CT, improves visualization and increases accuracy of in-stent stenosis assessment in a tantalum-core Conichrome stent.

CLINICAL RELEVANCE/APPLICATION
Carotid in-stent stenosis in high-attenuation metallic metal stents may be more accurately evaluated using effective atomic number (EAN) imaging produced by dual layer dual energy CT.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/
An optimal combination of stenosis \( \geq 50\% \), PB \( \geq 77\% \) and MLA \( \leq 2.0\text{mm}^2 \) produced a significantly improved positive predictive value (PPV) and specificity. Further analysis demonstrated that combinations of PB, MLA and stenosis could improve positive predictive value with AUC being 0.649, 0.732 and 0.737 for stenosis, PB and MLA, respectively. MR data from 165 lesions (112 culprit and 53 non-culprit) in 139 individuals were included. Culprit lesions were larger and longer with a bilateral minimum luminal area (MLA). A culprit plaque was defined as a lesion arising on the ipsilateral side to an ischemic stroke on neuroimaging with accompanying clinical symptoms, whilst a non-culprit plaque was defined as either a plaque occurring in a contralateral artery of a symptomatic patient or one in asymptomatic controls.

**METHOD AND MATERIALS**

Patients suspected with atherosclerotic stenosis of MCA underwent hrMRI. Luminal stenosis was measured from TOF images. Lumen and outer wall boundary were manually segmented, allowing calculation of plaque burden (PB), volume (PV), length (PL) and minimum luminal area (MLA). A culprit plaque was defined as a lesion arising on the ipsilateral side to an ischemic stroke on neuroimaging with accompanying clinical symptoms, whilst a non-culprit plaque was defined as either a plaque occurring in a contralateral artery of a symptomatic patient or one in asymptomatic controls.

**RESULTS**

MR data from 165 lesions (112 culprit and 53 non-culprit) in 139 individuals were included. Culprit lesions were larger and longer with a narrower lumen and increased PB compared with non-culprit lesions. More culprit lesions showed contrast enhancement. Both PB and MLA were better indicators than stenosis in differentiating lesion types with AUC being 0.649, 0.732 and 0.737 for stenosis, PB and MLA, respectively. Further analysis demonstrated that combinations of PB, MLA and stenosis could improve positive predictive value (PPV) and specificity significantly. An optimal combination of stenosis \( \geq 50\% \), PB \( \geq 77\% \) and MLA \( \leq 2.0\text{mm}^2 \) produced a significantly improved positive predictive value (PPV) and specificity.
**CONCLUSION**

hrMRI plaque imaging provides incremental information to luminal stenosis in differentiating patient clinical presentations. Both luminal and plaque-based measures should be considered in an integrative way for the accurate identification of MCA culprit plaques.

**CLINICAL RELEVANCE/APPLICATION**

For evaluating culprit plaque of MCA, both luminal and plaque-based measures should be considered in an integrative way, and the optimal combination of morphological characters were stenosis ≥50%, PB ≥77% and MLA ≤2.0mm².

**PURPOSE**

3D black-blood (BB) MRI can provide high-resolution images and improved anatomic coverage with retrospective visualization of the vessel wall using multiplanar reconstruction. However, no report has described the comparison between the two 3D T1-weighted (T1-W) sequences including 3D turbo spin-echo (TSE) and 3D turbo field-echo (TFE) T1-W BB MRI. The aim of our study is to compare the capability in the delineation of cervical carotid plaque and the difference of signal-intensity ratio of the plaque to adjacent muscle between 3D T1-W TSE and T1-W TFE BB MRI in patients with cervical carotid stenosis.

**METHOD AND MATERIALS**

43 patients with moderate or severe cervical carotid stenosis confirmed by 3D rotational angiography were studied with 3D T1-W TSE and 3D T1-W TFE BB MRI at 3T (Achieva, Philips). The border between plaque and the lumen was rated visually (four-point analysis) and quantitatively (contrast-to-noise ratio; CNR). The signal-intensity ratio (SIR) of the plaque to adjacent muscle was also measured. The data were analyzed statistically between 3D T1-W TSE and 3D T1-W TFE using a Wilcoxon signed-rank test.

**RESULTS**

Visual analysis and quantitative analysis revealed that the border between plaque and lumen was better delineated on 3D T1-W TSE than on 3D T1-W TFE BB MRI (p < 0.01, respectively). 3D T1-W TFE BB MRI occasionally showed incomplete suppression of blood signal, resulting in poor rating particularly in cases with iso-signal-intensity plaques. The SIR of plaque to adjacent muscle was higher on 3D T1-W TFE than on 3D T1-W TSE BB MRI (p < 0.05). High-signal-intensity plaques with a SIR greater than 1.5 (intraplaque hemorrhage) were underestimated in 20% of cases using 3D T1-W TSE BB MRI.

**CONCLUSION**

Our results showed that 3D T1-W TSE BB MRI was superior to 3D T1-W TFE BB MRI for plaque delineation. However, high-signal-intensity plaque suggesting intraplaque hemorrhage was underestimated using 3D T1-W TSE BB MRI. We need to know both advantages and disadvantages of the two 3D T1-W BB MRI sequences.

**CLINICAL RELEVANCE/APPLICATION**

3D T1-weighted black-blood MRI can demonstrate carotid plaque morphology and intraplaque hemorrhage and is recommended in the evaluation of cervical carotid artery stenosis.
PURPOSE
To test the feasibility of semi-quantitative dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) parameters for evaluating tumor hypoxia in a maxillofacial VX2 rabbit model.

METHOD AND MATERIALS
Eight New Zealand rabbits were inoculated with VX2 cell solution to establish a maxillofacial VX2 rabbit model. DCE-MRI were carried out using a 1.5 Tesla scanner. Semi-quantitative DCE-MRI parameters, maximal enhancement ratio (MER) and slope of enhancement (SLE), were calculated and analyzed. The tumor samples from rabbits underwent hematoxylin-eosin (HE), pimonidazole (PIMO) and vascular endothelial growth factor (VEGF) immunohistochemistry (IHC) staining, and the PIMO area fraction and VEGF IHC score were calculated. Spearman's rank correlation analysis was used for statistical analysis.

RESULTS
The MER values of eight VX2 tumors ranged from 1.132 to 1.773 (1.406±0.258) and these values were negatively correlated with the corresponding PIMO area fraction (p = 0.0000002), but there was no significant correlation with the matched VEGF IHC score (p = 0.578). The SLE values of the eight VX2 tumors ranged from 0.0198 to 0.0532 s\(^{-1}\) (0.030±0.011 s\(^{-1}\)). Correlation analysis showed that there was a positive correlation between SLE and the corresponding VEGF IHC score (p= 0.0149). However, no correlation was found between SLE and the matched PIMO area fraction (p = 0.662). The VEGF positive staining distribution predominantly overlapped with the PIMO adducts area, except for the area adjacent to the tumor blood vessel.

CONCLUSION
The semi-quantitative parameters of DCE-MRI, MER and SLE allowed for reliable measurements of the tumor hypoxia, and could be used to noninvasively evaluate hypoxia during tumor treatment.

CLINICAL RELEVANCE/APPLICATION
This preclinical feasibility study shows that DCE-MRI could serve as a potentially non-invasive and translational tool for tumor pathophysiological feature evaluation in clinical practice.
RESULTS

A total of 455 slices, 9.1±4.1 slices per patient, contained metal and were evaluated with each reconstruction method. Slices without metal were not affected by the algorithms and demonstrated identical image quality. 38% of the slices were considered nondiagnostic with FBP, 31% with MAR, but only 7% with IMAR. 33% of slices had poor image quality with FBP, 46% with MAR, and 10% with IMAR. 13% of slices with FBP, 17% with MAR and 22% with IMAR were of moderate, 16% of slices with FBP, 5% with MAR and 36% with IMAR were of good and 1% of slices with MAR and 31% with IMAR of excellent image quality.

CONCLUSION

IMAR yields the highest image quality in comparison to FBP and MAR in patients with metal hardware in the head and neck area.

CLINICAL RELEVANCE/APPLICATION

The 3D iterative approach to metal artifact reduction can significantly improve the imaging of the head and neck region whenever dental hardware might disturb clinical imaging.

SST10-03 Role of Arterial Spin Labelling in Characterizing Skull-Base Lesions

Friday, Dec. 4 10:50AM - 11:00AM Location: N227

Participants
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Didier Dormont, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
Delphine Leclercq, MD, Paris, France (Abstract Co-Author) Nothing to Disclose

PURPOSE

Classical dynamic susceptibility-contrast MRI (DSC-MRI) is a challenging technique in studying the skull base because of the air-interface artefacts. This work was aimed at investigating whether the pseudo-continuous Arterial Spin Labeling (pcASL)-MRI perfusion method can be used to adequately evaluate tumor perfusion of skull base tumors, as well as evaluating the diagnostic value of characterizing tumors by the ASL method.

METHOD AND MATERIALS

Forty-eight patients with skull base lesions were retrospectively enrolled. The lesions found were meningiomas (n=10), schwannomas (n=4), paragangliomas (3), chondrosarcoma (1), plasmocytomas (4), metastatic lesions (4), parotid lesions (4), epidermoid carcinomas (5), pituitary adenomas (5), cholesteatoma (1), hemangioblastoma (1), lymphoma (1), cystic lesions (3), and infections (2). Relative Tumor Blood Flow (rTBF) was calculated based on the pcASL data. Two expert neuroradiologists analyzed all the images. PcASL imaging was correlated to the pathology results for the lesions that underwent surgical resection (33), to other post-enhancement perfusion methods (9), to the lesion morphology, and to follow up results (10). The normalized rTBF values for the lesions in the same anatomical region were compared, at the significant level set to p<0.05.

RESULTS

The pcASL method allowed characterizing all the enrolled lesions. Moreover, there was a significant rTBF difference between cerebellopontine angle schwannoma and meningioma and between schwannoma and metastasis. For pituitary lesions, there was a significant difference between pituitary adenoma and meningioma. For jugular foramen region, there was a significant difference between paraganglioma, chondrosarcoma, and cholesteatoma. Interestingly, one case of osteoemyelitis, showed a pseudotumoral increased rTBF, and a plasmocytoma under treatment, showed low rTBF, in relation with treatment response.

CONCLUSION

The present preliminary study shows the interest of pcASL-MRI in evaluating tumor perfusion in the tumors that are located in the skull-base region. Moreover, pcASL can be helpful in the differential diagnosis of the tumors in this region without using contrast materials.

CLINICAL RELEVANCE/APPLICATION

This study shows that pcASL-MRI can be a powerful tool for detecting and characterizing skull-base lesions; it can be easily implemented in clinical practice.

SST10-04 Feasibility and Preliminary Experience of Quantitative T2 Star Mapping in the Differentiation of Benign and Malignant Thyroid Nodules in Comparison with Diffusion-weighted Imaging

Friday, Dec. 4 11:00AM - 11:10AM Location: N227

Participants
Lianming Wu, Shanghai, China (Presenter) Nothing to Disclose

PURPOSE

To investigate the feasibility of T2 star relaxation time for distinguishing benign from malignant thyroid node in comparison with diffusion-weighted (DW) imaging.

METHOD AND MATERIALS

A total of 56 consecutive patients (43 women and 13 men; age range, 23-76 years; mean [±SD] age, 51±12.3 years) with thyroid nodules, who were referred for fine-needle aspiration biopsy by endocrinology or general surgery clinics, were prospectively underwent 3.0T magnetic resonance imaging by using a multi-echo T2 star and DW imaging (maximum b value, 800 sec/mm2).
Parametric maps were obtained for apparent diffusion coefficient (ADC) and T2 star value. Two radiologists reviewed these maps and measured ADC and T2 star value. Data were analyzed by using mixed-model analysis of variance and receiver operating characteristic curves.

**RESULTS**

The T2 star values of the cancerous node (mean: 23.21 ± 0.87 ms) were significantly lower (P < 0.001) than those of benign node (mean: 5.08 ± 0.32 ms). Adopting a threshold value of 12.35 ms, Quantitative T2 star mapping resulted in 91.2% sensitivity, 79.3% specificity in the identification of thyroid cancer. The ADC values of the cancerous node (mean: 0.83 ± 0.37 ms) were significantly lower (P < 0.001) than those of benign node (mean: 1.53 ± 0.28 ms). Adopting a threshold value of 1.03 ms, ADC mapping resulted in 90.3% sensitivity, 73.2% specificity. Quantitative T2 star mapping showed significantly greater specificity for differentiating cancerous node from benign node than ADC mapping (93.3% vs 73.2%, P < 0.001), with equal sensitivity (91.2% vs 90.3%, P > 0.05).

**CONCLUSION**

Preliminary findings suggest the feasibility of performing T2 star mapping of the thyroid node acquired by using multi-echo T2 star that may provide increased sensitivity to the diagnostic performance of thyroid cancer compared with DWI. Further larger studies to confirm these preliminary findings are warranted.

**CLINICAL RELEVANCE/APPLICATION**

Preliminary findings suggest the feasibility of performing T2 star mapping of the thyroid node may provide increased sensitivity to the diagnostic performance of thyroid cancer compared with DWI.

**PURPOSE**

To assess the quantitative diffusion-weighted imaging (DWI) in distinguish papillary thyroid carcinoma (PTC) from benign thyroid nodules, and to evaluate the efficiency of DWI under different b values in discriminating between PTC and benign thyroid nodules, with pathologic analysis after surgery as reference standard.

**METHOD AND MATERIALS**

DWI was performed in 32 patients with thyroid nodules followed by surgery. DWI was examined by single-shot echo planar imaging (SE-EPI) under different b values including 0, 250, 500, 750, 1000, 1500, 2000 s/mm². The diffusion-weighted image quality of six b value groups was evaluated. Apparent diffusion coefficient (ADC) values were counted in region of interest (ROI) for b values of 0 and for each b value from 250 to 2000 s/mm². Mean ADC values in ROI and the difference between PTC regions and benign thyroid nodules were calculated using two independent sample t-test. Sensitivity, specificity and area under the curve (AUC) were acquired by ROC curve.

**RESULTS**

The contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR) were not satisfied when b value 1500 or 2000 s/mm² was adopted. The qualitative image quality was not enough to meet diagnostic requirement. The mean ADC values (± standard deviation) of the PTC regions were 1.33 ± 0.47, 0.92 ± 0.35, 0.69 ± 0.31, 0.57 ± 0.26, 0.43 ± 0.20, and 0.32 ± 0.15 x 10⁻³ mm²/s and were significantly lower than those of benign thyroid nodules (P < .005). b=500 acquired the highest AUC among all the b values. Applying a threshold ADC value of 1.32 x 10⁻³ mm²/s at b=500, the sensitivity is 73.7% and the specificity is 92.3%.

**CONCLUSION**

Quantitative DWI can distinguish PTC from benign thyroid nodules. The optimal b value for DWI at 3T MRI to identify PTC may be 500s/mm².

**CLINICAL RELEVANCE/APPLICATION**

Quantitative DWI for thyroid can play important role in the diagnose of the thyroid nodules. The optimal b value may be 500s/mm².

**PURPOSE**

Human papilloma virus (HPV) positive tumors carry a better prognosis than HPV negative ones. Although HPV positivity is proven to be independent of other known prognostic factors including age and TNM staging, yet treatment failure has been recorded. In our study we used Intra Voxel Incoherent Motion, dynamic contrast enhanced magnetic resonance perfusion imaging (DCE-MRI) and 2D, 3D volumetric parameters to find out which is the best predictor of treatment response in HPV positive oropharyngeal squamous cell carcinoma patients.
carcinoma.

**METHOD AND MATERIALS**

Patients with pathologically proven HPV positive oropharyngeal SCC were included in this study under an IRB approved protocol with signed study specific informed consent forms as a part of prospective ongoing clinical trial. All patients underwent two MRI studies, baseline scan within 1week before treatment and mid-treatment scan. According to response to treatment, patients were then categorized into 2 groups; complete responders (CR) in whom the primary has completely disappeared and partial responders (PR) where there was still a residual tumoral tissue. All morphological image analyses and segmentation were done using 3D Slicer 4.3.1 (slicer.org) and reviewed in consensus by 2 neuroradiologists. Multiple quantitative imaging features were identified including IVIM (D, D*, and f), MR-Perfusion (Ktrans, Vp, Ve, and Kep) as well as 2D and 3D volumes of the primary tumor at the first time point.

**RESULTS**

Median of the time between the two MRI was 25 days. Based on the second MRI, 75% of patients had complete response to treatment. Mann-Whitney U Exact test was used to compare baseline variables between patient with complete and partial response to therapy. Kep mean and Ktrans mean significantly higher in patients who showed partial response to treatment. Logistic Regression analysis was performed to determine the association between each of the perfusion parameters and response to treatment. Higher Ktrans had a significant association with partial response to treatment.

**CONCLUSION**

Treatment response in HPV positive oropharyngeal squamous cell carcinoma patients can be reliably predicted through different advanced MRI parameters.

**CLINICAL RELEVANCE/APPLICATION**

HPV positive OPCC response to treatment are detected using multiple advanced and conventional MRI

**SST10-07 Differentiation of the Metastatic Lymph Nodes from Thyroid Carcinoma and Squamous Cell Carcinoma and Lymphoma with Dual-Energy CT Monoenergetic Imaging**

Friday, Dec. 4 11:30AM - 11:40AM Location: N227

Participants
Yang Yaying I, MD, Kunming, China (Presenter) Nothing to Disclose
Li Qing, MD, Kunming, China (Abstract Co-Author) Nothing to Disclose
Zhao Wei, MD, Kunming, China (Abstract Co-Author) Nothing to Disclose
Yang Bin, MD, Dali, China (Abstract Co-Author) Nothing to Disclose

**Background**

Objective To explore the value of dual-energy CT monoenergetic imaging in differential diagnosis of the metastatic cervical lymph nodes in thyroid carcinoma, squamous cell carcinoma and lymphoma.

**Evaluation**

The spectrum curve slope of arterial phase and parenchymal phase can be used to differentiate lymph node metastasis of in thyroid carcinoma, the metastatic lymph nodes from lymphoma in the neck.

**Discussion**

Results Of 79 enlarged lymph nodes, 23 were metastatic lymph nodes from thyroid carcinoma, 24 from squamous cell carcinoma and 32 were lymphoma. With the increase of keV values (from 60 to 180 keV), the corresponding CT values of the three kinds of malignant lymph nodes were decreased. The higher the keV value, the smaller the CT value decrease, and the spectrum curve appeared as "drop type". The spectrum slope curve of the metastatic lymph nodes of thyroid carcinoma in arterial phase (1.23±0.41) and parenchymal phase (0.85±0.33) are maximal and the slope curve of lymphoma in arterial phase (0.40±0.16) and parenchymal phase (0.47±0.09) are the lowest. The spectrum slope curve of metastatic lymph nodes from the squamous cell carcinoma in arterial phase and parenchymal phase is 0.88±0.10 and 0.62±0.28, respectively. The spectrum curve slope of the three kinds of malignant lymph nodes have statistical significance. Comprehensive analysis showed, if 0.36 > K > 0.24 in arterial phase, it is most probably lymphoma; If 0.81≤K≤0.78, it is most probably the metastatic lymph nodes; and if 1.65≤K>0.98, it is most probably lymph node metastasis from thyroid carcinoma; in parenchymal phase, if 0.38>K≥0.34, it is most probably the metastatic lymph nodes, If 0.52>K≥0.38, it is most probably lymphoma, if 1.18≥K≥0.56, it is most probably lymph node metastasis from thyroid carcinoma.

**Conclusion**

The spectrum curve slope of arterial phase and parenchymal phase can be used to differentiate lymph node metastasis of in thyroid carcinoma, the metastatic lymph nodes from lymphoma in the neck.

**SST10-08 High Resolution Diffusion Weighted Imaging of Thyroid Gland Using Reduced FOV Technique: A Preliminary Clinical Application at 3T MRI**

Friday, Dec. 4 11:40AM - 11:50AM Location: N227

Participants
Hao Yonghong, MD, Wuhan, China (Presenter) Nothing to Disclose
Wenzhen Zhu, MD, PhD, Wuhan, China (Abstract Co-Author) Nothing to Disclose
Jianpin Qi, PhD, Wuhan, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

DWI has been shown to be useful for differentiation between benign and malignant thyroid nodules. However, due to severe susceptibility and distortion artifacts and image blurring, the diagnostic value of clinical thyroid DWI is limited. The purpose of this study was to evaluate the performance of reduced field of view (r-FOV) diffusion weighted imaging and compare the diagnostic value of r-FOV diffusion imaging and conventional diffusion imaging in patients with thyroid nodules.
METHOD AND MATERIALS

79 consecutive patients who were clinically suspected with thyroid malignant lesions by ultrasound or/and scintigraphy and 12 healthy controls were included in this study. All participants underwent r-FOV diffusion imaging and f-FOV diffusion imaging with a 3T MRI scanner. Image quality and lesion identifications were visually evaluated by two independent reviewers and image properties (SNR, CNR, geometric distortion) were quantified. The apparent diffusion coefficient values of thyroid lesions and normal thyroid parenchyma were calculated and compared between two diffusion methods. The ROC analyses for both DWI methods were performed and differences in the area under the curve were assessed.

RESULTS

Agreement between two reviewers was good for image quality and lesion identification. The image quality and lesion identification of r-FOV diffusion imaging was rated higher than that of f-FOV DW imaging (p<0.001). The geometric distortions for f-FOV DW imaging were significant higher than that for r-FOV imaging, while SNR of r-FOV imaging was slightly lower than that of conventional DW imaging. The mean ADCs of r-FOV diffusion imaging were lower than that of f-FOV diffusion imaging ignoring of different tissue types (1.42±0.44×10^-3 mm^2/s vs 1.54±0.45×10^-3 mm^2, p=0.001). There was significant difference among the ADCs of different tissue groups obtained from both r-FOV and f-FOV DWI. The areas under the curve for r-FOV (0.962) and conventional DW imaging (0.951) were not statistically different.

CONCLUSION

r-FOV diffusion imaging provide higher image quality and lesion identification than f-FOV diffusion imaging by reducing susceptibility artifacts, spatial distortion, image blurring, and were of comparable diagnostic values in nodules thyroid.

CLINICAL RELEVANCE/APPLICATION

High resolution DWI of thyroid could improve the identification and interpretation of nodules, especially for microcarcinoma.

SST10-09  The Optimization Weighting Factors of Linear Image Blending in Dual-Energy Computed Tomography for the Diagnosis of Laryngeal Carcinoma

Friday, Dec. 4 11:50AM - 12:00PM Location: N227

Participants
Mengxi Jiang, Beijing, China (Presenter) Research Grant, General Electric Company
Jian Jiang, MD, Beijing, China (Abstract Co-Author) Research Grant, General Electric Company
Yuan Jiang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Xiaoying Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the linear image-blending of varying weighting factors in dual-energy computed tomography of laryngeal carcinoma regarding subjective and objective image quality.

METHOD AND MATERIALS

Patients with biopsy-proven untreated primary laryngeal carcinoma who underwent DECT scan (100kVp/Sn140 kVp) of neck were retrospectively evaluated. Ten (9 men, 1 woman; age range, 46-76 years old) cases were enrolled. Linearly blended images series with 11 weighting factors (0 to 1.0 in steps of 0.1) were reconstructed. For objective assessment, attenuation of lesion, various anatomic landmarks, image noise, lesion contrast-to-noise ratio and signal-to-noise ratio were compared between different image datasets. For subjective assessment, two independent blinded radiologists rated overall image quality, lesion delineation, image sharpness, and image noise of each image dataset on a 5-point grading scale.

RESULTS

The mean attenuation of lesion, sternocleidomastoid muscle, internal jugular vein, and submandibular gland increased stepwise with decreasing tube voltage from Sn140 kVp through 100 kVp. CNR was the highest in the weighting factors of 0.8 (M_0.8; 12.5±5.7). M_0.8 images showed no significant differences between linearly blended image series M_0.6 (11.7±5.5; P=0.123), M_0.7 (12.3±5.6; P=1.000), M_0.9 (12.5±5.6; P=1.000) and M_1.0 (12.2±5.5; P=1.000), but differed significantly compared to the linearly blended image series M_0, M_0.1, M_0.2, M_0.3, M_0.4 and M_0.5 (P<0.05). SNR was the highest in the weighting factors of 0.7 (35.0±6.1). M_0.7 images showed no significant differences between linearly blended image series M_0.6 (34.7±6.1; P=1.000). Overall image quality was higher in M_0.9 (4.7) and M_1.0 (4.7) images, although differences to the M_0.8 (4.4) images did not reach statistical significance (P=0.083). Delineation of the tumour was rated significantly better in M_0.9 (4.4) and M_1.0 (4.4) images compared to other linearly blended image series. Scoring of the image sharpness revealed equally good results in all image series.

CONCLUSION

The linear-blending images of DECT data at the weighting factors of 0.9 and 1.0 can provide higher image quality for the diagnosis of laryngeal carcinoma.

CLINICAL RELEVANCE/APPLICATION

Linear image blending in DECT could provide more information about laryngeal carcinoma, which improved diagnostic confidence in the assessment of laryngeal carcinoma.
**PURPOSE**

Edited magnetic resonance spectroscopy (MRS), using the MEGA-PRESS sequence, is the most widely used technique for detecting gamma-aminobutyric acid (GABA) in the human brain. However, this method required a relatively large volume of interest (VOI), so the accuracy of VOI placement is important to ensure the reliability of GABA quantification. In this study the MRS voxels overlap of intra- and inter-subject were evaluated.

**METHOD AND MATERIALS**

Fifteen healthy volunteers (8 men and 7 women, 44.87±3.42 years) underwent MRS examinations. All subjects were examined on a 3T scanner using MEGA-PRESS sequence and T1-weighted 3D TFE images were used as a localizer. The unsuppressed water signal was obtained for quantification. The VOI was chosen in the parietal region (3x3x3 cm3). MEGA-PRESS was analyzed using 'Gannet' in Matlab with Gaussian curve fitting to the GABA peaks. GABA levels (institutional units) were calculated for each subject. In one subject, four continuous scans were conducted within a period of 3 weeks. The VOI was chosen in the three areas: frontal region (3x3x3 cm3), parietal region (3x3x3 cm3) and temporal region (4x2x2 cm3). Each pixel in the T1-weighted images was segmented as gray matter, white matter, or cerebrospinal fluid using the FSL software. VOIs were co-registered to the anatomical images using the "Re-creation of VOI" Matlab tool. The VOIs and anatomical images were registered to the baseline images (intra-subject) or standard space (inter-subject) using the SPM software. The Dice overlap coefficient was used to calculate the MRS voxels overlap of intra- and inter-subject.

**RESULTS**

The MRS voxels overlap of inter-subject was 78.87% ± 8.85% in parietal region. No correlation between GABA levels and gray matter volume within VOI was found in parietal region for all subjects (r=0.13, p=0.64). The MRS voxels overlap of intra-subject was 85.88% ± 5.36% in frontal region, 88.86% ± 2.45% in parietal region and 81.31% ± 3.38% in temporal region.

**CONCLUSION**

The high degree of MRS voxels overlap of intra- and inter-subject and low correlation between gray matter volume and GABA levels, suggesting that VOI placement using MEGA-PRESS has great repeatability, and the small variations in VOI placement and subject anatomy do not affect the GABA levels.

**CLINICAL RELEVANCE/APPLICATION**

VOI placement using MEGA-PRESS has great repeatability and MEGA-PRESS is recommended to measure GABA levels in vivo in the human brain.
Repeated intravenous administration of Gadolinium-based contrast agents (Gd-CA) has been associated with increased MRI signal intensity in T1-weighted sequences in dentate nuclei (DN). Our aim is to perform, for the first time, a quantitative MRI (qMRI) assessment of DN relaxometry in patients receiving multiple doses of Gd-CA using 0.7x0.7x1.3 mm3 resolved Gradient-Echo (GRE) sequences.

**METHOD AND MATERIALS**

From a total of 92 Multiple Sclerosis patients with normal renal function, we retrospectively selected 21 patients [Group A, M/F=5/16, age: 41±11 years, disease duration (DD): 15.9±4.1 years] who had performed, during the course of the disease, 9 or more contrast-enhanced (CE) MRI scans, and 28 patients (Group B, M/F=14/14, age: 36±11 years, DD: 7.8±6.8 years) who underwent less than 4 CE-MRI scans. A group of 28 age/sex-matched healthy controls (HC, M/F=11/17, age: 38±13 years), who underwent only unenhanced MRI, was also studied. In patients and HC, GRE sequences (TR=28ms, TE=[7,22]ms, FA=[3,20]°) were acquired at 3T and processed with an in-house software, providing quantitative estimates of R1, R2* and magnetic susceptibility (QSM) of the brain. ROIs were hand-drawn on the axial slice with the best representation of DN. Group differences in qMRI data were tested both in terms of absolute DN values and of ratios between DN and a brainstem (BS) ROI, used as internal reference.

**RESULTS**

The DN/BS ratio for R1 was significantly higher in Group A (1.17±0.09) when compared to Group B (1.10±0.08) and HC (1.11±0.07), p-values being 0.008 and 0.009, respectively. Instead, the DN/BS ratio for R1 did not differ between Group B and HC (p=0.79).

Also, no significant differences were found between the 3 groups in terms of R2* or QSM DN/BS ratios, nor of R1, R2* and QSM absolute DN values.

**CONCLUSION**

Our in vivo high-resolution quantitative relaxometric MRI analysis showed higher R1 values in patients undergoing repeated CE-MRI scans, supporting the hypothesis that Gd-CA accumulate in DN. Further longitudinal quantitative analysis of the mechanisms of Gd-CA clearance in the brain are warranted.

**CLINICAL RELEVANCE/APPLICATION**

Repeated administration of Gd-based contrast agents is associated with long-term changes in brain relaxometry, thus indirectly confirming the concerns about the stability of Gd-chelation over time.

**SST11-03 Metabolic Changes in the Bilateral Visual Cortex of Monocular Blindness Macaque Monkeys: A Multi-voxel Proton Magnetic Resonance Spectroscopy Study**

Friday, Dec. 4 10:50AM - 11:00AM Location: N230

Participants
Lingjie Wu, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Zuohua Tang, PhD, MD, Shanghai, China (Presenter) Nothing to Disclose

**PURPOSE**

To study adaptive plasticity and reorganization in the visual cortex of the monocular blind macaque using multi-voxel proton magnetic resonance spectroscopy study (1H-MRS).

**METHOD AND MATERIALS**

Four healthy neonatal macaques were randomly divided into 2 groups. One group served as control group (group A). Optic nerve transecting was performed in the right eye of the other group (group B), to establish the monocular blind model. Sixteen (group B16M) and thirty-two (group B32M) months after monocular optic nerve transecting, multi-voxel 1H-MRS was performed on the bilateral visual cortex of all monkeys, respectively. We compared NAA/Cr, Ins/Cr, Cho/Cr and Glx/Cr in the visual cortex between group A and group B as well as between the left and right visual cortices of group A and B in each time points, respectively. All of the metabolic changes detection by multi-voxel 1H-MRS were further compared with the hematoxylin-eosin and immunofluorescent staining findings.

**RESULTS**

Compared with group A, in bilateral visual cortex, NAA/Cr in both group B16M and group B32M, as well as Glx/Cr in group B32M were all significant decrease (p<0.05), whereas the Cho/Cr and Ins/Cr of group B32M were significant increase (p<0.05). Meanwhile, significant difference of NAA/Cr in group B32M was found between the left and right visual cortex, whereas no statistical difference of Ins/Cr, Cho/Cr and Glx/Cr between the left and right visual cortex was found in both group B16M and group B32M. All of these findings were further confirmed by the hematoxylin-eosin and immunofluorescent staining using anti-NeuN antibody, anti-Choline Acetyltransferase antibody and anti-EAAT3 antibody.

**CONCLUSION**

Multi-voxel 1H-MRS was able to detect the different metabolic changes in the visual cortex, which was valuable for investigating its adaptive plasticity and reorganization.

**CLINICAL RELEVANCE/APPLICATION**

Such alterations in the metabolism of the bilateral visual cortex could provide valuable information for future studies of adaptive plasticity and reorganization in visual loss or other sensory deprivation in animal models and human beings.

**SST11-04 Physiology-based MRI Assessment of CSF Flow in Chiari I Malformation (CMI)**

Friday, Dec. 4 11:00AM - 11:10AM Location: N230

Participants
Rafeeqe A. Bhadelia, MD, Chestnut Hill, MA (Presenter) Nothing to Disclose
Neel Madan, MD, Boston, MA (Abstract Co-Author) Consultant, Near Infrared Imaging, LLC; Board Member, Quindex Inc
Carl B. Heilman, Boston, MA (Abstract Co-Author) Nothing to Disclose
David B. Khatami, MD, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Yansong Zhao, Boston, MA (Abstract Co-Author) Researcher, Koninklijke Philips NV
SST11-05  Cerebral Perfusion Relates to Regional Cortical Thickness in the General Population

**PURPOSE**
Invasive pressure studies have suggested that in patients with Chiari I malformation (CMI), CSF flow across the foramen magnum transiently decreases after coughing in the presence of a clinically significant obstruction. The purpose of this study was to demonstrate this phenomenon non-invasively by assessing CSF flow response to coughing in CMI patients using MR pencil beam imaging (PBI) and compare it to healthy participants.

**METHOD AND MATERIALS**
7 CMI patients and 6 healthy participants were studied using PBI with a temporal resolution of ~50ms. Patients and participants were scanned for 90-seconds to continuously record cardiac-cycle related CSF flow waveforms as well as the heart rate and respiratory motion during resting, coughing and post-coughing periods. CSF flow waveform amplitude (ACSF), CSF stroke volume (SVCSF), and CSF flow rate (FRCSF; SVCSF x heart rate) in resting and immediate post-coughing periods were determined. Post-coughing values of all three parameters were calculated as a percentage of resting values, and compared between patients and healthy participants.

**RESULTS**
There was no significant difference in ACSF, SVCSF and FRCSF between CMI patients and healthy participants during rest. However, after coughing, a significant decrease in ACSF (p<0.001), SVCSF (p =0.001) and FRCSF (p =0.001) was observed in CMI patients compared to healthy participants.

**CONCLUSION**
Coughing decreases CSF flow across the foramen magnum in CMI patients but not in healthy participants. Real-time MRI measurement of CSF flow response to coughing may provide objective quantitative assessment of foramen magnum obstruction in CMI patients.

**CLINICAL RELEVANCE/APPLICATION**
Physiology-based MRI measurement of CSF flow may provide objective assessment of foramen magnum obstruction in CMI patients.

SST11-06  A Diffusional Kurtosis Imaging Study of Type-2 Diabetic Brain

**PURPOSE**
To investigate whether cerebral perfusion is associated with regional cortical thickness on magnetic resonance imaging (MRI) in community-dwelling persons free of stroke and a clinical diagnosis of dementia.

**METHOD AND MATERIALS**
2,961 persons (mean age 59.6 years; 54.5% women) from a prospective population-based study underwent brain MRI on a 1.5-tesla MRI system, yielding cortical thickness of 34 cortical regions using automated segmentation technique (FreeSurfer). Total cerebral blood flow (tCBF) was determined using 2D phase-contrast MRI by adding flow rates for the carotid arteries and the basilar artery and expressed in ml/min. Parenchymal CBF (mL/min/100mL) was calculated by dividing tCBF by each individual's brain volume (mL) multiplied by 100. We used multivariable linear regression models to investigate the association between cerebral perfusion and regional cortical thickness.

**RESULTS**
Both lower tCBF and pCBF were associated with thinner regions of the cortex predominantly involving the frontal lobe, and the medial posterior regions. Strongest association was found for tCBF with cortical thickness of the superior-frontal and rostral-middle-frontal region.

**CONCLUSION**
In community-dwelling persons, cerebral perfusion relates to cortical thickness variations in different brain regions.

**CLINICAL RELEVANCE/APPLICATION**
Our findings provide further insight into the pathophysiological role of cerebral perfusion in neurodegeneration in aging.
**SST11-07** Adaptive Tissue Cluster Tracking on Quantitative MRI for Fully Automatic Brain Segmentation on Young Children

Friday, Dec. 4 11:30AM - 11:40AM Location: N230

Xiaohong J. Zhou, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Diffusional kurtosis imaging (DKI) is an extension of diffusion tensor imaging (DTI) by taking non-Gaussian diffusion behavior into consideration, allowing more comprehensive characterization of diffusion in tissues. This study aims at investigating brain microstructural changes in both white matter (WM) and gray matter (GM) of type-2 diabetes mellitus (T2DM) patients using DKI.

**METHOD AND MATERIALS**

DKI (b=0, 1250, 2500 s/mm²; 25 directions) was performed at 3T on 30 T2DM patients (60.6±6.3 years old; 13 males) and 28 healthy controls (58.5±4.9 years old; 11 males). FMRIB Software Library (FSL) with tract-based spatial statistics (TBSS) was utilized to analyze the DKI metrics, including mean kurtosis (MK), axial kurtosis (Ka), and radial kurtosis (Kr) of multiple WM regions and specific GM structures in the bilateral thalamus, followed by a Pearson's correlation between MK values of selected WM fiber tracts and disease duration.

**RESULTS**

In the whole-brain TBSS analysis, the T2DM patients exhibited abnormalities in 35.4%, 10.5%, and 26.0% of WM regions as measured by MK, Ka, and Kr, respectively, when compared to the controls. A reduction in MK of the T2DM patients was caused primarily by the decreased Kr, suggesting compromised myelin sheath in the WM regions. MK and Ka also decreased in the bilateral thalamus, while Kr did not show statistically significant difference. This can be related to the compromised synapse in the thalamus, which is a sensory and movement relay between cerebral cortex and other regions of the brain and spinal cord. Atlas-based MK analyses on individual fiber tracts showed that pronounced MK reduction occurred in the internal capsule, corona radiata, cingulum (hippocampus), superior longitudinal fasciculus, corpus callosum, as well as the thalamus. Decreased MK values in the genu of the corpus callosum and anterior corona radiata were correlated with increased disease duration (R=-0.473 and -0.400 respectively, p<0.05) of the T2DM patients.

**CONCLUSION**

DKI can complement conventional DTI by providing new information to characterize and pinpoint brain microstructural changes in both WM and GM of T2DM patients.

**CLINICAL RELEVANCE/APPLICATION**

DKI can probe microstructural changes in WM and GM in patients with T2DM, and potentially provide valuable information to study diabetic encephalopathy, including cognitive impairment.

**Participants**

Marcel Warntjes, Linkoping, Sweden (Presenter) Employee, SyntheticMR AB
Suraj Serai, PhD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
James L. Leach, MD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
Blaise V. Jones, MD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose

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**SST11-08** Radiomic Texture Analysis Mapping Predicts Areas of True Functional MRI Activation

Friday, Dec. 4 11:40AM - 11:50AM Location: N230

Xiaohong J. Zhou, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Multi-parametric quantitative MRI of longitudinal T1 relaxation, transverse T2 relaxation and proton density (PD) can be achieved within a clinically acceptable scan time. It has been shown that values of T1, T2 and PD rapidly change during the first years of life. The purpose of this study was to create an algorithm that adaptively tracks the grey matter and white matter tissue properties in qMRI data, in order to segment grey matter, white matter and cerebrospinal fluid volumes of the brain, independent of age.

**METHOD AND MATERIALS**

A group of 23 quantified datasets at 3T of paediatric clinical cases in the range 0-20 years old was used to develop an algorithm to automatically track the mean T1, T2 and PD values of GM, myelinated WM and CSF. The positions of the tissue clusters were then used to define GM, myelinated WM and CSF partial volume. The sum of all partial volumes in the intracranial volume resulted in an estimation of total GM, WM and CSF volumes.

**RESULTS**

The observed T1/T2 relaxation times for GM changed from 1850/110 ms to 1360/86 ms in the first two years of life, whereas myelinated WM changed from 1080/98 ms to 720/70 ms. After two years the T1 and T2 relaxation were relatively constant. CSF had T1/T2 = 4200/1600 ms for all ages. Application of adaptive tissue cluster tracking on GM and WM showed that myelinated WM volume, an average, increased from 0 to 252 mL, CSF decreased from 241 mL to 40 mL and total brain volume increased from 403 mL to 1225 mL in the first 4 years of life. Without tissue cluster tracking the estimated WM volume was significantly lower and CSF volume was significantly higher.

**CONCLUSION**

Using adaptive tissue cluster tracking the differences in T1 and T2 relaxation between young children and adults can be corrected for, allowing fully automatic brain segmentation on all ages.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative MRI provides absolute values and improved means of statistics in clinical MRI. Automatic brain segmentation using qMRI may provide more precise monitoring and follow-up throughout life.

**Participants**

Marcel Warntjes, Linkoping, Sweden (Presenter) Employee, SyntheticMR AB
Suraj Serai, PhD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
James L. Leach, MD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
Blaise V. Jones, MD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose
Computational analysis of multi-parametric MRI data can lead to the extraction of informative and comprehensive features, equal to 0.82.

To develop an automated robust method using MR texture analysis to accurately predict areas of true functional activity

10 right-handed (5 male, 5 female) healthy individuals underwent a functional MRI study using the sentence completion task. IRB approval and informed consent were obtained in this HIPAA compliant study. fMRI data analysis was performed using statistical parametric mapping approach (SPM8). The resultant functional map was individually thresholded to optimize visualization of language area. A board-certified neuroradiologist classified different clusters into Expected (E) and Non-Expected (NE) based on their anatomical locations. Texture Analysis was performed using the mean EPI volume for each individual, and 20 rotation-invariant texture features were obtained. Logistic regression and treebagging models were used to identify significant discriminatory texture features and build predictive models for the E versus NE ROIs.

We identified 65 ROIs (23 E versus 42 NE). Logistic regression model identified specific texture features (sum variance p=0.014, sum average p=0.019, cluster shade p=0.028, cluster prominence p=0.046, correlation p=0.09) related with the homogeneity that allowed discrimination between E and NE ROIs. The AUC of the logistic regression model was 93.59% (86.58% cross-validated), specificity/sensitivity of 97.31%/74.17%. Tree-bagging model resulted in an AUC of 88.19% and specificity/sensitivity of 80.95%/86.96%.

Radiomic texture analysis of fMRI can be a useful tool for detecting areas of true functional activity and serve as a tool for eliminating false-positive or non-task related activity

Radiomic texture analysis can discriminate those areas of true functional task-related activity and thus allow for precise presurgical detection and mapping of areas of true functional eloquence in order that maximal extent of neurosurgical resection can occur while simultaneously maintaining intact neurological function.

We identified 65 ROIs (23 E versus 42 NE). Logistic regression model identified specific texture features (sum variance p=0.014, sum average p=0.019, cluster shade p=0.028, cluster prominence p=0.046, correlation p=0.09) related with the homogeneity that allowed discrimination between E and NE ROIs. The AUC of the logistic regression model was 93.59% (86.58% cross-validated), specificity/sensitivity of 97.31%/74.17%. Tree-bagging model resulted in an AUC of 88.19% and specificity/sensitivity of 80.95%/86.96%.

Non-Invasive Determination of Epidermal Growth Factor Receptor Variant III Expression in Glioblastoma through Analysis of Multi-Parametric Magnetic Resonance Imaging

Participants
Hamed Aikari, MD, PhD, Philadelphia, PA (Presenter) Nothing to Disclose
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Donald M. O'Rourke, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Christos Davatzikos, Philadelphia, PA (Abstract Co-Author) Shareholder, Gliomics LLC

PURPOSE
Epidermal growth factor receptor variant III (EGFRvIII) is the target of ongoing investigational drug trials for the treatment of glioblastoma (GB). However, tissue-based genetic testing of the EGFRvIII status is costly and not widely available. The goal of this study is to combine multi-parametric magnetic resonance imaging (MRI) data, with the intention of non-invasively determining the mutation status of EGFRvIII in patients with GB. We hypothesize that quantification of subtle, yet important, imaging phenotypes of GB from multiple MRI modalities may lead to non-invasively determining expression of molecular tumor characteristics, and particularly of the EGFRvIII oncogene.

METHOD AND MATERIALS
Preoperative multi-parametric MRI data (i.e. T1, T1-Gad, T2, T2-FLAIR, rCBV, DTI, and DSC) from 41 solitary de novo GB patients were retrospectively analyzed. Appropriate imaging features were extracted to create an integrative predictive model of EGFRvIII mutation, based on Support Vector Machines. The utilized features comprise the age of the patient, the size of the enhancing tumor, non-enhancing tumor, and edema; the tumor location, the mass-effect parameters, and the distribution of intensities of each region across all MRI modalities. Leave-one-out cross validation was used to test how well the predictive model generalizes on new unseen patient data. The results were compared with the EGFRvIII status obtained through tissue-based diagnostics.

RESULTS
The output of the predictive model is a value between -1 and 1. Values closer to 1 indicate higher probability for the subject to harbor the mutation, and values closer to -1 the opposite. A receiver operating characteristic (ROC) curve was calculated by changing the threshold in the range of the model’s output values. The accuracy of the model was calculated for the threshold equal to 0. The proposed method successfully identified the EGFRvIII mutation, with 83% accuracy and the area under the ROC curve equal to 0.82.

CONCLUSION
Computational analysis of multi-parametric MRI data can lead to the extraction of informative and comprehensive features.
Computational analysis of multi-parametric MRI data can lead to the extraction of informative and comprehensive features, representative of the distinctive imaging phenotypes related to the EGFRvIII mutation status in patients with GB.

CLINICAL RELEVANCE/APPLICATION

Analysis of multi-parametric MRI data reveals EGFRvIII mutation phenotypes in GB, hence assists in personalizing treatment whilst avoiding costly and not widely-available tissue-based genetic testing.
**Comparison of CBF Measured with Velocity-selective Arterial Spin Labeling (ASL) MRI and Pulsed ASL MRI in Pediatric Patients with Prolonged Arterial Transit Times Due to Moymoya Disease**

**Participants**
Manohar M. Shroff, MD, Toronto, ON (Moderator) Consultant, Guerbet SA; Consultant, Magellan Health, Inc
Jeremy Y. Jones, MD, Bellaire, TX (Moderator) Nothing to Disclose

**Sub-Events**

**Purpose**
To show that velocity-selective arterial spin labeling (VS-ASL) MRI is superior to pulsed ASL (PASL) MRI for measuring cerebral blood flow (CBF) in Moyamoya patients, as VS-ASL is theoretically insensitive to arterial transit delays (ATD) that can render PASL approaches inaccurate.

**Method and Materials**
Five pediatric Moymoya patients (2F, 3M, ages 3-9), two with unilateral and three with bilateral disease, one pre- and four post-syngangiosis, were imaged with both VS-ASL and PASL MRI at 3T (Siemens). VS-ASL parameters were VC=2.1 cm/s and TI=1300ms. PASL parameters were TI1=700 ms, TI2=2000-2400ms, tag width=100mm, and gap=21-25mm. Perfusion time-series data for PASL and VS-ASL were generated by performing pairwise subtractions between tag and control images. CBF maps were generated by averaging voxels across the perfusion time series and calibrating via ASL signal equations. CBF maps and values from gray matter (GM) are reported.

**Results**
For all patients, PASL shows large focal perfusion deficits and macrovascular flow artifacts, consistent with tag accumulating in large vessels and failing to reach target microvasculature. These findings highlight PASL sensitivity to increased regional ATD, resulting in artifact and apparent lack of parenchymal perfusion, a finding that could be misinterpreted as ischemia. VS-ASL, on the other hand, yields symmetric parenchymal perfusion bilaterally, and thus appears largely insensitive to the known ATD's seen in these patients. Angiographic data from one patient correlates the findings; both hemispheres show capillary blush, albeit delayed on the diseased side, as this tissue is primarily supplied by delayed flow through pial-pial collaterals. Quantitatively, VS-ASL GM CBF is similar in both hemispheres and in physiologic range (50.8± 9.8 ml/100g-min). PASL GM CBF, on the other hand, is more heterogeneous due to both perfusion deficit and macrovascular artifact, and measures below the normal physiological range (29.2± 9.0 ml/100g- min).

**Conclusion**
VS-ASL MRI is largely insensitive to arterial transit delays and as such more accurately images CBF and parenchymal perfusion in Moyamoya patients, compared to traditional PASL MRI.

**Clinical Relevance/Application**
VS-ASL has great potential for assessing perfusion in stroke, carotid stenosis, and Moyamoya patients, who often have delayed arterial transit due to large artery stenosis and secondary collaterization.

**Non-invasive Quantification of Cerebral Oxygen Metabolism in Children with Sickle Cell Disease**

**Participants**
Paula L. Croal, PhD,MSc, Toronto, ON (Presenter) Nothing to Disclose
Jackie Leung, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Andrea Kassner, PhD, Toronto, ON (Abstract Co-Author) Nothing to Disclose

**Purpose**
Ischemic stroke is a serious complication of sickle cell disease (SCD) that manifests in more than 10% of children SCD by the age of 20. It occurs when oxygen (O2) availability is inadequate to meet cerebral metabolic demands, despite the compensatory increase in cerebral blood flow (CBF) in SCD. The cerebral metabolic rate of O2 (CMRO2) may be a potential disease biomarker for ischemic risk in SCD. However, CMRO2 has not yet been quantified in children with SCD. Here, we combine MRI measurements of oxygen extraction fraction (OEF) and CBF to provide the first non-invasive quantitative measurement of CMRO2 in children with SCD.
Five SCD patients (11-18 yrs) and 4 healthy controls (12-18 yrs) were imaged on a 3T MRI scanner. Gray matter CBF was obtained using PICORE-QTIPS pulsed arterial spin labelling (TR/TE=2500/13ms, TI1/TI2=700/1800ms, voxel=3.4x3.4x4.5mm), quantified with a single-compartment kinetic model. T1 of blood was assumed to be 1660ms for a hematocrit (Hct) of 0.4 and corrected for reduced Hct on an individual basis. Global OEF is calculated from the arteriovenous difference, where arterial O2 saturation (SaO2) is assumed to be 1 in healthy controls and measured using pulse oximetry in patients. Using a 3D-FLASH GRE sequence (TR/TE=28/20ms, voxel=0.8x0.7x1.2mm), venous O2 saturation (SvO2) was measured from the phase difference between blood in the superior sagittal sinus and surrounding tissue. From Fick’s principle, CMRO2 can be computed from the product of OEF, CBF, and arterial O2 content, which is a function of SaO2 and Hct. Statistical comparisons were made between groups using an independent samples Student’s t-test (SPSSv22).

RESULTS

There was a trend for elevated GM CBF in SCD (87.3±20 ml/min/100g vs. 68.7±21 ml/min/100g), while significant reductions were observed in arterial O2 content (5.1±0.8 μmol O2/ml vs. 7.4±0.4 μmol O2/ml, p<0.01) and OEF (0.18±0.05 vs. 0.30±0.04, p<0.01). This resulted in a significantly reduced CMRO2 (78.4±23.4 μmol O2/min/100g vs. 149.4±44.9 μmol O2/min/100g, p=0.42) (Figure 1).

CONCLUSION

Global CMRO2 is significantly reduced in children with SCD and may present a novel biomarker for assessing stroke risk in this population.

CLINICAL RELEVANCE/APPLICATION

CMRO2 may provide a novel non-invasive biomarker for assessment of stroke risk in children with sickle cell disease.

SST12-03 Quantification of Age and Gender Dependence of Normal Cardiac and Intracranial Blood Flow in Pediatric Volunteers Using 2D Phase Contrast and 4D Flow MR Imaging

Friday, Dec. 4 10:50AM - 11:00AM Location: N229

Participants

Amir R. Honarmand, MD, Chicago, IL (Presenter) Nothing to Disclose
Can Wu, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Samantha E. Schoeneman, BA, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Ryan Kuhn, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Susanne Schnell, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Sameer A. Ansari, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Ali Shalbani, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

PURPOSE

To analyze the normal age and gender induced variability of cardiac and intracranial blood flow in pediatric volunteers using 2D Phase Contrast (PC) and 4D flow MRI.

METHOD AND MATERIALS

ECG-gated 4D flow MRI with volumetric coverage of the major intracranial vessels (spatial resolution =1.2mmx1.2mmx1.5mm, temporal resolution=44ms. acquisition time~10 min) was performed on volunteers under 18 years (range 6 months - 17 years) with no history of cardio/cerebrovascular diseases on 1.5 and 3T MRI scanners. In addition, 2D PC-MRI with through-plane velocity encoding at the level of proximal ascending aorta (AAo) and descending aorta (DAo) was performed in the same imaging session for all subjects. Following pre-processing, intracranial blood flow was quantified at manually positioned 2D planes orthogonal to the vessels (Fig. a). Total cerebral blood flow (TCBF) was defined as the sum of flow in bilateral intracranial carotid (ICA) and basilar arteries (BA). Aortic flow was quantified by manual segmentation of the AAo and DAo flow contours. Decomographics, body mass index (BMI), and body surface area (BSA) were obtained. Cardiac index (CI) was defined as AAo flow/BSA. Pearson correlation coefficient and polynomial and multiple regression models were used for statistical analyses.

RESULTS

Fifty two volunteers (mean age (yr) ± SD: 7.95 ± 5.04) were recruited. Both females (31) and males (21) had similar distributions of age, BMI, BSA, TCBF, and CI. An excellent correlation was observed between age and AAo/Dao flow (P<0.001, r=0.80/0.85, Fig. b). TCBF and TCBF/AAo ratio vs. age were best fitted with cubic polynomial models (P<0.001, r=0.84, r=0.93, respectively, Figs. c, d). Overall, a moderate but significant inverse correlation was detected between age and TCBF (P=0.013, r=0.34). TCBF/AAo ratio and CI were inversely correlated with age (p<0.001, r= -0.90 -0.65, respectively) (Figs. d, e). Stepwise multiple regression analysis selected CI as the only independent variable that was a predictor of TCBF (P=0.006).

CONCLUSION

These findings highlight the importance of age matched control data for the characterization of intracranial and aortic hemodynamics in children with anthropometric changes.

CLINICAL RELEVANCE/APPLICATION

Providing a control dataset for age-specific cardiac and cerebral hemodynamics in children is crucial to detect abnormal hemodynamics especially in cerebrovascular diseases’ early stages.

SST12-04 Assessment of Cerebral/Intestinal Perfusion Ratio Using Dynamic Color Doppler Sonography Quantification in Neonates with Hypoxic Ischemic Encephalopathy (HIE) Treated with Therapeutic Hypothermia

Friday, Dec. 4 11:00AM - 11:10AM Location: N229

Participants

Ricardo Faingold, MD, Montreal, QC (Presenter) Nothing to Disclose
Linda Morneault, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Guilherme Santanna, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose

PURPOSE
The objective of this study was to evaluate the perfusion ratio of the basal ganglia and intestinal wall using dynamic color Doppler sonography (CDS) in HIE neonates treated with hypothermia. We also aimed to investigate the correlation between this ratio and survival.

METHOD AND MATERIALS
Head ultrasound (HUS) and abdominal ultrasound were performed in all HIE neonates receiving hypothermia, as part of their routine care. CDS was performed with a 11LW4 MHz linear transducer to obtain DICOM color Doppler videos of the blood flow in the basal ganglia, in the coronal plane and sampled bowel loops in all quadrants. Videos of 3 seconds each were obtained for the region of interest (ROI) and used to calculate the cerebral perfusion intensity (CPI) of basal ganglia and intestinal perfusion intensity (IPI). Measurements of CPI and IPI were evaluated retrospectively by 2 radiologists using dedicated software. It allows automatic quantification of color Doppler data from a region of interest (ROI) by dynamically assessing color pixels and flow velocity during the heart cycle. Data is expressed in cm/sec and is calculated by multiplying the mean velocity of all pixels by the area divided by the ROI. Clinical and radiological data were evaluated retrospectively. Data are presented as mean ± SEM or median (quartiles). Appropriate statistical analysis was applied.

RESULTS
A total of 28 neonates were included: 16 male, 12 female, mean gestational age 39 ± 2 weeks, birth weight 3469 ± 607 grams, studies performed at 17.1 ± 10.5 hours of life. Seven neonates died. The basal ganglia/intestinal perfusion ratio was significantly higher in the 7 non survivors when compared to the 21 survivors (10.389 +/- 7.9 versus 2.660 +/- 2.5; p=0.001).

CONCLUSION
An increased basal ganglia/intestinal perfusion ratio was observed in non survivor neonates, submitted to hypothermia with severe HIE. Assessment of perfusion quantification with dynamic CDS in HIE might be a potential bedside biomarker of severity of insult in this critical population.

CLINICAL RELEVANCE/APPLICATION
Perfusion quantification with bedside ultrasound, using dynamic CDS, opens a window to better understand reperfusion injury and diving reflex in HIE neonates. This technique has the potential to be used as biomarker of severity of insult in this critical population.

SST12-05 Lesional Hyperperfusion in Leigh Disease Demonstrated by Arterial Spin-labeling

Participants
Matt Whitehead, MD, Washington, DC (Presenter) Nothing to Disclose
Bonmyong Lee, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Andrea L. Gropman, MD, Washington, DC (Abstract Co-Author) Nothing to Disclose

PURPOSE
Leigh disease is metabolic disorder of the respiratory chain or related components culminating in symmetric necrotizing lesions in the basal ganglia and/or brainstem among other locations. Apart from the classical gliotic and necrotic lesions found on histopathology, small vessel proliferation is also characteristic. Arterial spin-labeling (ASL) imaging has become a powerful adjunct for the detection of perfusion abnormalities during brain MR imaging. We have observed several cases of lesional hyperperfusion demonstrated by ASL sequences in patients with Leigh disease. The aim of this study is to evaluate lesional ASL perfusion characteristics in patients with Leigh disease and compare them to aged-matched normal exams.

METHOD AND MATERIALS
The brain MR imaging database from a single academic children's hospital was searched for the terms "ASL, arterial spin labeling, perfusion, and Leigh" to build a cohort for analysis. Each patient's electronic medical record was reviewed to confirm a diagnosis of Leigh disease. MR exams with excessive motion artifact, technical limitations, and without ASL images were excluded. ASL perfusion images were evaluated by a board certified neuroradiologist for the degree and extent of cerebral blood flow and relationship to brain lesions. Images were compared to normal exams from an aged-matched cohort.

RESULTS
The search yielded 33 exams; 23 were excluded. 10 exams from 5 separate Leigh patients were analyzed. 10 normal exams from aged-matched patients were also evaluated. In general, Leigh brain lesions ranged from hyperintense (n=8) to hypointense (n=2) on ASL perfusion images. Gliotic and necrotic lesions tended to be hypointense/hyperperfused. More active or recent lesions with associated restricted diffusion demonstrated hyperperfusion. ASL perfusion patterns differed significantly from aged-matched normal studies (p<.0001).

CONCLUSION
Leigh disease patients have abnormal perfusion to brain lesions. Hyperperfusion is associated with more recent or active brain lesions, possibly corresponding to small vessel proliferation characteristic to the disease.

CLINICAL RELEVANCE/APPLICATION
ASL hyperperfusion could help distinguish Leigh disease from other similar appearing metabolic abnormalities and disease mimickers.

SST12-06 The Effect of Conscious Sedation on SWI Sequence of Brain MRI

Friday, Dec. 4 11:10AM - 11:30AM Location: N229

Awards
Trainee Research Prize - Resident
Participants
Yaser Al-Qasimi, MBBS, Detroit, MI (Presenter) Nothing to Disclose
Deniz Altinkok, MD, Troy, MI (Abstract Co-Author) Nothing to Disclose
Sheena Saleem, MD, MBBS, Grosse Pointe Farms, MI (Abstract Co-Author) Nothing to Disclose

PURPOSE
Conscious sedation is frequently provided during MRI exams, especially in pediatric population. Medications used for conscious sedation have the inherent risk of affecting the oxygenation status, in part by their CNS inhibitory effect. The sensitivity of SWI sequence to deoxyhemoglobin is utilized in this study to evaluate the effects of various sedation medications on cerebral oxygenation.

METHOD AND MATERIALS
After applying selection criteria, retrospective analysis of SWI sequences from brain MRIs is performed. The degree of visualization of cerebral veins is evaluated and graded on a scale from 1 to 4. Other information recorded for each patient includes: the use of sedation medication, the use of supplemental oxygen, and the lowest recorded oxygen saturation during the exam. The investigators were blinded to patient information. The degree of visualization of cerebral veins is compared between different groups. Correlation is made to the lowest recorded oxygen saturation.

RESULTS
A total of 107 cases were enrolled: 33 non-sedated, 31 received pentobarbital (Nembutal), 31 received dexmedetomidine (Precedex), and 12 received diazepam (Valium). Patients who received Nembutal demonstrated significantly increased visualization of cerebral veins (p=0.0001), regardless of the use of supplemental oxygen. Patients who received either Precedex or Valium did not have statistically significant change in cerebral venous visualization compared to non-sedated patients. There was no correlation between the lowest recorded peripheral arterial oxygen saturation (pulse oximetry) readings and the degree of cerebral venous visualization on SWI. There was no statistically significant difference between pulse oximetry readings of different groups.

CONCLUSION
Evaluation of the SWI sequence shows evidence that pentobarbital administration is associated with higher concentrations of deoxyhemoglobin in cerebral venous blood. At the doses used for conscious sedation, this appears to be mediated by pentobarbital’s known effect on cerebral blood flow (decreased) rather than arterial hypoxia and central hypoventilation. This raises the concern for temporary cerebral hypoxia associated with pentobarbital use, and needs to be further investigated. SWI sequence appears to be promising in evaluating cerebral hypoxia.

CLINICAL RELEVANCE/APPLICATION
SWI sequence proves an important, non-invasive method to evaluate the oxygenation status of the brain.

SST12-07 Whole-brain T2 qMRI Relaxometry of Extremely Low Gestational Age Newborn (ELGAN) Children at Ten Years of Age: Gender Differences

Participants
Adam Aakil, MA, MBA, Boston, MA (Abstract Co-Author) Nothing to Disclose
Osamu Sakai, MD, PhD, Boston, MA (Abstract Co-Author) Speaker, Bracco Group; Speaker, Eisai Co, Ltd; Consultant, Guerbet SA
Alexander M. Norbash, MD, Boston, MA (Abstract Co-Author) Co-founder, Boston Imaging Core Laboratories, LLC;
Mufeed Mahd, PhD, Lowell, MA (Abstract Co-Author) Nothing to Disclose
Hernan Jara, PhD, Belmont, MA (Presenter) Patent holder, qMRI algorithms Research Grant, General Electric Company Royalties, World Scientific Publishing Co

PURPOSE
Extremely low gestational age newborns (ELGANs) are defined as infants born before the 28th week after gestation. The purpose herein was to study the whole-brain qMRI distributions of the transverse relaxation time (T2) in a population of ELGAN infants at nine to ten years of age. A further objective was to detect potential brain tissue T2 gender differences.

METHOD AND MATERIALS
Children were MRI scanned at twelve ELGAN participating sites: all scanners were 3T (GE, Philips and Siemens), except one 1.5T (GE). The dual-echo turbo spin echo (DE-TSE) MR images of ninety-eight subjects (38 males and 60 females) were qMRI processed resulting in three-dimensional T2 maps covering the whole head. All tissues contained in the intracranium (intracranial matter (ICM) = gray matter plus white matter plus meninges and cerebrospinal fluid) were segmented using a dual-clustering algorithm programmed in Mathcad. The ninety-eight ICM T2 histograms were tabulated in Excel as a function of increasing ICM volume and separated by gender; these were further processed in Mathcad to yield individual and population measures: mean and standard deviation brain T2 values.

RESULTS
The mean brain T2 values are graphed in Fig. 1 (top) for males (left) and females (right): the population T2 averages are 90.5±13.5 ms and 89.5±12.6 ms for males and females respectively. The combined population histograms are shown in Fig. 1 (bottom): note the much higher T2 data uniformity for female versus male infants (dotted red lines).

CONCLUSION
Both graphic data displays (Fig. 1 top and bottom) as well as the statistical measures point to a significantly higher T2 heterogeneity for the ELGAN brains of male versus female infants. This initial finding could indicate a higher vulnerability of very early preterm birth in males versus females.

CLINICAL RELEVANCE/APPLICATION
T2 qMRI relaxometry could become a valuable clinical tool for assessing the brain tissue integrity of children in the context of preterm birth.
SST12-08  Neuroimaging Findings in a New Pattern of Neonatal Ischemic Encephalopathy Associated with Excessive Uterine Activity

Friday, Dec. 4 11:40AM - 11:50AM Location: N229

Participants
Jill V. Hunter, MD, Houston, TX (Presenter) Author with royalties, UpToDate, Inc
Stewart Ater, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Michelle L. Murray, PhD, RN, Albuquerque, NM (Abstract Co-Author) Nothing to Disclose

PURPOSE
To test the null hypothesis that a pattern of neonatal, predominantly cortical, ischemic injury would not be associated with a labor and delivery during which there were extended periods of shortened resting interval.

METHOD AND MATERIALS
The neonatal imaging in 10 full term children with established motor and cognitive delays, in whom perinatal infection and metabolic disorders had been ruled out, was retrospectively reviewed and correlated with the electronic fetal monitoring (EFM) strips.

RESULTS
The children had a pattern of cortical laminar necrosis that was not a classic watershed, and with a lesser degree of deep gray nuclear ischemia that did not conform to the established patterns of a typical prolonged partial or acute profound hypoxic-ischemic injury. Most of these infants, (8/10), were delivered with a pH >7.0 and without features of systemic asphyxia. Retrospective analysis of the EFM in these 10 cases revealed a pattern of more than 2 hours of continuous excessive uterine activity with resting intervals of less than 60 seconds duration. Nine of the 10 mothers were nulliparous.

CONCLUSION
The null hypothesis is not proven and the results suggest an association between shortened resting intervals and a previously unrecognized pattern of neonatal, predominantly cortical, ischemic injury.

CLINICAL RELEVANCE/APPLICATION
Cerebral palsy and the sequelae of a previously unrecognized pattern of ischemic encephalopathy has enormous fiscal implications. These neonates do not meet current criteria for hypothermia therapy which may help improve their outcome. In addition if the underlying causes of a shortened resting interval can be recognized prospectively and terminated by the more judicious use of uterine stimulants then it may be feasible to prevent or minimize this cause of neonatal brain injury.

SST12-09  An Intraoral B0 Field Correction Device for Decreasing Magnetic Susceptibility Artifacts on Brain MRI Induced by Stainless Steel Orthodontic Appliances

Friday, Dec. 4 11:50AM - 12:00PM Location: N229

Participants
Zhiyue J. Wang, PhD, Dallas, TX (Presenter) Nothing to Disclose
Yong Jong Park, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Youngseob Seo, PhD, Daejeon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Michael C. Morriss, MD, Pinehurst, TX (Abstract Co-Author) Nothing to Disclose
Nancy K. Rollins, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
Susceptibility artifacts from orthodontia are a common problem that can interfere with MRI for acute CNS diseases. The artifacts result from ferromagnetic materials in the orthodontia and alteration in B0 field. Recently available rare earth iron permanent magnets have the potential in cancellation of the unwanted B0 effects. We report the initial experience with a prototype field correction device.

METHOD AND MATERIALS
Commercial NdFeB rectangular prism magnets (grade N38EH, intrinsic coercivity 30 kOe) were embedded in front of the teeth between 2 layers of dental plastic sheets in the shape of a mouth-guard, with the magnetization opposing the B0 field. The first prototype had one upper and one lower piece for maxillary and mandibular arches with a total magnetic moment of 0.124 A·m². Subsequent modifications used multiple upper and lower pieces to cover a range of magnetic moment from 0.010 to 0.200 A·m². Human subject studies were conducted with IRB approval at 1.5T without sedation. We studied 3 volunteers with orthodontia and one patient. Brain MRI scans were acquired without and with the subject wearing the field correction device.

RESULTS
Based on B0 map, the total induced magnetic moment of braces in the subjects ranged from 0.009 to 0.194 A·m², with a median value of 0.134 A·m². For the case of the lowest magnetic moment, the braces were essentially non-magnetic and the artifact arose from a unilateral ferromagnetic implant. The device improved B0 homogeneity. In 3 subjects adequate quality EPI-DWI scans were acquired with the device. However, complete correction of geometric distortions was not achieved. Sufficient correction of
geometric distortion on sequences sensitive to susceptibility, e.g. DWI, requires a fairly close match between the device and braces both in the total value and the spatial distribution of magnetic moment. The device may experience noticeable forces and torques near or inside MRI scanners. The device may break or escape from the mouth. The device should be wrapped inside a thin, soft plastic sheet and tethered down using a string during the MRI study for patient protection.

CONCLUSION

Susceptibility artifacts from orthodontia can be decreased with a novel B0 field correction device. This approach is promising although further improvement is needed.

CLINICAL RELEVANCE/APPLICATION

The study may lead to a device that enables diagnostic quality MR examinations for patients wearing braces.
SST13-01 Reproducibility of F18-FDG PET Radiomics Features through Different Cervical Tumors Delineation Methods

Participants
Kamil M. Yenice, PhD, Chicago, IL (Moderator) Nothing to Disclose
Cem Altunbas, PhD, Aurora, CO (Moderator) Nothing to Disclose

Sub-Events

Background
Several studies discussed various methods of tumor delineation based on PET FDG uptake. Where delineation based on a %threshold of SUVmax is the method most commonly used. This study recruited radiomics as an investigative tool to first, evaluate the sensitivity of radiomics features to the effect of different image segmentation and second, to evaluate the differences between tumors delineated based on SUVmax, SUVpeak and manually delineated Metabolic Tumor Volume (MTV).

Evaluation
Two radiation oncologists contoured primary tumors in cervix region based on pretreatment F-18 FDG PET/CT for a cohort of 74 patients. The cohort characteristics are: FIGO stage IB-IVA, age range 31-76 years, treated with external beam radiation therapy to a dose range between 45-50.4 Gy (median dose: 45 Gy), concurrent cisplatin chemotherapy and MRI-based Brachytherapy to a dose of 20-30 Gy (median total dose: 28 Gy). Co-occurrence (COM), Gray Level Size Zone (GLSZM), Run-Length (RLM) and Intensity Based (IBM) matrices were employed to extract the radiomics features. Mean Percentage Differences (Δ) of features were determined for each pair of contoured volumes; MTV was set as the reference contour in comparison with SUVmax then SUVpeak. The reproducibility among each pair of contours was assessed by Bland-Altman analysis. In addition, Interobserver agreement for 1) all three contours and 2) pairs of MTV-SUVpeak and MTV-SUVmax was assessed using Interclass Correlation Coefficients test (ICC) within the context of the test re-test format.

Discussion
Radiomics features, which showed statistical significance of \( p \text{-value} <0.05 \) on Bland-Altman test, indicated higher reproducibility between reference contour (MTV) and SUVpeak based contour. We set an acceptable reproducibility range of \( \pm 15 \). ICC test results were concordant with Bland-Altman results with absolute agreement range (0.75 - 0.95).

Conclusion
In general, 5 COM, 4 GLSZM and 4 IBM features were insensitive to contour delineation techniques. ICC revealed that MTV-SUVpeak contours pair scored higher interobserver agreement and precision than MTV-SUVmax contour pair.

SST13-02 By the Position of the Treatment Interruption: How to Affect the Local Control Rate

Participants
Hiroshi Sekine, MD, PhD, Tokyo, Japan (Presenter) Nothing to Disclose
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Koichiro Naruo, MD, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Kaoru Onoue, MD, Minato-ku, Japan (Abstract Co-Author) Nothing to Disclose
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Sayako Iwashita, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Over the New Year, Golden Week, and other local holidays, radiation therapy is sometimes stopped for long periods of time. In such cases, declines in the local control rates have been reported. Thus, we next investigated the effects of the length of time without treatment and the timing of this treatment break on the local control rate. Deliberately introducing a break period in a real clinical situation poses ethical problems; therefore, tumor model was created, and the local control rate was estimated after fractionated exposure with a set break period. The compensatory dose required to maintain the control rate was also estimated. Materials/Methods: The radiosensitivity of multifocal malignant tumors appears to be non-homogeneous. 1. We randomly allocated 1-7 tumor different radiosensitive clones. 2. Each clone multiplied exponentially. 3. The survival rate was determined using the novel LQ model. Design: Control arm includes 20 groups. In one group, total of 500 tumor cases were generated as per the above method, and each case was exposed to a standard treatment of 60 Gy/30 Fr, 5Fr/w. Test arm includes 5x20 groups. We assumed treatment interval of 2 weeks after continuous 5Fr, 10Fr, 15Fr, 20Fr, and 25Fr, for respective
groups. Results: When the 2-week break was introduced after the 5Fr, 64 Gy (adding 2x2Gy) was no significant difference in the control rate compared with continuous fractionated exposure of 60 Gy (p = 0.181). When the break was introduced after the 10Fr and the dose was increased by 2 Gy, the local control rate was lower than that of continuous fractionated exposure of 60 Gy. However, when the dose was increased by 2 x 2 Gy each, a significant increase in the control rate was observed. When the break period was introduced after the 15Fr or 20Fr and the dose was increased by 2 Gy, resulting in a total exposure of 62 Gy, there was no significant difference in the local control rate compared to continuous fractionated exposure of 60 Gy (p = 0.75 and p = 0.106, respectively). When the break period was introduced at the 25 Fr, a dose increase of 2 Gy resulted in an increased local control rate compared to that of continuous exposure of 60 Gy. On the other hand, when the break was introduced after the 25 Fr and there was no dose increase, the control rate was significantly reduced; and therefore, increases of at most 2 Gy are deemed appropriate. Conclusion: As the local control rates are further reduced when breaks occur sooner after the initiation of radiation, it is necessary to increase the compensatory dose in these cases.

**SST13-04 Novel Approaches for the 192-Ir Source Positional Verification Using the Direct-Conversion Flat-Panel Detector**

Friday, Dec. 4 11:00AM - 11:10AM Location: S403A

Participants
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**ABSTRACT**

Purpose/Objective(s): The direct-conversion flat-panel detector (d-FPD) has led the possibility of transformation for QA of a 192-Ir source. Our goal is to establish a new quality assurance (QA) for 192-Ir source positional accuracy test using the d-FPD.

Materials/Methods: Initially, the 192-Ir core position is adjusted to 1500.00 mm by two-point calibration with mechanical engineers using by dummy source and radioactive source as well as the d-FPD image. In subsequent 2-dimensional (2-D) verification using check ruler, six points (1500, 1450, 1400, 1350, 1300, 1250 mm) were measured weekly for six months. As for the 3-D verification, 14 dwell (5.0 mm step) coordinates in a series were compared between planned position and actual 192-Ir core, after planning by semi-orthogonal method with X-ray catheter using two intracavitary applicators (Fletcher Williamson tandem; bending 15° and CT/ MR-compatible ovoid; bending 45°). The center of the applicator coordinate system (ACS) was set at the arbitrarily-position using spherical metal marker. Five series are evaluated for each applicator, and also measured sagging shift caused by the d-FPD orthogonal movement. 3-D distances were calculated by following formula: d = square root of ([x1-x2]+[y1-y2]+[z1-z2])²

Results: 192-Ir core was adjusted 1500.05 mm by image-assisted positional calibration. An average (±SD) of all errors was 0.254±0.16 in 2-D verification. The highest accuracy point was 1500 mm where the most frequently used point in our clinical treatment, and it’s error was 0.19±0.04 mm. Sagging shift was 0.80 mm in superior direction. The most curved point of each applicator was the largest differences in 3-D verification, and it was 1.74±0.02 mm for CT/MR-applicator and 1.01 ±0.01 mm for Fletcher applicator. The largest accuracy point was 1.71 mm in anterior direction for CT/MR-applicator. Conclusion: The recommendation of the AAPM (American Association of Physicists in Medicine) for 192-Ir source positional accuracy is ± 1.0 mm (± 2.0 mm relative to the applicator system). In this study, all measurement errors for 192-Ir source positional accuracy were within the acceptable range. The source adjustment with the d-FPD may more accurately, and also d-FPD could confirm the movement and position (angle) of the 192-Ir core in the applicator system. Our quality assurance process using the d-FPD system may serve to improve aspects of QA, as well as the quality of HDR brachytherapy.

**SST13-05 Dynamic PET Imaging of Tumor Hypoxia in Non-small Cell Lung Cancer Patients Undergoing Stereotactic Body Radiotherapy**

Friday, Dec. 4 11:10AM - 11:20AM Location: S403A

Participants
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**PURPOSE**

Tumor hypoxia is correlated with treatment failure. To date, there are no published studies investigating hypoxia in patients with small, localized non-small cell lung cancer (NSCLC) undergoing SBRT. We aim to use 18F-fluoromisonidazole (18F-FMISO) PET imaging to non-invasively quantify the tumor hypoxic fraction (HF), to elucidate the potential roles of reoxygenation and tumor vascular response at high doses, and to identify an optimal time point for imaging with diagnostic value.

**METHOD AND MATERIALS**

Six patients with NSCLC tumors >1 cm and eligible for SBRT were prospectively enrolled in an IRB-approved study. CT and dynamic PET images (0-120 min, 150-180 min, and 210-240 min post-injection of radiotracer) were acquired using a Siemens Biograph mCT PET/CT scanner. This 18F-FMISO PET imaging protocol was performed at 3 different time points around a single SBRT delivery of 18 Gy and comparisons of HFs were made using a tumor-to-blood ratio (TBR) > 1.2 and the rate of influx, kinetic parameter Ki (mI/mg/min). HF regions were normalized to the absolute tumor volume defined by CT. TBR was defined as the ratio of the 18F-
FMISO signal in each tumor voxel in the tumor region of interest (ROI) summed from 210-240 min to the average signal in heart over the same time frame post-injection.

RESULTS

Results of all patients show substantial variation in the HF during SBRT. Using a TBR threshold >1.2, the HFs increased by nearly a factor of 2 after 18 Gy and then decreased almost to baseline 96 hours later in more than half of patients who completed the imaging protocol. In one representative patient, shown in Figure 1, the HFs were 19%, 31% and 13% of total tumor volume on day 0, 2 (48 hours post-SBRT), and 4 (96 hours post-SBRT).

CONCLUSION

For NSCLC patients receiving SBRT, 18F-FMISO PET imaging has the potential to measure temporal changes in tumor hypoxia. With the results of six patients, this novel pilot study highlights the potential benefit of non-invasive molecular imaging as results indicate substantial variation in tumor hypoxic fraction post-SBRT. Ongoing work includes the development of tracer kinetic analysis of respiratory-corrected dynamic data to enable treatment individualization based on patient-specific biological information.

CLINICAL RELEVANCE/APPLICATION

This novel pilot study highlights the potential benefit of non-invasive molecular imaging as results indicate substantial variation in tumor hypoxic fraction post-SBRT.

SST13-08  Dosimetric Impact of the Presence of the Bowel Gas in IMRT / VMAT Planning for Patients with Abdominal Tumors

Friday, Dec. 4 11:40AM - 11:50AM Location: S403A

Participants

Salim Balik, PhD, Cleveland, OH (Presenter) Nothing to Disclose
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Ping Xia, Cleveland, OH (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): To investigate dosimetric consequences of IMRT / VMAT planning with presence of the bowel gas for patients receiving SBRT/IMRT for abdominal tumors.

Materials/Methods: Six patients, 4 with pancreas tumor, 1 with adrenal gland receiving SBRT and 1 with pancreas tumor receiving conventional IMRT (with large PTV extending into bowel), who had extensive bowel gas visible in the planning CT images and treated with CBCT image guidance, were selected for this study. Two coplanar IMRT or VMAT plans were retrospectively created with the prescription dose (Rx) to 95% of PTV (27.5 Gy in 5 fractions for the SBRT plans and 50.4 Gy in 28 fractions for the IMRT plan), with and without overriding the bowel gas density to water in Pinnacle 9.6. Dose was calculated with heterogeneity correction and collapsed cone convolution algorithm. Planning CT and pre-treatment CBCT images were registered by aligning to the tumor. Patient body external and bowel gas was contoured on the planning CT and CBCT (5 random selected for pancreas IMRT case to represent whole treatment). The external and bowel gas contours were transferred from the CBCT to the planning CT. To estimate actual delivered dose, the following density overrides were performed on the planning CT. The CBCT external outside the CT external were assigned density zero and the CT external outside the CBCT external were assigned density zero. The bowel gas contour in CT was assigned one and the transferred bowel gas contour from CBCT were assigned zero. The dose was calculated on the planning CT. This process was repeated for all CBCTs. Finally, dose was accumulated from 5 fractions. For pancreas IMRT case, dose was rescaled to original prescription for analysis.

The estimated delivered CTV-VRx, PTV-VRx, maximum dose received by 0.5cc (D0.5cc) of bowel (duodenum, small and large bowel) were compared to plans made with and without bowel gas overriding. Results: For SBRT patients (PTV range: 25.9 – 144.4 cc), with and without override of bowel gas density, mean delivered PTV-VRx was 93.7 ± 2.0% (range: 90.8% - 95.6%) and 96.0 ± 1.6% (range: 95.0 - 99.5%), change in bowel D0.5cc between planning and delivery was 0.1 ± 0.7 Gy (range: -1.0 Gy, 1.5 Gy) and 0.8 ± 0.6 Gy (range: -0.6 Gy, 1.9 Gy), respectively. For the IMRT patient (PTV volume: 2184cc), without and with override of bowel gas density, delivered PTV-VRx was 66.5% and 93.2% and change in bowel D0.5cc was -2.7 Gy and 1.5 Gy, respectively. CTV-VRx was not affected by density overrides (100% for both techniques) for SBRT patients. For the IMRT patient, delivered CTV-VRx was 65.9% and 100% respectively without override and with override. Conclusion: Planning with overriding bowel gas density to water was better for target coverage but caused slightly increased toxicity to bowel compared to that without overriding. With the presence of the bowel gas, a lower bowel planning constraint may be applied if bowel gas is overriding.

SST13-09  Are Prostate Target Margins Adequate for Combined Brachytherapy Followed by External Beam Treatments?

Friday, Dec. 4 11:50AM - 12:00PM Location: S403A

Participants

Vrinda Narayana, Southfield, MI (Presenter) Nothing to Disclose
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ABSTRACT

Purpose/Objective(s): In this study, external beam prostate treatments were delivered as a boost after I-125 permanent prostate implants. Prostate motion during external beam treatments involves a novel combination of the implant dose moving with the prostate leaving the external beam irradiation susceptible to motion. The adequacy of target expansions on the combined external beam and implant dose was examined based on the measured daily motion of the prostate.

Materials/Methods: Thirty patients received an I-125 prostate implant prescribed to dose of 90 (25 patients) or 120 (5 patients) Gy. This was followed by an external beam boost to deliver a dose of 90 Gyeq (external beam equivalent) to the prostate over 10 to 30 fractions. An ideal IMRT plan was developed by optimizing the external beam dose based on the delivered implant dose. Targets in addition to the prostate were seminal vesicles (SV) (30 patients) and lymph nodes (LN) (13 patients). Target expansions were 0.5, 0.7 and 0.5 cm for the prostate, SV and LN, respectively. The limiting dose to the rectal volume had a higher priority during optimization over target coverage. The implant dose was converted to an equivalent external beam dose using the linear quadratic model. Patients were set up on the treatment table by daily orthogonal imaging and aligning the marker seeds in the prostate. For treatments 2 to 6,
orthogonal films were obtained at the end of treatment to assess the motion of the prostate. Based on the observed motion of the markers between the initial and final images, 5 individual plans showing the actual dose delivered to the patient were calculated. A final true dose distribution was established based on summing the implant dose and the 5 external beam plans. Dose to the prostate, SV, LN and normal tissues, rectal wall, urethra and lower sphincter were calculated. On 18 patients who were sexually active, dose to the corpus cavernosum and internal pudendal artery was also calculated. Results: The average prostate motion in 3 orthogonal directions was less than 1 mm with a standard deviation of less then ±2 mm. Dose and volume parameters for the targets and normal tissue are shown in the table below. Average Planned (GyEq or cc)Average Delivered (GyEq or cc)Average Planned/deliveredProstate D993.7±8.092.8±9.21.00±0.1Seminal Vesicle D950.4±9.749.1±9.91.0±0.1Lymph Nodes D945.1±1.144.2±1.141.02±0.02Rectal Wall V801.7±0.411.6±0.41.1±0.02Rectal Wall D1cc84.1±11.612.6±1.11.01±0.02Urethra D9071.7±25.370.6±26.11.01±0.1Lower Sphincter D9076.4±15.466.7±16.21.00±0.1Corpus Cavernosum D904.3±2.54.2±2.60.99±0.04Internal Pudendal Artery D9016.6±7.716.7±8.51.02±0.2 Conclusion: The delivered dose to the targets was within 2 % of the planned dose indicating that the target margins are adequate. Combined brachytherapy and external beam dose delivered to the prostate was not sensitive to prostate motion.
PURPOSE
An important attribute of medical imaging systems is Low Contrast (LC) performance which is known to have many caveats in measurement and interpretation. This study uses a number of commercial QA phantoms to investigate measures that might be useful in a constancy sense in an automatic QA program.

METHOD AND MATERIALS
Different modules of the Catphan® Phantom and Tomophan™ (The Phantom Laboratory, Salem, NY), present cylindrical and spherical targets of differing CT contrast and dimensions. Automated QA monitoring methods have been developed that calculate signal (contrast) to noise ratios and related detectability models. These include Rose models of the ratio of target contrast to target noise, predicted related Contrast-Detail (CD) diagrams, and results from applying matched filter models and other more advanced signal detection models. The same models are applied to cylindrical targets as well as spherical targets in both CT and DBT.

RESULTS
The automated results are presented and discussed for CT and DBT and compared to visual results from human observers. With care to identify non-uniformities and possible artifacts, the results are found to be quite reproducible and useful in a QA constancy sense. Caution is urged, however, in extending such physics and QA techniques applied to well-defined targets in relatively uniform backgrounds to the more complex case of more complicated structured clinical backgrounds with more non-uniformity.

CONCLUSION
Low contrast models can be used with automated approaches to produce reliable data on LC performance, at least in a QA constancy sense. Several caveats involving the need to adjust for non-uniformities and/or artifacts need to be considered and an extension to the clinical domain must be approached with caution.

CLINICAL RELEVANCE/APPLICATION
This study does not predict clinical low-contrast performance, but is useful in helping monitor scanner performance in a QA sense of factors such as statistical noise and edge resolution of targets.

PURPOSE
To compare the low-contrast detection (LCD), image quality, and radiation dose of a new, third-generation Adaptive Statistical Iterative Reconstruction-V methodology with a filtered back projection (FBP) at different tube voltages and radiation doses.

METHOD AND MATERIALS
Images of a proprietary Mercury phantom (v3.0) obtained with five different clinically relevant incremental 12-37 cm phantom sizes
and low contrast-detail were acquired on a prototype 256-detector row CT (Revolution, GE Healthcare) using varying tube potentials (80, 100, 120, 140 kVp) and a constant CTDIvol (3.0 mGy). A second set of scans was performed at 120 kVp with six different dose levels (0.7-24.0 mGy). Images were reconstructed using the FBP and the ASiR-V algorithms (at three strengths) at two different slice thicknesses. Image quality was evaluated using detectability index \(d'\) - a measure of LCD for a 5.0 mm, 200 HU contrast lesion as well as noise by comparing objective image noise on ASiR-V images to FBP images as a control. Statistical analysis was performed using ANOVA.

**RESULTS**

At variable kVps and a constant CTDIvol, a significantly higher \(d'\) was demonstrated at lower-kVp MDCT protocols using iodine-contrast media with either FBP or ASiR-V. At any given phantom diameter, \(d'\) for ASiR-V images was significantly higher than \(d'\) for FBP images \((P<.01)\). This effect was distinct in smaller pediatric-sized phantom diameters (12 and 16 cm). ASiR-V showed significantly higher \(d'\) than across all radiation doses \((0.7-24.0 \text{ mGy}; P<.01)\). At the lower radiation doses \((0.7-3.0 \text{ mGy})\), LCD was significantly better with only higher ASiR-V strengths \((\geq 80\%\)\). Compared to FBP, a statistically significant reduction in objective image noise was demonstrated \([\text{ASiR-V } 50\%\ (\text{range, } 24-38\% \text{ noise reduction}), \text{ASiR-V } 80\%\ (37-58\%), \text{ASiR-V } 100\%\ (44-70\%)]\). Percent decrease in noise was less with increasing phantom size and increasing CTDIvol.

**CONCLUSION**

ASiR-V iterative technology performed significantly better on low-contrast detectability and noise decrease rates compared to FBP technique at multiple kVp and radiation doses. This effect was amplified at both pediatric-sized phantom diameters, and at lower tube potential (such as 80 kVp using iodine contrast).

**CLINICAL RELEVANCE/APPLICATION**

Across phantom diameters, especially with pediatric sizes, ASiR-V technology affords significant quantitative improvements in image quality and lesion detection compared to conventional FBP technique.

**RESULTS**

Using model (1) fitted to data with a Tilt Index up to 0.8, the acceptable Tilt Index was found to be smaller with denser material: 0.4, 0.6, 0.7 and 0.7, for acrylic, water, lung-foam equivalent and air, respectively. The airway measurements and the MTF curve remain stable with Tilt Indices between 0 and 1.7.

**CONCLUSION**

Rotations of the COPDGene phantom with a tilt index above 0.4 will produce more than 1-HU shift in the mean density of at least one material. Because of this, at the time of phantom receipt at a radiology core laboratory, quality control procedures should include an assessment of the Tilt Index. A Tilt Index threshold of 0.4 is recommended.

**CLINICAL RELEVANCE/APPLICATION**

Quality control procedures in a radiology core laboratory should include an assessment of the Tilt Index. A Tilt Index threshold of 0.4 is recommended.
ESF was numerically fitted using a smoothing spline method, differentiated, and Fourier transformed to obtain the mA transfer function (mATF). Noise from each slice was also measured, plotted against the distance, and processed into a noise transfer function (NTF). To validate the technique, a continuously varying sized phantom was used. The measured mA and noise from the varying size of the phantom were compared to those predicted from the mATF and NTF method.

RESULTS
For the same pitch, mATF curves from different rotation times (0.5 s and 1 s) remained nearly identical. When pitch increased from 0.5 to 1, the frequency at 50% almost halved from 0.027 to 0.015 1/mm. The average difference between predicted and measured values was ~ 10% for mA, and ~ 20% for noise.

CONCLUSION
A mA and noise transfer function was proposed for characterization of tube current modulation. The transfer functions can be used to predict mA and noise properties of TCM scans. The methodology was validated using a varying sized phantom.

CLINICAL RELEVANCE/APPLICATION
A mA and noise transfer function was proposed for characterization of tube current modulation. The transfer functions can be used to predict mA and noise properties of TCM scans.

SST14-05 Multi-slice Reading in a Low-Contrast Detection Task in CT: Correlation between Human and Model Observer Performance

Participants
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PURPOSE
Model observers based on 2D images have been used to assess CT image quality. However, radiologists typically read images by paging through multiple slices. The purpose of this study was to correlate human and model observer performance in a low-contrast detection task that involves multi-slice (MS) reading.

METHOD AND MATERIALS
A low-contrast phantom containing 18 spheres (6 sizes x 3 contrast levels) was scanned on a 192-slice CT scanner at 5 dose levels (CTDI(vol) = 27, 13.5, 6.8, 3.4, and 1.7 mGy), each repeated 100 times. Images were reconstructed using both FBP and an iterative reconstruction method (ADMIRE, Siemens). A 3D volume of interest (VOI) around each sphere was extracted and placed side-by-side with a signal-absent VOI to yield a 2-alternative forced choice (2AFC) trial. 16 2AFC studies were generated, each with 100 trials, to evaluate the impact of radiation dose, lesion size and contrast, and reconstruction method. In total, 1600 trials were presented to both model and human observers. Three medical physicists served as human observers and were allowed to page through slices of the 3D volumes. A multi-slice channelized Hotelling observer (CHO_MS) was applied to the 16 2AFC studies. CHO_MS combined multi-slice responses through a separate Hotelling model. For comparison, the same 16 2AFC studies were also performed in a static 2D mode by the 3 readers and a previously validated CHO (CHO_2D).

RESULTS
In the multi-slice viewing mode, observer performance was highly correlated between human observers and the CHO_MS (two-tailed Spearman's correlation coefficient R=0.96, p<0.01). Human observer performance varied between the MS and 2D modes. One reader performed better in the MS mode (p=0.013); whereas the other 2 readers' performances showed no significant difference between the 2 modes (p=0.06 and p=0.38). The CHO_2D had a high correlation with human observers in both 2D (R=0.95, p<0.01) and MS mode (R=0.97, p<0.01).

CONCLUSION
A multi-slice CHO was shown to be highly correlated with human observers in a low-contrast detection task using multi-slice reading. For this task, a previously validated 2D CHO similarly predicted human observer performance for multi-slice reading of 3D images.

CLINICAL RELEVANCE/APPLICATION
Human observer performance in multi-slice reading may be predicted by either CHO_MS or CHO_2D. These tools are useful for objectively assessing and optimizing CT dose and system performance.

SST14-06 New Approaches to Determination of 3D Resolution in CT

Participants
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Hildur Olafsdottir, Salem, NY (Presenter) Research funded, Image Owl, Inc

PURPOSE
The growing trend toward 3D imaging involving Volume CT scanners and the use of 3D and Multiplanar Reconstruction (MPR)
techniques leads to the need for phantoms and test methods that reveal to the radiologist and physicist actual 3D resolution. That is, measures involving not only in-plane (x,y) resolution and related MTFs but also slice width and Slice Sensitivity Profiles (SSP). These "combined" effects can be studied with two new types of phantoms, the WAVE phantom and a 45° Resolution Gauge and are amenable to analysis by automated approaches.

METHOD AND MATERIALS

Newly available commercial phantoms, the WAVE phantom and 45° Resolution Gauge (The Phantom Laboratory, Salem NY) are designed to incorporate the combined effects of in-plane (x,y) resolution as well as slice thickness (z) resolution. These test objects can reveal the way in which the actual CT resolution can be limited by the choice of reconstruction filter and/or the slice thickness or SSP (z) used for the acquisition. Likewise, these phantoms can be used in direct 3D volume acquisition models and MPR or 3D reconstruction approaches. In the case of the WAVE phantom, automated analysis of the harmonics of an angled periodic step wave can be used to show the combined resolution limitations of the in-plane point spread function and the SSP (z) of the slice thickness used in the acquisition.

RESULTS

Examples are shown of the use of the WAVE phantom and the 45° Resolution Gauge with Volume and Multislice (MS) CT scanners. Both the third harmonic of the WAVE and the cutoff of the 45° Resolution Gauge are shown for various acquisition protocols involving different spatial resolution filters and different slice thicknesses. The limitations of using in-plane resolution filters when using a typical slice thickness of 1 to 5mm are clearly shown for several different volume and MS scanners.

CONCLUSION

Use of the new test methods and phantoms reveals useful information for 3D imaging on the combined effects of in-plane resolution and the slice thickness used in the acquisition or reconstruction process. These results can influence the appropriate choice of resolution filter and slice thickness in acquisition protocols.

CLINICAL RELEVANCE/APPLICATION

New approaches give the physician a quantitative and qualitative (visual) measure of the combined effects of in-plane resolution and slice thickness used in the acquisition or reconstruction process.

SST14-07 Optimization of CT Scan-mode and Reconstruction Kernel for Bone Fracture Detection Tasks

Friday, Dec. 4 11:30AM - 11:40AM Location: S403B

Participants
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Ke Li, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Timothy P. Szczypikowicz, PhD, Madison, WI (Abstract Co-Author) Equipment support, General Electric Company Research Grant, Siemens AG
Guang-Hong Chen, PhD, Madison, WI (Abstract Co-Author) Research funded, General Electric Company; Research funded, Siemens AG

PURPOSE

Hi-Resolution mode was recently introduced in some state-of-the-art CT systems to reduce view-angle aliasing and increase spatial resolution. Hi-Res mode allows users to reconstruct data using either conventional or High Definition (HD) kernels. Since high spatial resolution is often associated with a tremendous increase in image noise, the introduction of the Hi-Res mode confounds scan mode selection and the associated reconstruction protocols. In this work we investigate the optimization of scan mode and reconstruction kernel selection for bone fracture detection.

METHOD AND MATERIALS

A quantitative, task-driven imaging performance assessment framework was used for optimization. Spatial resolution was quantified with modulation transfer function (MTF) measurements using a tungsten bead. Similarly, the noise power spectrum (NPS) was measured under different conditions with repeated scans, and the impact of display window and level was incorporated into the analysis. A model observer was used to quantify the dependence of the overall imaging performance on different system parameters, and to optimize mode and kernel selection. Model observer results were validated with an ex vivo animal experiments.

RESULTS

(1) For conventional reconstruction kernels, the use of Hi-Res mode did not result in a major change in the MTF for centered positions, but it improved the MTF at off-centered positions. (2) The combined use of Hi-Res mode and HD kernels improved MTF at both centered and off-centered positions. (3) The use of HD kernels increased noise magnitude and pushed the noise power to higher frequencies. (4) The optimal kernel and scan mode strongly depend on fracture size and NPS. Model observer results were qualitatively verified by the ex vivo experimental results.

CONCLUSION

Optimal use of the Hi-Res mode and its associated HD kernels depends on patient positioning and imaging task. Optimal decision making for its use can be achieved based on the framework developed in this work.

CLINICAL RELEVANCE/APPLICATION

Despite its great potential in reducing aliasing and improving spatial resolution, Hi-Res mode has been underused clinically, most probably due to questions about how to optimize scan protocols for this technique. This work incorporates spatial resolution and noise properties of Hi-Res mode and HD kernels along with specific diagnostic task functions to optimize reconstruction kernel selection.

SST14-08 Quality Assurance in a Multicenter Trial Evaluating Quantitative CT Perfusion Imaging as a Biomarker of Patient Outcome in Ovarian Cancer Chemotherapy: An ECOG-ACRIN and NRG GOG Study

Friday, Dec. 4 11:40AM - 11:50AM Location: S403B
PURPOSE

3D printing is a rapidly evolving technology that allows the fabrication of complex three-dimensional and multi-material objects for anatomic models, medical tools, and even quality control (QC) phantoms. The design and QC performance analysis of 3D phantom for multi-modality system has not been investigated rigorously. The QC phantom can be easily fabricated with complicated shapes by 3D printing. The purpose of this work was to design a pre-clinical or clinical QC phantom and validate its performance for multi-modality system.

METHOD AND MATERIALS

For design of the phantom, the SOLIDWORKS 2012 Computer Aided Design (CAD) software was considered due to the flexibility of applications. The model was exported in mesh format (.STL) for 3D printing and a multi-material printer (Objet Eden, Stratasys Ltd.) was used. The prototype phantom was composed of 3 main parts to support both X-ray imaging and nuclear imaging. For nuclear imaging, phantom was designed to evaluate the image quality, including spatial resolutions and uniformity, in accordance with the NEMA NU-4 2008 protocols. For X-ray imaging, we developed 8 containers to be filled with dilutions containing 0.1% to 1.0% of contrast agent and high- and low contrast resolution disk and uniformity area.

RESULTS

Evaluation

19 CT scanners from 4 vendors were accredited. The image intervals in both CTP phases were correct in all scanners. CT noise normalized to 5 mm slice thickness was 10.1±1.6 HU. Spatial uniformity and temporal stability was 0.94±0.54 and 0.44±0.15 HU respectively. Both CT noise and spatial uniformity were within 15% of vendor specifications for all accredited scanners.

Discussion

Important factors affecting the accuracy and precision of CTP derived functional parameters include image intervals, CT noise, spatial uniformity and temporal stability of CT numbers. The accreditation process for the ACRIN 6695 evaluated specifically these factors using a practical process which can be implemented by scanning a routine quality control water phantom already present at the site with the specified protocol.

Conclusion

The ACRIN 6695 trial has demonstrated that CT scanner quality assurance for abdominopelvic CTP can be successfully accomplished with sufficient uniformity across multiple sites and scanner platforms to yield positive results in a multicenter biomarker trial.

SST14-09 Quality Control Phantom Using 3D Printing Technology in Multi-modality System

Friday, Dec. 4 11:50AM - 12:00PM Location: S403B

Participants

Byungdu Jo, Wonju-Si, Korea, Republic Of (Presenter) Nothing to Disclose
Dohyeon Kim, Wonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Su-Jin Park, Wonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyemi Kim, Wonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Geun Young Park, Wonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Chaeeneun Jung, Wonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Eunsup So, Wonju, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yong J. Kim, Wonju-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hee-Joung Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

Abstract Co-Author

Therese M. Weber, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Zheng Zhang, PhD, Providence, RI (Abstract Co-Author) Nothing to Disclose

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Susanna I. Lee, MD, PhD - 2013 Honored Educator
For the purpose of comparison with the NEMA NU 4-2008 image quality phantom, we considered mainly the uniformity and the spillover ratio. Indeed, the developed phantom resulted in very good qualities. Moreover, for X-ray imaging, preliminary analysis revealed consistent HU linearity with increasing iodine concentration and shows a high spatial resolution of up to 1.5 mm.

CONCLUSION

The results indicated that developing a complicate QC phantom can be designed to evaluate the systems for multi-modality imaging simultaneously. Our phantom has flexibility of changing quality parameters for the multi-modality system by changing the QC disk in a standard manner.

CLINICAL RELEVANCE/APPLICATION

The proposed QC phantom can be used for variety of pre-clinical or clinical applications in multi-modality system, SPECT/CT, PET/CT, Spectral-CT, simultaneously.
SST15
Vascular/Interventional (Innovation in Non-Vascular Interventions)
Friday, Dec. 4 10:30AM - 12:00PM Location: E350

Participants
Jonathan M. Lorenz, MD, Chicago, IL (Moderator) Nothing to Disclose
Robert G. Dixon, MD, Chapel Hill, NC (Moderator) Nothing to Disclose

Sub-Events
SST15-01 Gastroduodenal Stent Placement versus Surgical Gastrojejunostomy for the Palliation of Gastric Outlet Obstructions in Patients with Unresectable Gastric Cancer: A Propensity Score-Matched Analysis
Friday, Dec. 4 10:30AM - 10:40AM Location: E350

Participants
Jung-Hoon Park, MS, RT, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Ho-Young Song, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jiaywei Tsao, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Wei-Zhong Zhou, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Jin Hyoung Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young Chul Cho, BS, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the outcomes between stent placement and surgical GJ for the palliation of gastric outlet obstruction (GOO) in patients with unresectable gastric cancer.

METHOD AND MATERIALS
A retrospective study was performed in a single university hospital in 676 patients with GOO, and who were treated either by stent placement (n = 301) or surgical GJ (n = 375). The outcomes were assessed with reference to the following variables with the use of propensity-score matching: success rates; adverse events; dysphagia scores, albumin, and BMI; survival; symptom free duration; and hospitalization.

RESULTS
224 of 676 patients were enrolled in accordance with inclusion and exclusion criteria. In the 74 matched cohorts, there was no significant difference between the two groups following variables: success rates, adverse events, and survival. The dysphagia score seven days after treatment in the stent group was significantly better than in the surgery group (1.50 vs. 2.07, P < 0.001). Albumin level one month after treatments in stent group was significantly lower than in the surgery group (3.33 vs. 4.12, P < 0.001). Duration of symptom free and hospitalization were significantly longer in the surgery group than in the stent group (P = 0.002, P < 0.001, respectively). The recurrence rate was significantly higher in the stent group than in the surgery group (P = 0.032).

CONCLUSION
In a matched cohort of patients, stent placement can provide faster symptom relief and shorter hospitalization, while surgical GJ can provide longer symptom free duration, less recurrent obstruction symptoms and better nutritional status.

CLINICAL RELEVANCE/APPLICATION
Stent placement provides more immediate symptom relief and shorter hospitalization compared with surgical GJ, but is associated with a shorter symptom free duration, a greater chance of recurrent obstruction symptoms, and poorer nutritional status.

SST15-02 Fluoroscopic Stent Placement versus Endoscopic Stent Placement for the Palliation of Malignant Gastric Outlet Obstruction: A Retrospective Comparison Study
Friday, Dec. 4 10:40AM - 10:50AM Location: E350

Participants
Jiaywei Tsao, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Ho-Young Song, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jung-Hoon Park, MS, RT, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jin Hyoung Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young Chul Cho, BS, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Endoscopic stent placement (ESP) and fluoroscopic stent placement (FSP) are both well-established methods for the palliation of malignant gastric outlet obstruction (GOO). To date, there has been no study comparing these two procedures. The aim of this study was to compare retrospectively the outcomes of ESP with FSP in patients with malignant GOO.

METHOD AND MATERIALS
A retrospective study was performed in a single university hospital in 306 patients with malignant GOO, and who were treated either by ESP (n = 181) or FSP (n = 125). The outcomes were assessed with reference to the following variables: success rates;
procedure time; GOOSS scores; adverse events; re-intervention; stent patency; and survival.

RESULTS

A total of 193 patients met our inclusion/exclusion criteria, including 68 patients who underwent ESP and 125 patients who underwent FSP. The technical and clinical success rates, adverse events, re-intervention rates, stent patency, and patient survival rate were not significantly different between two groups. GOOSS score improved significantly in both groups after the procedure. Stent migration rate and number of re-intervention procedures was significantly higher in the ESP group than in the FSP group (P = 0.002 and P = 0.024, respectively). Stent collapse rate was lower in the ESP group than in the FSP group (P = 0.021). Six-month stent patency rate was statistically higher in the ESP group than in the FSP group (P = 0.044).

CONCLUSION

Despite similar outcomes and adverse events, partially covered SEMSs for TTS delivery system were associated with a higher migration rate and a more frequent need for re-interventional procedure, while lower stent collapse rate compared with partially covered dual SEMS for the palliation of malignant GOO.

CLINICAL RELEVANCE/APPLICATION

Our study demonstrated that both FSP and ESP using a partially covered SEMS are an effective therapeutic option for the palliation of malignant GOOs.

SST15-04  Fluoroscopic Removal of Retrievable Expandable Metallic Stents: Experiences in 129 Patients with Malignant Esophageal Strictures

Friday, Dec. 4 11:00AM - 11:10AM Location: E350

Participants
Pyeong Hwa Kim, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Ho-Young Song, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jung-Hoon Park, MS, RT, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jiaywei Tsao, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young Chul Cho, BS, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Wei-Zhong Zhou, Nanjing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the safety and efficacy of fluoroscopic removal of retrievable expandable metallic stents (REMSs) in patients with malignant esophageal strictures, to compare clinical outcomes regarding removal techniques and removal timing, and to identify predictive factors related to successful removal.

METHOD AND MATERIALS

With approval from our institutional review board, the records of 76 patients who underwent the new SEMS placement were retrospectively reviewed. Patients with benign strictures or who underwent temporary stenting for other therapies were excluded. Fifty-one patients (44 men, 86.3%; mean age, 63.7 years) were included in this study. Technical and clinical success, stent dysfunction, survival, and complications were analyzed.

RESULTS

Technical and clinical success was achieved in all patients (100%). The dysphagia score improved from 3.2±0.6 to 1.1±0.7 after treatment (P<0.001). Stent dysfunction occurred in 10 patients (19.6%): migration in four (7.8%), tumor overgrowth in five (9.8%), and food impaction in one (2.0%). The major complication was a tracheoesophageal fistula in one patient (2.0%). Minor complications, including mild pain and gastroesophageal reflux, were observed in 10 patients (19.6%). The median survival was 160 days. Twenty-four patients who underwent tumor treatments after stenting had a longer survival but had more stent dysfunction than those on supportive care (P<0.05).

CONCLUSION

The new stent was safe and effective for the palliation of malignant esophageal strictures, and resulted in relatively low migration and tumor overgrowth rates compared to those reported previously.

CLINICAL RELEVANCE/APPLICATION

This newly designed fully covered self-expandable metallic stent could be used for the management of malignant esophageal strictures. Owing to its new design, patients with malignant esophageal strictures could benefit from its low stent dysfunction and complication rates.
In this retrospective study, 129 patients with a total of 139 stent placements were reviewed retrospectively. Of the 139 stents, 95 stents were removed electively. Technical success rate and complication rate of the standard removal technique (Primary technical success) and modified removal technique (Secondary technical success) were evaluated. Logistic regression models were constructed to identify predictive factors related to successful removal.

RESULTS
Primary technical success rate was 78.4% (109/139) and secondary technical success rate was 100% (30/30). We observed 6 (4.3%) cases of complications associated with the removal. All complications were caused by the standard removal technique. There was no complication noted when REMSs were removed within 4 weeks of placement. Stent location at the upper esophagus (P=0.006), and stricture length ≥ 8cm (P=0.026) were negative predictive factors for technical success of the standard technique.

CONCLUSION
Fluoroscopic removal of retrievable SEMSs for malignant esophageal strictures can be performed in a safe and convenient manner. Caution should be posed when removing stents located at the upper esophagus and stricture length ≥ 8cm as they show higher tendency to failure of the standard removal technique.

CLINICAL RELEVANCE/APPLICATION
Stent removal within 4 weeks might be ideal in minimizing stent-induced complication, albeit further studies are to be performed for verification.

PURPOSE
To evaluate the technical feasibility and safety of airway stent placement for malignant tracheobronchial strictures in patients with an endotracheal tube.

METHOD AND MATERIALS
We retrospectively analyzed the data regarding retrievable, expandable, metal, stent placement under fluoroscopic guidance in 21 patients with an endotracheal tube inserted for malignant tracheobronchial strictures. The clinical effectiveness was assessed using the following variables: technical and clinical success; procedure and stent-related complications; and duration of intubation following stent placement.

RESULTS
Stent placement was technically successful in all 21 patients (100%), and with 20 of the 21 patients (95%) showing symptomatic improvement within five days. The endotracheal tube could be removed during (n=7) or after (n=13) stent placement, and the mean duration of intubation following stent placement was 1.4 days (range 0-4 days). One patient could not have his endotracheal tube removed and he died nine days following stent placement in an intubation state. Mild bleeding was a procedure-related complication that occurred in one patient and which resolved spontaneously within three days. Stent-related complications in four patients included stent migration (n=3) and tumor overgrowth (n=1), all of which were managed with a second stent placement (n=3) or stent removal and a second stent placement (n=1).

CONCLUSION
Airway stent placement under fluoroscopic guidance in patients with an endotracheal tube inserted for malignant tracheobronchial strictures, is both technically feasible and safe.

CLINICAL RELEVANCE/APPLICATION
Airway stent placement through an endotracheal tube is technically feasible and safe.

PURPOSE
To investigate the effects of a novel Laser Navigation System (LNS) on accuracy, efficiency and radiation dose compared to free-handed punctures at CT.

METHOD AND MATERIALS
Using a phantom body 60 punctures were performed comparing the conventional free-handed procedure to the LNS-guided method.
Using a phantom body 60 punctures were performed comparing the conventional free-handed procedure to the LNS-guided method to investigate accuracy, timely effort and radiation dose. Additional 20 LNS-guided interventions were performed on another phantom in order to confirm the accuracy. Ten subsequent patients then underwent LNS-guided puncture.

RESULTS

Phantom 1-LNS group showed a target point accuracy of 4.01 ±2.72 mm (freehand 6.30 ± 3.58 mm), entrance point accuracy of 0.76 ±0.6 mm (freehand 6.11 ±4.66 mm), needle angulation accuracy of 1.27 ±0.93° (freehand 3.36 ±3.10°), intervention time of 7:03 ±5:18 minutes (freehand 8:38 ±4:09 minutes) and the number of CT images 4.2 ±3.6 (freehand 7.9 ±5.1). Results showed significant improvement compared to freehand in 60 punctures. Phantom 2-LNS group showed a target point accuracy of 3.57 ±2.50 mm, entrance point accuracy of 1.39 ±1.99 mm, needle angulation accuracy of 0.95 ±1.19°, intervention time of 1:44 ±0.22 minutes and the number of CT images was 3.4 ±1.7. Regarding the first experience with patients, the LNS group achieved target point accuracy of 5.01 ±1.20 mm, an entrance point accuracy of 2.0 ±1.54 mm, a needle angulation accuracy of 1.5 ±0.3°, an interventional time of 12:08 ±3:07 minutes and using 5.7 ±1.6 CT-images.

CONCLUSION

LNS can improve CT-guided interventions with regard to accuracy, duration of intervention and radiation dose.

CLINICAL RELEVANCE/APPLICATION

The LNS may improve the accuracy, speed and safety of CT-guided interventions. With this system, the needle can be placed in a more accurate position at a faster speed while requiring a lower number of images, thereby reducing the patients’ and working staff exposure to radiation during the procedure.

SST15-07 Marked Reduction in Operator Radiation Dose by Decreasing kVp During CT-Guided Procedures

Friday, Dec. 4 11:30AM - 11:40AM Location: E350

Participants
Gabriel Howles-Banerjii, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose
Rajesh P. Shah, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Compared to fluoroscopy, CT-guided procedures typically use higher energy x-rays, exposing operators to higher energy scatter radiation, for which aprons provide less protection. In addition, higher energy x-rays are less attenuated by non-lead aprons than lead aprons. Recent studies have shown lower kVp can reduce patient dose during lung biopsies without compromising the procedure. We sought to measure the effects of reduced kVp and apron material on operator dose.

METHOD AND MATERIALS

A torso phantom was placed in a CT scanner (GE) with procedural settings: axial 3 x 5 mm slice thickness; 75, 135, or 315 mA; 80, 100, or 120 kVp. An electronic dosimeter (PDM-117, Hitachi-Aloka) was placed adjacent to the gantry 1 cm anterior, 36 cm lateral, and 48 cm inferior to the isocenter. Estimated operator dose measurements in µSv per gantry rotation were made without shielding or with 0.35mm Pb-equivalent aprons made of lead-vinyl or antimony-barium (Sb-Ba) (Burlington).

RESULTS

Aprons were more effective at lower kVp: attenuation by the Sb-Ba apron was 90%, 93%, and 97% at 120, 100, and 80 kVp (95% CI: +/- 0.1%, 1.5%, 0.5%). No statistically significant difference was observed between the lead-vinyl and Sb-Ba materials (p>0.35 at each kVp). Measured operator doses at 120, 100, and 80 kVp were 2.05, 0.87, and 0.20 µSv (95% CI: +/- 0.11, 0.195, 0.0). Thus, decreasing kVp from 120 to 100 reduced dose by 58% (p<0.001) and decreasing kVp from 120 to 80 reduced dose by 90% (p<0.001). When tube current was adjusted to maintain constant image noise and the measured dose was multiplied by the kVp-specific apron attenuation (above), estimated doses were 0.45, 0.35, and 0.20 µSv. Thus, decreasing kVp from 120 to 100 reduced dose by 22% and decreasing kVp from 120 to 80 reduced operator dose by 52%.

CONCLUSION

If anatomical contrast permits decreasing kVp from 120 to 100 or 80 (without changing mA), interventionalists can reduce their radiation dose by 58% or 90%, respectively. Even if mA are increased to maintain constant noise, the operator dose will still decrease by 22% or 52%, because aprons are more effective at lower kVp. The Sb-Ba apron was as effective as the lead-vinyl apron for attenuating the scatter radiation at all three kVp.

CLINICAL RELEVANCE/APPLICATION

By decreasing kVp during CT-guided procedures, interventionalists can decrease their occupational radiation dose by up to 90%.

SST15-08 CT-guided Percutaneous Jejunostomy Catheter Placement: A Retrospective Analysis of Safety and Efficacy in 28 Patients

Friday, Dec. 4 11:40AM - 11:50AM Location: E350

Participants
Stephen R. Lee, MD, Boston, MA (Presenter) Nothing to Disclose
Colin J. McCarthy, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Peter R. Mueller, MD, Boston, MA (Abstract Co-Author) Consultant, Cook Group Incorporated
Ashraf Thabet, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the safety and efficacy of CT-guided insertion of percutaneous jejunostomy catheters.

METHOD AND MATERIALS

Between January 1995 and February 2015, CT-guided percutaneous jejunostomy catheter placement was attempted on 31 patients. A retrospective chart review was performed to assess the technical success rate, procedural time, and rate of major and
RESULTS
Technical success was achieved in 87% of attempted placements (28 of 32 attempts). Technical failure was due to excessive target bowel mobility. Average procedural time was 88 minutes with a median of 77 minutes. Percatheter leakage was the most common complication, occurring in 78% of patients (22 of 28). There were no major complications.

CONCLUSION
Use of CT to guide placement of percutaneous jejunostomy catheters is safe and effective, with technical success and complication rates similar to reported rates when using fluoroscopy. CT offers distinct advantages in certain patients over fluoroscopy, including the ability to more easily select a bowel loop with no intervening structure at risk of inadvertent injury.

CLINICAL RELEVANCE/APPLICATION
Transgastric access for enteral feeding may be unavailable in patients with upper abdominal malignancy or prior GI surgery; CT-guided jejunostomy tube placement is a safe and effective method to obtain access in these patients.

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Peter R. Mueller, MD - 2012 Honored Educator
Peter R. Mueller, MD - 2013 Honored Educator

SST15-09  Central Stentoplasty: Technical Results from the First 40 Vertebral Levels
Friday, Dec. 4 11:50AM - 12:00PM Location: E350

Participants
Ivan Huang, 308433, Singapore (Presenter) Nothing to Disclose
Uei Pua, MBBS,FRCR, Singapore, Singapore (Abstract Co-Author) Nothing to Disclose

PURPOSE
Central stentoplasty is a novel technique where a single stent is implanted in the center of the vertebral body under cone-beam CT guidance. Data on this technique including technical feasibility, safety and outcome however remains limited. The purpose of this study is to described the technical results of the first 40 cases of central stentoplasty in our institution.

METHOD AND MATERIALS
Consecutive cases of central stentoplasty (CS) from our prospective registry was analysed. Patient demographics, indications and pre-procedural imaging were reviewed. Technical success was defined as successful midline stent implantation, on antero-posterior fluoroscopy and in the coronal view on completion cone-beam CT. Procedure related complications were recorded and pain score were obtained immediately before and within 6 hours after the procedure. In addition, fractured vertebral bodies with > 30% height loss were assessed for deformity correction using vertebral angle and anterior vertebral height ratio.

RESULTS
From September 2013 to March 2015, a total of 35 patients (9 men, 26 women) with mean age of 70.8 years (range 51 - 90 years) underwent central stentoplasty. Among them, 40 vertebral levels were treated, consisting of thoracic (n=17) and lumbar (n=23) vertebrae. Etiologies included osteoporotic (n=25), traumatic (n=5) and malignant (n=5). Technical success was achieved in 100% of the cases. Complications included: asymptomatic cement extravasation (n=4) and self-limiting track hematoma (n=1). No stent malpositioning, neurological deficit or complication resulting in escalation of care or surgical intervention was recorded. Visual analogue score improvement of > 3 was recorded in 39 out of 40 patients. A total of 15 fractured vertebral bodies had > 30% loss of height and were further analysed for deformity correction. These vertebral bodies had a mean pre-procedure sagittal index (SI) of 0.82 and the post procedure SI of 0.92. The pre-procedure wedge angle (WA) was -5.38° compared to post-procedure mean WA of -3.54°. The mean pre-procedure segmental kyphosis was -7.00° and the mean post-procedure segmental kyphosis was -4.43°.

CONCLUSION
CS is technically feasible and a low complication rate is expected. It can be applied across various etiologies and have the potential for deformity correction in vertebral bodies with significant vertebral height loss.

CLINICAL RELEVANCE/APPLICATION
CS is a feasible technique in spinal augmentation.
**Vascular/Interventional (Advances in CT angiography)**

Friday, Dec. 4 10:30AM - 12:00PM Location: E352

**Vascular/Interventional (Advances in CT angiography)**

Friday, Dec. 4 10:30AM - 10:40AM Location: E352

**Patient Tailored Contrast Volume for Preoperative CT Angiography of the Aorta: A Prospective Study Based on Patient Heart Rate and Body Surface Area Differences**

**Participants**
James C. Carr, MD, Chicago, IL (Moderator) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
Elizabeth M. Hecht, MD, New York, NY (Moderator) Nothing to Disclose

**Method and Materials**

We performed a randomized prospective study of 60 patients undergoing CT-angiography for aortic aneurysm/dissection. Patients were scanned on a Siemens Somatom Definition Flash optimized for fast acquisition. An in-house developed injection-calculator (iCalc by Nemoto Kyorindo, Tokyo) proposed an optimal patient contrast dose based on patient weight, length, heart rate and contrast medium concentration. Image quality was determined quantitatively (HU-measurements) and qualitatively (five-point visual scale with intra-observer control). All patients received a non-contrast and arterial phase acquisition. Triggering was performed at 120HU at the suprarenal level. Patients were randomly divided in 3 study groups: 1) a control group with standard dose of 120ml, 2) an injector-calculated contrast dose, 3) an additional dilution of 50% on top of the injector-calculated dose.

**Results**

The average contrast dose in group 2 was reduced by 15% (mean injected dose 101,8ml) compared to group 1 (p-value 0,0012), with a decrease in mean HU-values of only 1%. The range of HU units reduced from [156,3-569.8HU] to [155,6-421,3HU]. The visual score (4,5/5) was unchanged. For group 3, contrast dose reduction was 60% (mean injected dose 48,1ml) (p-value <<0,00001) with a mean decrease in HU-values of 32% (p-value 0,001) and range [79,1-449,1HU]. Average image quality dropped (3,7/5). In 2/20 patients, both diagnosed with dissection, image quality was suboptimal but still of diagnostic quality.

**Conclusion**

Contrast dose for CT-aortography was reduced by 15% without compromising image quality and interpretation. Images remained diagnostic even with further dose reduction to 60%. We would however recommend not to apply this in dissection patients.

**Clinical Relevance/Application**

The use of a patient specific contrast dose determination can be safely applied for CT aortography with a significant contrast dose reduction.

**Feasibility Study of Spectral CT Imaging Associated with Ultra-low Volume Contrast Medium for Aorta CTA: Compared with Conventional 120kVp**

**Participants**
Ping Hou, MD, Zhengzhou, China (Presenter) Nothing to Disclose
Xiang-Nan Feng, MS, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose
Jianbo Gao, MD, Zhengzhou, China (Abstract Co-Author) Nothing to Disclose
Jie Liu, Zhengzhou, China (Abstract Co-Author) Nothing to Disclose
Yaojun Jiang, MD, Zhengzhou, China (Abstract Co-Author) Nothing to Disclose

**Purpose**
To evaluate the image quality of Spectral CT associated with ultra-low volume contrast medium for aorta CTA, compared with conventional 120kVp scan with 70ml contrast medium.
METHOD AND MATERIALS

62 patients underwent aorta CTA examination on a spectral CT scanner (Discovery CT, GE Healthcare) were divided into 2 groups. 31 patients were scanned using GSI mode with contrast agent volume of 0.4ml/kg and injection rate calculated as volume/(delay time + exposure time) were the study group. After examined, images using 55keV and 70keV were reconstructed. Those two sets of images were named as set 1 and 2. Another 31 patients scanned using 120kvp with contrast agent volume of 70ml and 5ml/s injection rate were control group. The obtained images were regarded as set 3. CT values and CNR of aorta and its branches were obtained and compared. The overall image quality was evaluated on a five-point scale. Results were analyzed using rank-sum test, t test and Bonferroni test.

RESULTS

No significant differences existed in image quality of the renal arteries between set 1 and 3 (p=0.468). However, higher CNR values were obtained in set 1 than in set 2 and 3 (CNR 18.12±5.89 in ascending aorta; 16.82±4.47 in descending aorta; 17.27±4.73 in celiac trunk; 361.17±64.09 in renal arteries) (p<0.05), while there was no significant difference between set 2 and 3 (p>0.05). CT values for aorta and its branches were(358.8±21.62; 361.17±64.09; 336.89±55.70) (t=0.356, P=0.724), (386±59; 396±79; 348±61) (t=0.377, P=0.709), (428±99; 441±81) (t=0.377, P=0.709) for the set 1, 2 and 3. There were significant differences among the three groups (p<0.00) and between set 1 and 2, and set 2 and 3 (p>0.00). There was no significant difference between set 1 and 3 (p>0.05). The amount of contrast agent for each patient in the study group was 28.87±4.2ml, while that in the control group was 70ml. There were significant differences of the contrast medium volume among the two groups (F = 537.09, p=0.00).

CONCLUSION

Monochromatic images of 55keV in spectral aortic CTA with ultra-low volume contrast medium was feasible and can provide good image quality compared with conventional 120kVp scan.

CLINICAL RELEVANCE/APPLICATION

Monochromatic images of 55keV in spectral aortic CTA can significantly reduce the amount of contrast agent and injection rate with improved image quality.

SST16-03  Feasibility Study of Spectral CT Imaging Associated with Ultra-Low Volume of 20ml Contrast Medium for Pulmonary CTA

Friday, Dec. 4 10:50AM - 11:00AM Location: E352

Participants

Jie Liu, Zhengzhou, China (Presenter) Nothing to Disclose
Jianbo Gao, MD, Zhengzhou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the image quality of Spectral CT associated with ultra-low volume of 20ml contrast medium for pulmonary CTA compared with conventional 120kVp scan with 50ml contrast

METHOD AND MATERIALS

25 patients underwent CTPA examination on a spectral CT scanner (Discovery CT, GE Healthcare) using 20ml contrast agent and 5ml/s injection rate as group A. 15 patients scanned by 120kVp with 50ml contrast agent and 5ml/s injection rate was retrospectively reviewed as control group B. 5ml contrast agent were firstly used in the test bolus scan to get the peak time of the aorta and the pulmonary artery (T1, T2). Peak time of CTA scan was calculated as followed: Tpeak= T2+ 1/2(T2-T1). After the examination, images of 60keV with 50%ASiR were reconstructed. CT values of the pulmonary artery, lobar artery, and segmental artery were obtained. The overall image quality was evaluated on a five-point scale by two radiologists. Sample T test were used to compare image quality between A group and group B.

RESULTS

CT value of pulmonary artery, lobar artery and segmental artery in group A and B were 399± 15 vs 406±79, (t=0.356, P=0.724), 386±59 vs 396±77, (t=0.377, P=0.709) and 428± 99 vs 441±81, (t=0.377, P=0.709), SNR was 13.0 ± 2.3 and 14.7 ± 4.2 for Group A and B. CNR was 22.3 ± 9.5 and 23.6 ± 10.1.(both >0.05), respectively. There was no significant difference between group A and group B. But The image quality score were 3.4±0.6 vs 4.5±0.6,(t=4.279,P=0.001),There was significant difference between group A and group B

CONCLUSION

Spectral CT associated with ultra-low volume of 20ml contrast medium for pulmonary CTA can provide good artery enhancement and image quality saving half the contrast medium dose.

CLINICAL RELEVANCE/APPLICATION

There is also potential for further reduction in the contrast volume

SST16-04  Spot the Clot: Improvements in CT Detection of Thrombus Using an in Vitro Dual-Energy Based Phantom Model

Friday, Dec. 4 11:00AM - 11:10AM Location: E352

Participants

Jason DiPorce, MD, Jerusalem, Israel (Presenter) Nothing to Disclose
Jacob Sosna, MD, Jerusalem, Israel (Abstract Co-Author) Consultant, ActiViews Ltd Research Grant, Koninklijke Philips NV
Dorith Shaham, MD, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
Zinam Ronman, Haifa, Israel (Abstract Co-Author) Employee, Koninklijke Philips NV
Nahum Goldberg, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
PURPOSE
To determine the added value of dual energy CT utilizing low iodine concentration for the detection of thrombus in an in-vitro phantom model.

METHOD AND MATERIALS
Phantoms were constructed by collecting fresh swine blood which was allowed to form clots. These clots (n=8) were transferred into 11mL tubes. Heparinized blood containing 2 mg/ml iodine (Iomeron 350 mg/ml) was then added to the tubes. Control tubes (n=8) were filled with blood and the same iodine concentration without clot. A 17cm wide cube water bath phantom held the tubes. Scans were obtained using a 64-slice spectral detector CT (Philips Healthcare, Cleveland, OH) with the following iso-dose imaging parameters: 120kV, 250mAs and 80kV, 700mAs. For each scan, 120 and 80kV polyenergetic 1.5mm thick images were reconstructed. Monoenergetic images at 40, 50, 65, 80 and 100keV were generated from the 120kV scan. A 112 image presentation was created to display individual tubes in a random order. Three experienced radiologists blindly ranked the images for the presence of clots according to a 6 point certainty scale and a 4 point graded image quality scale. The clot detection confidence and image quality of monoenergetic compared to polenergetic images were analyzed using T-test.

RESULTS
The mean HU values of the iodinated blood at 120 and 80 kV, and 40, 50, 65, 80, 100 keV were 87, 118, 207, 142, 91, 66, and 51, respectively. Clot detection and image quality ranks were significantly better in low energy monoenergy images at 40 and 50 keV when compared to 120 and 80 kV polynenergetic images (p<0.05). Greater sensitivity and specificity were seen for 40 keV images (100% and 100%) and 50 keV (77.8% and 85.7%) compared to 120 kV conventional images (20.0% and 14%) and 80 kV conventional images (38.5% and 25.0%). Likewise, 40 and 50 keV monoenergy images significantly increased image quality ranks (3.9 and 3.6, respectively) compared to 120 and 80kV conventional images (2.8 and 3.1) (p<0.05, both comparisons).

CONCLUSION
Visualization of clot is improved when using dual energy monoenergetic images when compared to standard and low kV polynenergetic images. Our phantom model will likely also be useful in further identifying thresholds of low dose contrast for other diagnostic applications.

CLINICAL RELEVANCE/APPLICATION
Our results imply that dual energy scanning can permit reduced contrast dose while increasing reader confidence of clot detection.

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Jason DiPoece, MD - 2013 Honored Educator
Jacob Sosna, MD - 2012 Honored Educator

SST16-05 Preliminary Study of 70 kVp and Tailored Contrast Injection Protocol on Foot CT Perfusion

Friday, Dec. 4 11:10AM - 11:20AM Location: E352

Participants
Li Guo, MD, Beijing, China (Presenter) Nothing to Disclose
Xiaoying Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Xin Qi, Beijing, China (Abstract Co-Author) Nothing to Disclose
Han Chen Wang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Xiaohui Zhang, Shanghai, China (Abstract Co-Author) Employee, Siemens AG
Min Yang, Peking, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose of this study is to apply 70 kVp and tailored contrast injection protocol in foot CT perfusion, and investigate the clinical use of foot CT perfusion.

METHOD AND MATERIALS
18 patients with lower extremity arterial occlusive disease (including 7 patients with diabetic foot) were examined with foot CT perfusion, aged from 54 to 86 years old, 10 men and 8 women. Contrast enhancement was achieved with intravenous injection of nonionic iodinated contrast medium (320mgI/ml) and 30 mL of saline solution with the same flow rate. The volume (ranged from 29 to 54 mL) and the flow rate of contrast medium (ranged from 2.9 to 5.4 mL/s) was calculated with a tailoring approach according to the patients’ body weight, height and age. CT perfusion was carried out on Siemens dual source CT, with the following parameters: 128×0.6mm collimation, tube voltage 70 kV, rotation time 0.28s, acquisition time 57s(31 scans), with a fixed start delay of 20s. The radiation dose was 0.87 mSv (CTDI 70.59 mGy). The images were analyzed with commercial CT software (SyngoMMWP VE40B). A circular region of interest was placed in the distal anterior or posterior tibial artery of the foot to get a dose of 20s. The radiation dose was 0.87 mSv (CTDI 70.59 mGy). The images were analyzed with commercial CT software (SyngoMMWP VE40B). A circular region of interest was placed in the distal anterior or posterior tibial artery of the foot to get a

RESULTS
Three types TDC were obtained: type A, B and C. Most of the TDCs were type B, which has whole arising part, peak value and descending part. Type A curve was observed in a red hot diabetic foot, which genius-quickly peaks in the early parts of the scans. And type C curves were observed in black swollen feet, which peaks very slow or only has the arising part without the peak value and the descending part. 2. Because of motion artifact, perfusion parameters (including BV,BF and MTT) of 27 feet out of 36 (both sides for one patient) were obtained, and only 10 feet could get expected TDCs of the foot soft tissue, which shows a curve with whole arising part, peak value and descending part.

CONCLUSION

Our results imply that dual energy scanning can permit reduced contrast dose while increasing reader confidence of clot detection.
70 kVp CT perfusion could be a potential technique to determine the information about foot vascularization.

CLINICAL RELEVANCE/APPLICATION
70 kVp CT perfusion could be a potential technique to determine the information about foot vascularization.

SST16-06 Comparison of 4D Dynamic Computed Tomography Angiography and 4D Dynamic Magnetic Resonance Angiography in Patients with Peripheral Arterial Occlusive Disease

Friday, Dec. 4 11:20AM - 11:30AM Location: E352

Participants
Philipp Riffel, MD, Mannheim, Germany (Presenter) Nothing to Disclose
Holger Haubenreisser, Mannheim, Germany (Abstract Co-Author) Speaker, Siemens AG; Speaker, Bayer AG
Sonja Sudarski, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Mathias Meyer, Mannheim, Germany (Abstract Co-Author) Speaker, Siemens AG; Speaker, Bracco Group
Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (Abstract Co-Author) Institutional research agreement, Siemens AG
Thomas Henzler, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose of this study was to compare diagnostic image quality of 4D dynamic computed tomographic angiography (d-CTA) of the lower leg in comparison to 4D dynamic magnetic resonance angiography (MRA) at 3T in patients with peripheral arterial occlusive disease (PAOD).

METHOD AND MATERIALS
22 patients with PAOD (PAOD stage 1: 4 patients; PAOD stage 2: 7 patients; PAOD stage 3: 2 patients; PAOD stage 4: 9 patients) were examined with a combined CTA protocol on a 3rd generation 2 x 192 slice dual-source CT system consisting of a static CTA (s-CTA) of the lower leg runoff and d-CTA of the calves with a z-axis coverage of 80 cm. Additionally the patients underwent a MRA protocol combining continuous table movement (CTM) MRA of the runoff vasculature (s-MRA) as well as time-resolved MRA (d-MRA) of the calves with a z-axis coverage of 45 cm. Diagnostic image quality of s-MRA and s-CTA alone was compared with s-MRA and s-CTA in addition with d-MRA and d-CTA by two independent radiologists with a time interval of 4 weeks between the reading sessions for the static examination and for the combination of static and dynamic examinations. The images were evaluated according to a 4-point Likert-like rating scale assessing image quality on a segmental basis.

RESULTS
For static angiography 637 segments were included in the assessment of image quality. For s-CTA 62% of segments were rated as excellent, 20% as good, 16% as moderate and 2% as poor. No segments were rated as non-diagnostic. For s-MRA 20% of segments were rated as excellent, 20% as good, 20% as moderate and 26% as poor. 14% of segments were rated as non-diagnostic (all p-values < 0.0001). For dynamic angiography 264 segments were included in the assessment of image quality. For d-CTA 89% of segments were rated as excellent or good (78% as excellent, 11% as good). For d-MRA 40% of segments were rated as excellent or good (20% as excellent, 20% as good), while 28% of segments were rated as non-diagnostic.

CONCLUSION
In patients with PAOD the addition of d-CTA leads to an improved depiction of the calf vessels compared to s-CTA alone. The combined static and dynamic CTA yield improved image quality in comparison to a combined 3-T MRA protocol.

CLINICAL RELEVANCE/APPLICATION
A combined static and dynamic CTA yield improved image quality in comparison to a combined 3-T MRA protocol and should be considered as a valuable alternative in patients with all stages of PAOD.

SST16-07 Dual-Energy CT with Advanced Image-Based Virtual Monoenergetic Reconstructions Improves Depiction of Portal Vein Thrombosis

Friday, Dec. 4 11:30AM - 11:40AM Location: E352

Participants
Moritz H. Albrecht, MD, Frankfurt am Main, Germany (Presenter) Nothing to Disclose
Jan-Erik Scholtz, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Martin Beeres, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Boris Bodelle, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
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Julian L. Wichmann, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Andreas Bucher, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Lehnert, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the impact of an advanced monoenergetic reconstruction algorithm on visualization and diagnostic performance in dual-energy computed tomography (DECT) imaging of portal vein thrombosis (PVT).

METHOD AND MATERIALS
Forty patients (22 men; mean age, 67.5 years ± 17.6 years) who underwent contrast-enhanced portal-venous-phase DECT of the upper abdomen within clinical routine were retrospectively evaluated. Standard linearly blended (M_0.5, 50% low-kV spectrum) and virtual monoenergetic images were calculated using a basic (Mono) and an advanced image-based monoenergetic algorithm (Mono+) with energy levels ranging from 40-100 keV (10-keV increments). ROI measurements were performed in the portal vein proximally and, if visible, distal to the thrombus, and the splenic and superior mesenteric vein for objective contrast-to-noise ratio (CNR) calculation. Five-point likert scale ratings regarding image quality, contrast, noise, suitability for PVT assessment and
diagnostic performance of 2 radiologists in the diagnosis of PVT were evaluated.

RESULTS
Twenty patients (50%) showed findings of PVT. Mono+ images at 40 keV showed the best objective image quality (mean CNR, 7.2 ± 5.1, P < 0.01) compared to all other image series and were rated most suitable for PVT assessment (rating, 4.9 ; P = 0.03). Intravenous attenuation and contrast between Mono and Mono+ series showed no significant difference (objectively, P > 0.88 ; subjectively, P < 0.52), but substantially increased noise was found for Mono 40 and 50 keV compared to Mono+ and all other reconstructions (objectively, P < 0.01 ; subjectively, P < 0.01). Mono+ 60 keV images were rated best regarding subjective image quality ( P = 0.67). Diagnostic performance for diagnosis of PVT was highest for both radiologists at Mono+ 40 keV compared to all other available image series (mean sensitivity, 100 % ; mean specificity, 93.4 %, P < 0.04).

CONCLUSION
Mono+ reconstructions at 40 keV in DECT facilitate significantly improved diagnostic performance for detection of PVT compared to both standard linearly blended and basic Mono images.

CLINICAL RELEVANCE/APPLICATION
Additional reconstruction of Mono+ DECT series at 40 keV may improve detection and assessment in cases of suspected PVT.

SST16-08  **AngioCTA in the Preoperative Planning of Perforator Flaps in Plastic Reconstructive Surgery**

Friday, Dec. 4 11:40AM - 11:50AM Location: E352

Participants
Ruben Guerrero Vara, MD, Barcelona, Spain (Presenter) Nothing to Disclose
Claudia Alejandro Nunez Peralta, MD, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Gemma Pons Playa, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Jose Sarria, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Fernando Gomez, MD,PhD, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the utility of CTA in planning perforator surgery in different kind of flaps. To demonstrate the radiologic correlation between intraoperative and radiological findings.

METHOD AND MATERIALS
202 CTAs performed from January 2011 to January 2014 and their intraoperative findings were reviewed. We focused on DIEP(96), SIEA (25), ALTF(51), TDAP(18) and SGAP(12) flaps. The images were pre-operatively evaluated by a radiologist and a plastic surgeon. The best perforator vessel was selected and its position was identified by means of an X and Y axis respect to anatomic references. These anatomic references were different depending on the kind of flap. The obtained coordinates (x-y) for each perforator vessel were transferred to patient's skin before the surgical intervention. All the vessels depicted in CTA were found in the surgery. We consider good correlation if doppler ultrasound over the skin located at the exact given reference, could detect the vessel. We consider poor correlation if the vessel was located more than 10 mm distant from the reference or if the vessel was not found during surgery.

RESULTS
We found a very reliable relationship for DIEP (99.5%), SIEA (97%) and ALTF (98%) flaps. In SIEA flap (80%) the correlation was less exact since it has an inconstant anatomy and a learning curve for the radiologist is necessary. However, when we analysed the data of the last year, a 94% success was achieved.In TDAP flap (80%) the different position between the image acquisition and the surgery was the cause of the results. TDAP was the only flap where the images couldn't be acquired in the same position as surgery would be performed. Nevertheless, all perforators were always found in an area of 2 cm² around the point given by CTA.

CONCLUSION
CTA provides important information about vascular anatomy before perforator flap surgery. Choosing the dominant vessel allows faster and safer perforator flap surgical procedures. A proper knowledge of the anatomy and a good understanding of the surgical procedure by the radiologist are of paramount importance to achieve optimal results.

CLINICAL RELEVANCE/APPLICATION
CTA is nowadays a pre-operative examination of choice to perform perforator flap surgery since faster and safer surgical procedures have been demonstrated after its use.

SST16-09  **The Gravitational Gradient (GG), Defined as the Dependent Divided by Independent Region of Interest (ROI) Attenuation in Abdominal Aortic Aneurysms (AAA), Strongly Predicts Rapid Aneurysm Growth in Patients with Less Intramural Thrombus**

Friday, Dec. 4 11:50AM - 12:00PM Location: E352

Participants
Ayaz Aghayev, MD, Boston, MA (Presenter) Grant, Toshiba Corporation
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Frank J. Rybicki III, MD, PhD, Ottawa, ON (Abstract Co-Author) Research Grant, Toshiba Corporation;

PURPOSE
The GG quantifies 1st pass AAA CTA contrast variation; uniform enhancement (0.90.4 cm/y) AAA growth, and (b) the presence of
Near-Circumferential (>270° of sac) Intraluminal Thrombus (NCIT) significantly modifies the ability of GG to predict rapid growth.

METHOD AND MATERIALS
156 consecutive pre-intervention AAA pts who met study criteria (multiple exams >6mo apart to compute growth, >= 1 first-pass CTA to compute GG) underwent AAA dimension and volume (sac, lumen, and intramural thrombus) measurements. The GG was computed from the CTA dated closest to intervention. We evaluated (a) the relationship between abnormal GG (defined as <0.9 and >1.1) and rapid growth, and (b) if the presence of NCIT modifies the GG predictive ability.

RESULTS
42/156 (26%) pts were female; age=71±9.6 (22-92yrs). 103 pts had >2 scans. 66/156 (42%) had NCIT. The mean of the largest AAA diameter was 4.2±0.7cm on the first scan and 5.0±0.9 cm on the scan closest in time to the intervention. Mean vol of AAA sac, lumen, and thrombus on initial scan=65.2±34.7cc, 38.6±16cc and 26.6±25.7 cc, respectively. On scan closest to intervention, mean volume of AAA sac, lumen, and thrombus=91.0±38.9cc, 52.6±24.3cc and 38.4±29.3cc, respectively. 53/156 (33%) of patients had rapid growth (>0.4cm/year). 63/156 (40%) of patients had an abnormal GG. GG is significantly associated with rapid growth with unadjusted OR 1.19 (95% CI: [1.03, 1.38], p<0.02). Furthermore, its ability in predicting rapid growth is dependent on the presence of circumferential thrombus. Based on a logistic regression model including an interaction between GG and presence of circumferential thrombus, the OR for GG=6.05 (95% CI: [2.0, 18], p<0.001) for those without NCIT and 1.30 (95% CI: [0.45, 3.72], p=0.63) for those with NCIT. The presence of NCIT significantly modifies the ability of GG to predict rapid growth (test for interaction, p<0.05).

CONCLUSION
Patients with a positive GG within the AAA sac have rapid aneurysm growth, and AAA patients with an abnormal GG and without NCIT have an odds ratio > 6 for rapid growth, a significant modification of the predictive ability of the GG.

CLINICAL RELEVANCE/APPLICATION
Observation of a positive GG in an AAA sac warrants close attention, particularly when there is little intramural thrombus.