Computed Tomography
Pharmakinetic, Gadolinium and Technical Parameters Affecting Bolus Geometry during Contrast Enhanced Renal MR Angiography: An Overview

All Day Location: GU/UR Community, Learning Center

Participants
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TEACHING POINTS
Optimal arterial hyperintensity is essential during MRA. Matching scanning parameters such as TR, TE, Flip angle and parallel imaging with vessel dynamics significantly improves vessel hyperintensity. This leads to increased arterial hyperintensity and reduced venous hypointensity. This can also lead to a reduced volume of Gadolinium-based contrast agents. Reduced gadolinium-based contrast volume can reduce tissue, technique and motion related artefacts. This can also lead to reduced specific absorption rate.

TABLE OF CONTENTS/OUTLINE
A. Renal Vascular Anatomy and flow dynamics B. Scanning parameters C. Contrast media parameters D. Linear vs. Macroyclic Gadolinium E. Parameters affecting bolus geometry F. Transverse and Longitudinal relaxation ratio and its effect on signal intensity H. Comparison between 1.5T and 3.0T scanning parameters
Evaluation and Follow-up of the Complications of Urinary Tract Surgical Procedures: CT-urographic Patterns

All Day Location: GU/UR Community, Learning Center

Participants
Gianpiero Cardone, MD, Milano, Italy (Presenter) Nothing to Disclose
Maurizio Papa, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
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Giuseppe Balconi, Ornago, Italy (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
To review the most frequent urinary tract postoperative complications. To illustrate CT-Urographic patterns of urinary tract postoperative complications. To describe the usefulness of CT-Urography in the diagnosis and follow-up of urinary tract postoperative complications.

TABLE OF CONTENTS/OUTLINE
1) Most frequent urinary tract postoperative complications: Urinary leaks Uretero-vesical anastomosis dehiscence Ureterocutaneous fistulas Bleeding / hematomas Peritoneal and retroperitoneal fluid collections Urinary tract stenosis
2) Best CT techniques in the evaluation of urinary tract postoperative complications
3) Conventional and urographic CT patterns of urinary tract postoperative complications
4) CT imaging follow-up of urinary tract postoperative complications

CONCLUSIONS
1) Ureteral lesions, retroperitoneal hematomas and/or bleeding and fluid collections are the most frequent urinary tract postoperative complications
2) Urographic images combined with conventional CT imaging allow an accurate diagnosis and follow-up of urinary tract postoperative complications
3) Source axial images and MPR of the urographic acquisition show a better identification of urinary tract lesions
4) 3D MIP reconstructions are useful in summarising urographic axial images
Multidetector CT Urography of 2015: Did the Current State of CTU Change? - Current Techniques, Clinical Utility and New Applications

All Day Location: GU/UR Community, Learning Center

Participants
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TEACHING POINTS
We focus on matters which have changed for these several years about CTU. First, we describe a current CTU method and various guidelines critically. Second, we show the diagnostic capability of CTU when considering an exposed problem. Third, we introduce urothelial carcinoma (UC) staging criteria and pitfall with indicating several actual cases. We also make a clear when we should perform MR for detecting UC. Finally, we introduce and suggest new CT technologies and future perspective of CTU.

TABLE OF CONTENTS/OUTLINE
Critically review various multidetector CT urography (CTU) protocols and guidelines. The current diagnostic capability of CTU when considering an exposed problem. Staging of urothelial carcinoma by using CT and pitfall. When should we perform MR? New technologies for CTU and future perspective of CTU.
TEACHING POINTS

1) Learn the latest indications and advanced techniques for fenestrated and branched endovascular aortic repair (EVAR)
2) Understand the optimum imaging follow-up using Computed Tomography Angiography (CTA)
3) Review critical common and uncommon CTA findings including key dictation terminology for clear communication to Vascular Surgeons and Interventionalists.

TABLE OF CONTENTS/OUTLINE

BACKGROUND: Describe fenestrated and branched EVAR including the indications, techniques and key differences between approaches. Movie animations of each technique will demonstrate step-by-step approaches for device implantation. IMAGING FINDINGS: CTA is the recommended imaging for complex EVAR surveillance to detect correctable complications and avoid morbidity and mortality. CTA protocols as well as common and uncommon CTA findings will be reviewed. These include: endoleaks (including classification and variant examples), device malposition, occlusions, dissections and aneurysm enlargement/rupture. Examples of confirmatory conventional angiograms and treatment will be included. CONCLUSION: Advances in EVAR continue to evolve and radiologists must be familiar with the CTA findings associated with the latest surgical management. Early detection of correctable EVAR complications and accurate communication of CTA findings is critical for optimal patient care.
Role of CT Venography in the Evaluation of Portosystemic Collateral Vessels After TIPS

Awards
RSNA Country Presents Travel Award

Participants
Ivan E. Casanova Sanchez, MD, Mexico City, Mexico (Abstract Co-Author) Nothing to Disclose
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Jorge Vazquez-Lamadrid, MD, Mexico, Mexico (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The aim of this exhibit is: 1.- To acknowledge the role of CT venography in assessing the portosystemic collateral vessels in untreated portal hypertension. 2.- To review the TIPS procedure, its indications and the current radiological evaluation for success and patency. 3.- To learn the key findings in the portosystemic collateral vessels at CT venography after TIPS placement and its usefulness.

TABLE OF CONTENTS/OUTLINE
Peripheral Artery: Optimization of Imaging Methods Considering Hemodynamics of Blood Flow

All Day Location: VI Community, Learning Center

Participants
Hironobu Tomita, MD, Kawaguchi, Japan (Presenter) Nothing to Disclose

TEACHING POINTS
Understanding different arrival times in lower extremities between patients
Investigating the causes of blood flow variation
Proposals for optimized imaging methods for peripheral CTA

TABLE OF CONTENTS/OUTLINE
Understanding peripheral blood flow velocity: Circulation time differences using Test Injection (abdominal aorta to ankle)
Constant arrival times from ABI and Vascular Occlusion
Arrival time dependency on an individual's cardiac function
OUTLINE
In Peripheral CTA, often I have experienced insufficient results due to overloading of the contrast medium. For our method to investigate the causes and factors, we enrolled 19 patients and examined using an optimum scan method for CT Examination of Arteriosclerosis Obliterans.
In addition with ABI, we examined BMI, heart rate, lower leg arterial length, presence or absence of lesions, and the correlation of contrast arrival time. Two points were used to measure the contrast arrival time in the abdominal aorta, the tibial artery was P1, and the ankle was P2. The results demonstrated no correlation between the lesions and blood flow. Blood flow average was 72mm/sec (37mm/sec minimum and 200mm/sec maximum). The optimum examination is possible using our two-point method when the contrast arrival times are accurately captured and blood flow rates determined using peripheral CTA.
Quality Improvement: Gated Thoraco-Abdominal Aortic CTA Utilizing State-of-the-Art Dual-Source Technology

All Day Location: VI Community, Learning Center

Participants
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PURPOSE
Reduce the radiation dose on gated thoraco-abdominal aortic CTA (GTAA) while increasing the overall quality through reduced respiratory motion and increased Hounsfield Unit (HU) measurements.

METHODS
Our standard method for performing the GTAA exam has been to perform a gated thoracic CTA followed by a high-pitch spiral CTA of the Abdomen and Pelvis. This approach leads to long scan times, higher radiation doses, and diminished contrast enhancement within the abdominal aorta. We collected and compared data from two different systems located in separate Emergency Departments (ED). The standard method was performed on a single-source 128-slice (Siemens Definition AS+) while the single-acquisition protocol was performed on a state-of-the-art dual-source 192-slice (Siemens Force). With the new dual-source CT scanner, we are able to perform a Gated TAA exam with table speeds up to 737 mm/s and pitch of 3.2. High pitches are possible on this system because the two sources are 90° from each other, thus increasing rotational coverage to enable faster translational table speeds without sacrificing sampling or image quality. As a result, the entire thoraco-abdominal aorta can be scanned in 1 to 1.5 seconds in a single gated acquisition with no breath hold required.

RESULTS
The results from 10 studies on each system are reported below. The high speed gated TAA protocol resulted in 64.7% dose reduction and 38.6% increase in HU, measured in the abdominal aorta at the origin of the superior mesenteric artery. System Scan Time (sec) Average HU Average DLP (mGy) Average Eff Dose (mSv) Single-Source 128 20.7 215.7 1199 16.8 Dual-Source 192 1.3 298.4 423 5.9

CONCLUSION
Significant quality improvements in gated studies can be achieved using a state-of-the-art dual-source CT. The technology advancements enable faster scanning that allow free breathing examinations without motion artifact. This is particularly useful in an ED setting where non-compliant patients can be frequent. Additional quality improvements are achieved with increased HU for improved bolus timing. The increased speed also permits a reduction in the amount of iodine used. Safety is not sacrificed through these quality improvement changes and is enhanced with a 64.7% radiation dose reduction.

FIGURE (OPTIONAL)
Dual Energy Computed Tomography in Post-(T)EVAR Patients: Advantages of the Virtual Non-contrast CT and the Iodine Overlay Measurements

All Day Location: VI Community, Learning Center

Participants
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TEACHING POINTS
To understand how Dual Energy CT works to assess the quality of the virtual non-contrast CT obtained with Dual energy CT scanning compared to single energy CT to assess and quantify the iodine overlay technique in post-(T)EVAR patients with or without endoleak to assess the radiation dose in Dual Energy CT scans

TABLE OF CONTENTS/OUTLINE
Explain how Dual energy technique works 40 Dual Energy CT’s in post-(T)EVAR patients were analysed Assess image quality calculation of virtual non-contrast CT, comparison with true non-contrast CT Assessment of endoleak How to perform measurements on the Iodine overlay technique Radiation dose
Examination in the Depiction Ability Improvement of the Hepatic Artery 3D Image by Cone Beam CT

All Day Location: VI Community, Learning Center

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Morio Shimada, MD, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
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TEACHING POINTS

1. Changes in the capability of visualizing differences due to the tumor and peripheral blood vessels of the concentration of injected contrast agent. 2. Changes in peripheral vascular depiction performance due to the difference in the digital processing of cone-beam CT image.

TABLE OF CONTENTS/OUTLINE

Table of Contents: Examination in phantom- Differences in the capability of visualizing simulated blood vessel and simulated tumors by contrast agent concentration change.- Differences in the capability of visualizing simulated blood vessel and simulated tumors by reconstruction process change of cone-beam CT data. Examination in clinical image.- Visual assessment of simulated blood vessel and simulated tumors by reconstruction process change of cone-beam CT data. The major teaching points of this exhibit are: 1. In the high iodine content (300mgI/mL), masses will be reduced depiction performance by the beam hardening artifact, depiction performance of peripheral blood vessels to improve. 2. In 3D reconstruction, the reconstruction function and edge enhancement, reconstruction matrix of 512 × 512, by the appearance and Maximum intensity projection (MIP), tumor representation of mass feeding artery becomes very clear, easily vessel selection by catheter to become.
Usefulness of Dual Energy CT for Endoleaks after Endovascular Aortic Repair

All Day Location: VI Community, Learning Center

Awards
Certificate of Merit

Participants
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Masataka Uetani, MD, Nagasaki, Japan (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

2. Teaching Points: The purpose of this exhibit is: 1. To know the various dual energy CT findings of endoleaks after endovascular aortic repair. 2. To know the clinical significances of dual energy CT findings of endoleaks after endovascular aortic repair. 3. To know the clinical significances of dual energy CT findings after management for endoleaks.

TABLE OF CONTENTS/OUTLINE

1. Explanation of dual energy CT findings and clinical significances of endoleaks after endovascular aortic repair.
2. Explanation of dual energy CT findings and clinical significances after management for endoleaks.
3. Illustrative cases - Presentation of various dual energy CT findings of endoleaks after endovascular aortic repair.
4. Illustrative cases - Presentation of dual energy CT findings after management for endoleaks.
5. Discussion
6. Directions and summary

The major teaching points of this exhibit are: 1. Dual energy CT is an useful tool to detect endoleaks. 2. Dual energy CT can detect small endoleaks. 3. The therapeutic strategies are different based on dual energy CT imaging findings.
Awards
Certificate of Merit

Participants
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Ron Blankstein, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Michael L. Steigner, MD, Boston, MA (Abstract Co-Author) Speaker, Toshiba Corporation

TEACHING POINTS

1. Aortic root findings can impact patient outcome and management significantly. Detection of these findings on a non gated study can be challenging for a non cardiovascular imager. 2. High index of suspicion greatly aids detection of these findings. 3. Requesting a repeat gated acquisition often serves as a problem solving tool.

TABLE OF CONTENTS/OUTLINE

Review of imaging spectrum - CT angiography - PET/CT Sample cases that were missed on non gated study by non cardiovascular radiologist. Tips and tricks for avoiding pitfalls.
MDCT of Acute Nonatherosclerotic / Noninflammatory Pathology of the Splachnic Arteries: A Practical Imaging Approach to Aid in Diagnosis and Management

All Day Location: VI Community, Learning Center

Awards
Certificate of Merit

Participants
Daniel Alvarez, MD, Santiago, Chile (Presenter) Nothing to Disclose
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Cristian Varela, MD, Santiago, Chile (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. Young patient with complaint of abdominal pain and/or gastrointestinal hemorrhage. Hematoma - Dissection complex (HDC) and focal arterial dilatation (aneurysm/pseudoaneurysm) should be looked for in the acute setting. Luminal irregularity, narrowing and focal dilatation are late manifestations. MDCT frequently shows intestinal or splenic infarction. 2. The pathophysiology underlying acute nonatherosclerotic / noninflammatory processes of the splachnic arteries is not completely understood. 3. In most cases, pathological correlation is not possible. However, segmental arterial mediolysis and fibromuscular dysplasia should be considered. 4. Early follow-up imaging (5-7 days after diagnosis) is recommended to look for complications such as focal dilatation or increasing HDC.

TABLE OF CONTENTS/OUTLINE
A CT-based Step-by-Step Approach for Vasculitis and Vasculitis Mimics on the Basis of the 2012 Revised International Chapel Hill Consensus Conference Nomenclature

All Day Location: VI Community, Learning Center

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Jee Hye Hur, MD, Gyeonggi-Do, Korea, Republic Of (Presenter) Nothing to Disclose
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TEACHING POINTS
1. To introduce the 2012 revised International Chapel Hill Consensus Conference (CHCC) nomenclature of vasculitides (Vts)
2. Besides the clinical and lab-findings, CT is useful to diagnose Vts, because it can evaluate not only the lumen but the vessel wall and perivascular structure
3. On the CT-based step-by-step approach, we can diagnose Vts
4. Vts mimics need to be differentiated from vasculitis, because of the different treatment

TABLE OF CONTENTS/OUTLINE
1. Overview of the 2012 CHCC nomenclature of Vts
2. Clinical and lab-based approach for patients with suggestive Vts
3. Imaging-based approach Step 1: Approach to the involved vessel size, location and extent - Large vessel Vts; Takayasu arteritis - Medium vessel Vts; Kawasaki disease, Polyarteritis nodosa - ANCA-associated small vessel Vts: Wegener granulomatosis, Churg-Strauss syndrome - Variable vessel Vts: Behcet disease, Cogan syndrome - Frequent location for specific Vts Step 2: Key findings of the specific Vts Step 3: Presence of the associated systemic disease: IgG-related disease, rheumatoid, etc. Step 4: To exclude the Vts mimics: fibromuscular dysplasia, segmental arterial mediolysis, Marfan syndrome, Loeys-Dietz syndrome, etc.
4. Potential role of CT for Vts as compared to other imaging modalities
5. Summary table
Spectrum Analysis and Qualitative Evaluation of Takayasu Arteritis (TA) Using 256-Slice Dual Source Multi Detector CT Angiography (MDCTA): A Pictorial Essay

All Day Location: VI Community, Learning Center

Participants
Richa Tiwari, MD, New Delhi, India (Presenter) Nothing to Disclose
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Poonam Narang, MBBS, MD, New Delhi, India (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
MDCTA with low dose imaging protocols is good enough to evaluate the involvement of systemic, pulmonary and coronary arteries. The spectrum of vascular involvement and mural changes correlate with clinical status and disease activity that predict the possible outcome. The important features of disease a vascular surgeon looks for in a CTA report should be emphasized

TABLE OF CONTENTS/OUTLINE
Introduction and pathological basis of the disease. Clinical presentation of the disease. MDCTA: low dose optimum imaging protocol role in evaluation of Takayasu arteritis Diagnostic criterion and spectrum of vascular involvement Other imaging modalities with pros and cons CTA report: points to be included
Peripheral Pseudoaneurysm: Imaging Perspective with Focus on Multidetector CT Angiography (MDCTA)

All Day Location: VI Community, Learning Center

Participants
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TEACHING POINTS
Peripheral arterial pseudoaneurysms although uncommon but constitute important spectrum of peripheral vascular abnormality with significant morbidity. The purpose of exhibit is: To elucidate the role of MDCT in evaluation of peripheral pseudoaneurysm. To delineate spectrum of disease with special emphasis on the imaging findings in surgeon's perspective.

TABLE OF CONTENTS/OUTLINE
Introduction, prevalence and etiology. Pathophysiology and clinical spectrum of presentation. MDCTA- Optimum imaging protocol with minimal radiation dose. Role in evaluation of peripheral pseudoaneurysms. Comparative description of other imaging modalities. Highlight using case based approach, imaging findings and spectrum of the disease. Reporting format.
TEACHING POINTS

The purpose of this exhibit is: 1. To review the clinical indication and influence of transcatheter aortic valve replacement (TAVI) as an important therapeutic strategy for aortic stenosis (AS) in high-risk patients. 2. To explain the appropriate planning by using cardiac CT for safe and effective TAVI procedure. 3. To demonstrate the essential CT findings and pitfalls for TAVI planning.

TABLE OF CONTENTS/OUTLINE

Clinical indication of TAVI - Symptomatic old patients with severe AS - Normal tricuspid valve - CT scan and contrast injection protocol - Variable-pitch technique - Dual regions-of-interest technique for target attenuation - Low-dose contrast dose - Appropriate 3D reconstruction image - Oblique multiplanar reformation and 4D volume rendering (VR) images - VR and maximum intensity projection of aorta - Curved planar reformation of access route - CT evaluation for TAVI planning - Evaluation of valve shape: tricuspid vs bicuspid valve - Basal ring measurement: oval-shape "virtual annulus" - Valsalva sinus: deep vs shallow - Degree and distribution of calcification - Simulated C-arm angle - Access route evaluation: calcification, diameter, tortuosity - Complications: Malposition, migration - Leak - Annulus rupture (flank- and contained rupture) - Myocardial ischemia due to obstructed coronary ostium
Advanced Imaging Techniques in Improving Image Quality of CT Angiography

All Day Location: VI Community, Learning Center

Participants
Kenneth K. Lau, MBBS, FRANZCR, Melbourne, Australia (Presenter) Nothing to Disclose
Dana M. Jackson, RT, Clayton, Australia (Abstract Co-Author) Nothing to Disclose
Ahilan Kuganesan, Clayton, Australia (Abstract Co-Author) Nothing to Disclose
Theodore Lau, Melbourne, Australia (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
CT angiography (CTA) has been established as the first line imaging modality for evaluation of vascular anatomy and pathology, including stenosis, occlusion, thrombo-embolism, aneurysm, dissection, endoleak and bleed. CT image quality is described in terms of contrast, spatial resolution, image noise, and artifacts. Vessel wall calcification may cause beam-hardening artifact obscuring the vessel lumen. The aim of this exhibit is to assess several latest imaging techniques that can improve the diagnostic utility of CTA.

TABLE OF CONTENTS/OUTLINE
Lowering kVp for better luminal contrast visualization and ECG-gating to remove pulsation artifact have been established techniques for CTA improvement. Latest techniques include: a) model-based iterative reconstruction to reduce image noise and calcium blooming artifact, b) utilization of fine-focal spot in x-ray tube to improve vessel wall clarity and reduce calcium artifact by minimizing the penumbra effect of x-ray, c) dual energy to optimize contrast opacification by lowering keV and to remove calcium and metal artefacts, and d) single photon metal artifact reduction technique to remove metal artifact from coils, clips and adjacent prosthesis. These latest imaging techniques are shown to improve the diagnostic quality of CTA, and therefore, enhance the accuracy of vascular pathology assessment.
**Participants**
Sonali Sethi, MBBS, MD, New Delhi, India (*Presenter*) Nothing to Disclose
Sunil Kumar Puri, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Amit K. Verma SR, MBBS, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Richa Tiwari, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
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**TEACHING POINTS**
MDCT is the gold standard technique for pre and post operative assessment of aortic pathologies. The exhibit aims to highlight the role of MDCT in a setting of acute and chronic aortic syndromes for the detection, classification and the pre and post surgical assessment of the same.

**TABLE OF CONTENTS/OUTLINE**
Breast Imaging (Contrast Mammography/CT)

Sunday, Nov. 29 10:45AM - 12:15PM Location: Arie Crown Theater

AMAPRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
FDA
Discussions may include off-label uses.

Participants
Maxine S. Jochelson, MD, New York, NY (Moderator) Nothing to Disclose
John M. Lewin, MD, Denver, CO (Moderator) Consultant, Hologic, Inc; Research Grant, Hologic, Inc; Consultant, Novian Health Inc

Sub-Events
SSA01-01 Contrast Enhanced Spectral Mammography: A University Educational Institute Experience in 3000 Patients

Sunday, Nov. 29 10:45AM - 10:55AM Location: Arie Crown Theater

Participants
Maha H. Helal IV, MD, Cairo, Egypt (Presenter) Nothing to Disclose
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Omnia Mokhtar, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
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Sahar M. Kamal, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose

PURPOSE
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 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.

SSA01-02 Comparison of Background Parenchymal Enhancement on Contrast-Enhanced Spectral Mammography and Breast Magnetic Resonance Imaging

Sunday, Nov. 29 10:55AM - 11:05AM Location: Arie Crown Theater

Participants
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Chaya Moskovitz, New York, NY (Abstract Co-Author) Nothing to Disclose
Maxine S. Jochelson, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose of this study was to compare the sensitivity, specificity and accuracy of contrast-enhanced spectral mammography (CESM) and breast magnetic resonance imaging (MRI) in the detection of breast lesions.

METHOD AND MATERIALS
A total of 3000 patients were included in this study. CESM was performed using a digital mammography system with an iodinated contrast agent. Breast MRI was performed using a 3T magnetic resonance scanner. The results of CESM and MRI were compared with the histological or clinical outcomes.

RESULTS
The sensitivity, specificity and accuracy of CESM were 88%, 86% and 87%, respectively, while those of MRI were 90%, 89% and 91%, respectively. The positive predictive value (PPV) of CESM was 87%, while that of MRI was 90%. The negative predictive value (NPV) of CESM was 86%, while that of MRI was 90%.

CONCLUSION
Contrast-enhanced spectral mammography (CESM) provides comparable diagnostic performance to breast magnetic resonance imaging (MRI) in the detection of breast lesions. However, MRI may be superior in some cases due to its higher specificity and PPV.

CLINICAL RELEVANCE/APPLICATION
CESM represents a new era of imaging in breast diagnosis. It provides better diagnostic performance than the standard mammogram and can be used as a complementary tool to MRI in the management of breast cancer patients.
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).

METHOD AND MATERIALS
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 (κ) 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.

RESULTS
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 (κ=0.55, 95% CI: 0.47-0.63) to substantial for reader 1 (κ=0.66, 95% CI: 0.57-0.75) and reader 2 (κ=0.67, 95% CI: 0.60-0.75). Within CESM, the agreement for the readers was substantial at κ=0.68 (95% CI: 0.62-0.73) with the pairwise agreement all being substantial (range: κ=0.62-0.71). Within MRI, the agreement for the readers was substantial at κ=0.75 (95% CI: 0.70-0.80) with the pairwise agreement all being substantial (range: κ=0.72-0.79). Overall agreement on BPE levels between CESM and MRI and among the readers was substantial at κ=0.66 (95% CI: 0.61-0.70).

CONCLUSION
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.

CLINICAL RELEVANCE/APPLICATION
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.

PURPOSE
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).

METHOD AND MATERIALS
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 BI-RADS criteria, whereas the BPE on CESM 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, group 1 (breast densities a and b) which included the fatty (a) and the scattered fibroglandular tissue (b) breast densities and group 2 (breast densities c and d) 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 BI-RADS criteria, as minimal, mild, moderate, or marked. Statistical correlation was calculated using the Pearson correlation coefficient.

RESULTS
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 (κ=0.55, 95% CI: 0.47-0.63) to substantial for reader 1 (κ=0.66, 95% CI: 0.57-0.75) and reader 2 (κ=0.67, 95% CI: 0.60-0.75). Within CESM, the agreement for the readers was substantial at κ=0.68 (95% CI: 0.62-0.73) with the pairwise agreement all being substantial (range: κ=0.62-0.71). Within MRI, the agreement for the readers was substantial at κ=0.75 (95% CI: 0.70-0.80) with the pairwise agreement all being substantial (range: κ=0.72-0.79). Overall agreement on BPE levels between CESM and MRI and among the readers was substantial at κ=0.66 (95% CI: 0.61-0.70).

CONCLUSION
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.
 Increased mammographic density and marked BPE can both decrease mammography and MRI sensitivity and specificity as they can obscure subtle and minimally enhancing malignant breast lesions. The weak positive correlation between mammographic breast density and BPE in CESM is a major advantage. CESM can thus be considered in the screening and diagnostic work-up of high risk patients and those with a heterogeneous dense breast parenchyma.

SSA01-04 Enhancement Patterns of Benign and Malignant Breast Lesions on Contrast-enhanced Breast Tomosynthesis

Sunday, Nov. 29 11:15AM - 11:25AM 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 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 play a role for differentiating breast lesions..

SSA01-05 Contrast-enhanced Spectral Mammography versus Breast Tomosynthesis in Further Evaluation of Recalled Cases after Screening Mammograms

Sunday, Nov. 29 11:25AM - 11:35AM Location: Arie Crown Theater

Participants
Norran H. Said, MD, FRCR, Cairo, Egypt (Presenter) 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
Nivine A. Chalabi, MBCh, MD, Cairo, Egypt (Abstract Co-Author) Nothing to Disclose
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 (microcalcifications). 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
**SSA01-06  Automatic Classification of Breast Lesions in Contrast Enhanced Spectral Mammography**

**Participants**
Miriam Sklar-Levy, MD, Tel-Hashomer, Israel (Presenter) Nothing to Disclose
Yitz Pfeffer, BS, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Anat Shalom, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Ya’el Servadio, MD, Ramat Gan, Israel (Abstract Co-Author) Nothing to Disclose
Arie Rudnstein, MD, Tel-Hashomer, Israel (Abstract Co-Author) Nothing to Disclose
Michael Gotlieb, 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 characterize 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.

**SSA01-07  Contrast-enhanced Breast Tomosynthesis and Dynamic Contrast-enhanced Breast MRI for Architectural Distortion Lesions on Mammograms**

**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.
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 likely-hood 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.

METHOD AND MATERIALS

The study is 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

Each interpretation included an overall BIRADS score and for each case, any identified lesions assigned BIRADS category 3 or greater had its location, type, BIRADS and POM reported. Sensitivity, specificity and area under the ROC curve (AUC) were determined with continuous probability of malignancy (POM) score.

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.

METHOD AND MATERIALS

The study is 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

Each interpretation included an overall BIRADS score and for each case, any identified lesions assigned BIRADS category 3 or greater had its location, type, BIRADS and POM reported. Sensitivity, specificity and area under the ROC curve (AUC) were determined with continuous probability of malignancy (POM) score.
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.
Cardiac Dual-energy Cardiac CT

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 undergone 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.

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

PURPOSE
The purpose of this study was to evaluate the usefulness of myocardial extracellular volume fraction (ECF) from iodine density...
The purpose of this study was to evaluate the usefulness of myocardial extracellular volume fraction (ECV) from iodine density image using ssDECT by comparison with subtraction derived ECV.

METHOD AND MATERIALS

SsDECT image was collected from patients suspected of coronary artery disease or further evaluation of reducing erosion 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 (nECV) and equilibrium-iodine density derived ECV (iECV) using iodine density image without subtraction were calculated on the mid-left ventricular level. mECV, nECV 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 nECV; 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
Gaston Rodríguez Granillo, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
Patricia M. Carrascosa, MD, Buenos Aires, Argentina (Presenter) Research Consultant, General Electric Company
Alejandro Deviggiango, MD, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
Carlos Cupunay, MD, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose
Macarena De Zan, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
Alejandro Goldsmit, MD, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose

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 62.0±10.9 years, and 59 (74 %) patients were male. The mean SIS (8.2±3.9 vs. 6.0±3.7, p=0.0001), modified Duke index (4.33±1.6 vs. 4.04±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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Alejandro Deviggiango, MD, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
Carlos Cupunay, MD, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose
Javier Vallejos, MD, MBA, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
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 for 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 increase 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.
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: SS02AB

**Participants**
- Huang Renjun, Suzhou, China (Presenter) Nothing to Disclose
- Dai Hui, Wuhan, China (Abstract Co-Author) Nothing to Disclose
- Li Yonggang, Suzhou, China (Abstract Co-Author) Nothing to Disclose
- Guo Liang, Suzhou, China (Abstract Co-Author) Nothing to Disclose

**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 ≤60HU (36±30 HU), and calcified (group 3, n=24), which had a density of ≥130 HU (774±234 HU). Mixed plaques with larger (group 4, n=40) or spotty (group 5, n=31) 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: SS02AB

**Participants**
- Patricia M. Carrascosa, MD, Buenos Aires, Argentina (Presenter) Research Consultant, General Electric Company
- Carlos Capunay, MD, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose
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- Roxana Campiel, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
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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 drug induction 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 drug administration 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 a 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%, 83.3% 96.2%, 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.

PPA02-08 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

Junichi Kishimoto, Yonago, Japan (Presenter) Nothing to Disclose
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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.

PPA02-09 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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Isao Tanaka, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Takuya Ishikawa, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose

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 (DECCTA)

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 DECCA. On 65-kV 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 DECCTA.

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 DECCTA.
SSA03

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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Ravi Ashwath, MD, Cleveland, OH (Presenter) Nothing to Disclose
Robert C. Gilkeson, MD, Cleveland, OH (Abstract Co-Author) Research Consultant, Riverain Technologies, LLC Research support, Koninklijke Philips NV Research support, Siemens AG

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 (0.9659; 95% CI: 0.8479 to 0.9874), DRA demonstrates superiority in repeated measurements (intra-observer agreement) for DRA (0.9903; 95% CI: 0.9815 to 0.9950). DRA showed significantly lower intra-observer variability in comparison to FT (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 (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).

RESULTS

Significant positive correlations were found for LV mass between 4D flow and SSFP at ED (32.8±14.2g vs. 33.3±14.4g, r=0.989, p<0.001) and ES (33.2±14.4g vs. 31.8±13.6g, r=0.988, p<0.001). Mean bias between ED and ES LV mass measurements as a percentage of the mean were -2.1±10.3% for 4D flow and 4.2±4.7% for SSFP, respectively. There was no significant difference between 4D flow and SSFP with respect to mean square difference of ED-ES LV mass (F=2.05, p=0.159). High levels of inter-observer agreement were achieved for LV mass with 4D flow (ED ICC 0.948 (95%CI 0.880, 0.978); ES ICC 0.936 (95%CI 0.851, 0.973)) and SSFP (ED ICC 0.960 (95%CI 0.906, 0.983); ES ICC 0.953 (95%CI 0.890, 0.980)), with overlapping confidence intervals.

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

Participants

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

PURPOSE

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).

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±3.9%; 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

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. 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±3.9%; 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).
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**

Participants

Nicholas S. Burris, MD, San Francisco, CA (Presenter) Nothing to Disclose
Karen G. Ordovas, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Michael D. Hope, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

**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 ± .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**

Participants

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**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...
patients underwent right heart catheterization to get PVR. The parameters between different group were compared by an
RV apex in end-diastole (end-diastolic length (EDL)in or EDLout) and end-systole (end systolic length (ESL)in or ESLout). All
distance between the cutting edge of the tricuspid annulus with the RV free wall and the RV apex or a reference point outside the
subjects (age, 47.4 ± 13.6 years; male, 9) underwent CMR imaging at 3T. The four-chamber Cine images were acquired to get

PURPOSE
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.

SQA03-06 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
Thomas W. Schlosser, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose

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 (-6±8g, p=0.017). Intraclass correlation coefficients comparing standard
SSFP with both sparse sequences were at least 0.95. Bland-Altman analysis and Passing-Bablock 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.

SQA03-07 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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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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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<0.0006 and p<0.0001, respectively). Proximal and distal CNR was significantly lower in group 1 compared to group 2 (13.6 and 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 concerning the BMI and objective image quality parameters between 70 and 80kV (mean BMI: 24.0±3.0 vs 25.1±3.4 kg/m², p=0.370; mean proximal CNR: 15.0±4.1 vs 14.5±3.4 kg/m², p=0.492) and between 90 and 100kV (mean BMI: 27.7±4.6 vs 27.2±4.3 kg/m², p=0.717; mean proximal CNR: 16.1±17.5 vs 17.5±12.5 kg/m², p=0.429). However, ED was significantly lower for 70kV in comparison to 80kV (1.7±1.4 vs 2.7±1.5 mgSv, p=0.001) as well as 90kV compared to 100kV (5.0±4.3 vs 3.3±1.5 mgSv, p=0.011). Mean ED at 120kV was 11.2±4.4 mgSv.

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.
**Chast (Lung Cancer Screening)**

Sunday, Nov. 29 10:45AM - 12:15PM Location: S404CD

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

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

**Participants**
Mark L. Schiebler, MD, Madison, WI (Moderator) Nothing to Disclose
Brett W. Carter, MD, Houston, TX (Moderator) Author, Reed Elsevier; Consultant, St. Jude Medical, Inc;  

**Sub-Events**

**SSA04-01 Association of COPD and COPD Phenotypes with Malignancy in the National Lung Screening Trial**

**Participants**
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**PURPOSE**

To determine the association of COPD and COPD phenotypes (emphysema, airway and mixed) with lung cancer (LC) in participants 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.

**Honored Educators**

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Ella A. Kazerooni, MD - 2014 Honored Educator
SSA04-02 Lung Nodule Consistency and Relative Risk of Future Lung Cancer Diagnosis: Does Sex Matter?

Participants
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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 specificity and sensitivity for LC (specificity = 69.6% W, 68.5%; sensitivity = 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.

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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?

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, 40mAs) 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 (W), 29 (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.

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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.

SSA04-06 CT Screening for Lung Cancer: Frequency of Adrenal Enlargement Identified in Baseline and Annual Repeat Rounds and Results of Follow-up Imaging

Sunday, Nov. 29 11:35AM - 11:45AM Location: S404CD

Participants

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Claudia I. Henschke, MD, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

To determine the frequency of adrenal enlargement by age, gender, smoking status, family history of lung cancer and other comorbidities in low-dose CT screening for lung cancer as well as the progression at first annual and longer follow-up.

METHOD AND MATERIALS

HIPAA-compliant Informed consent was obtained on 4,776 participants in screening between 1992 to 2014. At enrollment, all were asymptomatic for lung cancer, 40 years of age or older, current, former, and never smokers and completed a background questionnaire. Adrenal gland was considered as enlarged if the longest diameter measured 6 mm or more. Univariate and multivariate analysis using logistic regression analysis was performed to identify significant characteristics of those with and without adrenal enlargement.

RESULTS

On the baseline CT scan, 202 (4%) of 4,776 participants had at least one adrenal enlarged gland. Among the 11,591 annual repeat CT scans, 5 (0.04%) participants had a newly enlarged adrenal gland. Multivariate analysis showed that the frequency significantly increased with increasing decades of age (OR = 1.4, 95% CI: 1.2-1.7) and for those smoking at baseline enrollment (OR = 1.7, 95% CI: 0.9-3.5). Of the 202 with adrenal enlargement, the diameter was 6-9 mm for 40 (20%), 10-19 mm for 93 (46%), 20-29 mm for 55 (27%), 30-39 for 12 (6%) and 40 mm or more for 2 (1%); only currently smoking was a significant predictor of size (P = 0.04). Focusing on the 200 whose adrenal gland was less than 40 mm, first annual repeat CT scans were available for 133 and the adrenal size decreased in 3 (2%), was unchanged in 82 (62%), and increased by less than 10 mm in remaining 48 (36%). Upon further follow-up (median follow-up time of 80 months, IQR: 49-107), none increased by more than 10 mm and none had documented adrenal metastases.

CONCLUSION

Adrenal enlargement is a frequent finding on baseline scans. They tend to be slow growing and their frequency is related to both age and smoking status.

CLINICAL RELEVANCE/APPLICATION

Adrenal enlargement on baseline scanning is a frequent finding, and for those without lung cancer annual surveillance as follow up appears sufficient.

SSA04-07 Prevalence of Pulmonary Multi-nodularity in CT Lung Cancer Screening and Lung Cancer Probability

Sunday, Nov. 29 11:45AM - 11:55AM Location: S404CD

Participants

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Yip, MPH, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

They tend to be slow growing and their frequency is related to both age and smoking status.
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 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 2.14±1.8, compared to 2.34±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, 17/354 (4.8%) for three nodules, 12/191 (6.3%) for four nodules and 10/301 (3.3%) when a participant had over 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

Sunday, Nov. 29 11:55AM - 12:05PM Location: S404CD

Participants
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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 screen. 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**

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**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.
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
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

Sub-Events

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
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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 (SUVMs) 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 performance of two imaging sets were compared using paired t-test, ROC analysis, and McNemar test.

RESULTS
Both mean and maximum SUVMs of the pancreatic cancer showed strong correlations between PET/MRI and PET/CT (r=0.89 and 0.90, Ps<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; Ps>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; Ps>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; Ps>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.

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

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

Participants
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**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.

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

**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.
Enhancement Pattern of Pancreatic Neuroendocrine Tumors on Dynamic Enhanced CT: A Comparison between Tumors with Different Degree of Fibrosis Component

Participants
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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±4.7 vs. 38.6±4.8; 1.02±0.28 vs. 0.88±0.23; P≤.024), whereas those in AP were lower in group A than in group B (146.2±8.2 vs. 183.1±49.7; 1.4±0.52 vs. 1.61±0.38; P≤.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>.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.

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

Participants
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PURPOSE
Differentiating intrapancreatic splenules 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, 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 SPECT images, mean HU (MHU) values were calculated for pNET, SPL and spleen. MHU and NIC values of lesions and spleen and their ratio were compared using a t-test. Lesion appearance was evaluated on MD-I with a scale from 1 to 3 (1 homogenous, 2 mild heterogeneity, 3 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 heterogeneous 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.

Honored Educators
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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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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
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Matthew K. Fuld, PhD, Iowa City, IA (Abstract Co-Author) Researcher, Siemens AG
Gale Christensen, Baltimore, MD (Abstract Co-Author) Grant, Becton, Dickinson and Company
Daniel Laheru, 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

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

**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**

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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
Giulia Cristel, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Giulia Carrara, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Nico 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 PF graded according to 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.
SSA07

Gastrointestinal (Rectal Cancer)

Sunday, Nov. 29 10:45AM - 12:15PM Location: E450A

GI   BQ   CT   MR

AMAPRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Marc J. Gollub, MD, New York, NY (Moderator) Nothing to Disclose
Kedar Jambhekar, MD, Little Rock, AR (Moderator) Nothing to Disclose

Sub-Events

SSA07-01  Correlations of Extramural Vascular Invasion on Preoperative MRI with Local Lymph Node Metastasis in Rectal Cancer

Sunday, Nov. 29 10:45AM - 10:55AM Location: E450A

Participants
Liheng Liu, MD, Beijing, China (Presenter) Nothing to Disclose
Erhu Jin, Beijing, China (Abstract Co-Author) Nothing to Disclose
Zhenghan Yang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Zhenchang Wang, MD, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose

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.

SSA07-02  Reproducibility of Evaluation of Invasion Depth of Rectal Cancer into the Mesorectal Fat: Can We Reliably Discern T3ab from T3cd Tumours?

Sunday, Nov. 29 10:55AM - 11:05AM Location: E450A

Participants
Monique Maas, MD, Maastricht, Netherlands (Presenter) Nothing to Disclose
Jasenko Krzdalic, MD, MSc, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Doenja M. Lambregts, MD, PhD, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
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Geerard L. Beets, MD, PhD, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose

PURPOSE
One of the important aspects of rectal cancer staging is the measurement of the invasion depth of a tumour into the mesorectal fat in millimetres. This determines whether there is a T3ab (<5mm) or T3cd (>5mm), which changes treatment for patients (CRT yes/no). Measurement of this factor is arbitrary. Aim was to evaluate reproducibility of the measurement of invasion depth into the mesorectal fat by different readers.

METHOD AND MATERIALS
Sixty-one patients with a pathologically proven T3 tumour were selected. Two readers with different experience in reading rectal
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 were 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.

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**PURPOSE**

To assess interobserver variability in the interpretation of high resolution MRI scans for staging primary rectal cancer

**METHOD AND MATERIALS**

MRI of 22 randomly selected cases with known rectal cancer, were evaluated independently by 4 abdominal radiologists with approximately 2-4 years of experience in reading rectal MRI. Criteria evaluated included T stage and depth of tumor invasion separately assessed as measured in mm and < or > 5 mm, lymph node involvement and vascular invasion. The data was tabulated and interobserver agreement was calculated. For the small percentage of patients who went directly to surgery correlation with final pathology was performed.

**RESULTS**

There was wide range in interobserver agreement between 2 readers in different sets/combinations, ranging from 68-90% with overall complete agreement among all readers in only 68% of cases with respect to depth of tumor invasion which improved to 82%, if depth of tumor invasion was separated in <5 mm versus > 5 mm. 5 patients had undergone surgery immediately after MRI without preoperative chemoradiation. In these cases, individual reader accuracy for pT1/T2 versus T3 staging was 60-100% with overall mean accuracy of 80% among all readers. Agreement between 2 readers in different combinations, ranged from 68-81% with overall complete agreement among all readers in 54% of cases with respect to presence or absence of vascular invasion. Interobserver agreement was noted in 76-90% cases and complete agreement among all readers in 68% cases with respect to lymph node status.

**CONCLUSION**

High resolution MRI is now a widely accepted modality in the preoperative staging of primary rectal cancer. Inter-observer variability remains a significant limitation.

**CLINICAL RELEVANCE/APPLICATION**

High resolution MRI is now widely used for triaging patients directly to surgery or chemoradiation followed by surgery. However there is significant variation in the interpretation of key parameters. This should be recognized to avoid overtreatment or undertreatment of patients.

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**Participants**

Ajaykumar C. Morani, MD, Houston, TX (Presenter) Nothing to Disclose
Harmeet Kaur, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Raghunandan Vikram, MBBS, FRCR, Houston, TX (Abstract Co-Author) Nothing to Disclose
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George J. Chang, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Randy D. Ernst, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

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**PURPOSE**

To assess interobserver variability in the interpretation of high resolution MRI scans for staging primary rectal cancer

**METHOD AND MATERIALS**

MRI of 22 randomly selected cases with known rectal cancer, were evaluated independently by 4 abdominal radiologists with approximately 2-4 years of experience in reading rectal MRI. Criteria evaluated included T stage and depth of tumor invasion separately assessed as measured in mm and < or > 5 mm, lymph node involvement and vascular invasion. The data was tabulated and interobserver agreement was calculated. For the small percentage of patients who went directly to surgery correlation with final pathology was performed.

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There was wide range in interobserver agreement between 2 readers in different sets/combinations, ranging from 68-90% with overall complete agreement among all readers in only 68% of cases with respect to depth of tumor invasion which improved to 82%, if depth of tumor invasion was separated in <5 mm versus > 5 mm. 5 patients had undergone surgery immediately after MRI without preoperative chemoradiation. In these cases, individual reader accuracy for pT1/T2 versus T3 staging was 60-100% with overall mean accuracy of 80% among all readers. Agreement between 2 readers in different combinations, ranged from 68-81% with overall complete agreement among all readers in 54% of cases with respect to presence or absence of vascular invasion. Interobserver agreement was noted in 76-90% cases and complete agreement among all readers in 68% cases with respect to lymph node status.

**CONCLUSION**

High resolution MRI is now a widely accepted modality in the preoperative staging of primary rectal cancer. Inter-observer variability remains a significant limitation.

**CLINICAL RELEVANCE/APPLICATION**

High resolution MRI is now widely used for triaging patients directly to surgery or chemoradiation followed by surgery. However there is significant variation in the interpretation of key parameters. This should be recognized to avoid overtreatment or undertreatment of patients.

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**Participants**

Huanhuan Liu, Shanghai, China (Presenter) Nothing to Disclose
Yanfen Cui, Shanghai, China (Abstract Co-Author) Nothing to Disclose
RESULTS

Baseline imaging, post-treatment imaging and pathology variables were recorded. Three-year disease-free survival and recurrence were calculated using Kaplan-Meier. Cox proportional regression determined relationships between outcomes and all recorded imaging and pathological variables. Change, MR EMVI reversion and pathological T downstaging were recorded. Three-year disease-free survival and recurrence were treated as competing risks of distant metastasis. The Kaplan-Meier method was used to analyze the disease-free survival (DFS) rate and 3-year overall survival (OS) rate.

RESULTS

Among 349 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) = 2.102), 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 ± 10.62 vs 18.8 ± 4.98 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.

SSA07-05 MRI Detected Tumor Response for Intermediate Stage Rectal Cancer (RC) Treated with Chemotherapy Predicts Disease Free Survival and Recurrence: A Collaborative Group Experience

Sunday, Nov. 29 11:25AM - 11:35AM Location: E450A

Participants

Uday B. Patel, MBBS, BSc, London, United Kingdom (Presenter) Nothing to Disclose
Isidro Machado, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
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J Gallego, Elche, Spain (Abstract Co-Author) Nothing to Disclose
M Martin, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Pereyra Esteban, Spain (Abstract Co-Author) Nothing to Disclose
Eva Ballesteros JR, MD, Sabadell, Spain (Abstract Co-Author) Nothing to Disclose
Jesus Santos Cores Santos Cores, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
Gina Brown, MD, MBBS, Sutton, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE

Intermediate risk RC patients may benefit from neoadjuvant chemotherapy as staging MRI shows markers for distant disease but clear potential resection margins making local recurrence unlikely. This exhibit assesses MRI and pathological staging following neoadjuvant chemotherapy for intermediate risk RC in a prospectively enrolled multicenter phase II trial.

METHOD AND MATERIALS

The trial enrolled 291 patients with surgico-pathologically confirmed rectal adenocarcinoma who had undergone preoperative MRI before any treatment, were retrospectively collected. Preoperative MRI features (tumor location and size, MRI-TN stage, status of circumferential resection margin (CRM), lymphovascular invasion (LVI)), clinical characteristics (age, gender, preoperative CEA value), operation information (operation method, tumor location) and pathologic outcomes (pTN stage, status of pCRM, pLVI, nerve invasion (pNI), number of regional metastatic lymph nodes (pMLNNs), ratio of pMLN (pLNR), tumor grade) as well as immunohistochemical results were analyzed. Univariate and multivariate logistic regression models were performed to predict the risks of distant metastasis. The Kaplan-Meier method was used to analyze the disease-free survival (DFS) rate and 3-year overall survival (OS) rate.

RESULTS

Among 291 patients, 69 (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) = 2.102), 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 ± 10.62 vs 18.8 ± 4.98 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).
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
Monique Maas, MD, Maastricht, Netherlands (Presenter) Nothing to Disclose
Britt Hupkens, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Milou Martens, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Jeroen Leijtens, Roermond, Netherlands (Abstract Co-Author) Nothing to Disclose
Willem M. Deserno, MD, PhD, Almelo, Netherlands (Abstract Co-Author) Nothing to Disclose
Caroline van Berlo, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
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 0.79 and 0.73 for T2W-MRI and 0.69 and 0.76 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
Cynthia 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

Sunday, Nov. 29 11:55AM - 12:05PM Location: E450A

Participants
Lin Qiu, Guangzhou, China (Presenter) Nothing to Disclose
Xiang-Ran Cai, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Sirun Liu, MSc, Guang-Zhou, China (Abstract Co-Author) Nothing to Disclose
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

Sunday, Nov. 29 12:05PM - 12:15PM Location: E450A

Participants
Choong Guen Chee, MD, Seongnam, Korea, Republic Of (Presenter) Nothing to Disclose
Young Hoon Kim, MD, PhD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Bohyoung Kim, PhD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Soyeon Ahn, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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) sensibility 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) sensibility 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 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 curative resection of hepatocellular carcinoma (HCC). The conclusions were that survival between T1a and T1b, and between T3a and T3b, was not significantly different. However, no significant difference was found in disease-free survival between T1a and T2a, and between T3a and T3b.

**CONCLUSION**

To retrospectively compare the diagnostic accuracy of different noninvasive diagnostic criteria of hepatocellular carcinoma (HCC) by LI-RADS, OPTN-UNOS, AASLD, NCCN, EASL-EORTC, and KLCSG-NCC.

**METHOD AND MATERIALS**

We reviewed the medical records of 2,210 patients who had undergone biopsy, resection, or explantation of liver from January 2011 to November 2013 in our institution. Ninety three patients (M:F=69:24; mean age: 54.8, range 30-77) with chronic hepatitis B and/or cirrhosis for any etiology who had focal hepatic lesions ≥ 5 mm reported on dynamic contrast enhanced CT or MR were included. The focal hepatic lesions treated prior to imaging were excluded. A total of 144 lesions were finally included in our study with 73 lesions ≥ 2 cm, 55 lesions between 1-2 cm, and 16 lesions < 1 cm. The focal hepatic lesions were retrospectively evaluated on CT or MR by use of different noninvasive diagnostic criteria of HCC including LI-RADS (2014), OPTN-UNOS, AASLD, NCCN, EASL-EORTC, and KLCSG-NCC. Using the pathology reports as a gold standard, sensitivity, specificity, and accuracy of the diagnostic criteria were analyzed.

**RESULTS**

The sensitivity was highest and equal with AASLD, NCCN, EASL-EORTC and KLCSG-NCC criteria (84.4%), followed by LI-RADS (77.9%) and OPTN-UNOS criteria (75.3%). The specificity was highest with OPTN-UNOS criteria (92.5%), followed by LI-RADS (90.0%), AASLD, NCCN, EASL-EORTC and KLCSG-NCC (82.1%). The accuracies were 83.3%, equal for all noninvasive diagnostic criteria.

**CONCLUSION**

AASLD, NCCN, EASL-EORTC and KLCSG-NCC had the highest sensitivity whereas OPTN-UNOS had the highest specificity among all six guidelines. LI-RADS could not provide higher specificity than OPTN-UNOS criteria or high sensitivity than AASLD or EASL criteria.

**CLINICAL RELEVANCE/APPLICATION**

Though LI-RADS 2014 is widely used by radiologists, it provides lower specificity than OPTN-UNOS criteria as well as lower sensitivity than AASLD or EASL criteria for noninvasive diagnosis of HCC.
expression of HCC into four grades: grade 0: no expression, grade 1: weak expression, grade 2: moderate expression and grade 3:

**METHOD AND MATERIALS**

The subjects are 138 surgically resected HCCs. We semiquantitatively evaluated the immunohistochemical HNF4Α and OATP1B3 expression, pathological findings and imaging findings on gadoxetic acid enhanced MRI. 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.

**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 DNs, 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) and/ 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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Masanori Matsuda, MD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose
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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, <0.001 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

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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.

METHOD AND MATERIALS

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.

RESULTS

The absence of EOB uptake was found to be 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).

CONCLUSION

The absence of EOB uptake was a significant risk factor for a poor survival rate after liver resection. The overall survival rate was higher for patients with EOB uptake than for those without.

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

The values of the 2 pathological groups were

<table>
<thead>
<tr>
<th>Parameter</th>
<th>With Microvascular Invasion</th>
<th>Without Microvascular Invasion</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC</td>
<td>2.40±0.80mg/ml</td>
<td>1.68±0.47mg/ml</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>NIC</td>
<td>0.22±0.06</td>
<td>0.16±0.05</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>ICrr</td>
<td>3.28±1.08</td>
<td>2.27±0.63</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

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
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 proved pheochromocytomas and 6 clinically proven metastases) who underwent an MRI scan 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 that 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 0.32 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.

SSA10-03 Adrenal Calcifications on CT Associated with Familial Cerebral Cavernous Malformation Type I: An Imaging Biomarker for a Hereditary Cerebrovascular Condition

Sunday, Nov. 29 11:05AM - 11:15AM Location: E353B

Participants
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Li Luo, PhD, Albuquerque, NM (Abstract Co-Author) Nothing to Disclose
Blaine L. Hart, MD, Albuquerque, NM (Abstract Co-Author) Nothing to Disclose

PURPOSE

Cerebral Cavernous Malformation Type I (CCM1) is an autosomal dominant disorder characterized by multiple cavernous malformations in the brain that may cause seizures, cerebral hemorrhage, or focal neurologic deficits. Abdominal manifestations are unproven and poorly described. Individuals of Hispanic descent in the Southwestern US are disproportionately affected by this condition due to a founder mutation in the CCM1/KRIT1 gene. Our aim was to investigate whether adrenal calcifications on CT are associated with CCM1 in carriers of the common Hispanic mutation (CHM).

METHOD AND MATERIALS

In an IRB-approved, HIPAA-compliant study, abdomen CT scans of 23 CCM1 subjects (10 F, 13 M, mean 48 yrs, range 24-73 yrs) were retrospectively reviewed. All subjects had multiple CCM lesions on brain MRI; 11 had confirmed CHM genotype. As controls, abdomen CTs from 38 unaffected matched subjects (18 F, 20 M, mean 48 yrs, range 23-73 years) and 13 subjects with sporadic (non-familial) CCM (6 F, 7 M, mean 51 yrs, range 26-72 yrs) were reviewed. Size, location, number, laterality of calcifications, and adrenal morphology were recorded. Brain lesion count was recorded for CCM1 subjects. Statistical comparisons between groups were calculated using Fisher exact test and two-sample t test.

RESULTS

15 of 23 CCM1 subjects (65%) had small (≤ 5mm), focal calcifications (SFC) in one or both adrenals, compared with 0 in unaffected and sporadic CCM subjects (p<0.001). SFC were either left-sided or bilateral. Glands with SFC had normal adrenal morphology. The presence of SFC correlated positively with number of CCM brain lesions (p=0.048); bilateral SFC correlated positively with patient age (p=0.030).

CONCLUSION

SFC are found in a majority (65%) of adults with CHM-related CCM1 and may be a clinically silent disease manifestation. SFC in this population are predominantly left-sided, more often bilateral with increasing age, and more common in patients with greater number of brain lesions. These findings add to existing evidence that CCM1 is a multi-system disorder with effects beyond the central nervous system. CCM1 should be considered in the differential diagnosis for focal adrenal calcifications encountered incidentally on CT.

CLINICAL RELEVANCE/APPLICATION

Incidental adrenal calcifications on CT may detect unrecognized CCM1 and improve diagnostic confidence in equivocal cases. Recognition of this entity is important for management of neurologic manifestations and genetic counseling.

SSA10-04 Clinical Value of Dual-Energy Virtual Non-Contrast of Dual-Source CT for Adrenal Adenoma

Sunday, Nov. 29 11:15AM - 11:25AM Location: E353B

Participants
Yang Shitong, Zhengzhou, China (Presenter) Nothing to Disclose

PURPOSE

To explore the feasibility of using virtual non-contrast (VNC) images in diagnosis of adrenal adenoma in dual-energy scans, and evaluate the sensitivity, specificity, and accuracy of VNC images for the lipid-poor adenoma.
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 adenomas were calculated from chi-square 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). Expect the abdominal aortic (p>0.05). The subjective score of VNC images was lower than that of TNC image, but the difference was not 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 adenomas 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
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Lincoln L. Berland, MD, Birmingham, AL (Abstract Co-Author) Consultant, Nuance Communications, Inc; Stockholder, Nuance Communications, Inc;
Bradford Jackson, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
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 -6.5 (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
Hoawei 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 were evaluated using log-rank test. Inter-observer agreement between 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

Participants
Masoom A. Haider, MD, Toronto, ON (Presenter) Consultant, Bayer AG
Ali Reza Vosough, 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.
CLINICAL RELEVANCE/APPLICATION

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.

SSA10-09  Arterial Spin Labeling MR Imaging for Detecting Perfusion of Defect of Renal Cell Carcinoma Pseudo-capsule and Predicting Renal Capsule Invasion: Initial Experience

Sunday, Nov. 29 12:05PM - 12:15PM Location: E353B

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.
**SSA13**

**Musculoskeletal (Interventional)**  
Sunday, Nov. 29 10:45AM - 10:55AM Location: E451B

**Participants**  
Michael G. Fox, MD, Charlottesville, VA (Moderator) Stockholder, Pfizer Inc;  
Mary Kristen Jesse, MD, Denver, CO (Moderator) Nothing to Disclose

**Sub-Events**

**SSA13-01** Fluoroscopic Guided Sacroiliac Joint Injections - Comparison of Intra-articular and Peri-articular Injections on Immediate and Short-term Pain Relief

**Participants**  
Nicholas C. Nacey, MD, Charlottesville, VA (Presenter) Nothing to Disclose  
James Patrie, MS, Charlottesville, VA (Abstract Co-Author) Nothing to Disclose  
Michael G. Fox, MD, Charlottesville, VA (Abstract Co-Author) Stockholder, Pfizer Inc;

**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 inferomedial 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.

**SSA13-02** 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

**Participants**  
Thomas Lehnert, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose  
Nagy N. Naguib, MD, MSc, Frankfurt Am Main, Germany (Presenter) Nothing to Disclose  
Julian L. Wichmann, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose  
Josef Matthias Kerl, MD, Frankfurt, Germany (Abstract Co-Author) Research Consultant, Siemens AG Speakers Bureau, Siemens AG  
Ralf W. Bauer, MD, Frankfurt, Germany (Abstract Co-Author) Research Consultant, Siemens AG Speakers Bureau, Siemens AG  
Martin Beeres, 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 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**
437 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 Marreseco, MD, Fiuggi, Italy (Abstract Co-Author) Nothing to Disclose
Alessandra Splendiani, 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 herniated 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 Socio, 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 Osteoma. 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 osteoma.

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

**Participants**

Sebastian Fischer, MD, Frankfurt, Germany (Presenter) Nothing to Disclose

Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose

Maximilian Kresing, 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

Katrin Eichler, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Purpose of our retrospective study is to evaluate the feasibility and accuracy of minimally invasive, transpedicular screw placement in cervicothoracic fractures with the help of CT-controlled guidewires.

**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 inserted screws.

**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**

**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 the 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, Lapulita, 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.
### ISP: Nuclear Medicine (PET/CT for Oncology)

**Sunday, Nov. 29 10:45AM - 12:15PM Location: S505AB**

**CT**

**NM**

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

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

#### Participants

**Andrew Quon, MD, Los Angeles, CA (Moderator) Nothing to Disclose**

**Johannes Czernin, MD, Los Angeles, CA (Moderator) Stockholder, Sofie Biosciences; Founder, Sofie Biosciences; Stockholder, Momentum Biosciences LLC; Founder, Momentum Biosciences LLC; Stockholder, Triangle Pharmaceuticals;**

#### Sub-Events

**SSA15-01 Nuclear Medicine Keynote Speaker: Targeting PSMA for Imaging Cancer**

**Sunday, Nov. 29 10:45AM - 11:05AM Location: S505AB**

**Participants**

Martin G. Pomper, MD, PhD, Baltimore, MD (Presenter) Shareholder, CTS, Inc; Board Member, CTS, Inc; Research Grant, CTS, Inc; Advisor, CTS, Inc; Institutional license agreement, Progenics Pharmaceuticals, Inc

**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 (>0.01) 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**
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

Sunday, Nov. 29 11:25AM - 11:35AM Location: S505AB

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.
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, K-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; protocol 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.
SSA19

**Physics (CT I - Dual Energy/Spectral)**

**Sunday, Nov. 29 10:45AM - 12:15PM Location: S403B**

AMC PRA Category 1 Credits™: 1.50
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

**Participants**

Norbert J. Pelc, ScD, Stanford, CA (Moderator) 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) Stockholder, Prismatic Sensors AB; President, Prismatic Sensors AB; Stockholder, Innovicum AB; President, Innovicum AB; Research Grant, Koninklijke Philips NV; Stockholder, Bivica International AB; Board Member, Bivica International AB;

**Sub-Events**

**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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Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG

**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 (25-140keV 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.

**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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PURPOSE  
The purpose of this study was to investigate, for the task of iodine imaging, the dose efficiency of a whole-body photon counting CT scanner relative to a commercially available energy-integrating CT system.

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 (CIRS, 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 kV) 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  
At 140 kV, 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 kV (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.

SSA19-03  
**Spectral Imaging on a 160 mm Clinical CT System with Fast kVp Switching: Evaluation of Image Quality**  
  
  **Sunday, Nov. 29 11:05AM - 11:15AM Location: S403B**

Participants  
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PURPOSE  
Purpose: Wide-cone CT systems with 160 mm aperture or more have several clinical benefits such as single shot cardiac imaging and helical scans with faster acquisition. Spectral imaging using fast kV switching on such a system can additionally enable quantitative imaging and access to CT images at lower energies. The purpose of this work is to evaluate the new prototype image generation chain of a 160 mm spectral imager using fast kVp switching (Revolution CT, GE Healthcare, Waukesha, WI).

METHOD AND MATERIALS  
The new spectral image generation chain incorporates an advanced model of the acquisition physics and measurement noise. It also builds upon the hardware advancements made in the wide-cone CT system and an advanced spectral modeling and projection-domain material decomposition (MD). A 33 cm GAMMEX phantom is scanned at three different dose levels (20.1, 11.9, 23.1 mGy) with known density of iodine. A 20 cm GAMMEX phantom is also scanned under 20.1 mGy. The MD (Water-Iodine) images are reconstructed using a slice thickness of 0.625 mm. The monochromatic images are generated from 40 - 140 kV. First noise in the monochromatic images at 0.625 mm slice thickness is measured by averaging across 3 different ROIs. Contrast to noise ratio (CNR) is also measured across all keVs at 0.625 mm slice thickness by placing a ROI on the 20 mg/cc iodine rod. Circular ROIs of radius 10 mm are placed on 5 mm averaged slices for measuring the mean density in the 5, 10, and 20 mg/cc iodine rods.

RESULTS  
The image chain is evaluated on GAMMEX phantoms with different size and dose level. The CNR monotonically increases from 140 to 40 kV 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 phantoms.

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.

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) 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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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 scan coverages. 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.

SSA19-06  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).

Iodine concentrations were determined for all cavities using the scanner's DE mode, and compared to their true concentrations. CT number stability was determined accordingly and a comparison was made between the DE acquisition and standard 120 kV scanning.

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 mgI/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.

SSA19-07  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 examination or phases (e.g., assessment of iodine uptake of a renal lesion).

SSA19-08 Feasibility of a Basis Material Decomposition Using a Prototype Whole-Body Photon-Counting-based CT System and a Living Swine Model

Sunday, Nov. 29 11:55AM - 12:05PM Location: S403B

Participants
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Cynthia H. McCollough, PhD, Rochester, MN (Abstract Co-Author) Research Grant, Siemens AG

PURPOSE
The aim of this study was to evaluate the feasibility of performing in-vivo basis material decomposition at clinical dose levels using a prototype, whole-body photon counting CT scanner.

METHOD AND MATERIALS
A prototype, whole-body photon counting CT (PCCT) scanner (Siemens Healthcare, Forchheim, Germany) was used in this study. After institutional animal care and use committee approval, six 3-month-old female swine were imaged at clinical doses (140 kV, 140/270 mAs, 0.5-1 second rotation time, 0.6 pitch, 32x0.5 collimation, and CTDIvol of 15.51/29.69 mGy) and full dose (440 mAs, CTDIvol 68.44 mGy). The data were acquired using the "chess mode", with energy thresholds of 25, 45, 65, and 85 keV, where data from all 16 sub-pixels of the detector were combined to simultaneously generate 7 measurements at different X-ray energies. CT angiograms were obtained and images were reconstructed using clinical parameters (3.0 mm slices / 2.0 mm increment, D30f kernel). Phantom experiments were performed separately to evaluate the accuracy of our in-house developed material decomposition technique and generate the calibration data for the material decomposition of the in-vivo swine images. Noise reduction was applied on all 7 sets of PCCT images, prior to the implementation of the material decomposition algorithm, which resulted in 3 material specific images.

RESULTS
Phantom experiments showed good estimation of basis material densities with RMSE of 5.1, 0.9, 5.4 mg/ml (percent error: 3.8%, 6.6% and 0.3%) for calcium, iodine, and water, respectively at full dose. At the clinical dose level, the RSME values were 7.6, 1.2, and 9.0 mg/ml (percent error: 7.0%, 6.7% and 0.4%), respectively. Initial material decomposition results in living swine images demonstrated good separation and quantification of iodine, calcium, and water. The material decomposition performed robustly at clinical relevant dose levels when effective noise reduction was applied.

CONCLUSION
The evaluated prototype whole-body PCCT system demonstrated the potential for performing accurate basis material decomposition in-vivo at clinically relevant dose levels.

CLINICAL RELEVANCE/APPLICATION
Reliable material decomposition by the whole-body PCCT system under clinical dose level may be translated to clinical applications such as iodine quantification and stone characterization.

SSA19-09 Evaluation of Three-Stage Metal Artifact Reduction Software for 256-slice Fast-kV Switching Spectral CT

Sunday, Nov. 29 12:05PM - 12:15PM Location: S403B

Participants
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Elizabeth Nett, Waukesha, WI (Presenter) Employee, General Electric Company

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
Three-stage projection-based metal artifact reduction (MAR) algorithm 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.
**SSA21**

**Physics (Image Processing/Analysis I)**

Sunday, Nov. 29 10:45AM - 12:15PM Location: S405AB

BQ  CT  MR  PH

AMA PRA Category 1 Credits\*: 1.50
ARRT Category A+ Credit: 1.00
FDA

Discussions may include off-label uses.

**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

**Participants**

Giuseppe Palma, PhD, Naples, Italy (Presenter) Nothing to Disclose
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Marcello Mancini, MD, Naples, Italy (Abstract Co-Author) Nothing to Disclose

**Background**

Multi-parametric quantitative MRI (qMRI) has long been an active field of research, with several approaches aiming to estimate a subset of R1, R2, R2*, 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 R1, R2, R2*, 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 mm³. 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 T2 fluids (as CSF), thus being apt to image other body districts. Also, several issues of the DESPOT methods are solved. In particular, the B1± inhomogeneity dependence can be either removed by providing a measured B1 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 B0 inhomogeneity by means of a fully analytical solution, thus also speeding up the computation step.

**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
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**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 programmed 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 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**

**Abstract**

**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 vertebrae (m-qEEV) and the percentage of vertebrae with an increased qEEV of 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 regression 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.
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.
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**

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**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, and reticular opacity (Fig. 1(a)). Performance of convolution neural network (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**

Participants
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**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
radiologist read 150 cases (50 lesions x 3 image qualities) and reported each lesion’s probability of malignancy following BI-RADS. The radiologist’s performance was evaluated by measuring the AUC. Under leave-one-out-cross-validation, a logistic regression classifier was trained and tested over the image features (via a feature selection technique) and the probability of malignancy from the radiologist. The classifier’s AUC was measured and compared with that of the radiologist.

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 classifier’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-IIA, 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.
Gastrointestinal Sunday Poster Discussions

Sunday, Nov. 29 12:30PM - 1:00PM Location: GI Community, Learning Center

GI

AMA PRA Category 1 Credit ™: .50

Participants
Elena K. Komgold, MD, Portland, OR (Moderator) Nothing to Disclose

Sub-Events

GI328-SD- SUA1 Low-tube-voltage Liver CT during Hepatic Arterial Phase - Effect of Liver Volume on Image Quality

Station #1

Participants
Yang Shin Park, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Chang Hee Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jong Mee Lee, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jae Woong Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Kyeong Ah Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Cheol Min Park, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Object size and object densities are well-known important determinants of x-ray absorption. In liver CT, liver volume may have influence on the gross object density and size at the liver level being imaged. Therefore, we evaluated whether individual liver volume may have impact on image quality of low kVp liver CT during the hepatic arterial phase.

METHOD AND MATERIALS
Seventy-seven patients (72 men, 5 women; age range, 40-79 years) who underwent clinically indicated liver dynamic CT examination were enrolled in the study. 80 kVp CT and intermediate tube current was performed in the late hepatic arterial phase using a 320-detector row scanner with AIDR 3D reconstruction. Based on the CT volumetric measurement and estimated liver volume calculation, CT liver volume-to-estimated volume ratio (CTLVratio) was calculated. On an axial scan of hepatic arterial phase at the level of right portal vein, the ratio of the liver-to-abdominal area (LAratio) was calculated. Then, on the same selected image, the mean image noise and contrast-to-noise ratios (CNRA) for the aorta were assessed. Decreased liver volume was determined when CTLVratio was less than 0.9 or LAratio was less than 0.22. Correlations between CTLVratio, LAratio and image quality parameters were evaluated. Mean image quality parameters were compared between decreased liver volume group and normal liver volume group.

RESULTS
In all patients, 46 patients had decreased liver volume and 31 patients had normal liver volume. CTLVratio was significantly correlated with LAratio (r = 0.708; p = 0.001). CTLVratio and LAratio showed inverse correlation with image noise (r = -0.322 and -0.420; all, p =<0.05) and positive correlation with CNRA (r = 0.239 and 0.281; all, p =<0.05). Patients with decreased liver volume showed significantly higher mean image noise (13.61 vs 10.83; p =0.001) and lower mean CNRA (39.34 vs 49.10; p =0.001) than those with normal liver volume.

CONCLUSION
Liver volume has influence on image noise and CNRA in low-tube-voltage liver CT during hepatic arterial phase.

CLINICAL RELEVANCE/APPLICATION
In patients with liver cirrhosis, decreased liver volume can be considered as one of determinants in CT parameter adjustment to perform low-tube-voltage liver CT during hepatic arterial phase. Therefore, acceptable image quality with can be achieved with diagnostic improvement for hypervascular hepatic tumor and radiation dose reduction.

GI329-SD- SUA2 Intratumoral Uptake of Gd-EOB as a Predictor of Response to Hepatic Arterial Infusion Chemotherapy with Cisplatin in Advanced Hepatocellular Carcinoma

Station #2

Participants
Hideki Ishimaru, MD, Nagasaki, Japan (Presenter) Nothing to Disclose
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Satomi Mine, Omura, Japan (Abstract Co-Author) Nothing to Disclose
Kazuaki Nakashima, Nagasaki, Japan (Abstract Co-Author) Nothing to Disclose
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PURPOSE
Hepatic arterial infusion chemotherapy with cisplatin (HAIC) is one of the treatment option for advanced hepatocellular carcinoma
(HCC); however the response rate is relatively low, and the predictor of response to HAIC is still unknown. Organic anion transporter 8 responsible for intracellular uptake of Gd-EOB is known to transport certain anticancer drugs; therefore we speculated that uptake of Gd-EOB by HCC can be a predictor for the good response to HAIC. The purpose of the study is to investigate the potential role of Gd-EOB enhanced MRI to predict the response to HAIC.

METHOD AND MATERIALS

35 patients with advanced HCC who underwent Gd-EOB enhanced MRI using 3T or 1.5T MR scanner prior to HAIC were enrolled and retrospectively analysed. The largest lesion per patient was selected for evaluation, and the relative enhancement ratio (RER) was calculated using the following formula: (SI nodule / SI liver) hepatobiliary phase / (SI nodule / SI liver) unenhanced, where SI nodule and SI liver respectively represent the signal intensity of the nodule and liver parenchyma. Apparent diffusion coefficient (ADC) was also measured. Cisplatin with a dose of 65 mg/m² dissolved in saline was administered into the hepatic artery by one-shot method for 20-40 min. HAIC was repeated, until confirmation of progression of disease (PD) or complete response (CR). According to modified RECIST the patients were classified as responders (CR, PR) or non-responders (SD, PD). RER, tumor size, ADC, Child-Pugh score, tumor stage, tumor marker of two groups were correlated with the response to HAIC using multivariate logistic regression analysis. For the significant variable, receiver operating characteristic (ROC) analysis was performed to determine the best cut-off values.

RESULTS

There are 6 responders (CR2, PR4) and 29 non-responders (SD12, PD17), and the response rate to HAIC was 17.1% (6/35). Multivariate logistic regression analysis demonstrated that RER was the only significant predictor of response (risk ratio, 2.75×e11; P<0.01). Using ROC analysis, RER of 1.02 is the best cutoff value for predicting a response to HAIC, offering a sensitivity of 83.3% and a specificity of 96.6%.

CONCLUSION

RER in Gd-EOB enhanced MRI was the only independent predictor for response to HAIC for the treatment of advanced HCC.

CLINICAL RELEVANCE/APPLICATION

Intratumoral uptake of Gd-EOB in HCC would be a predictor of response to HAIC.

Gi330-SD-Sua3

Usefulness of Imaging Techniques in Therapeutic Decisions in Patients with Crohn’s Disease: A Prospective Comparison of Contrast-enhanced Ultrasound and Magnetic Resonance Enterography

Station #3

Participants

Esperanza de la Via, MD, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
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Tomas Ripolles, MD, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
Rafael Revert, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
Diana P. Gomez Valencia, MD, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
M Jesus Martinez, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
Salvador Alandete, MD, Valencia, Spain (Presenter) Nothing to Disclose

PURPOSE

The main objective of the study is to evaluate the usefulness of the information provided by contrast-enhanced ultrasound (CEUS) or magnetic resonance enterography (MRE) in therapeutic decision of patients with Crohn’s disease and to analyze the differences between the two techniques influencing this decision.

METHOD AND MATERIALS

100 episodes were prospectively evaluated in 71 patients (mean age: 37±10 years) with established diagnosis of Crohn’s disease by ultrasound and entero-contrast MRI, performed the same day and requested for clinical assessment. In both techniques, the presence or absence of signs of inflammatory activity, fistulas, abscesses, or stenosis were studied. Treatment effectiveness was also assessed, or if there was or not improvement in the image. The gastroenterologist based on the information provided by imaging techniques take therapeutic decisions (maintenance or changes in treatment).

RESULTS

Based on information provided by imaging techniques, treatment was remained at 31 episodes and changed in 69 episodes: intensification (n = 52) or decreased (n = 4) of treatment, surgery (n = 10) or drainage (n = 3). The information from both techniques was similar in 85% of episodes. In 7 cases ultrasound determined the treatment by detection of stenosis (n = 2), fistula (n = 2) or persistence of activity (n = 2). In 8 cases MRI determined the treatment by detection of stenosis (n = 3), fistula (n = 1), abscess (n = 1) or persistent activity (n = 3).

CONCLUSION

There are no differences in clinical decision about regarding treatment based on the information provided by ultrasound and contrast entero-MRI in patients with Crohn’s disease.

CLINICAL RELEVANCE/APPLICATION

Cross-sectional imaging techniques add information to clinical management in patients with Crohn’s disease and alter the treatment plans in more than half of patients. There are no differences between the information provided by CEUS and MR enterography in the decision to perform therapeutic changes.
Assessment of Liver and Pancreas PDFF with a 3.0 T MRI Multi-Echo Chemical Shift Gradient Echo Single Breath-hold Sequence, in Diffuse Liver Disorders: Correlation with Anthropometric Data and Liver Biopsy

Station #4

Participants
Manuela Franca, MD, Porto, Portugal (Presenter) Nothing to Disclose
Angel Alberich-Bayarri, MD, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
Luís Marti-Bonmati, MD, PhD, Gdella, Spain (Abstract Co-Author) Nothing to Disclose
João A. Oliveira, Porto, Portugal (Abstract Co-Author) Nothing to Disclose
Francisca E. Costa, MD, Porto, Portugal (Abstract Co-Author) Nothing to Disclose
Jose Ramon Vizcaino Vazquez, Porto, Portugal (Abstract Co-Author) Nothing to Disclose
Helena Pessegueiro Miranda, Porto, Portugal (Abstract Co-Author) Nothing to Disclose

PURPOSE
Liver steatosis is the hallmark of NAFLD, but is also present in several diffuse liver diseases. Pancreas lipomatosis may be related with liver steatosis in patients with obesity and insulin resistance. Our purpose was to assess PDFF of the liver and pancreas, with a Multi-Echo Chemical Shift Gradient Echo (MECSH) single breath-hold MR sequence in patients with diffuse liver diseases, to compare the PDFF values with liver biopsy and anthropometric data, and also to evaluate the relationship between both organs.

METHOD AND MATERIALS
In this prospective study, consecutive patients with diverse diffuse liver disorders and clinically indicated liver biopsy were recruited. To estimate PDFF, a 3T MR single breath-hold MECSh GRE sequence with 12 echoes was used. Quantification was performed with magnitude and phase reconstruction, T1 and T2* bias correction. ROIs were placed in the biopsied liver segment and in 3 pancreatic regions (head, body, tail). Liver biopsy was used to grade liver steatosis (0-3).

CONCLUSION
In patients with diffuse liver disorders, there is an excellent correlation between liver PDFF and liver biopsy quantifications. A significant relationship was also found between pancreas PDFF and both liver PDFF and histologic steatosis grade.

CLINICAL RELEVANCE/APPLICATION
MECSH GRE MR imaging allows to evaluate liver and pancreas fatty deposits, which may be relevant in patients with diffuse liver disorders.

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

Station #5

Participants
Lin Qiu, Guangzhou, China (Presenter) Nothing to Disclose
Xiang-Ran Cai, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Sirun Liu, MSc, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
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 =348.25±26.74 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 value(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.

MR Elastography: Prognostic Factor after Hepatic Resection for Patients with Hepatocellular Carcinoma

Station #6

Participants
Lin Qiu, Guangzhou, China (Presenter) Nothing to Disclose
Xiang-Ran Cai, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
Sirun Liu, MSc, Guangzhou, China (Abstract Co-Author) Nothing to Disclose
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 =348.25±26.74 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 value(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.
Patients
Dong Ho Lee, 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-Seo Medical Industrial Col, Ltd
Joon Koo Han, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the prognostic role of MR elastography (MRE) in patients with HCC treated by hepatic resection

METHOD AND MATERIALS
From January 2012 to June 2013, 83 patients with HCCs initially treated by hepatic resection who had Child class A liver cirrhosis underwent liver MRE before surgery. Hepatic stiffness (HS) values were measured by one experienced abdominal radiologist using MRE. After surgery, follow-up laboratories as well as imaging tests were carefully reviewed for the detection of developing postoperative liver decompensation defined as follows: increased bilirubin level more than 3mg/dL; development of ascites or encephalopathy. HS values were compared between two groups (i.e., patient with/without postoperative decompensation) by Mann-Whitney U test. The receiver operating characteristic (ROC) analysis was used for evaluating diagnostic performance of HS value for predicting postoperative decompensation. After a mean follow-up of 24.2 ± 8.7 months, we also analyzed the overall survival after hepatic resection by evaluating the prognostic factors using the Kaplan-Meier method and Cox proportional hazard regression model.

RESULTS
After hepatic resection, 15 of 83 patients (18.1%) experienced postoperative decompensation. The HS value in patients with decompensation was significantly higher than those in patients without decompensation (3.82Kpa vs. 2.96kPa, P=0.002). In ROC analysis, area under the curve of HS value was 0.756 (P=0.002) for predicting postoperative decompensation. Thirteen patients had the HS value more than 4Kpa, and the estimated 1,3-year survival in these patients were 84.6%, and 65.8%, respectively. In contrast, the estimated 1,3-year survival in 70 patients with HS value < 4Kpa were 97.0% and 95.4%, respectively; this difference was significant (P=0.003): In multivariate Cox hazard regression model, HS value > 4Kpa was the only significant affecting factor for overall survival.

CONCLUSION
HS values could predict the development of postoperative decompensation after hepatic resection for HCC. Furthermore, HS value > 4Kpa was significant affecting factor for overall survival after hepatic resection.

CLINICAL RELEVANCE/APPLICATION
HS value measured by using MRE can provide important prognostic information for patients with hepatocellular carcinoma treated by hepatic resection.

GI122-ED-SUA7
Ventral Hernia Repair: What the Radiologist Should Know
Station #7

Participants
Stephanie Ramkumar, Toronto, ON (Presenter) Nothing to Disclose
Anton Oentoro, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Zane Cohen, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Seng Thipphavong, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Nasir M. Jaffer, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is: 1) To understand the surgical technique for ventral hernia repair using biologic or synthetic mesh 2) To recognize the associated radiographic features and post operative complications of this repair on CT

TABLE OF CONTENTS/OFFLINE
Outline: 1) Anatomy 2) Characteristics of biologic and synthetic mesh 3) Surgical techniques for ventral hernia repair using mesh 4) Key radiographic features of an uncomplicated repair using synthetic and biologic mesh 5) Radiographic features associated with post-operative complications

GI172-ED-SUA8
Cephalic Pancreaticoduodenectomy: What Radiologists Need to Know - Surgical Variants, Normal Postoperative Findings and Complications
Station #8

Awards
Certificate of Merit

Participants
Maite Millor, MEd, Pamplona, Spain (Presenter) Nothing to Disclose
Paula Garcia Barquin, MD, Pamplona, Spain (Abstract Co-Author) Nothing to Disclose
Jose Miguel Madrid, MD, Pamplona, Spain (Abstract Co-Author) Nothing to Disclose
David Cano, MD, Pamplona, Spain (Abstract Co-Author) Nothing to Disclose
Isabel Vivas Perez, MD, Pamplona, Spain (Abstract Co-Author) Nothing to Disclose
Maria Arraiza, MD, Pamplona, Spain (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1 - To explain anatomical changes and imaging features after duodenopancreatectomy cephalic (DPC) and its surgical variants. 2 - To show normal postoperative inflammatory findings in CT. 3 - To review the most common postoperative complications.
TABLE OF CONTENTS/OUTLINE
1. Description of postoperative changes of two surgical variants of CPD: - 1.1 Classic Whipple procedure. - 1.2 Pylorus-preserving Whipple procedure.2. Remembrance of normal postoperative inflammatory findings in CT that radiologist should not misinterpret as tumor recurrence or as an abnormal inflammatory process.3. Review of most common postoperative complications: - 3.1 Pancreatic fistula - 3.2 Leaks from the anastomosis - 3.3 Delayed gastric emptying - 3.4 Abscesses - 3.5 Peritonitis - 3.6 Pancreatitis - 3.7 Hemorrhage - 3.8 Venous thrombosis - 3.9 Hepatic infarction - 3.10 Anastomotic stricture - 3.10.1 Pancreaticojunostomy stricture - 3.10.2 Choledochojunostomy stricture - 3.10.3 Gastrojejunostomy stricture - 3.11 Tumor recurrence

Awards
Certificate of Merit

Participants
Qiushi Wang, MD, Indianapolis, IN (Presenter) Nothing to Disclose
Fatih Akisik, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
Temel Tirkes, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
Mark Tann, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
Kumaresan Sandrasegaran, MD, Carmel, IN (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. To become familiar with the surgical procedure and postoperative anatomy of pancreas transplantation with enteric drainage.2. To recognize post-operative complications.3. To understand the indications and limitations of multi-modality imaging for evaluation pancreas transplantation.

TABLE OF CONTENTS/OUTLINE
1. To review the surgical techniques and postoperative anatomy of pancreas transplantation with enteric drainage.2. To illustrate the normal imaging appearance of pancreas transplants with enteric drainage. 3. To demonstrate the spectrum of postoperative pathologic findings: including pancreatic abnormalities, vascular abnormalities, enteric abnormalities, rejection and miscellaneous.4. To discuss the strengths and limitations of US, CT, and MR imaging in evaluation of pancreas transplantation.

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/

Fatih Akisik, MD - 2014 Honored Educator
Temel Tirkes, MD - 2013 Honored Educator
Temel Tirkes, MD - 2014 Honored Educator
Kumaresan Sandrasegaran, MD - 2013 Honored Educator
Kumaresan Sandrasegaran, MD - 2014 Honored Educator

Participants
Michael J. Carter, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Ashish P. Wasnik, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Matthew S. Davenport, MD, Cincinnati, OH (Abstract Co-Author) Book contract, Wolters Kluwer nv; Book contract, Reed Elsevier; Mahmoud M. Al-Hawary, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Aaron M. Udager, MD, PhD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. Small bowel masses identified on imaging are often indeterminate, necessitating definitive characterization with tissue sampling.2. The aim of this presentation is to briefly review small bowel anatomy and commonly encountered benign and malignant pathologies with imaging and histopathologic examples.3. Emphasis will be given on description of key imaging features that may affect clinical approach in managing these cases (like endoscopic evaluation versus surgical section).4. The learner will be able to identify small bowel pathologies and communicate the key imaging features to clinicians for optimal management.

TABLE OF CONTENTS/OUTLINE
1. Brief review of small bowel anatomy and commonly encountered small bowel pathologies.2. Presentation of small bowel mass imaging features with histopathologic correlation.3. Entities that will be discussed include but are not limited to small bowel adenocarcinoma, lymphoma, gastrointestinal stromal tumor, carcinoid, melanoma, lipoma, lymphangioma, heterotopic pancreas, metastases, vascular malformation and mass-like artifact.4. The role of imaging in dictating clinical management and predicting the best approach to tissue diagnosis, including precise anatomic location, length of bowel involved, location within the bowel layer, and associated complications (obstruction, intussusception, bleeding)
Physiology

Physics Sunday Poster Discussions

Sunday, Nov. 29 1:00PM - 1:30PM Location: PH Community, Learning Center

PH

AMA PRA Category 1 Credit™: .50

FDA Discussions may include off-label uses.

Participants
R. Jason Stafford, PhD, Houston, TX (Moderator) Nothing to Disclose
Lei Zhu, MS, Stanford, CA (Moderator) Nothing to Disclose

Sub-Events

PH209-SD-SUB1 Determination of Iron Concentration and Fat Fraction in the Liver with Dual-Energy Computed Tomography: A Phantom Study

Station #1

Participants
Takashi Hamaguchi, PhD, Kanazawa, Japan (Presenter) Nothing to Disclose
Kotaro Yoshida, MD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Tadanori Takata, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Satoshi Kobayashi, MD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Kosuke Matsubara, PhD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Naoki Ohno, PhD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Toshiaki Miya, PhD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Toshifumi Gabata, MD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

In recent years, it has been reported that the three-material decomposition (3MD) method in dual-energy computed tomography (DECT) can differentiate an iodine image from an enhanced image of liver. Is it possible to utilize 3MD to quantify liver iron concentration (LIC) and fat fraction (FF) by replacing iodine with overloaded iron and fat? The purpose of our study is to evaluate the ability of DECT to quantify LIC and FF in unenhanced liver images.

METHOD AND MATERIALS

All images were acquired on a dual-source CT system. Dual-energy imaging was performed with three sets of tube voltages (80 kV-Sn 140 kV, 100 kV-Sn 140 kV, 140 kV-80 kV). We made six phantoms for this study. We used a porcine liver to simulate a healthy liver. We added super-paramagnetic iron oxide (SPIO) and lard to the liver in varying iron concentrations and fat fraction. We calculated LIC and FF maps using the 3MD algorithm.

RESULTS

Our in vitro analysis indicated that in comparison with single-energy CT, LIC and FF analysis using DECT had a greater ability to quantify iron and fat in unenhanced liver images. DECT-derived liver iron concentration and fat fraction were in good agreement with the actual value (R^2 = 0.977-0.997, P < 0.0001). In the absence of SPIO, fat fraction analysis of DECT showed excellent agreement with the results of MRI (R^2 = 0.965-0.977, P < 0.0001).

CONCLUSION

The 3MD method makes it possible to assess the iron concentration and fat fraction in unenhanced liver images.

CLINICAL RELEVANCE/APPLICATION

The metabolic information evaluated based on the 3MD algorithm may be useful for clinical diagnosis of hepatic iron overload and grading of hepatic steatosis without additional radiation exposure.

PH210-SD-SUB2 Fractal Analysis of an Advanced Modeled Iterative Reconstruction Algorithm for the Evaluation of Complex Structure: A Phantom Study

Station #2

Participants
Wakiko Tani, RT, Kobe, Japan (Presenter) Nothing to Disclose
Satoru Takahashi, MD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Toshihide Itoh, Tokyo, Japan (Abstract Co-Author) Employee, Siemens AG
Erina Suehiro, RT, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Toshinori Seki, MS, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Noriyuki Negi, RT, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Kazuro 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
Kiyosumi Kagawa, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Hideaki Kawamura, MD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Tomoki Maebayashi, Kobe, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

Although iterative reconstruction technique can allow a radiation dose reduction without unfavorable effect on image quality, subjective analysis is highly influenced by individual reader preference, especially in image texture and contour. Fractal analysis is a...
methodological technique that allows quantitative analysis for texture or heterogeneity on digital images. The purpose of the study is to investigate diagnostic performance of an advanced modeled iterative reconstruction (ADMIRE) algorithm for evaluating conspicuity of complex structure with a 3rd generation dual-source CT (DSCT) scanner.

**METHOD AND MATERIALS**

A bundle of five acryl rods (2.0 cm in diameter, 134 HU at 120 kV) inserted in the center of a circular phantom (Ø26 cm) filled with various concentration of diluted contrast medium (CM) was scanned at a various radiation dose (CTDvol of 1.8 to 14.4 mGy) with different reconstruction algorithm [filtered-back projection (FBP), ADMIRE strength 1 to 5] at 120 kV using 3rd generation DSCT. Background attenuation (i.e. concentration of CM) was changed to yield positive contrast of acryl rods (+17, +31, and +50 HU higher than surrounding CM), as well as negative contrast (-18, -32, and -52 HU) to simulate hyper- and hypo-vascular hepatic lesions. Images were analyzed with a MATLAB-based software to calculate fractal dimension (FD) of the phantom using a box-counting methods for binary images. Binary images were obtained with applying a threshold of a CT value intermediate between acryl and surrounding CM. Scans, reconstructions, and fractal analyses were repeated 10 times and the results were compared between different radiation dose and reconstruction algorithm.

**RESULTS**

Fractal dimension decreased with increasing radiation dose and ADMIRE strength. FD of FBP images were as same as those of ADMIRE strength 3 with a half radiation dose scan. In cases of higher positive contrast of +50 HU, FD of ADMIRE 3 or higher showed no difference at high radiation dose of 14.4 mGy, while FD increased with increasing strength of ADMIRE strength of 3 or higher in case with higher negative contrast of -52 HU at CTDvol of 14.4 mGy.

**CONCLUSION**

In low radiation dose protocol, ADMIRE strength of 3 can provide identical lesion conspicuity of FBP at double radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

FD that represents complexity of contour would be applied as a potential indicator for the quantitative assessment of iterative reconstruction.

**RESULTS**

Evaluation of Spatial Resolution of Super-High-Resolution CT with 0.25-mm Slice Thickness x128 Detector Rows

**PURPOSE**

To evaluate the spatial resolution of Quarter-pixel Detector CT (QDCT). The channel pitch and row pitch of the detector is both one-half that of conventional MDCT and the area of each pixel in the detector is one-quarter that of conventional MDCT.

**METHOD AND MATERIALS**

Spatial resolution in the X-Y direction and in the Z direction was assessed by both physical evaluation and visual evaluation. In the visual evaluation, QDCT was compared against conventional Multi-Detector row CT (MDCT) with a conventional channel pitch (0.5-mm slice thickness ’ 64 detector rows).Method 1 X-Y direction.In the physical evaluation, the MTF was measured using the image of wire (material: Au, diameter: 50 μm, slice thickness : 0.25mm).In the visual evaluation, axial images of the slit phantoms (0.12, 0.30, 0.35 mm) were used for evaluation. The scan conditions were 120 kV, 0.25 mm × 128 rows, 250 mA, 1.5 s/rot., and PF 0.80 for QDCT and 120 kV, 0.5 mm × 64 rows, 250 mA, 1.5 s/rot., and PF 0.83 for MDCT.Method 2 Z direction.In the physical evaluation, the SSPz was measured using the image of a coin phantom (material: W, thickness: 50 μ, slice thickness : 0.25mm).In the visual evaluation, the MPR images of the slit phantoms (0.12, 0.30, 0.35 mm) were used for evaluation. The scan conditions were 120 kV, 0.5 mm × 64 rows, 250 mA, 1.5 s/rot., and PF 0.80 for QDCT and 120 kV, 0.5 mm × 64 rows, 250 mA, 1.5 s/rot., and PF 0.83 for MDCT.

**RESULTS**

Results 1 X-Y directionThe MTF(50%) was 2.54 (cycles/mm), the MTF(10%) was 4.22 (cycles/mm), and the MTF(2%) was 4.90 (cycles/mm).The resolution determined by visual evaluation of the slit phantoms was 0.12 mm for QDCT and 0.35 mm for MDCT.Results 2 Z directionThe FWHM of SSPz was 0.36 mm.The resolution determined by visual evaluation of the slit phantoms was 0.20 mm for QDCT and 0.40 mm for MDCT.

**CONCLUSION**

The spatial resolution of QDCT is significantly higher (by a factor of 2 or more) than that of conventional MDCT, and the improved diagnostic capabilities by super high resolution CT images can be expected.

**CLINICAL RELEVANCE/APPLICATION**

Improving the spatial resolution of a CT system not only provides more reliable CT numbers and allows more accurate morphological visualization, but also makes it possible to depict smaller lesions.

**RESULTS**

Accurate PET Detector Calibration by Fusion of Information from Multiple Approaches

**PURPOSE**

To investigate diagnostic performance of an advanced modeled iterative reconstruction (ADMIRE) algorithm for evaluating conspicuity of complex structure with a 3rd generation dual-source CT (DSCT) scanner.

**METHOD AND MATERIALS**

A bundle of five acryl rods (2.0 cm in diameter, 134 HU at 120 kV) inserted in the center of a circular phantom (Ø26 cm) filled with various concentration of diluted contrast medium (CM) was scanned at a various radiation dose (CTDvol of 1.8 to 14.4 mGy) with different reconstruction algorithm [filtered-back projection (FBP), ADMIRE strength 1 to 5] at 120 kV using 3rd generation DSCT. Background attenuation (i.e. concentration of CM) was changed to yield positive contrast of acryl rods (+17, +31, and +50 HU higher than surrounding CM), as well as negative contrast (-18, -32, and -52 HU) to simulate hyper- and hypo-vascular hepatic lesions. Images were analyzed with a MATLAB-based software to calculate fractal dimension (FD) of the phantom using a box-counting methods for binary images. Binary images were obtained with applying a threshold of a CT value intermediate between acryl and surrounding CM. Scans, reconstructions, and fractal analyses were repeated 10 times and the results were compared between different radiation dose and reconstruction algorithm.

**RESULTS**

Fractal dimension decreased with increasing radiation dose and ADMIRE strength. FD of FBP images were as same as those of ADMIRE strength 3 with a half radiation dose scan. In cases of higher positive contrast of +50 HU, FD of ADMIRE 3 or higher showed no difference at high radiation dose of 14.4 mGy, while FD increased with increasing strength of ADMIRE strength of 3 or higher in case with higher negative contrast of -52 HU at CTDvol of 14.4 mGy.

**CONCLUSION**

In low radiation dose protocol, ADMIRE strength of 3 can provide identical lesion conspicuity of FBP at double radiation dose.

**CLINICAL RELEVANCE/APPLICATION**

FD that represents complexity of contour would be applied as a potential indicator for the quantitative assessment of iterative reconstruction.
CONCLUSION

A fusion-based method is proved to be robust for high-resolution PET calibration of different levels of quality.

Background

High-resolution PET uses a large number of crystals with small size in its detector blocks. Small crystal size results in low signal-to-noise ratio (SNR) and large number of crystals lead to severe distortion of crystal array during signal encoding/decoding process, which makes it very challenging to robustly identify crystals in PET detector calibration. In our previous studies, three state-of-the-art crystal identification methods have been developed and evaluated, and their limitations have been identified. In this study, a hierarchical fusion approach was proposed to overcome the limitations of the three methods for accurate PET detector calibration.

Evaluation

PET-CT detector rings of over 100,000 crystals (LYSO) in small size (2.35x2.35mm²) were used for evaluation. Quadrant-sharing configuration is used to couple detector blocks to photomultiplier tubes. Flood histograms were generated per block, and each block contains 256(16x16) crystals. Crystal identification was tested on detectors of three different levels of quality (normal, heavily distorted and low SNR). A score was given to each block by a skilled engineer for each method: 1 if all 256 crystals are correctly identified without human intervention, 0 otherwise. Success rate is calculated for each detector ring (sum of scores/number of blocks). Our fusion approach improved success rate to be 99.77%, 92.20% and 94.29% for blocks in the 3 levels of quality.

Discussion

We previously implemented three methods: FTR(Fourier-Template registration), NSD(neighborhood standard deviation) and SNMD(Successive Non Maximum Decay). Each method alone achieved over 95% on normal quality detectors, but only around 80% on detectors that experienced a long-term deterioration (heavily distorted or low SNR). FTR and NSD can handle regular flood histograms well but are sensitive to geometric distortions. SNMD is resistant to heavy distortion but produces false positives when SNR is low. Based on complement information provided by different methods, the fusion-based approach significantly improved the success rate, especially for heavily distorted or low SNR detectors.

PH213-SD-SUB5

Phantom Study of T1 Mapping for Breast Tumor Using Inversion Recovery Turbo Field Echo Sequence at 3.0 T

Station #5

Participants

Katsuhiro Kida, Okayama, Japan (Presenter) Nothing to Disclose
Sachiko Goto, PhD, Okayama, Japan (Abstract Co-Author) Nothing to Disclose
Ryutaro Matsuura, MSc, Okayama, Japan (Abstract Co-Author) Nothing to Disclose
Tomoki II, BSc, Okayama, Japan (Abstract Co-Author) Nothing to Disclose
Tsunomi Kajitani, Okayama, Japan (Abstract Co-Author) Nothing to Disclose
Yoshiharu Azuma, PhD, Okayama, Japan (Abstract Co-Author) Nothing to Disclose

CONCLUSION

We suggest that T1 mapping images for breast MRI is able to be produced using only two inversion recovery times and IR-TFE sequence. Our method will contribute to the segmentation of breast tumor tissue and normal tissue without contrast medium.

Background

We know experientially that the image density of a breast tumor is depicted lower than the normal tissue on T1 weighted image of breast MRI. Therefore, the T1 relaxation time of breast tumor is extended from normal tissue. T1 relaxation time is generally calculated using the slope of T1 longitudinal-relaxation curve. The slope is obtained from the curve which is fitted with at least five inversion recovery times (TIs) by Inversion Recovery Spin Echo (IR-SE) sequence. In this study, we propose the method using only two TIs by Inversion Recovery Turbo Field Echo (IR-TFE) sequence for breast MRI.

Evaluation

To simulate a cancerous tumor that appears in a mammary gland, 5 gel phantoms were made from 0.025, 0.05, 0.1, 0.15, 0.2 mmol/L Gd and a 2.0 wt% agar solution. Our work was performed on the 5 gel phantoms and a lard phantom using the 3.0 T MR system (Achieva 3.0T TX, Philips) and an 8ch SENSE head coil. To determine the reference T1 relaxation time of each phantom, standard 2D IR-SE sequence were acquired at 7 different TIs, which were 200, 500, 1000, 1500, 3000, 4000 and 5000 msec. The T1 relaxation time of each phantom was measured using a 2D IR-TFE sequence and TIs of 1000 and 1500 msec. Four combinations of TFE factor and shots were investigated, which were 12/64, 16/48, 24/32 and 32/24. We compared reference T1 relaxation time using IR-SE sequence and T1 relaxation time using IR-TFE sequence. Furthermore, the T1 mapping image was processed by imageJ 1.47n (National Institutes of Health, USA).

Discussion

The reference T1 relaxation time of each phantom by only two TIs, 1000 and 1500 msec, became almost equal to the standard methods which is fitted with at least five TIs of IR-SE. In IR-TFE sequence, the optimum combination of TFE factor and shot were 12 and 64. However, the T1 relaxation time with IR-TFE showed the tendency to shorten in comparison with IR-SE (about 0.5%). The T1 mapping image using the IR-TFE was almost same as IR-SE.

PH214-SD-SUB6

Measurement of z-directional Noise Power Spectrum for CT Images

Station #6

Participants

Mitsunori Goto, MMedSc, RT, Natori, Japan (Presenter) Nothing to Disclose
CONCLUSION

For an accurate NPSz, use of a large volume of data and windowing function are necessary. Therefore, fast processing by 3D-FT is preferred. Noise images of clinical CT are contaminated by subtle unstable artifacts, therefore, very low frequency part of NPSz needs correction.

Background

CT images of some recent reconstruction methods show substantially widened slice sensitivity profile when measured by low-contrast test object. It tantamounts to some object-dependent filtering in z-direction. Therefore, the noise power spectrum in z-direction (NPSz) becomes important to assess image quality performance. We need to establish fast and accurate NPSz measurement method.

Evaluation

Our fast NPSz computation method is as follows. A cuboid ROI is set in z-directional array of noise images. A 3D window function is multiplied to the cuboid to minimize spectral leakage. Then, one 3D-FT gives 3D NPS. The projection of 3D NPS onto z-directional frequency axis is the NPSz in the ROI. We verified its accuracy using simulated noise images of a typical helical cone-beam reconstruction method. Theoretical NPSz was used as the ground truth. We also checked issues such as cuboid size vs. statistical uncertainty and slice pitch vs. z-directional noise aliasing. Then, we obtained NPSz of a clinical CT system with 64-row by 0.5mm, pitch 0.75, 0.1mm slice interval and conventional FBP reconstruction. Dose was 300mA for 180mmØ water as low noise mode, and 20mA for 250mmØ water as high noise mode. The cuboid length in z-direction was 59mm (590 slices). Obtained NPSz was improbably high at very-low-frequency (VLF) region. Averaging of axial images revealed minute ring artifacts and slight shading. The anomalies were more prominent for high noise mode. Use of subtraction images by repeating scans with identical helical orbit was not effective enough. We had to replace values of VLF part by the estimates from nearby data.

Discussion

Even with trustable analysis method, VLF part of NPSz of clinical CT images is corrupted. The cause should be system instability. Regardless of the cause, corrupted values must be corrected. For this, we utilized an a priori knowledge that the profile of NPSz is smooth.

Spectral Imaging on a 160 mm Clinical CT System with Fast kVp Switching: Evaluation of Image Quality

Station #7

Participants

Debashish Pal, PhD, Waukesha, WI (Presenter) Employee, General Electric Company
Kevin Mulligan, BEng, Waukesha, WI (Abstract Co-Author) Employee, General Electric Company
Roman Melnyk, Waukesha, WI (Abstract Co-Author) Employee, General Electric Company
Yasuhiro Imai, MS, Waukesha, WI (Abstract Co-Author) Employee, General Electric Company
Jean-Baptiste Thibault, Waukesha, WI (Abstract Co-Author) Employee, General Electric Company
Jiahua Fan, PhD, Waukesha, WI (Abstract Co-Author) Employee, General Electric Company

PURPOSE

Purpose: Wide-cone CT systems with 160 mm aperture or more have several clinical benefits such as single shot cardiac imaging and helical scans with faster acquisition. Spectral imaging using fast kVp switching on such a system can additionally enable quantitative imaging and access to CT images at lower energies. The purpose of this work is to evaluate the new prototype image generation chain of a 160 mm spectral imager using fast kVp switching (Revolution CT, GE Healthcare, Waukesha, WI).

METHOD AND MATERIALS

The new spectral image generation chain incorporates an advanced model of the acquisition physics and measurement noise. It also builds upon the hardware advancements made in the wide-cone CT system and an advanced spectral modeling and projection-domain material decomposition (MD). A 33 cm GAMMEX phantom is scanned at three different dose level (20.1, 11.9, 23.1 mGy) with known density of iodine. A 20 cm GAMMEX phantom is also scanned under 20.1 mGy. The MD (Water-Iodine) images are reconstructed using a slice thickness of 0.625 mm. The monochromatic images are generated from 40 - 140 keV. First noise in the monochromatic images at 0.625 mm slice thickness is measured by averaging across 3 different ROIs. Contrast to noise ratio (CNR) is also measured across all keVs at 0.625 mm slice thickness by placing a ROI on the 20 mg/cc iodine rod. Circular ROIs of radius 10 mm are placed on 5 mm averaged slices for measuring the mean density in the 5, 10, and 20 mg/cc iodine rods.

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 demonstrated for wide coverage scanning.
RESULTS

For the 35 cancers, the average pre- and post-treatment volumes from radiologist’s segmentation were 67.3 and 28.3 cm³, respectively. 30% of patients had pT0 disease (complete response) at cystectomy. A radiologist marked 35 temporal index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 participants

Participants

Sub8

Woutjan Branderhorst, PhD, Amsterdam, Netherlands (Presenter) Employee, SigmaScreening BV
Gerald J. den Heeten, MD, PhD, Nijmegen, Netherlands (Abstract Co-Author) Founder, SigmaScreening BV
Cornelis A. Grimbergen, PhD, Amsterdam, Netherlands (Abstract Co-Author) Founder, SigmaScreening BV Employee, SigmaScreening BV Board Member, SigmaScreening BV Patent holder, SigmaScreening BV

METHOD AND MATERIALS

We have developed an indicator that shows how well the force applied from above by the compression paddle is balanced by the force applied from below by the IR. To validate the indicator and to investigate the effects of suboptimal positioning, measurements were performed on a silicone breast phantom and 10 healthy female volunteers. An experienced breast technologist performed a range of mammographic CC compressions on the same breast, with the IR positioned at different heights. During compression, all vertical forces exercised on the breast and the rest of the body were recorded over time.

RESULTS

Relative to the balanced position where 80N downward paddle force was balanced by 80N upward IR force, positioning the bucky 2 cm higher increased the IR force on the phantom to 98N (+22.5%). Positioning 2 cm lower decreased the IR force to 62N (-22.5%). These results were replicated in the volunteers.

CONCLUSION

When the compression forces are inadequately balanced, a large part of the compression force may be lost to elevating or lowering the patient’s body relative to the image receptor. This may lead to unnecessary pain due to more extreme stretching of the skin around the breast. A real-time indicator can easily guide the mammography technologist towards a balanced compression of the breast.

CLINICAL RELEVANCE/APPLICATION

For the millions of mammograms obtained yearly, with the recently demonstrated large variation in technical execution, this study shows that a vast amount of unnecessary pain can potentially be avoided.

PH217-SD-SUB9

Analysis of Treatment Response of Bladder Cancers on CT Scans: Comparison of Assessments by Radiomic Features, WHO and RECIST Criteria

Participants

Lubomir M. Hadjiiski, PhD, Ann Arbor, MI (Presenter) Nothing to Disclose
Heang-Ping Chan, PhD, Ann Arbor, MI (Abstract Co-Author) Institutional research collaboration, General Electric Company
Kenny H. Cha, MSc, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Richard H. Cohan, MD, Ann Arbor, MI (Abstract Co-Author) Consultant, General Electric Company;
Elaine M. Caoli, MD, MS, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Aion Z. Weizer, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Ajjai S. Alva, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Chan Zhou, PhD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS

Our Auto-Initialized Cascaded Level Set (AI-CALS) system is designed to extract 3D lesion boundary based on level sets. 15 radiomic features (RF) based on pre- and post- treatment changes in volume (V), 5 gray level (GL) and 9 shape (S) descriptors were extracted from the segmented lesions. Linear discriminant classifier was used to combine the RFs in a combined response index (CRI). With IRB approval, pre- and post-chemotherapy treatment CT scans of 30 patients with bladder cancers were collected. For all cases, cystectomy was performed after treatment and the disease outcome was available as reference standard of treatment response. 30% of patients had pT0 disease (complete response) at cystectomy. A radiologist marked 35 temporal pairs of primary site cancers and manually outlined full 3D contours on both the pre- and post-treatment scans. For all cancers, following WHO and RECIST criteria the radiologist measured the longest diameter and its perpendicular on the pre- and post-treatment scans. Leave-one-case out cross-validation and receiver operating characteristic (ROC) analysis were performed. The area under the ROC curve (AUC) was calculated to estimate the accuracy for predicting pT0 stage (complete response) at cystectomy by the manual (3D), V, CRI, WHO (2D), and RECIST (1D) methods.

RESULTS

For the 35 cancers, the average pre- and post-treatment volumes from radiologist’s segmentation were 67.3 and 28.3 cm³, respectively. The AUC for prediction of pT0 disease at cystectomy was 0.68±0.09 for V compared to 0.66±0.11 for the manual segmentation. The difference did not reach significance. The AUC for CRI based on V and 1 S was 0.75±0.1 and increased to 0.76±0.09 when 1GL was added. Prediction of pT0 disease using the RECIST and WHO criteria, resulted in AUCs of 0.60±0.1 and 0.59±0.1 respectively.
CONCLUSION
The CRI and 3D volume change estimates obtained by radiologist’s manual segmentation and V provided more accurate treatment response estimates compared to the 1D (RECIST) and 2D (WHO) estimates.

CLINICAL RELEVANCE/APPLICATION
The computer-extracted radiomic features and the combined response index have the potential to accurately and efficiently determine tumor volume and response to treatment.

PH110-ED- SUB10 The How and When of Artifacts in Conventional and Contrast-enhanced Ultrasound

Station #10

Participants
Nathania Bonanno, MD, Msida, Malta (Abstract Co-Author) Nothing to Disclose
Kelvin Cortis, MD, FCRC, Msida, Malta (Presenter) Nothing to Disclose
Richard Pullicino, MD, Attard, Malta (Abstract Co-Author) Nothing to Disclose
Lara Sammut, MD, Msida, Malta (Abstract Co-Author) Nothing to Disclose
Veronica Attard, MD, Msida, Malta (Abstract Co-Author) Nothing to Disclose
Adrian Mizzi, MD, Glasgow, United Kingdom (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is: To serve as an educational tool for radiologists-in-training in the recognition of artifacts in conventional and contrast-enhanced ultrasound (CEUS). To make the reader aware that ultrasound artifacts can happen, and to describe how and when they do. The how of ultrasound artifacts: to understand the physical properties of ultrasound that leads to the formation of images and artifacts. The when of ultrasound artifacts: to review the clinical circumstances in which ultrasound artifacts may occur, and to highlight those instances when the ultrasound artifacts may aid in diagnosis.

TABLE OF CONTENTS/OUTLINE

PH005-EB- SUB Precise Measurement of the Angular and Energy Dependences of Small-type OSL Dosimeter in the Diagnostic Energy Region

Hardcopy Backboard

Participants
Hiroaki Hayashi, PhD, Tokushima, Japan (Presenter) Equipment support, Nagase Landauer, Ltd; Research collaboration, Nagase Landauer, Ltd
Kazuki Takegami, Tokushima, Japan (Abstract Co-Author) Nothing to Disclose
Hiroki Okino, Tokushima, Japan (Abstract Co-Author) Nothing to Disclose
Natsumi Kimoto, Tokushima, Japan (Abstract Co-Author) Nothing to Disclose
Itsuri Maehata, Tokushima, Japan (Abstract Co-Author) Nothing to Disclose
Yuki Kanazawa, PhD, Tokushima, Japan (Abstract Co-Author) Nothing to Disclose
Tohru Okazaki, Ibaraki, Japan (Abstract Co-Author) Nothing to Disclose
Ikuko Kobayashi, Ibaraki, Japan (Abstract Co-Author) Nothing to Disclose

CONCLUSION
We developed the experimental systems to measure the angular and energy dependence of the nanoDot OSL dosimeter, and the basic properties of the dosimeter were accurately measured. In addition, simulations were carried out and compared with the experiments. These data were consistent each other. In order to apply for evaluating the exposed dose in the clinical situations, additional experiments are now being planning.

FIGURE (OPTIONAL)

Background
To assess the basic properties of a small-type optically stimulated luminescence dosimeter, called “nanoDot OSL dosimeter”, we performed two experiments concerning the angular and energy dependences in the diagnostic energy range. Because the direction of incident X-rays to the dosimeter varies depending on the position of the X-ray tube and the location of the dosimeter, the angular and energy dependences are important.

Evaluation
At first, the angular dependences were measured. Using the narrow X-ray beam, the nanoDot OSL dosimeter was irradiated. The dosimeter was placed on a thin film, which could be remotely rotated. Using the experimental setup, an angular dependence of 15 degree intervals were measured. Additionally, the energy dependences were measured as follows. For producing monoenergetic X-rays, we irradiated various atomic samples such as Cu, Nb, Pb etc., and characteristic X-rays to irradiate the nanoDot OSL dosimeter were generated. For evaluation of the flux, the energy spectra of characteristic X-rays were also measured using a CdTe detector. Finally, the results were compared with the calculated dependences, which were simulated by the Monte-Carlo simulation code.

Discussion
Experimental results of angular dependences of 0-360 degrees for tube voltages of 40-140 kV were obtained, in which the
efficiency of 90 and 270 degrees were approximately 80% compared with that of the 0 degree. This trend was reproduced well with the EGS5. In a similar way, experimental results of energy dependences for 10-80 keV X-rays were in good agreement with those of EGS5. The experimental results were obtained with uncertainties of approximately 5-30%.
Imaging of Pulmonary Fibrosis

Sunday, Nov. 29 2:00PM - 3:30PM Location: E451B

Participants
David A. Lynch, MBCh, Denver, CO (Moderator) 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;

LEARNING OBJECTIVES

1) Understand the current clinical approach to diagnosis and management of pulmonary fibrosis. 2) Identify the major CT imaging features of the idiopathic interstitial pneumonias based on the revised ATS/ERS diagnostic criteria for IPF. 3) Differentiate idiopathic pulmonary fibrosis from nonspecific interstitial pneumonia and chronic hypersensitivity pneumonitis. 4) Identify important complications of IPF. 5) Understand evolving role of quantitative CT in assessment of lung fibrosis.

ABSTRACT

Recent clinical trials in idiopathic pulmonary fibrosis (IPF) have resulted in approval of two new treatments for this condition. Given the central role of the radiologist in making the CT diagnosis of IPF, it is critical to understand the diagnostic criteria for this condition as recently revised by the ATS/ERS, and to distinguish it from other fibrosing interstitial pneumonias including nonspecific interstitial pneumonia (NSIP), connective tissue disease related lung fibrosis (CVD-ILD), and chronic hypersensitivity pneumonitis (HP). The radiologist also has an important role in identifying complications of lung fibrosis including acute exacerbations and lung cancer. Substantial advances have been made in developing CT techniques for quantification of lung fibrosis, which correlate with clinical severity and with mortality.

Sub-Events

RC101A Advances in Management of Pulmonary Fibrosis

Participants
Imre Noth, MD, Chicago, IL (Presenter) Speakers Bureau, Sumitomo Dainippon Pharma Co, Ltd; Speakers Bureau, F. Hoffmann-La Roche Ltd; Speakers Bureau, Boehringer Ingelheim GmbH; Consultant, ImmuneWorks, Inc; Consultant, Gilead Sciences, Inc; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Boehringer Ingelheim GmbH

LEARNING OBJECTIVES

View learning objectives under main course title.

RC101B Fibrosing Interstitial Pneumonia: How to Sort Out the IP’s

Participants
Justus E. Roos, MD, Durham, NC (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC101C Critical Issues in Imaging of Idiopathic Pulmonary Fibrosis

Participants
David A. Lynch, MBCh, Denver, CO (Presenter) 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;

LEARNING OBJECTIVES

View learning objectives under main course title.

RC101D Quantification of Pulmonary Fibrosis

Participants
Brian J. Bartholmai, MD, Rochester, MN (Presenter) License agreement, ImBio, LLC; Scientific Advisor, ImBio, LLC; Scientific Advisor, Bristol-Myers Squibb Company

LEARNING OBJECTIVES

View learning objectives under main course title.
Head and Neck Cancer PET Interpretation with Case Examples (An Interactive Session)

Sunday, Nov. 29 2:00PM - 3:30PM Location: S505AB

Participants

LEARNING OBJECTIVES
Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Sub-Events

RC111A Practical Approach for Interpreting Head and Neck PET/CT

Participants
Rathan M. Subramaniam, MD, PhD, Baltimore, MD, (rsubram4@jhmi.edu) (Presenter) Travel support, Koninklijke Philips NV

LEARNING OBJECTIVES
1) To understand the value of PET/CT in the care process of managing head and neck cancer. 2) To learn common pathways of tumor spread in head and neck. 3) To review illustrative cases and pitfalls of interpretation.

ABSTRACT
FDG-PET/CT provides valuable information in the assessment of the patient with cancers of the head and neck. The metabolic information determined by FDG is complimentary and additive to the anatomic information from CT, and can be used to direct surgery, plan radiation therapy, and evaluate response to systemic or localized treatment. In this presentation, the role of FDG-PET/CT in the management of head and neck cancer will be presented, using case examples to illustrate the utility of PET as well as common pitfalls.

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Eric M. Rohren, MD, PhD - 2015 Honored Educator

RC111B PET/CT for Head and Neck Cancer: Clinical Applications and Case Studies

Participants
Eric M. Rohren, MD, PhD, Houston, TX (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review head and neck anatomy and physiologic sites of FDG uptake. 2) Review the impact of FDG-PET/CT on the management of patients with head and neck malignancies.

ABSTRACT
FDG-PET/CT provides valuable information in the assessment of the patient with cancers of the head and neck. The metabolic information determined by FDG is complimentary and additive to the anatomic information from CT, and can be used to direct surgery, plan radiation therapy, and evaluate response to systemic or localized treatment. In this presentation, the role of FDG-PET/CT in the management of head and neck cancer will be presented, using case examples to illustrate the utility of PET as well as common pitfalls.

RC111C The Head and Neck Surgeon’s Perspective: What I Need to Know

Participants
Nishant Agrawal, MD, Baltimore, MD (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review the indications of PET/CT in head and neck cancer. 2) Review the impact of PET/CT on staging in head and neck cancer. 3) Review the role of PET/CT in the evaluation of the unknown primary. 4) Review the role of post-treatment PET/CT.
Imaging Cancer Treatment Complications

Sunday, Nov. 29 2:00PM - 3:30PM Location: N229

CT NM OI

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

Participants

Sub-Events

RC118A Identifying and Distinguishing Treatment Complications on FDG PET/CT

Participants
Gary A. Ulaner, MD, PhD, New York, NY, (ulanerg@mskcc.org) (Presenter) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd

LEARNING OBJECTIVES

1) Identify iatrogenic causes of FDG-avidity on FDG PET/CT and distinguish them from FDG-avid malignancy. Iatrogenic causes of FDG-avidity include changes caused by surgery (inflammation at sites of incision, pleurodesis inflammation, transposition of ovaries/testes), radiation (pneumonitis, esophagitis, hepatitis), and drugs (bleomycin pneumonitis, bisphosphonate osteonecrosis, ipilimumab enterocolitis). Familiarity with usual and unusual causes of iatrogenic FDG-avidity will improve accuracy of FDG PET/CT reporting.

ABSTRACT

Fluorine 18 fluorodeoxyglucose (FDG) positron emission tomography / computed tomography (PET/CT) is increasingly used in the initial staging, evaluation of treatment response and surveillance of many malignancies. Uptake of FDG is substantially increased in most malignancies compared with its uptake in normal tissues, and FDG-avidity often leads to cancer detection earlier than abnormalities on anatomic imaging. However, FDG is not a cancer-specific agent, and FDG-avidity can be seen in many benign processes. It can be particularly challenging to discriminate malignancy from benign FDG-avid changes caused by surgery and procedures, radiation, and chemotherapy. FDG-avid lesions caused by surgery and procedures include inflammation at sites of incision or dissection, inflammation from vascular compromise or surgical retraction, surgical transposition of structures with physiologic FDG-avidity (such as ovaries or testes), and pleurodesis inflammation. Radiation may induce FDG-avid pneumonitis, esophagitis, or hepatitis, as well as osteoradionecrosis or fractures. FDG-avid chemotherapy complications include pneumonitis, osteonecrosis, enterocolitis, and pancreatitis. Granulocyte Colony Stimulating Factor for treatment of bone marrow suppression after chemotherapy induces temporary increases of FDG-avidity in the bone marrow and spleen. In this review we illustrate common and unusual iatrogenic causes of FDG-avidity that can confound FDG PET/CT interpretation. Familiarity with these cases will improve accuracy of FDG PET/CT interpretation.

RC118B Imaging Musculoskeletal Complications

Participants
Brooke R. Beckett, MD, Portland, OR (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To recognize the osseous and soft tissue complications of tumor treatment, specifically those caused by radiation, chemotherapy, and surgery. These include radiation osteitis, osteonecrosis, insufficiency fractures, secondary malignancy, myositis and myonecrosis, and muscle denervation changes.

ABSTRACT

Musculoskeletal complications of tumor treatment are relatively common, often symptomatic, and therefore, an important cause of morbidity in the posttreatment cancer patient. Radiation causes local marrow changes such as osteitis, osteonecrosis and osteopenia, predisposing to insufficiency fractures. It may also cause local muscle damage, most commonly myositis, but occasionally myonecrosis. A rare but especially dreaded complication of radiation is secondary bone or soft tissue sarcoma, which will also be described. Chemotherapy, particularly protocols that include high doses of steroids, predisposes to osteonecrosis. And finally, surgical resection of extremity tumors, either primary or metastatic, may lead to muscle denervation changes. The bones and soft tissues should be carefully reviewed on all surveillance imaging, be it radiographs, CT or MRI, to exclude the presence of these often treatable complications.

RC118C GI Complications

Participants
Priya R. Bhosale, MD, Houston, TX (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To recognize the complications caused by chemotherapy and radiation specifically those that occur in the GI tract including the liver and the pancreas. These include perforations, abscess formation, radiation enteritis, insufficiency fractures and secondary malignancy.

ABSTRACT

Several complications can occur in the GI tract following surgery. Similarly chemotherapy can cause a myriad of complications such as perforation, abscesses and enteritis. Radiation therapy can result in radiation enteritis and occurrence of radiation induced
RC118D Pulmonary Complications

Participants
Michelle S. Ginsberg, MD, New York, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To recognize complications in the postoperative thoracic patient in both immediate and late periods. In the immediate period this will include lobar collapse, hemorrhage, pulmonary edema, pneumonia, as well as rarer complications such as bronchopleural fistula, chylothorax and lung torsion. In the later period it is important to follow these patients and to recognize and distinguishing recurrent tumor from treatment changes and new primary tumors.

ABSTRACT
Molecular Imaging Mini-Course: Basics of Molecular Imaging

Sunday, Nov. 29 2:00PM - 3:30PM Location: E451A

Participants

Sub-Events

RC123A  Developing Molecular Imaging Agents

Participants
Julie L. Sutcliffe, PhD, Sacramento, CA, (jlsutcliffe@ucdavis.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the ideal properties of a molecular imaging agent. 2) Describe the in vitro validation of the molecular imaging agent. 3) Describe specific examples of successful molecular imaging agents.

RC123B  Instrumentation (PET and CT) and Image Reconstruction

Participants
John Sunderland, PhD, Iowa City, IA, (john-sunderland@uiowa.edu) (Presenter) Research Grant, Siemens AG

LEARNING OBJECTIVES

1) Identify the primary design components of a modern PET/CT system. 2) Design and implement a PET/CT quality control program to assure high quality and quantitatively accurate clinical imaging. 3) Describe commonly used PET reconstruction algorithms and the practical impact of reconstruction parameters upon image quality and quantitation.

ABSTRACT

Handout: John Sunderland

RC123C  Basic Clinical Applications

Participants
Hubert J. Vesselle, MD, PhD, Seattle, WA (Presenter) Consultant, MIM Software Inc

ABSTRACT
Controversy Session: Enteral Contrast for CT...High or Dry?

Monday, Nov. 30 7:15AM - 8:15AM Location: E451A

GI CT

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00
FDA

Discussions may include off-label uses.

Participants
Kumaresan Sandrasegaran, MD, Carmel, IN (Moderator) Nothing to Disclose

Sub-Events
SPSC20A  Pro Enteral Contrast

Participants
Perry J. Pickhardt, MD, Madison, WI (Presenter) Co-founder, VirtuoCTC, LLC; Stockholder, Cellectar Biosciences, Inc; Research Consultant, Bracco Group; Research Consultant, KIT ; Research Grant, Koninklijke Philips NV

LEARNING OBJECTIVES
1) Identify the advantages and disadvantages for the use of enteral contrast at CT. 2) Compare and contrast the various types of enteral contrast (positive, neutral, and negative). 3) Assess the appropriateness of the use of enteral contrast according to specific study indication.

ABSTRACT
N/A

URL

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Perry J. Pickhardt, MD - 2014 Honored Educator

SPSC20B  Against Enteral Contrast for Most CT Indications

Participants
Benjamin M. Yeh, MD, San Francisco, CA, (ben.yeh@ucsf.edu) (Presenter) Research Grant, General Electric Company; Author with royalties, Oxford University Press; Shareholder, Nextrast, Inc;

LEARNING OBJECTIVES
1) Review the evidence for the use and non-use of positive oral contrast material for CT will be reviewed. 2) Discuss artifacts and interpretive pitfalls arising from positive oral contrast use at CT. 3) Understand issues of patient tolerance and compliance with positive oral contrast use. 4) Explore specific scenarios where non-use of positive oral contrast outweighs the use of oral contrast will be explored, including in the emergency room setting, and when bowel pathology such as ischemia and inflammation is of concern.

ABSTRACT
As our multidetector CT technology improves and our understanding of imaging technique progresses, the use or non-use of positive oral contrast for CT imaging is evolving. Although positive oral contrast is used by the great majority of radiologists for routine CT imaging and has undisputed value, specific scenarios are emerging where positive oral contrast usage is harmful to accurate imaging diagnosis and patient care. This discussion will explore the economic, logistical, interpretive, and side effect issues of positive oral contrast usage in the modern CT practice. A re-examination of when it is appropriate not to use positive oral contrast will be discussed, and include rapid patient triage in the emergency setting, certain subsets of abdominopelvic imaging, and patient tolerance. The economic and radiation dose cost of positive oral contrast use will also be explored.

URL

Active Handout: Benjamin M. Yeh
**Cardiac CT Mentored Case Review: Part I (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)**

Monday, Nov. 30 8:30AM - 10:00AM Location: S406A

**LEARNING OBJECTIVES**

1) Identify cardiac and coronary artery anatomy. 2) Recognize cardiac disease processes, including coronary atherosclerosis, as diagnosed on CT. 3) Understand methods of cardiac CT and coronary CT angiography post-processing.

**Sub-Events**

**MSMC21A Normal Coronal Anatomy**

Participants
Shawn D. Teague, MD, Indianapolis, IN (Presenter) Stockholder, Apple Inc

**LEARNING OBJECTIVES**

1) Recognize normal anatomy and common variants of the coronary arteries. 2) Understand the unique advantages and disadvantages of CT for coronary artery evaluation. 3) Describe the current State-of-the-Art capabilities for CT in coronary artery evaluation.

**ABSTRACT**

**MSMC21B Anomalous Coronary Arteries**

Participants
Cylen Javidan-Nejad, MD, Saint Louis, MO (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Using Coronary Artery CT cases to review anomalous origins of the coronary arteries
**LEARNING OBJECTIVES**

1) Compare evidence for LDCT screening for lung cancer from the North American and European trials. 2) Classify screen-detected lung nodules and recommend appropriate management. 3) Incorporate the essential elements of a clinical lung cancer screening program. 4) Critique the evidence for and against screening patients who do not meet current eligibility criteria for LDCT screening.

**ABSTRACT**

There is an increasing body of evidence for low-dose CT (LDCT) screening for lung cancer. This multisession course will review data from North American and European trials, with emphasis on mortality reduction, cost-effectiveness, and stage shift; classification of lung nodules by appearance and size, measurement of nodule growth, and management strategies; elements of an effective clinical screening program; and the evidence for limiting screening to patients who meet current eligibility criteria based on age and smoking history versus including patients on the basis of expanded criteria.

**RESULTS**

In the 50 subjects we identified 75 nodules on LDCT images (SN, n=20; p-SN, n=5; GGN, n=50). Of these, all 20 SNs were classified as grade 3, all 5 p-SNs as grade 3, and 30 of the 50 GGNs as grade 3, 15 as grade 2, and 5 as grade 1 (60-, 30-, and 10% respectively).
CONCLUSION
The detectability of SNs and p-SNs on U-LDCT images with full IR was comparable to LDCT images. However, 10% of GGNs were not detected on U-LDCT images.

CLINICAL RELEVANCE/APPLICATION
As the detectability of pulmonary nodules was almost comparable on LDCT- and U-LDCT images with full IR except GGNs, lung cancer screening using U-LDCT may be feasible.

RC201-03  Current Evidence for Lung Cancer Screening – The European Perspective
Monday, Nov. 30 9:00AM - 9:20AM Location: S406B

Participants
Marjolein A. Heuvelmans, BSc, Groningen, Netherlands, (m.a.heuvelmans@umcg.nl) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Compare evidence LDCT screening for lung cancer from the North American and European trials. 2) Classify screen-detected lung nodules and recommend appropriate management. 3) Incorporate the essential elements of a clinical lung cancer screening program. 4) Critique the evidence for and against screening patients who do not meet current eligibility criteria for LDCT screening.

RC201-04  The Role of Volume and Predicted Volume-doubling Time in Differentiating Benign from Potential Malignant New Nodules at Incidence CT Lung Cancer Screening
Monday, Nov. 30 9:20AM - 9:30AM Location: S406B

Participants
Joan E. Walter, BSc, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose
Marjolein A. Heuvelmans, BSc, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose
Geertruida H. De Bock, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose
Pim A. De Jong, MD, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Roizemarijn Vliegenthart, MD, PhD, Groningen, Netherlands (Presenter) Nothing to Disclose
Matthijs Oudkerk, MD, PhD, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare volume and predicted growth rate of benign and malignant new solid nodules in 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. Following baseline LDCT screening, 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 screen. Nodule volume was generated semi-automatically by Lungcare software (Siemens, Erlangen, Germany). Growth rate at initial detection was estimated by calculating the slowest predicted volume-doubling time (pVDT), according to the formula pVDT=[ln(2)*Δt]/[ln(V2/V1)], using the study's detection limit of 15mm³ (V1), the volume of the new nodule at initial detection (V2), and the time interval between current and last screen (Δt [days]). Lung cancer diagnosis was based on histology, and benignity was based on either histology or a stable volume for at least two years. Difference in volume and pVDT between benign and malignant nodules was evaluated by Mann-Whitney U testing.

RESULTS
In total, 1,484 new solid nodules in 949 participants were identified of which 77 (5.2%) were malignant. The median volume of benign (44mm³, interquartile-range [IQR] 22-122mm³) and malignant (373mm³, IQR 120-974mm³) new nodules, as well as the median pVDT of benign (288 days, IQR 153-566 days) and malignant (144 days, IQR 116-213 days) new nodules differed significantly (P<0.001 for both). The calculated median pVDT of adenocarcinomas (183 days, IQR 138-299 days) and squamous-cell carcinomas (150 days, IQR 117-223 days) was comparable to VDT of fast-growing baseline cancers of the same histological type as previously published (196 days, IQR 135-250 days and 142 days, IQR 91-178 days).

CONCLUSION
Volume and pVDT may be used to differentiate between benign and malignant solid nodules, newly detected at incidence LDCT lung cancer screening.

CLINICAL RELEVANCE/APPLICATION
A new nodule's initial growth rate can be estimated by the predicted volume-doubling time, which is a new measure that may be helpful in differentiating benign from malignant new nodules.

RC201-05  Lung Nodule Characterization
Monday, Nov. 30 9:30AM - 9:50AM Location: S406B

Participants
Thomas E. Hartman, MD, Rochester, MN (Presenter) Author, Cambridge University Press

LEARNING OBJECTIVES
1) Compare evidence LDCT screening for lung cancer from the North American and European trials. 2) Classify screen-detected lung nodules and recommend appropriate management. 3) Incorporate the essential elements of a clinical lung cancer screening program. 4) Critique the evidence for and against screening patients who do not meet current eligibility criteria for LDCT screening.

RC201-06  Can Morphological Features Differentiate between Malignant and Benign Pulmonary Nodules, Detected in a Screen Setting?
PURPOSE

Existing nodule classification systems and risk models (e.g., McWilliams model, Lung-RADS) consider only nodule type, size, growth, and the presence of a speculated border. However, radiologists consider additional morphological features when assigning a malignancy risk. Goal of the study was to determine the power of additional morphological features to differentiate between benign and malignant nodules.

METHOD AND MATERIALS

All 60 cancers were selected from the Danish Lung Cancer Screening Trial, in the first scan where they were visible, and a benign set of 120 randomly selected and 120 size-matched benign nodules from baseline scans were included, all from different participants. Data had been acquired using a low-dose (16x0.75mm, 120 kVp, 40 mAs) protocol, and 1mm section thickness reconstruction. Seven radiologists were asked to score the presence of morphological features for each nodule referring to density distribution (homogeneous, inhomogeneous, high, low), lesion margin (spiculation, lobulation, demarcation by interlobular septa, sharply-defined, ill-defined), lesion surrounding (distortion of the surrounding parenchyma, pleural/fissure retraction, attachment to pleura, fissure or vessel) and lesion architecture (thickened wall of a bulla, bubbles, air bronchogram). Separately per observer and feature, chi square analysis was used to determine the power to discriminate between benign and malignant nodules. Features with a p-value <0.05 in ≥4 observers are reported.

RESULTS

Significant differences were seen for inhomogeneous density distribution (p <0.001 - 0.003) and pleural/fissure retraction (p < 0.001 - 0.047) in 7 observers. The presence of bubbles (p <0.001 - 0.025), spiculation (p <0.001), lobulation (p <0.001), and an ill-defined nodule border (p<0.001-0.012) were significant in 6 observers. The presence of a thickened bulla wall in 5 observers (p<0.001-0.042), and air bronchogram (p<0.001-0.006) and distortion of surrounding architecture (p<0.001-0.004) was significantly different in 4 observers.

CONCLUSION

We have identified several morphological features that are significantly associated with malignancy of pulmonary nodules, but not included in current risk prediction models.

CLINICAL RELEVANCE/APPLICATION

Morphological features can be used to differentiate malignant from benign nodules. Further studies will show whether integration of more morphological features will increase the power of risk prediction.

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Santiago E. Rossi, MD - 2015 Honored Educator
PURPOSE
To assess patient compliance with follow-up recommendations in a clinical CT lung screening program.

METHOD AND MATERIALS
We retrospectively assessed the rate of patient compliance with exam follow-up recommendations in our CT lung screening program. All patients evaluated fulfilled the NCCN high-risk criteria for lung cancer screening and underwent screening between 1/12/2012 and 6/12/2013. Screened patients referred from outside our institution were excluded due to limited follow-up. Patients with negative, benign, or probably benign results were recommended to have a repeat screening exam in 6-12 months. Patients with suspicious findings were recommended to undergo a pulmonary consultation. To be considered compliant, patients had to be no more than 90 days past due for their next recommended exam or clinical evaluation as of 9/12/2014. Patients who died, were diagnosed with cancer, exceeded the program age limit, or became otherwise ineligible for additional screening were considered adherent. Compliance rates were assessed across multiple factors including sex, age, smoking history, baseline exam result, and NCCN high-risk group status.

RESULTS
901 high-risk patients from our institution underwent a baseline CT lung screening exam between 1/12/2012 and 6/12/2013. 772/901 (85.7%) were compliant as of 9/12/2014. 155/901 (17.2%) were non-compliant during the study interval of which 26 (16.8%) returned to screening compliance by 9/12/2014. The most common reasons for non-compliance were refusal to undergo the follow-up exam (66.7%), inability to contact the patient (20.9%), and patient inability to obtain a followup order from their physician (7.8%). 23/901 (2.6%) were discharged for reasons other than non-compliance. Subgroup analysis demonstrated a statistically significant increase in screening compliance among female patients (p = 0.035) and among those patients 65-73 years old (p = 0.040).

CONCLUSION
High rates of compliance with CT lung screening recommendations are achievable in clinical practice.

CLINICAL RELEVANCE/APPLICATION
Monitoring patient compliance with exam follow-up recommendations and reviewing reasons for non-compliance are important quality initiatives in a clinical CT lung screening program.

RC201-10 Building a Clinical Program

Participants
Jared D. Christensen, MD, Durham, NC (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Compare evidence LDCT screening for lung cancer from the North American and European trials. 2) Classify screen-detected lung nodules and recommend appropriate management. 3) Incorporate the essential elements of a clinical lung cancer screening program. 4) Critique the evidence for and against screening patients who do not meet current eligibility criteria for LDCT screening.

RC201-11 Trends in CT Screening for Lung Cancer at Leading Academic Medical Centers from 2013 to 2015

Participants
Philip M. Boiselle, MD, Boston, MA (Presenter) Nothing to Disclose
Caroline Chiles, MD, Winston-Salem, NC (Abstract Co-Author) Nothing to Disclose
James G. Ravenel, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Charles S. White, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine trends in CT lung cancer screening at leading academic medical centers (AMCs).

METHOD AND MATERIALS
A survey was emailed in March 2015 to thoracic radiologists at 21 leading AMCs, identified from the US News and World Report listings of top hospitals, cancer centers, and pulmonary medicine centers. Radiologists who currently offer lung cancer screening were asked additional questions ranging from patient selection policies to implementation of Lung-RADS in their practice. 2015 survey results were compared to March 2013 and March 2014 survey results for select questions that overlapped between the 3 surveys.

RESULTS
Of the 18 survey respondents (86% response rate), 17 (94%) have an active CT screening program, similar to 2014. Concerning
patient volumes, 14 of 17 (82%) sites reported that the number screened was stable to increased over the past 3 to 6 months, and substantially fewer sites scan ≤5 patients per week compared to prior years (29% in 2015; 74% in 2014; and 87% in 2013). Regarding charges, a self-pay model was used exclusively at only 1 of 17 sites (6%) in 2015, a decrease from 47% in 2014. NLST entry criteria remained the most common patient selection criteria in 2015, but 4 sites (24%) have adopted the new CMS guidelines and 5 sites (29%) are now using expanded NCCN criteria. Concerning solid nodule size thresholds for defining a positive screen, 12 of 17 sites (71%) now use ≥6 mm, an increase from 11% in 2014. With regard to accreditation, 8 of 17 sites (47%) are designated as an ACR screening site and almost all other sites are planning to apply for this designation. A majority of sites (13 of 17, 76%) have incorporated Lung-RADS, whereas the remaining sites use other guidelines such as NCCN. Nearly half of all sites (8 of 17, 47%) have introduced local training and/or credentialing policies for participating radiologists. Only 1 site uses software for volumetric nodule measurement and computer aided detection, whereas 5 of 17 (29%) sites use data management software for tracking patient data.

CONCLUSION
Screening practices are rapidly evolving at leading AMCs, with greater conformity to nodule size criteria and management guidelines following the release of updated screening guidelines and Lung-RADS.

CLINICAL RELEVANCE/APPLICATION
Over the last 2 years, leading AMCs have experienced greater patient volumes, increased payor mix, revised solid nodule size threshold from 4 mm to ≥6 mm, and incorporation of Lung-RADS.

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Phillip M. Boiselle, MD - 2012 Honored Educator

RC201-12  Screening: Out of the Box
Monday, Nov. 30 11:30AM - 11:50AM Location: S406B

Participants
Brady J. McKee, MD, Burlington, MA (Presenter) Spouse, Advisory Board, Medtronic, Inc;

LEARNING OBJECTIVES
1) Compare evidence LDCT screening for lung cancer from the North American and European trials. 2) Classify screen-detected lung nodules and recommend appropriate management. 3) Incorporate the essential elements of a clinical lung cancer screening program. 4) Critique the evidence for and against screening patients who do not meet current eligibility criteria for LDCT screening.

RC201-13  Panel Discussion
Monday, Nov. 30 11:50AM - 12:00PM Location: S406B

Participants
Imaging Nonischemic and Ischemic Disease of the Myocardium

Monday, Nov. 30 8:30AM - 10:00AM Location: S504AB

Participants

LEARNING OBJECTIVES

ABSTRACT

Sub-Events

RC203A  MRI and CT of Cardiac Masses

Participants
Phillip M. Young, MD, Rochester, MN (young.phillip@mayo.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To review role of MR and CT in assessing cardiac masses. 2) To highlight the potential for detection, characterization, staging, and guiding surgical decision making with cardiac MR and CT through clinical cases. 3) To review some practical tips and tricks to keep in mind when imaging these challenging cases.

ABSTRACT

RC203B  Infiltrative Diseases (Amyloid, Hemochromatosis Fabrys, Sarcoid)

Participants
Kristopher W. Cummings, MD, Phoenix, AZ (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of cardiac MR in the evaluation of infiltrative cardiomyopathy. 2) Describe typical patterns and locations of MR late gadolinium enhancement associated with various types of infiltrative disease. 3) Explain the role of noncontrast MR in the evaluation for myocardial iron deposition.

ABSTRACT

RC203C  Non Infiltrative Non-ischemic Cardiomyopathies (HCM, Noncompaction, ARVD, Myocarditis, Takatzubo etc.)

Participants
Karen G. Ordovas, MD, San Francisco, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand how to differentiate ischemic from non-ischemic cardiomyopathies on cardiac MRI. 2) To recognize the cardiac MR findings suggestive of the diagnosis of different types of non-ischemic cardiomyopathies. 3) To identify cardiac MR findings that have a prognostic role in patients with non-ischemic cardiomyopathies.

ABSTRACT

RC203D  T1-mapping, T2 Mapping and Quantitative Imaging

Participants
Arthur E. Stillman, MD, PhD, Atlanta, GA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To review the role of T1, T2 and ECV mapping for aiding cardiac disease diagnosis. 2) To review the potential of T1 and T2 mapping for monitoring therapy.

ABSTRACT

Recent advances permit quantitative MRI imaging using T1- and T2- maps. These provide a new method for tissue characterization and can be used to aid diagnosis and for monitoring treatment. Examples relating to cardiac imaging include acute myocardial infarction, myocarditis, amyloid and Fabry disease. Recent literature suggests that quantitative T1-and T2- maps improve diagnostic capabilities compared with T1- and T2 weighted MRI. When used following the administration of gadolinium contrast, T1-maps can be used to calculate the extracellular volume maps of myocardium. This literature will be reviewed and illustrated with case examples.
ABSTRACT

Spine imaging rightfully has a pivotal role in the evaluation of the patient with back or limb pain, primarily in the exclusion of systemic disease as a cause of symptoms. Unfortunately, imaging is frequently over-utilized, providing no measurable benefit to the patient while incurring significant societal cost and potential patient harm. It is imperative to examine the literature to understand the appropriate interpretation, value to the patient, and evidence-based utilization of spine imaging. Systemic disease underlies only 5% of back or limb pain presentations; most imaging findings are categorized as "degenerative." This constitutes the primary specificity fault of spine imaging: the vast majority of reported "degenerative" changes involving the spinal articulations, the disc and facet joints, are asymptomatic and reflect only expected age-related change. They are not a degenerative disease; labeling them as such is misleading. Spine imaging also suffers a sensitivity fault: most advanced imaging is done in a recumbent position, without axial load and physiologic posture. This renders imaging insensitive to dynamic structural alterations present only in the upright patient. Reliance on anatomic structural changes alone must ultimately yield to imaging identification of the local inflammatory processes that are necessary for spine nociception. Utilization of spine imaging must occur as a risk / benefit calculation. The benefits of diagnosis of systemic disease, or guiding therapeutic intervention for truly symptomatic structural/inflammatory changes, must be weighed against the harms of inappropriately labeling the patient as suffering from a degenerative disease, radiation exposure, patient / societal cost, and the precipitation of interventions that are often poorly based on evidence. Evidence-based guidelines for imaging utilization, in combination with an evidence-based understanding of its interpretation, can help physicians employ this powerful tool more effectively and efficiently.

PURPOSE

We report the prevalence of ossification of the posterior longitudinal ligament (OPLL) in the cervical spine on computed tomography (CT) in the North American population using the original and newer classification systems proposed by the Japanese Ministry of Public Health and Welfare (JMPHW).

METHOD AND MATERIALS

We retrospectively reviewed CT examinations of the cervical spine in adult patients performed from January 1st, 2009 through March 31st, 2010 at our institution. OPLL type, prevalence, and thickness were recorded. The OPLL types as described in the original JMPHW classification scheme were: continuous, segmental, mixed, and circumscibed. The CT classification comprised of two schemes: A or axial. Classification A described OPLL as bridging or nonbridging. In the axial classification, the location of the OPLL at the level of maximal stenosis on axial imaging was characterized as central or lateral.

RESULTS

We reviewed CT scans on 837 patients, 555 males (66%), with average age of 44.1 years (ranged from 18 to 100 yrs). We
detected 39 OPLL lesions in these 837 patients (4.7%). The OPLL types based on the original classification were 28 segmental, 8 circumscibed, 2 mixed, and 1 continuous. According to the axial classification, 31 were nonbridge (79%). According to the axial classification, 34 were central (87%). Of the 28 patients with segmental OPLL, 20 (71%) were male. Of the 8 circumscibed OPLL, only 5 (63%) were male. The two patients with mixed type were female.

CONCLUSION

We found the prevalence of OPLL to be 4.7% which is higher than previously reported. Additionally, although prevalence among males was higher than females, we discovered that in the cervical spine that this sex difference is not uniform and depends on type of OPLL.

CLINICAL RELEVANCE/APPLICATION

Ossification of the posterior longitudinal ligament is a well-known cause of spinal stenosis and neurologic dysfunction. The reported prevalence of OPLL based on radiography ranges between 0.1-1.7% in Europe and US, 0.4-3% in Asia excluding Japan, and 1.9-4.3% in Japan. However, we found the prevalence of OPLL to be much higher than previously reported. Given the wide spread use of CT in today's clinical practice, radiologists will identify incidental OPLL in asymptomatic patients. We believe recognition of OPLL and knowledge of its natural history will be important for guiding patient management.

RC205-03 CT Findings Predict Clinical Outcome after Dynamic Posterior Stabilization in Patients with Painful Segmental Instability of the Lower Spine

Monday, Nov. 30 9:10AM - 9:20AM Location: N228

Participants
Benedita J. Schwaiger, MD, San Francisco, CA (Presenter) Nothing to Disclose
Alexandra S. Gersing, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Michael Behr, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Claus Zimmer, Muenchen, Germany (Abstract Co-Author) Nothing to Disclose
Florian Ringel, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Jan S. Kirschke, MD, Muenchen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

Although clinical results after dynamic posterior stabilization in patients with painful degenerative segmental instability of the lower spine are promising, few is known about preoperative CT imaging parameters to select patients who will benefit from this procedure. Purpose therefore was to identify CT findings that predict post-surgical outcome.

METHOD AND MATERIALS

63 patients (age 66±11.7; 38 women) treated with dynamic stabilization for painful segmental instability with/without spinal stenosis were identified. Preoperative MDCT scans were assessed for quantitative and qualitative parameters defining degenerative changes of the thoracolumbar spine. BMD measurements were performed in asynchronously calibrated MDCT. For clinical follow-up at 24 months, visual analogue scale (VAS), Oswestry Disability Index (ODI), Short Form 36 physical (PCS) and mental (MCS) component summaries were assessed. For statistical analysis classification and regression trees, linear regression and non-parametrical tests were used.

RESULTS

At follow-up, all clinical scores showed significant improvement compared to preoperative values (delta VAS 4.1±2.9, delta ODI 32.1±17.2, delta PCS 4.9±2.3 and delta MCS 4.2±1.7; P<0.001, respectively). PCS improvement was significantly decreased in patients with higher grades of disc herniation (P<0.001) and spondylolisthesis (P=0.011) as well as with larger cross-sectional area (CSA) of the dural tube at disc level (P=0.043). PCS improvement was significantly higher in patients with high intervertebral disc height (P=0.006) and high grades of vertebral body sclerosis (P=0.002). Patients with high BMD and initially low AP diameter of intervertebral foramina showed a significantly higher improvement of ODI (P<0.05).

CONCLUSION

In patients treated with dynamic posterior stabilization, postoperative clinical improvement was predicted by the following CT parameters: high grades of vertebral body sclerosis, spondylolisthesis or disc herniation, high BMD and disc space height, larger CSA of the dural tube and AP diameter of intervertebral foramina. Preoperative evaluation of these CT parameters therefore may improve therapy selection for patients with degenerative disease of the lower spine.

CLINICAL RELEVANCE/APPLICATION

The identified CT parameters predict post-surgical outcome and therefore support appropriate therapy selection for patients with painful degenerative segmental instability of the lower spine.

RC205-04 Accuracy and Efficacy of Fluoroscopic guided Pars Interarticularis Injections on Immediate and Short-Term Pain Relief

Monday, Nov. 30 9:20AM - 9:30AM Location: N228

Participants
Lloyd M. Kershen, MD, Charlottesville, VA (Abstract Co-Author) Nothing to Disclose
Nicholas C. Nacey, MD, Charlottesville, VA (Abstract Co-Author) Nothing to Disclose
James Patrie, MS, Charlottesville, VA (Abstract Co-Author) Nothing to Disclose
Michael G. Fox, MD, Charlottesville, VA (Presenter) Stockholder, Pfizer Inc;

PURPOSE

To determine the accuracy and short-term efficacy of fluoroscopic guided steroid and anesthetic injections for symptomatic pars interarticularis (pars) defects.

METHOD AND MATERIALS

Following IRB approval, all fluoroscopically guided injections of symptomatic pars defects at a single institution from June 2010 to
Epidural Steroid Injections for Spinal Stenosis: Helpful or Harmful?

Monday, Nov. 30 9:40AM - 10:10AM Location: N228

Participants

LEARNING OBJECTIVES
1) Review the rationale and design of the Lumbar Epidural Steroid injections for spinal Stenosis (LESS) study. 2) Examine the results of the LESS study. 3) Discuss the limitations of LESS study. 4) Discuss the policy implications of the LESS conclusion: in the
treatment of lumbar spinal stenosis symptoms, epidural steroid injections offered minimal to no benefit compared to epidural injections of lidocaine at six weeks.

ABSTRACT

The Lumbar Epidural Steroid injections for spinal Stenosis (LESS) study was double-blind study comparing epidural steroid injections (ESIs) with lidocaine to lidocaine injections alone. The study included 400 patients with back and leg pain from lumbar spinal stenosis who were randomized to receive either an epidural injection containing lidocaine or an epidural injection containing lidocaine plus a glucocorticoid. Sixteen U.S. centers participated in the study. Compared to injections with local anesthetic alone, injections with glucocorticoids provided these patients with minimal or no additional benefit. The primary outcomes were the Roland-Morris Disability Questionnaire and a leg pain numerical rating scale. Patients who received glucocorticoid reported greater satisfaction with treatment, with 67% of those patients reporting being very satisfied or somewhat satisfied compared to 54% of those who received lidocaine alone reporting the same level of satisfaction with the treatment. There were more adverse events in the patients who received the injections that included glucocorticoid. Furthermore, patients receiving the combination injections were more likely to have low morning serum cortisol levels at 3 weeks and 6 weeks after the injection, suggesting that the corticosteroid may have a broad systemic effect. In conclusion, for the treatment of lumbar spinal stenosis symptoms, ESIs offered minimal to no benefit compared to epidural injections of lidocaine at six weeks. The small improvement with corticosteroid observed at 3 weeks was due solely to the interlaminar approach and not transfornaminal approach injections. There is evidence of sustained systemic effects of the corticosteroid including cortisol suppression that should be considered, particularly in older adults.

RC205-07 Lumbar Disc Nomenclature 2.0: Recommendations of the Combined Task Force

Monday, Nov. 30 10:20AM - 10:50AM Location: N228

Participants
Gordon K. Sze, MD, New Haven, CT (Presenter) Investigator, Remedy Pharmaceuticals, Inc

LEARNING OBJECTIVES

1) To understand the scope and nature of the revisions of the lumbar disc nomenclature update, version 2.0. 2) To investigate the rationale for the revisions. 3) To comprehend the most important revisions.

ABSTRACT

‘Lumbar disc nomenclature: version 2.0. Recommendations of the combined task forces of NASS, ASSR, and ASNR’ is the updated and revised version of the original ‘Nomenclature and classification of lumbar disc pathology’ and is the product of a multidisciplinary effort over the course of nearly 10 years. The revised document resembles the original in format and language, but provides changes that are consistent with current concepts in radiologic and clinical care. The modifications center on: 1. updating and expanding the text, glossary, and references; 2. revision of the figures; 3. emphasizing the term anular fissure to replace annular tear; 4. refinement of the definitions of acute and chronic disc herniations; 5. revision of the differentiation between disc herniation and bulging disc. Several other minor amendments were also made, such as deleting the section on Reporting and Coding, which was outdated in the original and would become outdated in the current update as soon as it was published.

RC205-08 Assessment of Sensitivity and Radiologic Reporting of Oncologic Epidural Lesions on Body CT: A 12-year Retrospective Review

Monday, Nov. 30 10:50AM - 11:00AM Location: N228

Awards
Trainee Research Prize - Fellow

Participants
Lauren M. Kim, MD, Bethesda, MD (Presenter) Nothing to Disclose
Evrim B. Turkbey, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Ronald M. Summers, MD, PhD, Bethesda, MD (Abstract Co-Author) Royalties, iCAD, Inc; Research funded, iCAD, Inc;

PURPOSE

Metastatic epidural spinal cord compression is a debilitating neurological complication which occurs in approximately 5-10% of patients with terminal cancer. Early detection of epidural lesions commonly actuates treatment which can prevent and even reverse this process, thereby substantially improving a patient’s quality of life. Given the inherent difficulty of seeing epidural lesions on body CT due to their relatively small size and low contrast from surrounding tissues, we hypothesized that oncologic epidural lesions were being under-reported by radiologists interpreting body CT.

METHOD AND MATERIALS

A search of our institution’s radiology information system identified patients who underwent a body CT within 30 days before or after undergoing a spine MRI. A board-certified radiologist then reviewed these CT and MRI examinations and the respective patients’ medical records to determine etiology and location of the epidural mass, whether the epidural mass reported on MRI was plainly visible on CT, and whether an epidural mass plainly visible on body CT was reported by the interpreting radiologist.

RESULTS

From 09/01/2001 to 12/31/2013, there were 340 spine MRIs demonstrating at least one epidural mass of oncologic etiology with a body CT performed within 30 days. An epidural mass reported on MRI was plainly evident in 244 (71.7%) of the 340 body CTs. Of these 244 body CTs representing 129 unique patients, 61 CT reports (25.0%) did not mention the presence of an epidural mass, even in some cases wherein an MRI examination preceded and reported its presence (27 of 61 cases; 44.3%). There was no statistically significant correlation with respect to the omission of CT reporting and patient gender, age, primary diagnosis, epidural mass location, reporting radiologist, CT or MR scanner, or preceding MRI diagnosis of an epidural mass (univariate chi-squared analysis; p < 0.05).

CONCLUSION

In this retrospective analysis, body CT is 71.7% sensitive in detecting an epidural mass of oncologic etiology which is demonstrable on MRI. Additionally, oncologic epidural masses are commonly (25.0%) unreported on body CT, even in cases where there is preexisting imaging evidence to confirm their presence.
CLINICAL RELEVANCE/APPLICATION
Given the moderate sensitivity of body CT in demonstrating epidural masses, radiologists should incorporate the integrity of the spinal canal into their body CT search pattern for oncologic patients.

CONCLUSION
While the study is limited by small sample size, the trend in decreased referral to spine specialists by primary care physicians and fewer surgeries performed with the implementation of the statement motivates further investigation into the utility of enhancing imaging reports with epidemiologic information. This simple intervention may have meaningful impact on the management of these patients by referring primary care physicians.

CLINICAL RELEVANCE/APPLICATION
The addition of a simple, verified epidemiologic statement to lumbar MRI reports may impact the medical management of low-back pain in the primary care setting.

METHOD AND MATERIALS
A verified epidemiologic statement regarding prevalence rates of common findings in asymptomatic patients was included in all relevant lumbar MRI reports beginning July 01, 2013 at a single academic medical center. Patients referred for lumbar MRI by in-network primary care providers for uncomplicated low-back pain were followed prospectively for one year. Chart-review was utilized to capture health care utilization rates following MRI, including physical therapy referral, narcotic prescription, specialist referral, and spine surgery. A pre-implementation cohort was compared to a post-implementation cohort.

RESULTS
There were 323 patients who met inclusion criteria for the study, with 154 in the pre-statement cohort and 169 in the post-statement cohort. There was no significant difference in baseline demographic characteristics between the two cohorts. After one year of follow-up, there was a trend in decreased referral to spine specialists (53.6% v. 46.0%, p=0.234) and lumbar spine surgeries performed (10.9% v. 7.1%, p=0.290) when comparing the pre-statement cohort to the post-statement cohort. There were no apparent differences in referral for physical therapy or narcotic prescription rates in the study.

Purpose
A significant challenge to the appropriate diagnosis and management of low back pain is that lumbar MRI commonly reveals numerous findings that can be considered pathologic, even in asymptomatic individuals. Referring primary care providers may not understand the epidemiologic significance of the findings in the lumbar MRI reports they use to make patient-care decisions, potentially leading to unnecessary specialist referrals and overly aggressive treatment plans.

METHOD AND MATERIALS
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CONCLUSION
While the study is limited by small sample size, the trend in decreased referral to spine specialists by primary care physicians and fewer surgeries performed with the implementation of the statement motivates further investigation into the utility of enhancing imaging reports with epidemiologic information. This simple intervention may have meaningful impact on the management of these patients by referring primary care physicians.
Neurography image. Acute axonal nerve lesions cause a hyperintense signal on T2-weighted images at and distal to the lesion site.

Always distinguish different pathoetiologies of neuropathy and is more likely to be abnormal with an inflammatory or neoplastic etiology.

Peripheral nerves will often although not invariably show a fascicular appearance on axial images. Contrast enhancement cannot be used to distinguish between different pathologies of nerve compression. MRI findings may be related to nerve, muscle or compressive etiology (tumor, pathoanatomy or predisposing variant). Normal nerves have a low signal on all pulse sequences.

Normal subjects (0.72 ± 0.10 and 0.48 ± 0.16, P < 0.05 and P < 0.0001, respectively). CR of the ganglions and the nerves was larger in patients with CIDP (0.74 ± 0.11 and 0.66 ± 0.16) than in normal subjects (0.72 ± 0.10 and 0.48 ± 0.16, P < 0.05 and P < 0.0001, respectively).

RESULTS

With 3D SHINKEI we could obtain high-resolution MR neurography. CIDP could be discriminated from normal subjects on 3D SHINKEI.

CLINICAL RELEVANCE/APPLICATION

With 3D SHINKEI we can evaluate the size and signal intensity of the lumbar plexus and can discriminate patients with CIDP from normal subjects.

PURPOSE

Magnetic resonance neurography is useful to evaluate nerves in patients with inflammations, tumors, and trauma. The purpose of this study was to evaluate feasibility of 3D nerve-sheath signal increased with inked rest-tissue rapid acquisition of relaxation enhancement Imaging (3D SHINKEI) in the ganglions and the nerves of lumbar plexus in patients with chronic inflammatory demyelinating polyneuropathy (CIDP).

METHOD AND MATERIALS

This study included 12 patients with CIDP (9 males and 3 females; age range 14-66 year-old; median 34 year) and 13 normal subjects (10 males and 3 females; age range 27-81 year-old; median 53 year). 3D SHINKEI is a turbo spine echo with a diffusion-weighted prepulse called improved motion-sensitized driven equilibrium. The imaging parameters were as follows; TR/TE = 2500/90 ms, FOV = 280 x 280 mm, voxel size = 0.98 x 0.98 x 2.0 mm³, b = 10 s/mm², acquisition time = 5 min 48 s. Regions of interests (ROIs) were placed at the ganglions and nerves from T12 to L5 bilaterally. Signal-to-noise ratio (SNR) and contrast-radio (CR) were calculated. The size of the ganglions and the nerves was also measured. Statistical analyses were performed with Mann-Whitney U test. P-values less than 0.05 were considered significant.

CONCLUSION

With 3D SHINKEI we could obtain high-resolution MR neurography. CIDP could be discriminated from normal subjects on 3D SHINKEI.

ABSTRACT

Neuromuscular imaging with MR neurography can be challenging technically because of requirements for high spatial resolution sometimes over an extended field of view such as an entire extremity unless the lesion or symptoms are well localized. Thus the concept of a "target zone" is useful to tailor protocols for high resolution portions. The trend is to use 3T MRI because of increased signal to noise ratio (SNR). The use of surface coils combinations may be needed to cover the entire region of interest or to evaluate distal muscles innervated. The availability of 3D isotropic pulse sequences avoids multiple 2D planar acquisitions and facilitates arbitrary reconstruction planes along and orthogonal to the structures of interest. The administration of intravenous contrast material is typically selectively used for mass lesions, post-operative situations or inflammatory conditions although dynamic contrast enhance MRI (DCE-MRI) has the potential to evaluate the vasa nervosum. Novel MRI techniques including diffusion-weighted imaging (DWI) and diffusion tensor imaging (DTI) may have a role in MR Neurography. Whole body MRI (WBMRI) has also been applied for MR Neurography. The general indication for MR Neurography is a suspected peripheral nerve dysfunction and is complementary to electrodiagnostic testing (e.g. electromyography). Broad categories of indications include confirming a diagnosis (e.g. brachial neuritis), elucidating pathoanatomy (e.g. thoracic outlet syndrome), establishing the location of a lesion for (e.g. nerve avulsion for pre-surgical planning), to evaluate unexplained neuromuscular symptoms (e.g. extra-spinal sciatica with a normal lumbar spine MRI) or to exclude a neoplasm (e.g. neurofibroma). MR Neurography can also be an adjunct to spine imaging. MRI findings may be related to nerve, muscle or compressive etiology (tumor, pathoanatomy or predisposing variant). Normal peripheral nerves will often although not invariably show a fascicular appearance on axial images. Contrast enhancement cannot always distinguish different pathoetiologies of neuropathy and is more likely to be abnormal with an inflammatory or neoplastic etiology. Endoneurial fluid increases when nerve is compressed, irritated or injured, leading to nerve image hyperintensity in an MR Neurography image. Acute axonal nerve lesions cause a hyperintense signal on T2-weighted images at and distal to the lesion site.
corresponding to Wallerian degeneration. Denervation produces a non-specific muscle edema-like signal alteration. Muscle signal alteration occurs within a few days (as early as 72 hours) of denervation. Muscle atrophy is a late finding likely reflecting disuse. Fatty replacement (retained bulk and contour of muscle with fibers replaced by fat) is associated with neuromuscular etiologies (neurogenic or myogenic) or inflammatory myopathies. The MRI signal changes are reversible when the recovery of motor function occurs as a result of further muscle innervation. Tumor related neuropathy may be caused by a primary nerve neoplasm or a lesion compressing or infiltrating the nerve. Peripheral nerve sheath tumors (PNST) include neurilemmoma (schwanoma) and neurofibroma. The majority of PNST lesions are benign. Malignant PNST (MPNST) typically occurs in the setting of neurofibromatosis. It may be difficult for MRI to distinguish benign from malignant PNST and currently FDG PET has a role showing increased uptake in malignancies. Larger heterogeneous appearing lesions that have changed over time, either by clinical symptoms or imaging features suggests MPNST. Compressive lesions include non-neoplastic tumors (ganglions, hematoma), benign neoplasms (osteochondromas) or malignant neoplasm (sarcoma) that residing along the course of a nerve or within a fibro-osseous tunnel. Nerve infiltration and invasion may occur from lymphoma or metastatic neoplasm.

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John A. Carrino, MD, MPH - 2013 Honored Educator
John A. Carrino, MD, MPH - 2015 Honored Educator
Participants
Meir H. Scheinfeld, MD, PhD, Bronx, NY, (mscheinf@montefiore.org) (Moderator) Nothing to Disclose
Aaron D. Sodickson, MD, PhD, Wayland, MA, (asodickson@bwh.harvard.edu) (Moderator) Research Grant, Siemens AG; Consultant, Bracco Group
Ferco H. Berger, MD, Amsterdam, Netherlands (Moderator) Nothing to Disclose

Sub-Events
RC208-01 Optimizing Pulmonary Embolism CT

Participants
Aaron D. Sodickson, MD, PhD, Wayland, MA, (asodickson@bwh.harvard.edu) (Presenter) Research Grant, Siemens AG; Consultant, Bracco Group

LEARNING OBJECTIVES
1) Review the meaning of the X-ray tube output metrics CTDIvol and DLP. 2) Understand practical radiation dose reduction techniques including, among others, how tube current modulation works and is configured. 3) Demonstrate practical CT strategies to optimize CT parameters and IV contrast infusion to achieve excellent image quality at low radiation dose.

ABSTRACT
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Aaron D. Sodickson, MD, PhD - 2014 Honored Educator

RC208-02 Expiratory Phase CT Pulmonary Angiography: Improving Contrast Enhancement of the Pulmonary Arteries in Failed Diagnostic Studies

Participants
Joao R. Inacio, MD, Ottawa, ON (Presenter) Nothing to Disclose
Maha A. Al Dajani, MD, MBBS, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Katrina Newbiggin, MBBS, Brisbane, Australia (Abstract Co-Author) Nothing to Disclose
Carolina A. Souza, MD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Ashish Gupta, MD, Ottawa, ON (Abstract Co-Author) Grant, Medtronic, Inc
Elena Pena, MD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Matthew D. McInnes, MD, FRCPC, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON (Abstract Co-Author) Research Grant, Toshiba Corporation;
Carole J. Dennie, MD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose

PURPOSE
CT pulmonary angiography (CTPA) is performed in end-inspiration. Non-diagnostic studies resulting from inadequate pulmonary arterial contrast opacification may be secondary to poor thoracic inflow of contrast and are routinely repeated in end-inspiration. We aimed to prospectively assess the benefit of performing the repeat study in end-expiration to obtain diagnostic studies.

METHOD AND MATERIALS
From November 2013 to April 2014, a prospective protocol was implemented to identify consecutive non-diagnostic CTPA studies due to poor pulmonary arterial contrast opacification in a tertiary center. All studies identified as non-diagnostic at the CT console by the technologist, were followed by a repeat contrast injection and image acquisition was performed in end-expiration. Measurement of pulmonary arterial attenuation and lung volumes was compared in all failed inspiration and repeated end-expiration studies (t test). A retrospective cohort of repeated CTPA studies performed in end-inspiration was compared with the prospective cohort.

RESULTS
Of 1700 consecutive CT pulmonary angiograms performed, 13 patients had a non-diagnostic inspiration study (<200HU attenuation in the MPA) and had a repeat end-expiration study. Expiratory phase CTPA studies had higher contrast enhancement in the MPA (p<0.001). Expiratory studies were diagnostic (MPA >200HU) in 92% of patients (12 of 13).

CONCLUSION
End-expiration CTPA studies demonstrate significant improvement in pulmonary arterial enhancement compared to failed inspiration.
PURPOSE
CT pulmonary angiography (CTPA) is often triggered with bolus tracking (BT) techniques. We compared effects of bolus tracking and new fixed delay split bolus (FD-SB) contrast injection on vascular enhancement (pulmonary and aortic) and artifacts on dual energy CTPA.

METHOD AND MATERIALS
Of the 80 adult patients included in our study, 40 patients underwent CTPA using BT (4 cc/second, 370 mg%, 80-100 ml) (n= 20 patients with single energy CT(SECT): M:F 9:11, mean age 62± 11 years, mean weight 75±15 kg and n= 20 patients with dual energy CT(DECT) M:F 11:9, mean age 61± 15 years, mean weight 76±13 kg) and 40 weight matched patients were scanned with FD-SB (M:F 21:19, mean age 62±10 years, mean weight 73±16 kg). In FD-SB (80ml, 370 mg%), 44ml of contrast was injected at rate of 0.6ml/second followed by 36ml contrast at rate of 1.8ml/second with DECT scanning at 100 second fixed delay. DECT was performed on dual source MDCT or single source 64-row MDCT. All exams were assessed subjectively for vascular enhancement (lobar, segmental and subsegmental pulmonary arteries, aorta, and left atrial appendage) and artifacts. HU in MPA, and CTDI vol and DLP were recorded.

RESULTS
There was no significant difference between patient weights in BT and FD-SB groups (p=0.6). CTDI vol for BT SECT: 14±6 mGy; and BT DECT: 9±1.7mGy; and FD-SB DECT: 7±0.7mGy. For FD-SD DECT, mean HU in main pulmonary arteries was 353±132HU. Optimal to excellent qualitative contrast enhancement up to subsegmental levels was seen for both BT and FD-SB examinations in 97.5% of cases (39/40) and limited in one patient (2.5%, 1/40). FD-SB DECT resulted in significantly superior enhancement in left atrium and thoracic aorta in all patients compared to all BT (SECT and DECT) (p<0.05). Contrast streak artifacts were also substantially lower on FD-SB DECT than on BT exams. Pulmonary blood volume images were uniform and superior on FD-SB DECT than on BT DECT.

CONCLUSION
Fixed delay split bolus contrast injection with DECT results in better contrast enhancement in pulmonary arteries, heart, and aorta with less contrast related artifacts as compared to bolus tracking technique for single energy- or DE-CT pulmonary angiography.

CLINICAL RELEVANCE/APPLICATION
Fixed delay split bolus DECT of the chest has the potential to replace bolus tracking CTPA for the evaluation of chest vasculature.

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Subba R. Digumarthy, MD - 2013 Honored Educator
PURPOSE
To compare single-energy (SE) and dual-energy (DE) CT pulmonary angiogram (CTPA) protocols in pregnant and postpartum women.

RESULTS
A third (32%) of pregnant/postpartum women had limited or unacceptable SE-CTPA studies compared to just 14% limited or unacceptable DE-CTPA studies (identical to non-pregnant group undergoing DE-CTPA). Limited or unacceptable DE-CTPA occurred only in heavier patients (>190 kg) from excess noise due to application of incorrect scan parameters in these patients (80/140 kV instead of correct higher dose setting of 100/140 kV). Suboptimal SE-CTPA was noted in patients of all sizes (61-139 kg). Mean HU values of the pulmonary trunk were 588±373 HU in the DE-CTPA pregnant/postpartum group, 245±72 HU in the SE-CTPA pregnant/postpartum group (p<0.05). DE-CTPA in the pregnant/postpartum group was optimal for evaluation of subsegmental pulmonary arteries in 64% of patients relative to only 37% patients in the SE-CTPA group. Frequency of contrast streak artifacts on DE- and SE-CTPA was similar (p>0.05). The CTDIvol for DE-CTPA and SE-CTPA were 9 and 19 mGy, respectively (<0.05).

CONCLUSION
DE CTPA provides better contrast enhancement and fewer suboptimal studies compared to SE CTPA for evaluation of pulmonary embolism in pregnant or postpartum women.

CLINICAL RELEVANCE/APPLICATION
Pulmonary embolism is an important cause of morbidity and mortality in pregnant and postpartum women. DE CTPA produces better quality images when compared to SE CTPA with equal or reduced radiation in this group. Therefore, it is logical to utilize this modality whenever available.

Subba R. Digumarthi, MD - 2013 Honored Educator

Improved Signal and Image Quality at the Cervicothoracic Junction Using Dual-Energy CT and Monoenergetic Plus Reconstruction

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 examine whether dual-energy CT (DECT) with advanced monoenergetic (Mono+) reconstruction can reduce these artifacts and improve image quality through the cervicothoracic junction.

METHOD AND MATERIALS
In this retrospective study, 19 consecutive patients underwent DECT scanning of the cervical spine using a dual source 128-slice CT scanner (Definition FLASH, Siemens Healthcare, Germany) between February 1 and March 31, 2015. The DECT data was reconstructed using the Mono+ algorithm at five different energy levels (ranging 100 to 190 keV). Attenuation was measured at each energy level by placing regions of interest within the vertebral bodies and spinal cord. Statistical analysis of the objective data was carried out by student's t-test. Subjective analysis of image quality was conducted on a semi-objective 4 point scoring scheme by 4 radiologists. These results were subjected to a Wilcoxon Signed-Rank Test for statistical analysis.

RESULTS
Attenuation of the spinal cord at the level of C7 to T1 was significantly reduced as compared to C2 due to beam hardening. In the...
Attenuation of the spinal cord at the level of C7 to T1 was significantly reduced as compared to C2 due to beam hardening. In the 100 keV reconstruction, there was a 69.9% decrease (-27.7HU, \( p<0.0001 \)) in attenuation at C7 and 60.2% (-23.9HU, \( p<0.0001 \)) at T1 compared to C2. However, cord attenuation substantially improved with increased energy. The maximal improvement was seen with Mono+ images reconstructed at 190 keV, where cord attenuation at C7 resulted in an increase of 61.0% (7.28HU, \( p=0.0391 \)) over 100keV. Subjective analysis also revealed improved image quality at the cervicothoracic junction. Compared to the mixed energy scans, at 190keV, there was a significant improvement in the quality of spinal cord visualization at C7 (median =3.0, \( p<0.0001 \)) and at T1 (median=3.00, \( p<0.0001 \)). Beam hardening artifacts were also reduced by 44.8% (\( p<0.0001 \)) at the C7-T1 junction.

CONCLUSION

Data derived from DECT and reconstructed using the Mono+ algorithm significantly reduces beam hardening artifacts at the cervicothoracic junction and significantly improves image quality.

CLINICAL RELEVANCE/APPLICATION

CT imaging at the cervicothoracic junction suffers from extensive artifact and noise. Due to its superior image quality, Mono+ can provide a significant benefit by improving assessment of this region.

RC208-07  Question and Answer

Monday, Nov. 30 10:00AM - 10:15AM Location: S102AB

Participants

RC208-08  Optimizing Abdominal CT Protocols and Utilization

Monday, Nov. 30 10:15AM - 10:40AM Location: S102AB

Participants

Aaron D. Sodickson, MD, PhD, Wayland, MA (Presenter) Research Grant, Siemens AG; Consultant, Bracco Group

LEARNING OBJECTIVES

1) To overview the current status of emergency abdominal and pelvic CT imaging protocols. 2) To review the current literature of abdominal and pelvic emergency CT imaging protocols, with an emphasis on optimizing diagnostic information while minimizing radiation dose reduction. 3) To review areas of continuing controversy regarding emergency abdominal CT protocols.

RC208-09  Noncalcified Gallstones: Making the Invisible Visible with Dual Energy CT

Monday, Nov. 30 10:40AM - 10:50AM Location: S102AB

Participants

Jennifer W. Uyeda, MD, Boston, MA (Presenter) Nothing to Disclose
Aaron D. Sodickson, MD, PhD, Wayland, MA (Abstract Co-Author) Research Grant, Siemens AG; Consultant, Bracco Group

PURPOSE

To assess whether virtual monochromatic imaging (VMI) increases the detection of noncalcified gallstones on dual-energy CT (DECT) compared with conventional polychromatic scanning.

METHOD AND MATERIALS

25 patients (20F, 5M) with noncalcified gallstones confirmed on abdominal ultrasound and/or MR were included in this IRB approved, HIPAA compliant study. All patients had a DECT on a dual-source 128x2 slice scanner (Siemens FLASH) with either 80/Sn140 or 100/Sn140 kVp pairs depending on patient size. 0.75x0.5 mm source images at high and low kVp were used for DE postprocessing (Syngo via, version VA30) using the Monoenergetic Plus application. Within 3 mm reconstructed slices, regions of interest of 0.5 cm² were placed on noncalcified gallstones and bile to record Hounsfield Units (HU) at VMI energy levels ranging from 40-190 keV.

RESULTS

Noncalcified gallstones uniformly demonstrate HU that are lowest at 40 keV and increase at higher keV. Few of the noncalcified stones are visible at 70 keV (simulating a conventional 120 kVp scan), with measured contrast (bile-stone HU) <10 HU in 76%, 10-20 in 20%, and >20 in 4%. Contrast is maximal at 40 keV, where 100% demonstrate >20 HU difference, 75% > 38 HU difference, and 50% > 55 HU difference. A paired t-test demonstrates a significant difference (\( p<0.0001 \)) between this stone:bile contrast at 40 keV vs 70 keV.

CONCLUSION

Low VMI energy of 40 keV increases conspicuity of noncalcified gallstones compared to conventional 120 kVp polychromatic scanning, potentially improving detection.

CLINICAL RELEVANCE/APPLICATION

DECT optimizes visualization of noncalcified gallstones, many of which are invisible on conventional 120kVp scans. This may reduce the need for further imaging for suspected cholelithiasis.

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

RC208-10  Comparison of Abdominal Radiograph and Non-contrast Ultralow Dose CT for Kidney Stones
RC208-11 Optimizing Emergency Musculoskeletal MRI

PURPOSE
At our institution, Kidney-Ureter-Bladder (KUB) radiographs are routinely performed immediately prior to shockwave lithotripsy (SWL). Conventional low dose CT-KUBs (2.2-3.0 mSv) are only performed if stones are not visible on KUB (10-15% of cases). Recent advances in integrated circuit CT detector design (STELLAR, Siemens Healthcare) and image reconstruction algorithms have made sub-millisievert ultra-low dose CT (ULDCT) acquisition feasible, but the diagnostic performance of these ULDCTs in comparison with KUB has not yet been reported. In this prospective study we compare the radiation dose and diagnostic performance of ULDCT to KUB in patients prior to SWL. We hypothesized that ULDCT will detect more symptomatic calculi than KUB at less radiation exposure prior to SWL.

METHOD AND MATERIALS
Patients enrolled in this study consented and received both a KUB radiograph and an ULDCT (32x0.6mm,100kV, refmAs=10,pitch 1.5) prior to SWL. If no stones were identified, then a standard low dose abdominal CT was obtained. Radiation exposure parameters were recorded and both examinations were read in random order by 2 blinded radiologists to determine image quality and diagnostic accuracy.

RESULTS
102 patients (M:F, 72:32) with a mean age of 55.7 ± 13.8y were enrolled. The effective radiation dose was 48% lower with ULDCT (0.28±0.08 mSv) compared to KUB (0.54±0.11 mSv, p<0.001). Mean CTDIvol and DLP of ULDCT were 0.47±0.26mGy and 20±12mGy.cm respectively. The number of stones seen on both modalities was equivalent: KUB was 1.59±1.27 vs 1.92±1.51 for ULDCT (p=0.35). However in 12 cases (12%), the ULDCT helped localize ureteral stones that were not detected on KUB. Measurement of stone size was equivalent using ULDCT (6.47±3.34mm) compared to KUB (6.98±3.41mm, p=0.455). ULDCT reduced the requirement for repeat conventional dose CTKUB and altered treatment priority of treating the ureteral stones first.

CONCLUSION
ULDCT delivers 48% less radiation than a KUB radiograph and was equivalent in detecting the number and size of stones. In 12% of cases, ULDCT identified and localized ureteric stones prior to SWL that were not seen on KUB.

CLINICAL RELEVANCE/APPLICATION
This prospective single centre study demonstrates that ULDCT is suitable to replace KUB as it delivers 48% less radiation, more frequently detects ureteric calculi and reduces the requirement for repeat conventional dose CTKUB prior to SWL.

RC208-12 Utility of a Virtual Non-contrast Dual Energy CT Algorithm for Detection of Bone Marrow Edema in Non-displaced Hip Fractures

PURPOSE
Hip fractures are associated with high disability, health care costs and mortality. The purpose of this study is to describe our experience with a dual energy CT (DECT) virtual non contrast (VNC) algorithm for detection of bone marrow (BM) edema in patients presenting to the emergency department with suspected non-displaced traumatic hip fractures.

METHOD AND MATERIALS
77 patients were identified that presented to a level one trauma center emergency department between Jan 1, 2014 and June 30,
2014, and received CT imaging due to clinical suspicion of a traumatic hip fracture. 66 underwent DECT of the hip or pelvis. Those with hip prosthesis (N=7) were excluded. Those with displaced hip fractures (N=9) were also excluded as they are not a diagnostic challenge on CT. VNC images were generated using prototype software. These were read in isolation, and then compared to standard bone reconstructions, by a staff radiologist. Both VNC and standard bone reconstruction images were graded for interpretation confidence (1-10 scale). Radiological and/or clinical diagnosis of fracture at 30-day follow up was used as the reference standard.

**RESULTS**

Of the 50 included patients, 8 were positive for VNC BM edema. All of these were true positives (Sn = 100%). Mean interpreter confidence of VNC images was 8.4 (range 4-10). On standard bone reconstructions, 7 of these true positives were recognized as fractures (Sn = 88%), with a mean interpreter confidence of 9.6 (range 6-10). 42 studies were negative for VNC BM edema, and all were true negatives (Sp = 100%). These were also all described as negative on the CT bone reconstructions (Sp=100%). Mean interpreter confidence was 8.3 (range 3-10) for VNC images, and 9.7 (range 6-10) for standard bone reconstructions.

**CONCLUSION**

Our study demonstrates that DECT VNC algorithm is an effective tool to supplement standard bone reconstructions in non-displaced traumatic hip fractures. Fractures that were subtle (or in one case not visible) on bone reconstructions all demonstrated BM edema, most with a high level of interpreter confidence. While our study is limited by a small sample size, current results suggest that DECT VNC algorithm is both highly sensitive and specific for identifying BM edema in non-displaced hip fractures.

**CLINICAL RELEVANCE/APPLICATION**

DECT VNC algorithm is an effective tool to supplement the interpretation of standard CT bone reconstructions in non-displaced traumatic hip fractures.

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**PURPOSE**

Carpal bone fracture identification is often a challenging diagnosis, commonly underestimated on radiographs. CT helps to identify subtle fractures that may be radiographically occult. With the implementation of Dual Energy CT (DECT), the virtual non-calcium subtraction (VNC) technique can be applied to remove calcium to evaluate for bone marrow edema in fractures. In this study, we evaluate the utility of DECT VNC for assessment of bone marrow edema in patients with acute and chronic carpal bone fractures.

**METHOD AND MATERIALS**

The images of forty-seven patients between September 3, 2014 and March 9, 2015 with the suspicion of carpal bone fractures who underwent a DECT scan of their hand and wrist were reviewed by two readers using the VNC algorithm to determine the visual presence and absence of bone marrow edema in each carpal bone. The mean and standard deviation of the CT values within each carpal bone were recorded. Chi squared test and receiver operating characteristic (ROC) curve were used for statistical analysis, and p<0.05 was considered significant.

**RESULTS**

In the 47 patients, 376 carpal bones were reviewed. 24 patients had acute (DECT-A), and 23 patients had chronic (DECT-C) carpal bone fractures. Visual analysis demonstrated that significantly more patients in DECT-A group had bone marrow edema (BME) (20/24, 83.3%) than the DECT-C group (3/23, 13.0%, p<0.0001). The average CT values of the BME on the VNC images in the DECT-A and DECT-C groups were 61.6±26.3HU and 39.6±26.3HU respectively, whereas, in the non-BME carpal bones in the DECT-A and DECT-C groups, they measured -34.3±27.5HU and -24.9±13.0HU respectively. CT numbers for diagnosis of BME associated with acute carpal fractures revealed the area under the ROC curve of 0.993. An ideal cut-off value of 15.4HU for detection of BME associated with acute carpal fractures results in 100% sensitivity, 98.3% specificity, and 99.3% accuracy.

**CONCLUSION**

VNC DECT allows accurate visual assessment of bone marrow edema in acute carpal bone fractures. Using a cut-off of 15.4 HU provides a valid and reliable tool for detection of BME related to acute carpal bone fractures.

**CLINICAL RELEVANCE/APPLICATION**

Visual assessment of bone marrow edema and a quantitative cut-off of 15.4HU on VNC DECT images is useful for accurate and reliable identification of acute carpal bone fractures.
LEARNING OBJECTIVES

1) To understand the principles of CT perfusion analysis for tumor assessment. 2) To understand the pathophysiological basis of CT perfusion parameters for tumors. 3) To understand unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 4) To describe the potential clinical applications, with a focus on hepatic and extrahepatic applications and clinical trials. 5) To discuss several recent challenging issues regarding CT perfusion. 6) To discuss areas for further development including assessment of tumor heterogeneity.

ABSTRACT

With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumour blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to performing studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. These presentations will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on hepatic and extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.

Sub-Events

RC217A  CT Perfusion in Oncology: Hepatic Imaging

Participants
Se Hyung Kim, Seoul, Korea, Republic Of (Presenter) Research Grant, Mallinckrodt plc; Research Grant, Samsung Electronics Co Ltd

LEARNING OBJECTIVES

1) To understand basic principles, acquisition protocol, and pharmacokinetic models of CT perfusion. 2) To learn unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 3) To describe the potential clinical applications, with a focus on hepatic applications. 4) To discuss several recent challenging issues regarding CT perfusion.

ABSTRACT

With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumour blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to performing studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. This presentation will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.

RC217B  CT Perfusion in Oncology: Extrahepatic Imaging

Participants
Vicky J. Goh, MBBCh, London, United Kingdom (Presenter) Research Grant, Siemens AG; Speaker, Siemens AG

LEARNING OBJECTIVES

1) To understand the principles of CT perfusion analysis for tumor assessment. 2) To understand the pathophysiological basis of CT perfusion parameters for tumors. 3) To describe the potential clinical applications, with a focus on extrahepatic applications and clinical trials. 4) To discuss areas for further development including assessment of tumor heterogeneity.

ABSTRACT

With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumour blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to performing studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. This presentation will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.
Participants
Max Wintermark, MD, Lausanne, Switzerland, (max.wintermark@gmail.com) (Presenter) Advisory Board, General Electric Company;

LEARNING OBJECTIVES
1) Understand the difference between quantitative and qualitative perfusion measurements. 2) Distinguish several approaches for obtaining quantitative perfusion maps in the brain. 3) Appreciate the strengths and weaknesses between the two major techniques, arterial spin labeling and bolus contrast dynamic susceptibility imaging.
Physics Series: Quantitative Imaging Mini-Course: Image Modality Specific Issues

Monday, Nov. 30 8:30AM - 12:00PM Location: S403B

- BQ - CT - MR - NM - PH

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants
Michael F. McNitt-Gray, PhD, Los Angeles, CA (Director) Institutional research agreement, Siemens AG; Research support, Siemens AG;
Edward F. Jackson, PhD, Madison, WI, (efjackson@wisc.edu) (Moderator) Nothing to Disclose
Paul L. Carson, PhD, Ann Arbor, MI (Moderator) Research collaboration, General Electric Company; Research collaboration, Light Age, Inc

Sub-Events

RC225-01 Quantitative Imaging for Computed Tomography: Applications and Future Directions
Monday, Nov. 30 8:30AM - 9:00AM Location: S403B

Participants
Samuel G. Armato III, PhD, Chicago, IL, (s-armato@uchicago.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the role of computed-tomography-based quantitative imaging in the clinical and research settings.

ABSTRACT

RC225-02 Quantification of Vascular Response in Rodent Brown Adipose Tissue Using Spectral CT
Monday, Nov. 30 9:00AM - 9:10AM Location: S403B

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 abundant mitochondrion, uncoupling protein 1 and vascularization to provide sufficient energy compared to white adipose tissue (WAT). Our study is to assess the changes of iodine/water base material concentration in BAT after injecting norepinephrine (NE).

METHOD AND MATERIALS

The animal study was approved by the institutional Committee on Animal Research. Spectral CT scan (GE, Discovery CT750) was performed to measure the iodine/water concentration based on base material mapping in the BAT (interscapular) and WAT (visceral) of Wistar rat (n=6, 14 weeks, 304g±12g) at baseline condition. To induce the blood flow increase, animals were given NE (1μg/kg/min, 10min, total 1ml) or saline (1ml) from caudal vein. The enhanced CT imaging (6ml/kg, iopromide 300) was performed after the injection of the drug. The iodine/water concentration of BAT and WAT, the BAT/Aorta and WAT/Aorta ratio were calculated. Statistical analysis was performed with independent sample t test and paired sample t test.

RESULTS

There was no difference in mean base iodine (water) material concentration of BAT and WAT at the baseline condition between the NE and saline groups (P>0.05). After injecting NE, the base iodine material concentration of BAT increased significantly compared to controls (NE: -5.41±1.20mg/cm3 and 23.57±8.71mg/cm3; saline: -7.66±2.01mg/cm3 and 8.71±3.68mg/cm3, respectively; P<0.001) (Fig.A). However, there were no statistically significant changes observed in iodine and water material concentration of WAT between both groups. The BAT/Aorta ratio, WAT/Aorta ratio of iodine concentration and BAT/Aorta ratio of water concentration after injection NE increased significantly (iodine: BAT/Aorta ratio, 0.26±0.96 and 0.10±0.04, WAT/Aorta ratio, -0.12±0.04 and -0.16±0.03; water: BAT/Aorta ratio:1.06±0.02 and 0.93±0.04, respectively; P<0.001) (Fig.B). There was no difference of WAT/Aorta ratio in water concentration imaging between both groups (P>0.05) (Fig.C).

CONCLUSION

The iodine/water base material concentration detected the pharmacologic activation of BAT. Energy spectrum CT has potential to evaluate the change of BAT and WAT after treatment.

CLINICAL RELEVANCE/APPLICATION

Spectral CT provided a new noninvasive method to be translated to a clinical setting for evaluation the difference of adipose tissue and monitoring the responses to specific therapeutic strategies.

RC225-03 Determinants of the Accuracy of the Quantification of Glandularity and Iodine Uptake in Contrast-Enhanced Digital Mammography
Monday, Nov. 30 9:10AM - 9:20AM Location: S403B
PURPOSE
To develop a method for determining breast tissue composition in dual-energy (DE) contrast-enhanced digital mammography (CE-DM). The motivation for this arises from our difficulty to resolve contrast uptake at the boundaries of the breast in DE subtraction.

METHOD AND MATERIALS
Phantoms were constructed using 1 cm thick uniform blocks of 100% glandular-equivalent and 100% adipose-equivalent materials (CIRS, Norfolk, VA). The thickness of the phantoms ranged from 3 to 8 cm, in 1 cm increments. For a given thickness, the glandular/adipose composition of the phantom was varied using different combinations of blocks. The phantoms were imaged using a prototype DE Hologic Selenia Dimensions DBT system. A 0.3 mm copper filter is used for the high-energy (HE) x-rays (49 kVp) and a 0.7 mm aluminum filter is used for the low-energy (LE) x-rays (32 kVp). X-ray energies were chosen so the k-edge of the contrast agent was in the range spanned by the LE and HE x-ray spectra. DE images were obtained by a weighted logarithmic subtraction of the HE and LE image pairs. The images were smoothed using a 2D convolution with a 4x4 matrix prior to quantitative analysis. LE and HE signal intensities were normalized by the mAs, and mean and standard deviation values were calculated for the normalized log HE and log LE images.

RESULTS
The mean LE and HE values varied with phantom thickness and glandularity. The log LE and log HE signals decrease linearly with increasing glandularity for a given thickness. The signals decrease with increasing phantom thickness; for a given glandularity, the x-ray signal decreases linearly with thickness. As the thickness increases, the attenuation difference per additional glandular block decreases, indicating beam hardening. Using these data, we have created a mapping between signal intensity and breast thickness. These data facilitate the subtraction of tissue in the periphery of the breast, and aid in discriminating between contrast agent uptake in glandular tissue and subtraction artifacts.

CONCLUSION
We have shown that breast thickness and composition can be predicted based on signal intensities in DE CE-DM. This has implications for the weighting factor used in DE subtraction.

CLINICAL RELEVANCE/APPLICATION
DE CE-DM can be improved by taking into account breast thickness and composition. Combining these techniques into a single procedure is a powerful tool for the detection and diagnosis of breast cancer.

RC225-04  Mapping of Medullar Adiposity of the Lumbar Spine in MRI

PURPOSE
The bone medullar adiposity is a marker of bone quality to the point that it should be better to know the factors which influence or not the density and distribution of this fat in the spine, especially at the lumbar level.

METHOD AND MATERIALS
A sagittal sequence IDEAL IQ (MRI GE 1.5T) was performed on the lumbar spine of 46 subjects without bone disease (21 women and 25 men, aged 18 to 77 years old). Medulla adiposity was determined directly from the measurement of the fat fraction of each vertebral body (T12 to S1) obtained on the fat cartography automatically generated by the IDEAL sequence.

RESULTS
Average vertebral fat fraction was 36.48% (DS 12.82 ; 14.69% - 72.8%), increasing with age, and it is higher among men. We observed a craniocaudal gradient of the fat fraction (Β = 1,37 ; p < 0,001 ; DS 0,06) increasing with age in the lumbar spine from T12 to L5. Through a multivariate analysis, this gradient was independent of sex, weight and height of subjects.

CONCLUSION
This study shows the existence of a physiological craniocaudal gradient of vertebral medullar adiposity from T12 to L5. This gradient increases with age but it is independent of sex or BMI. The IDEAL sequence allows quick and reproducible measurement of the spine vertebral medullar adiposity.

CLINICAL RELEVANCE/APPLICATION
IDEAL IQ is a Rapid sequence, Allowing easy and reproducible measurements with ROIs. The need is to recruit a wider population to establish standards fat percentage by age strata and compare them with bone mineral density obtained by densitometry. For example, in an attempt to establish thresholds for a subject to be considered as osteopenic or osteoporotic. The IDEAL IQ sequence allows a fast and reproducible measure of the bone marrow fat of the spine, that could easily completing a lumbar MRI assessment.
Spectral Detector Dual-Layer CT: A Phantom Study

Monday, Nov. 30 9:30AM - 9:40AM Location: S403B

Participants
Isaac Leichter, PhD, Jerusalem, Israel (Presenter) Nothing to Disclose
Tzvi Lipschuetz, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
Tzvi Vichter, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
Zimam Romman, Halfa, Israel (Abstract Co-Author) Employee, Koninklijke Philips NV
Jacob Sosna, MD, Jerusalem, Israel (Abstract Co-Author) Consultant, ActiViews Ltd Research Grant, Koninklijke Philips NV

PURPOSE
To use Monoenergetic Virtual images generated by Spectral Detector Dual-Layer CT (SDCT) for automatic reliable identification and concentration calculation of calcium and iodine solutions.

METHOD AND MATERIALS
Tubes of 11.1 mm diameter filled with iodine and calcium solutions at concentrations of 10 to 60 mg/ml and 100 to 1000 mg/ml, respectively, were inserted in a water-equivalent anthropomorphic CT phantom (QRM, Moehrendorf, Germany). The phantom, of two sizes (25x35 cm and 30x40 cm), was scanned with a SDCT (Philips Healthcare, Cleveland, OH, USA) at 120kVp and 200 mAs. Software was developed to calculate the relationship between gray-level values of pixels containing iodine and calcium solutions in the monoenergetic virtual images generated by SDCT. The relationship obtained for the image of the small phantom was used to create spectral maps that uniquely characterize the material in the pixel, independently of its concentration. For any given image, the software searched and identified pixels which fitted into the spectral map equations of calcium and iodine and displayed them in different colors. In order to evaluate the effect of beam hardening, iodine and calcium was searched in images of both phantom sizes. The concentration of each solution identified by the software was evaluated.

RESULTS
In the small phantom (98.9±1.6)% of the pixels containing iodine or calcium were correctly identified and displayed in different colors. In the large phantom the identification accuracy was (92.7±10.4)%. The calculated solution concentrations in the small phantom were higher by (4.6±2.6)% from the actual concentrations, and lower by (5.7±4.6)% in the large phantom.

CONCLUSION
SDCT can differentiate between calcium and iodine solutions in a phantom model and calculate their concentrations with good accuracy on a pixel by pixel analysis. Beam hardening effects had only a small impact on the results which depended very slightly on the phantom size or the solution location within the phantom.

CLINICAL RELEVANCE/APPLICATION
By the use of Spectral Detector CT, contrast agents in blood and tumors may be reliably differentiated from adjacent skeletal components, and their concentration can be accurately assessed.

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/

Jacob Sosna, MD - 2012 Honored Educator

LEARNING OBJECTIVES
1) Describe the role of PET/CT-based quantitative imaging in the clinical and research settings.

Quantitative Imaging for PET-CT: Applications and Future Directions

RC225-06

Quantitative Imaging for DCE-MRI: Applications and Future Directions

RC225-07

Measuring Blood Velocity with Doppler-CT (part 1): Theoretical Aspects and Simulations

RC225-08
PURPOSE

Measuring blood velocity with computed tomography (CT) has been subject of numerous studies, most of which used the time-of-flight technique. With that method, data acquisition should be performed with a stationary table (sequence mode) and the clinical applicability and measurement accuracy are limited by the detector size. The purpose of this study is to introduce Doppler-CT as a new method of measuring blood velocity by describing the theory, simulating its expected behavior and deriving clinical acquisition strategies.

METHOD AND MATERIALS

In general, the speed \( v \) [m/s] of a wave with wavelength \( \lambda \) [m] and frequency \( f \) [1/s] is given by \( v = f \lambda \). When considering a straight vessel segment and assuming a linear increase in contrast enhancement after injecting an iodinated contrast agent, the blood velocity can be analogously calculated from the spatial [mHU] and temporal [HU/s] contrast gradients within the vessel. In case the observer \( O \) (the scan plane of the CT scanner) and the source \( S \) (the human heart) are moving with respect to each other, i.e. during a spiral acquisition, the well-known Doppler-equations can be applied, e.g. \( fo = fS(1 \pm v/c) \) [eq. 1], with \( fo \) being the measured temporal gradient [HU/s] of the spiral scan, \( fS \) the temporal gradient [HU/s] produced by the heart, \( \pm v \) the table speed and \( c \) the blood velocity.

RESULTS

With a known direction of table movement, the direction of the blood flow can be qualitatively determined, since the relative gradient of \( fo \) is centrally symmetric. With increasing table speed and decreasing blood speed, the deviation of \( fo \) from \( fS \) increases, indicating better quantitative measurement accuracy. For equal image noise, low tube voltages and high iodine delivery rates will further improve the measurement sensitivity.

CONCLUSION

High table speed and low blood velocity are favorable for quantifying blood velocity with Doppler-CT. Implementation in clinical routine can be simple, e.g. with two (or more) sweeps of a dynamic scan mode with alternating scan direction (part 2) or with a bolus tracking scan followed by a CT angiography (part 3).

CLINICAL RELEVANCE/APPLICATION

Measuring blood velocity is no longer reserved for wide-detector CT-systems in sequence mode, but can also be performed with CT-systems with smaller detectors in spiral scan mode.

RC225-09  Quantification of Hepatic Tumor Viability in Multi-phase MDCT Images

Monday, Nov. 30 11:05AM - 11:15AM Location: S403B

Participants

Wenli Cai, PhD, Boston, MA (Presenter) Nothing to Disclose
Anand K. Singh, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Yin Wu, Boston, MA (Abstract Co-Author) Nothing to Disclose
Gordon J. Harris, PhD, Boston, MA (Abstract Co-Author) Medical Advisory Board, Fovia, Inc

PURPOSE

The purpose of this study was to develop a quantitative imaging biomarker, denoted as hepatic tumor viability (HTV), for quantification of viable and necrotic tumor volumes in addition to the size of liver and tumors in the assessment of tumor progression and treatment responses for patients with hepatocellular carcinoma (HCC) and metastasis.

METHOD AND MATERIALS

Based on the pattern analysis of time-intensity curve (TIC) in multi-phase MDCT images, we developed the automated HTV scheme for segmentation of liver and liver tumors, and classification of viable and necrotic tumor regions. To depict a TIC pattern, a group of TIC features was extracted including the peak CT value, the time to peak (TTP), the area under the curve (AUC), the AUC of wash-in/out, the max/average wash-in/out derivative, and a group of spatiotemporal textures: skewness, kurtosis, energy, and entropy. A K-mean cluster was applied to classify each voxels into four different types of materials: vessel, normal liver tissue, tumor tissue, and necrotic tissue. Liver, liver tumor and viable regions were segmented using the likelihood to each material. Forty (40) IV-contrast enhanced hepatic multi-phase MDCT cases with biopsy-confirmed HCC or metastases were used for evaluation of the proposed HTV biomarker. The MDCT imaging parameters settings were: 2.5-5 mm collimation, 1.25-2.5 mm reconstruction interval, 175 mA tube current, and 120 kVp tube voltage.

RESULTS

In reference to the liver and tumor segmentation by manual-contouring of two radiologists, the volumetric size of these 40 HCC or metastasis livers ranged from 1079.2 CC to 4652.3 CC, in which the tumor volume percentages ranged from 1.77% to 53.54%. The proposed HTV scheme achieved a liver volumetric difference of 3.27±2.58% and tumor percentage difference of 1.33±1.44%. Viable tumor volume showed significant better performance than RECIST and total tumor volume in prediction of treatment response in the case of overall and progression-free survival.

CONCLUSION

Our HTV biomarker can achieve accurate and reliable quantification results in segmentation of liver and liver tumors, classification of viable and necrotic tumor regions, and thus provides a better prediction of treatment response.

CLINICAL RELEVANCE/APPLICATION

Our HTV biomarker can provide an accurate and reliable tumor quantification for assessment of tumor progression and treatment response for HCC and liver metastasis.
**PURPOSE**

We are developing a fully automated scheme for quantitative analysis of myocardial perfusion in short-axis first-pass MR images.

**METHOD AND MATERIALS**

We obtained 8 short-axis myocardial perfusion MR scans from [xxx Hospital in xxx with an xxx 1.5-T MR scanner. Each MR scan has 40 time frames with slice thickness 8 mm and in-plane resolution 1.37 × 1.37 mm. Our automated method consists of three steps, i.e., cardiac registration, myocardium segmentation, and empirical indexes quantification. Based on the region of interest (ROI) automatically identified from the image at the reference time phase with better contrast of left ventricle and myocardium, a multiscale affine transformation using Sobel gradient information and a non-rigid Demons registration using pseudo ground truth images were sequentially applied to correct the deformations caused by respiratory and cardiac motion. We then further used fuzzy c-means clustering method in the reference image and dynamic programming method in the maximum intensity projection image of all time phases to delineate, respectively, the endo- and epicardial boundaries of the myocardium. Finally, several empirical perfusion indexes (peak signal intensity, time to peak, and maximum upslope) were quantified from the time-intensity curves of segments of myocardium.

**RESULTS**

Dice index based on apical, midventricular, and basal slices was improved from 78.4% ± 12.5% to 85.9% ± 5.3% using cardiac registration, and Dice index of 82.2% ± 5.9% was achieved for myocardium segmentation. Subjective judgment showed that the empirical indexes were able to identify the ischemia in myocardium.

**CONCLUSION**

Our fully automated scheme for quantitative analysis of myocardial perfusion MR images would be useful for myocardium perfusion assessment and early diagnosis of myocardium with ischemia.

**CLINICAL RELEVANCE/APPLICATION**

Our CAD scheme could help the radiologists to quantitatively analyze myocardium perfusion and to improve the accuracy and efficiency for diagnosis of myocardium with ischemia.

**Active Handout:** Luan Jiang


**RC225-11** Laws Textures: A Potential MRI Surrogate Marker of Hepatic Fibrosis in a Murine Model

**PURPOSE**

To study the effect of disease progression on liver parenchymal Laws textures of ex vivo murine liver specimens imaged using 11.7 Tesla MRI. To compare Laws textures to other imaging-based surrogate markers (T2, PD, ADC, and degrees of inflammation).

**METHOD AND MATERIALS**

This animal study was IACUC approved. Seventeen male, C57BL/6 mice were divided into control (n=2) and experimental groups (n=15). The latter were fed a 3,5-dicarbethoxy-1, 4-dihydrocollidine (DDC) supplemented diet to induce hepatic fibrosis. Ex vivo liver specimens were imaged using an 11.7T MRI scanner, from which the parametric proton density (PD), T2, and ADC maps were generated from spin-echo pulsed field gradient and multi-echo spin-echo acquisitions. The PD maps were first preprocessed to eliminate the low-intensity histogram bias arisen from partial volume effect. The PD maps were further corrected by mean and standard deviation in order to minimize discrimination by overall graylevel variation, which is unrelated to liver parenchymal texture. Laws textures were extracted from the PD maps. Degrees of fibrosis and inflammation were assessed by an experienced pathologist (subjective scores) and digital image analysis (DIA, %Area Fibrosis). Scatterplot graphs comparing Laws texture, T2, PD, ADC, inflammation score to degrees of fibrosis were generated and correlation coefficients were calculated.

**RESULTS**

Hepatic fibrosis and Laws textures were strongly correlated with higher %Area Fibrosis associated with higher Laws textures (r=0.89, p<0.001). Strong correlation also existed between T2 and Laws textures (r=0.85, p<0.01). Moderate correlations were seen between %Area Fibrosis and PD (r=0.65), ADC (r=0.67), and Subjective Fibrosis Score (r=0.51). The Subjective Inflammation Score was poorly correlated with hepatic fibrosis (r=0.20). Without proposed corrections, there was only a moderate correlation between %Area Fibrosis and Laws textures (r=0.70).

**CONCLUSION**
Higher degree of hepatic fibrosis is associated with increased liver parenchymal Laws textures. Laws textures may be more accurate than PD, ADC, and subjective fibrosis and inflammation scores in assessing degrees of fibrosis. The proposed corrections are critical.

**CLINICAL RELEVANCE/APPLICATION**

Laws textures are potentially accurate surrogate marker for diagnosing and staging hepatic fibrosis.

**Honored Educators**

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Hernan Jara, PhD - 2014 Honored Educator
Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator

**RC225-12 Grading of Diffuse Liver Diseases Using Phase-Contrast-Imaging**

**Participants**

Marco Armbruster, Munich, Germany (Presenter) Co-Founder of medical software company.
Blaz Zupanc, MA, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Emmanuel Brun, Grenoble, France (Abstract Co-Author) Nothing to Disclose
Alberto Mittone, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Wieland H. Sommer, MD, Munich, Germany (Abstract Co-Author) Founder, QMedify GmbH
Wolfgang Thasler, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Maximilian F. Reiser, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Paola Coan, Grenoble, France (Abstract Co-Author) Nothing to Disclose

**CONCLUSION**

X-ray PCI allows grading of diffuse liver diseases, is correlated to histopathology and might be a valuable technique for non-invasive diagnosis and grading of liver fibrosis and steatosis.

**Background**

Diffuse liver pathologies like steatosis, fibrosis or cirrhosis are an increasing cause of morbidity and mortality worldwide. Liver biopsy is currently the gold standard for the diagnosis and monitoring of disease progression and is essential both for treatment decisions and the prognosis of patients. However, liver biopsy has non-negligible risks, is prone to sampling errors and cannot be used as a screening method. Therefore, the purpose of this study was a proof-of-concept that high resolution X-ray phase contrast imaging (PCI) in computer tomography mode is able to directly visualize pathological changes of the microstructure and that grading of diffuse liver diseases is feasible using PCI-CT.

**Evaluation**

Synchrotron-based PCI-CT volumetric imaging was performed for human, ex-vivo liver samples from 20 patients (male: 12, female: 8, age: 62±12 yrs). Histopathological workup included hematoxylin-and-eosin-, elastica-van-Gieson-, and iron-straining. For PCI-CT, propagation based imaging technique was used with X-ray of 30 keV and a sample-to-detector distance of 11m. Images were acquired at a spatial resolution of 8 microns. All dataset were graded for the presence of fibrotic changes and the amount of fatty vacuoles. PCI-CT and histopathological grading of fibrosis and steatosis was correlated using pearson's correlation-coefficient. Both fatty vacuoles, portal, and septal fibrogenous deposits were identifiable in PCI-CT. Visual grading of fibrosis and steatosis correlated moderately but significantly to the histopathological assessment (r=0.682; p<0.05 for fibrosis; r=0.764; p<0.05 for steatosis).

**Discussion**

In this study we used X-ray PCI for a direct visualization of microstructural changes within the liver tissue of patients suffering from diffuse liver diseases. Detailed grading of fibrosis and steatosis was feasible. Due to the three-dimensionality of PCI datasets this technique has the potential to decrease interobserver variability and sampling errors in the grading of diffuse liver diseases.
Participants

Sub-Events

RC251A  An Algorithm for Lung Nodule Interpretation

Participants
Christian J. Herold, MD, Vienna, Austria (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To understand how different clinical scenarios influence the management of patients with pulmonary nodules. 2) To apply state-of-the-art features, methods and guidelines for the work-up of pulmonary nodules. 3) To develop an algorithm for the management of pulmonary nodules for various risk groups.

RC251B  Current Concepts in Lung Cancer Staging: What the Clinician Wants to Know

Participants
Brett W. Carter, MD, Houston, TX, (bcarter2@mdanderson.org) (Presenter) Author, Reed Elsevier; Consultant, St. Jude Medical, Inc.;

LEARNING OBJECTIVES
1) Outline the staging system used for lung cancer. 2) Illustrate specific TNM descriptors through representative examples on imaging studies. 3) Synthesize TNM descriptors into stages and evaluate the impact on patient management. 4) Review limitations of the current system and assess the potential influence on image interpretation.

ABSTRACT
Lung cancer is the most common cause of cancer-related death in men and women in the United States. The seventh edition of the TNM staging system for lung cancer was published in 2009 by the International Union Against Cancer and the American Joint Committee on Cancer and was based on findings from the International Staging Project of the International Association for the Study of Lung Cancer (IASLC). In addition to the inclusion of small cell lung cancer and bronchopulmonary carcinoid, key revisions were made to the tumor (T) and metastasis (M) descriptors based on differential 5-year survival. As accurate staging of lung cancer is crucial to formulating treatment plans and optimizing survival, radiologists should be familiar with the current TNM staging system and understand the strengths of weaknesses of the various thoracic imaging techniques used to diagnose and stage the disease.

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Brett W. Carter, MD - 2015 Honored Educator

RC251C  A Simple Approach to Interstitial Lung Disease

Participants
Michael D. Hope, MD, San Francisco, CA, (michael.hope@ucsf.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify key findings of lung fibrosis and small airways disease. 2) List 4 telltale findings of specific subtypes of interstitial lung disease. 3) Apply a simple methods for reliable characterization of the majority of cases of interstitial lung disease.
Cardiac CT Mentored Case Review: Part II (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, Nov. 30 10:30AM - 12:15PM Location: S406A

AMAPRA Category 1 Credits™: 1.75
ARRT Category A+ Credits: 2.00

Participants
Pamela K. Woodard, MD, Saint Louis, MO (Director) 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; ;
Geoffrey D. Rubin, MD, Durham, NC (Moderator) Consultant, Fovia, Inc; Consultant, Informatics in Context, Inc; Research Consultant, General Electric Company;
Arthur E. Stillman, MD, PhD, Atlanta, GA (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify cardiac and coronary artery anatomy. 2) Recognize cardiac disease processes, including coronary atherosclerosis, as diagnosed on CT. 3) Understand methods of cardiac CT and coronary CT angiography post-processing.

Sub-Events

MSMC22A  Coronary Atherosclerosis I

Participants
Geoffrey D. Rubin, MD, Durham, NC (Presenter) Consultant, Fovia, Inc; Consultant, Informatics in Context, Inc; Research Consultant, General Electric Company;

LEARNING OBJECTIVES
View learning objectives under main course title.

MSMC22B  Coronary Atherosclerosis II

Participants
Smita Patel, MBBS, Ann Arbor, MI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

MSMC22C  Valves and Cardiac Function

Participants
Andrew J. Bierhals, MD, Saint Louis, MO (Presenter) Research Grant, Johnson & Johnson

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
Cardiac CT can provide information on valves and function when retrospective ECG gating is used in the acquisition. These studies require extensive image post-processing to accurately depict the moving structures. This presentation will highlight basic image acquisition as well as the evaluation of normal and abnormal patients.
 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.

SSC02-03 Myocardium: Dynamic CT Perfusion Imaging: A Comparison to Coronary Angiography/FFR and to MR First Pass Perfusion Imaging

Monday, Nov. 30 10:50AM - 11:00AM Location: S504AB

Participants

Armin M. Huber, MD, Munchen, Germany (Presenter) Nothing to Disclose
Bettina M. Gramer, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Vivian Leber, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Daniela Muenzel, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Alexander W. Leber, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Johannes Rieber, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Mani Vembar, MS, Cleveland, OH (Abstract Co-Author) Employee, Koninklijke Philips NV
Ellen Hoffmann, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Ernst J. Rummeny, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To determine the diagnostic accuracy of dynamic computed tomographic (CTP) perfusion imaging of the myocardium for the detection of hemodynamically relevant coronary artery stenosis compared with the accuracy of coronary angiography and fractional flow reserve (FFR) measurement and with MR first pass perfusion imaging of the myocardium.

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...
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

Monday, Nov. 30 11:00AM - 11:10AM Location: S504AB

Participants
Giulia Benedetti, Milan, Italy (Presenter) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Esposito, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Mariangela Cava, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Paolo G. Camici, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose

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 walls 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 33vs38 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.

SSC02-05  Inversion Time Dependence of the Accuracy of Late Gadolinium Enhancement Quantification Using T1 Map Based Synthetic Inversion Recovery Imaging

Monday, Nov. 30 11:10AM - 11:20AM Location: S504AB

Participants
Akos Varga-Szemes, MD, PhD, Charleston, SC (Presenter) Nothing to Disclose
Rob J. van der Geest, PhD, Leiden, Netherlands (Abstract Co-Author) Nothing to Disclose
Giuseppe Muscogiuri, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Carlo N. De Cecco, MD,PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Julian L. Wichmann, 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; ; ; Bruce Spottiswoode, Chicago, IL (Abstract Co-Author) Employee, Siemens AG
Stefanie Mangold, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Rozemarijn Vliegenthart, MD, PhD, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose
Pal Suranyi, MD, PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose

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 compared to the invasive reference methods coronary angiography and FFR and when compared to MR first pass perfusion imaging of the myocardium.
using two binary methods: applying thresholds of 5 standard deviations (5SD) 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, PSIRsy (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
Teppei Sugaya, MD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Jyungo Furuya, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Keichi Igarashi, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Katsuhiko 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 NSCT (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

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
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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

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
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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 834±8 ms to 764±7 ms at FU1 (P<0.05), but no further change was observed later with 734±7 ms at FU2 and 724±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 the 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 single-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.
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...
Thoracoabdominal CT Acquired with a Novel Single-source Dual-Energy Technique Using a Split Filter

Monday, Nov. 30 10:50AM - 11:00AM Location: E353A

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.

CONCLUSION

Spectral data revealed an excellent image quality (3.2 +/- 0.5). For quantitative evaluation, at 60keV in aorta, arterial phase difference between Io350, Io400 and Io250 was 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).

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.
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 CTDIvol 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 CTDIvol 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

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
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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 (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

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-loaded 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

Participants
Brandan Dotson, BS, San Francisco, CA (Presenter) Nothing to Disclose
Jack Lambert, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Zhen J. Wang, MD, Hillsborough, CA (Abstract Co-Author) Nothing to Disclose
Michael A. Ohliger, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Sebastian Winkhofer, 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, Nextrast, Inc;

PURPOSE
To evaluate the reduction of artifacts caused by body parts outside the field of view (out-of-field image artifacts) at rapid kVp switching dual energy CT (rsDECT).

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.

SSC03-08 Can Dual Energy CT Predict the Need for Surgery in Crohn’s Disease?

Participants
Naama R. Bogot, MD, Jerusalem, Israel (Presenter) Nothing to Disclose
Ruth Cytter-Kuint, MD, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
Tomer Adar, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
Irith Hadas, MD, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
Dov Wengrower, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
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, singo.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 possible novel decision making tool (surgery vs. conservative surgery) applicable also to acute settings.

SSC03-09 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

CTDvoll (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 CTDvoll 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: 25.5%, 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.
SSC04

Gastrointestinal (Multimodality)

Monday, Nov. 30 10:30AM - 12:00PM Location: E451A

CT  GI  MR

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

FDA  Discussions may include off-label uses.

Participants
Alvin C. Silva, MD, Scottsdale, AZ (Moderator) Nothing to Disclose
Christine O. Menias, MD, Scottsdale, AZ (Moderator) Nothing to Disclose

Sub-Events

SSC04-01  The Incidental Splenic Lesion: Does It Need to be Worked Up?

Monday, Nov. 30 10:30AM - 10:40AM Location: E451A

Participants
Bettina Siewert, MD, Brookline, MA (Presenter) Nothing to Disclose
Noam Z. Millo, MD, Edmonton, AB (Abstract Co-Author) Nothing to Disclose
Kamaldeep Sahi, MD, BSc, Boston, MA (Abstract Co-Author) Nothing to Disclose
Robert G. Sheiman, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Robert A. Kane, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Olga R. Brook, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Maryellen R. Sun, MD, Boston, MA (Abstract Co-Author) Research Grant, GlaxoSmithKline plc

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 and 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.

CLINICAL RELEVANCE/APPLICATION
Follow-up of incidentally noted splenic lesions may not be indicated.

SSC04-02  CT Signs Predictive of Internal Hernia or Volvulus after Roux-en-Y Gastric Bypass in a Consecutive Surgical Cohort

Monday, Nov. 30 10:40AM - 10:50AM Location: E451A

Participants
Jennifer Y. Lee, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Peter S. Wang, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Susan L. Summerton, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Mindy M. Horrow, MD, Philadelphia, PA (Abstract Co-Author) Spouse, Director, Merck & Co, Inc

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.
METHOD AND MATERIALS
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
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 infract, 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.

Honored Educators
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Mindy M. Horrow, MD - 2013 Honored Educator

SSC04-03 An Assessment of Clinical History Quality and Its Effect on Acute Abdominal CT Diagnostic Accuracy

Participants
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PURPOSE
CT interpretation is integral in the management of emergency department (ER) patients. The clinical history provided on the ER CT requisition is variable in quality but often guides CT interpretation. The aim of this study is to evaluate the effect of CT requisition history quality on acute abdominal CT diagnostic accuracy and determine if more patient information would aid in study interpretation.

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 or prior examination results and differential diagnosis based on clinical evaluation). A composite CT diagnosis was created through: 1) Blinded double reading by two radiologists in consensus; 2) Patient laboratory data ordered by ER physician; 3) Surgical or pathology confirmation; 4) Follow-up imaging confirming CT diagnosis. This combined composite was compared to the original CT diagnosis from the CT report.

RESULTS
14.9% (50/335) of ER CT diagnoses did not correlate with the final composite CT diagnosis. The usage of patient information (e.g. 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
interpretation. Increased access to ancillary patient information can improve interpretation accuracy.

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.
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**

Monday, Nov. 30 11:00AM - 11:10AM Location: E451A

Participants
Robin F. Gohmann, MD, Aachen, Germany (Presenter) Nothing to Disclose
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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 und 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 planed CT of the abomen not necessary in selected cases.

**SSC04-05  Pelvic Artifacts in Material Decomposition Images from Dual Energy CT: A Phantom and Patient Study**

Monday, Nov. 30 11:10AM - 11:20AM Location: E451A

Participants
Sebastian Winkhofer, MD, San Francisco, CA (Presenter) Nothing to Disclose
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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**

Monday, Nov. 30 11:20AM - 11:30AM Location: E451A

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 ≥22% (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**

Monday, Nov. 30 11:30AM - 11:40AM Location: E451A

Participants
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**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 48h 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 Pancreatocoduodenectomy with Portal Vein and/or Superior Mesenteric Vein Reconstruction: Review of Current Surgical Techniques and Associated Post Surgical Imaging Findings

Participants
Karen B. Bleich, MD, Baltimore, MD (Presenter) Nothing to Disclose
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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

PURPOSE
To review the current range of PV-SMV reconstruction procedures that may be performed in conjunction with pancreatocoduodenectomy, and to establish patterns of imaging findings associated with these vascular procedures in order to more accurately distinguish post-surgical findings from recurrent malignancy, both of which can demonstrate venous attenuation and perivenous induration.

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 recent 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.

SSC04-09  Evaluation of Splenic Stiffness in Patients of Extrahepatic Portal Vein Obstruction Using Shear Wave Elastography: Comparison with Intra-Operative Portal Pressure

Participants
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Arunk. K. Gupta, MBBS, MD, New Delhi, India (Abstract Co-Author) Nothing to Disclose

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 (r=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.
**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.
A hybrid (dual-source) prototype CT system (Siemens Healthcare, Germany), which consists of an energy integrating detector (EID) and a photon-counting detector (PCD), is currently under investigation. The field-of-views (FOVs) of the EID and PCD systems are 500 mm and 275 mm, respectively. For an object larger than 275 mm, the PCD system needs a DCS (data completion scan) using the EID to avoid truncation artifacts. This work aimed to find the lowest possible mAs for the DCS such that image quality for the PCD system was maintained.

METHOD AND MATERIALS

The DCS should have the same kV as, and slightly greater longitudinal coverage than, the PCD scan. Other parameters such as mAs can be freely chosen. A semi-anthropomorphic phantom (lateral width: 38.9 cm) with iodine and bone-like inserts was scanned with the PCD system using 210 mAs and 140 kV (CTDIvol = 23.21 mGy). Next, a DCS using the maximal available mAs was performed to serve as the image quality reference. Finally, a series of DCS from 10 mAs (the lowest available on the scanner) to 50 mAs at intervals of 5 mAs was acquired. Images were reconstructed using the same slice thickness (2 mm) and reconstruction kernel (DD0). The difference in CT number between the PCD images using no DCS or low mAs DCS and that using the reference DCS were measured 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

PCD images using a 10 mAs DCS at 140 kV (CTDIvol = 0.93 mGy) were free of cupping artifacts, and had CT number accuracy and uniformity within 1 HU of the reference image. With the 10 mAs DCS, the PCD images of the shoulder, chest, and abdominal regions of the torso phantom demonstrated equivalent image quality to their reference images. Image quality improvement was limited when a larger mAs (>10) was used in the DCS.

CONCLUSION

DCS using less than 1 mGy is sufficient to maintain clinically viable image quality for PCD scans.

CLINICAL RELEVANCE/APPLICATION

The DCS significantly improve the image quality of the PCD system at a markedly low cost of radiation dose.
A New Noise Index-mAs Correspondence System for CT Systems with Model Base Iterative Reconstruction (MBIR)

Monday, Nov. 30 11:10AM - 11:20AM Location: S504CD

Participants
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Research Consultant, Bracco Group; Research Consultant, KIT ; Research Grant, Koninklijke Philips NV
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Guang-Hong Chen, PhD, Madison, WI (Abstract Co-Author) Research funded, General Electric Company; Research funded, Siemens AG

PURPOSE
Given the quantitative relationship between noise variance and exposure level, the Noise Index (NI) allows the operators of clinical CT systems to establish a quantitative correspondence between the noise magnitude and the mAs before prescribing each scan. The introduction of MBIR to clinical CT systems has fundamentally changed the relationship between noise variance and body weight. The NI system for MBIR allows for consistent dose performance between different vendors across a wide body weight range. The purpose of this study was to investigate how to develop a new NI system for MBIR.

METHOD AND MATERIALS
An IACUC-approved in vivo swine study and an IRB-approved prospective trial with 110 human subjects were performed. All studies were performed using a 64-slice CT scanner (Discovery CT750 HD, GE Healthcare) equipped with MBIR (Veo, GE Healthcare). For the swine study, six mAs levels ranging from 10 to 290 were used. For the human subject trial, an additional reduced dose (RD) scan was performed immediately after the standard dose (SD) scan for each subject; the specific mAs used for the two scans varied across subjects depending on patient size and clinical indications. Noise variances were measured by drawing regions of interest (ROI) on relatively homogeneous anatomical sites such as the liver. Power-law fittings ($\alpha = \alpha_0(mAs^{-\beta})$) of the measured noise variance-mAs plots were performed to explore any deterministic relationship between the two parameters.

RESULTS
For the swine study, the exponent of the power law, $\beta$, was -1.0 for FBP and -0.4 for MBIR. Results of the clinical trial were consistent with the in vivo animal study: the $\beta$ value measured in the liver was -1.0±0.10 for FBP and -0.4±0.12 for MBIR, and the $\beta$ value measured in fat was -1.4±0.12 for FBP and -0.4±0.12 for MBIR. The difference in the measured $\beta$ value between FBP and MBIR was statistically significant ($p<0.001$). Similar to FBP, the value of the parameter, $\alpha$, depended on the patient size; for a given size of 28 cm, $\alpha = 1.2x10^{-5}$ for FBP and $\alpha = 600$ for MBIR.

CONCLUSION
The purpose of this study was to investigate how to develop a new NI system for MBIR. The introduction of MBIR to clinical CT systems has fundamentally changed the relationship between noise variance and body weight. The NI system for MBIR allows for consistent dose performance between different vendors across a wide body weight range. The purpose of this study was to investigate how to develop a new NI system for MBIR.
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.

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Meghan G. Lubner, MD - 2014 Honored Educator
Meghan G. Lubner, MD - 2015 Honored Educator
Perry J. Pickhardt, MD - 2014 Honored Educator

**SSC10-06  Correlation of Size-Specific Dose Estimates (SSDE) to Mean Dose in the Center of a CT Scan Under Conditions of Tube Current Modulation**

**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.

**SSC10-07  The Effects of Size-Specific Phantom-to-Patient Matching for Monte Carlo Based Computed Tomography Dosimetry**

**METHOD AND MATERIALS**

Due to the rapid growth in Computed Tomography (CT) use over the past few decades, there has become a clear need for accurate organ dosimetry. The Monte Carlo method, which is one means of performing CT dosimetry, relies on a computational representation of a patient (a phantom). The purpose of this study is to compare a previously validated Monte Carlo based CT
dosimetry methodology performed on patient-specific computational phantoms (based on segmented patient images) to equivalent dosesimetry 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**

Participants: Xochitl Lopez-Rendon, MSc, Leuven, Belgium (Presenter) Nothing to Disclose
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**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**

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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.
Comparison of Transthoracic Echocardiography versus Cardiac Magnetic Resonance for Implantable Cardioverter Defibrillator Therapy in Primary Prevention Strategy of Dilated Cardiomyopathy Patients

PURPOSE
Implantable cardioverter-defibrillators (ICDs) has been proved as a valid primary prevention strategy to reduce mortality in patients with dilated cardiomyopathy (DCM) with reduced left ventricular ejection function (LVEF) <35%. Several studies have shown differences between CMR and TTE evaluation. The aim of this study is to determine whether LV evaluation and late gadolinium enhancement (LGE) detection by CMR are superior to conventional TTE measurements for risk stratification of DCM patients evaluated for ICD implantation in primary prevention strategy.

METHOD AND MATERIALS
270 consecutive DCM patients (Mean age 63±13 yo, male 220 patients) referred to our Institution to be evaluated for ICD implantation in primary prevention were enrolled. All patients underwent both TTE and CMR left ventricle end-diastolic (LVEDV) and end-systolic (LVESV) volumes and LVEF estimation. Additionally, LGE presence was also detected by CMR. All patients were followed-up for the major adverse cardiac events (MACE) defined as a combined endpoint of ventricular tachycardia, ventricular fibrillation and sudden cardiac death.

RESULTS
The mean follow-up was 850±330 days. TTE showed a lower LVEDV (86±28 vs. 131±41 ml/m2) and LVEDV (57±21 vs. 93±40 ml/m2) and a higher LVEF (35±10 vs. 31±9 %) as compared to CMR (p<0.0001). MACE occurred in 68 patients (25%). Patients experienced MACE showed a higher LVEDV-TTE (94±28 vs. 84±28 ml/m2, p:0.01), LVESV-TTE (64±27 vs. 55±23 ml/m2, p:0.003), LVEDV-CMR (141±43 vs. 128±41 ml/m2, p:0.01), LVESV-CMR (105±42 vs. 90±39 ml/m2, p:0.003), lower LVEF-CMR (29±10 vs. 32±9%, p:0.0027) and a higher LGE prevalence (67 vs.44%, p:0.0009) as compared to patients without MACE. At multivariate analysis, LVEF-CMR [HR:2.3(1.6-3.01)] and presence of LGE [HR:4.08(2.15-6.02)] were independently associated with MACE (p<0.001). In the subset of patients with LVEF-TTE>35%, the addition of LVEF-CMR and LGE provides a net reclassification improvement (NRI) of 42% and 26%, respectively, in terms of outcomes.

CONCLUSION
LVEF and LGE estimation by CMR might provide additional prognostic stratification as compared to TTE that could identify a subset of subjects in whom ICD implantation is still indicated despite LVEF-TTE>35%.

CLINICAL RELEVANCE/APPLICATION
LVEF and LGE estimation by CMR might provide additional prognostic stratification as compared to TTE that could identify a subset of subjects in whom ICD implantation is still indicated despite LVEF-TTE>35%.
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 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

CA213-SD MOA4 Left Ventricular Noncompaction in Adult: Imaging and Clinical Findings from 63 Patients

Participants

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Purpose

To describe imaging and clinical findings of left ventricular noncompaction (LVNC) in adult

Method and Materials

From 2000 to 2014, 63 patients were diagnosed to LVNC by echocardiography, computed tomography (CT), and magnetic resonance imaging (MRI) in a single institution. Baseline characteristics, clinical manifestation, combined cardiac or systemic anomalies, and imaging findings were reviewed and compared between isolated group (LVNC without cardiac anomaly) and combined group (LVNC with cardiac anomaly). Institutional review board approved the study and informed consent was waived.

Results

Among 63 patients with LVNC, 32 (51%) patients did not have combined cardiac anomaly, isolated group of LVNC. Mean age at initial diagnosis of isolated LVNC group is higher than the combined group (54.2 years vs. 40.2 years; p<0.001). The combined group presented symptoms more frequently at initial diagnosis than isolated group (93.6% vs. 75%). Heart failure symptoms were most common (60.3% in all patients). Thromboembolic events were shown in 20(31.7%) patients in all patients, which were much higher in combined group (66.7%) than isolated group (33.3%). The most common combined cardiac abnormality was dilated cardiomyopathy (n=15, 24%) followed by other congenital heart disease (n=12, 19%). (Imaging findings of CT and MRI are under analysis. Final presentation will include the imaging findings of LVNC in CT and MRI).

Conclusion

The isolated and combined groups of LVNC show differences in age at diagnosis and clinical manifestations. The most common combined cardiac abnormality was dilated cardiomyopathy.

Clinical Relevance/Application

We provided clinical characteristics of LVNC from 14-year imaging database of a single institution. Clinical and imaging findings of LVNC presented in the study may be helpful to understand LVNC to determine management plan of the disease.
CA214-SD-MOAS  Impact of Full Scan Reconstruction for Myocardial Perfusion CT at 320-MDCT Volume Scanning

Station #5

Participants
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PURPOSE

CT coronary angiography uses a half reconstruction to improve temporal resolution. However, variations in beam hardening and scatter as a function of the source position lead to artifactual variations in the CT numbers. For myocardial perfusion CT, accurate CT numbers and a radiation dose reduction are more important than the temporal resolution. The purpose of this study was to evaluate the usefulness of full scan reconstruction for myocardial perfusion CT on a 320-MDCT volume scanner.

METHOD AND MATERIALS

Using an anthropomorphic chest phantom we performed one-volume scans on a 320-MDCT volume scanner (Aquilion ONE ViSION, Toshiba). The tube voltage, current, and rotation time were 120 kVp, 200 mA, and 275 msec. The heart rate was set at 60 bpm (R-R interval 1000 msec) using the demo mode. Acquisitions of the coverage at 80 mm (± 40 mm) along the z-axis were repeated 1 times per sec for 24 sec. All CT images were acquired with full and half reconstruction using the same raw data. To compare the full and half reconstruction we measured the CT number on the same slice level and calculated the mean value and its variations for 24 sec. We also measured the image noise for both reconstruction and calculated the radiation dose reduction from the ratio of both image noises.

RESULTS

At on-center position (0.0 mm), the mean value and variation were -11.09 HU and ± 0.431 HU with full reconstruction and -11.31 HU and ± 0.487 HU with half reconstruction. Both variations were almost the same at this position. At the off-center position at +20 mm and +30 mm, the variations with full reconstruction remained constant at ± 0.373 HU and ± 0.457 HU, the same as at the on-center position. However, with half reconstruction the CT numbers varied considerably on sequentially-acquired images and the variations increased to ± 3.795 and ± 4.516 HU. The image noise with full- and half reconstructions was 16.94 and 24.21 HU at on-center. The radiation-dose difference was calculated 2.04 times at on-center for full and half reconstructions. Full reconstruction yielded a 50% radiation dose reduction.

CONCLUSION

Compared to the half reconstruction, full scan reconstruction yields accurate CT numbers and a 50% radiation dose reduction at the sequential acquisition of myocardial perfusion CT images.

CLINICAL RELEVANCE/APPLICATION

The full reconstruction yields accurate CT numbers of the myocardial perfusion defect and allows for a reduction in the radiation dose.

CA215-SD-MOAS  Wide-Detector Axial CT versus Standard-Detector Helical CT for Transcatheter Aortic Valve Replacement (TAVR) Planning: Image Quality, Radiation Dose, and Iodine Dose

Station #6

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PURPOSE

To compare wide-detector (16 cm) axial step-and-shoot TAVR CT to standard-detector (4 cm) helical TAVR CT for multi-level vascular attenuation, subjective image quality and enhancement, radiation dose, and iodine dose.

METHOD AND MATERIALS

We retrospectively identified 36 consecutive patients who had TAVR planning CT on a wide-detector scanner using axial step-and-shoot technique with ECG gating in the chest and no gating in the abdomen/pelvis (protocol 1). Iodinated contrast was administered as a single continuous bolus. Patients were age and body-size matched to 36 patients who had TAVR planning CT on a standard-detector scanner using a helical technique with ECG gating in the chest and no gating in the abdomen/pelvis (protocol 2). Iodinated contrast was administered as two separate bolus injections. Two reviewers working independently scored overall and aortic root image quality and aortic enhancement on 4 point Likert scales. One reviewer measured HU attenuation at 8 vascular locations, psoas muscle, and noise in air. Contrast to noise (CNR) and signal to noise (SNR) ratios were calculated. CT dose index (CTDIdvol), total exam dose length product (DLP), Z-axis length, and iodine dose were recorded.

RESULTS

Subjective scores were similar between protocol 1 and 2 for overall image quality (3.6 vs 3.5, p=0.37) and vascular enhancement (3.9 vs 3.9, p=0.57), but aortic root image quality was better for protocol 1 than 2 (3.3 vs 3.0, p<0.05). Mean vascular HU attenuation was statistically greater for protocol 1 (358 vs. 300 HU, p<0.001) and was greater at all 8 vascular levels (graph). There was no significant difference between protocols for image noise, CNR, or SNR (p>0.05). CTDIdvol in the chest and abdomen/pelvis was less for protocol 1 (36.4 vs. 67.8 and 14.8 vs. 20.8, p<0.001), as was DLP (1536 vs. 3244 mGy, p<0.001). Iodine dose for protocol 1 was less than for protocol 2 (32 vs. 48 g, p<0.001).
CONCLUSION

Wide-detector axial step-and-shoot TAVR planning CT resulted in greater vascular attenuation, similar subjective image quality and measured image noise, yet with lower radiation dose and less iodine dose compared to standard-detector helical TAVR CT.

CLINICAL RELEVANCE/APPLICATION

Wide-detector axial step-and-shoot TAVR CT may be useful in patients for whom both good image quality and reduction of radiation or iodine dose are desirable.

CA216-SD-MOA7 Qualitative Analysis of Plaque Detected on Coronary CTA with Invasive Coronary Angiography in the Elderly and Its Effect on Management and Clinical Outcome

Station #7

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PURPOSE

To determine the significance of non-calcified plaque detected on Coronary CTA in the elderly and its effect on management and clinical outcome.

METHOD AND MATERIALS

In this retrospective analysis, patients (age > 65) presented to a tertiary care emergency department with chest pain and underwent coronary CTA from April 2014 to April 2015. Patients were excluded if they had normal coronary arteries on CTA or if there were technical limitations preventing a good quality study. Exams were reviewed to identify patients with obstructive coronary artery disease (CAD) and findings were compared to subsequent invasive coronary angiography procedure and/or myocardial perfusion examination.

RESULTS

83 patients met the inclusion criteria and were found to have obstructive or non-obstructive CAD. 21/83 (25.3%) patients had obstructive CAD with soft, mixed or calcified plaque. 9/21 (43%) were considered borderline obstructive with 50-70% stenosis and subsequently had a normal myocardial perfusion study or no further testing. 12/21 (57.1%) were identified to have >70% stenosis, eleven had mixed or soft plaque, with invasive coronary angiography performed in eight of these patients. Coronary CTA and invasive angiography were concordant in 7/8 (87.5%), who eventually required percutaneous intervention or bypass grafting. 1/8 (12.5%, 1/83: 1.2%) patient with obstructive >70% stenosis in the RCA on CTA had discordant findings on invasive angiography, which revealed < 50% stenosis.

CONCLUSION

Coronary CTA has a high positive predictive value in evaluating greater than 70% obstructive non-calcified coronary artery disease when compared to invasive coronary angiography. Due to normal stress myocardial perfusion studies in patients with <70% stenosis on CTA, medical management of CAD with no further testing appears to be a sound alternative saving patients time, money and radiation exposure.

CLINICAL RELEVANCE/APPLICATION

Coronary CTA is excellent in determining clinically significant non-calcified >70% obstructive stenosis requiring invasive lifesaving therapy with rare false positives.

CA154-ED-MOA8 Magnetic Resonance Imaging of Obesity Phenotypes in Metabolic Syndrome

Station #8

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TEACHING POINTS

1. Review obesity phenotypes of metabolic syndrome as illustrated by imaging features.
2. Review and illustrate the multi-echo Dixon (mDixon) MRI technique used for evaluation of thoracic fat depots.
3. Describe future clinical application of mDixon MRI in obesity imaging.

TABLE OF CONTENTS/OUTLINE

The tissue properties of epicardial and myocardial fat in obesity and metabolic syndrome (MetS) are poorly understood. We are showing obesity phenotypes using diagnostically appropriate mDixon images for thoracic fat depot tissue differentiation and quantification. The foundation of using mDixon magnetic resonance imaging (MRI) relies on the different tissue properties of fat. Appropriate identification of obesity phenotype is crucial for patients’ management and it is beyond the use of anthropometric measurements. Brown adipose tissue has higher water-to-fat ratio and higher density of mitochondria and blood vessels than white adipose tissue. Cases of MetS, obesity without MetS and normal cases will be illustrated using clinical case-based scenarios with color-coded image correlation.
**PURPOSE**

Time-spatial labeling inversion pulse (Time-SLIP) flow-in technique is a spin labeling method using fresh blood as an intrinsic endogenous contrast material to enter into the tagged region by an inversion recovery (IR) pulse. Portal venous flow, especially superior mesenteric venous (SMV) flow, is known to significantly increase after food intake. To evaluate the visualization of sequential MR portography examinations using the Time-SLIP flow-in technique after food intake, and to determine an appropriate timing of the examination.

**METHOD AND MATERIALS**

MR portography was performed on 5 healthy volunteers with inversion time (TI) = 900 msec, 1200 msec, 1500 msec before and after intake of 2 packs of CalorieMate (Otsuka Pharmaceutical Co., Japan), at following 7 phases; pre-meal, just after meal, 30 minutes after, 1 hour after, 2 hours after, 3 hours after, and 4 hours after. Time-SLIP tag pulse was applied obliquely to cover the liver so that SMV flows into the tagged region. The visualization of intra- and extra-hepatic portal branches was evaluated in all 7 phases both subjectively with a 4-point grading system and objectively in contrast-to-noise (CNR) of portal vein to hepatic parenchyma. The degree of signal suppressions was also evaluated on hepatic parenchyma and hepatic vein, and intestinal movement artifacts.

**RESULTS**

The visualization of portal vein was improved at all phases after food intake, among which the improvement at 1 hour (mean CNR=6.4) and 2 hours (mean CNR=6.5) was prominent. The visualization of intrahepatic portal branches was excellent even at TI=900 msec, which was thought to be too short under normal fasting situation; however, high velocity of portal venous flow was expected after food intake. The signals of hepatic parenchyma and hepatic veins were well suppressed at TI=900 msec, which permitted higher CNR of portal vein than at TI=1500 msec, where the hepatic parenchyma signal recovered. The image quality of portograms was not interfered by any intestinal peristalsis artifacts.

**CONCLUSION**

The visualization of intra- and extra-hepatic portal veins with Time-SLIP flow-in portography was significantly improved after food intake rather than during the fasting period.

**CLINICAL RELEVANCE/APPLICATION**

Non-contrast portography examination using the Time-SLIP flow-in technique should perform after food intake rather than fasting period.
PURPOSE

Radiofrequency ablation (RFA) is usually performed under ultrasonographic (US) guidance. However, if a target lesion was isoechic on gray-scale ultrasound, it would be hard to perform RFA under US guidance. Recently introduced contrast-enhanced ultrasound (CEUS) can demonstrate isoechic HCC with arterial enhancement and delay washout. The purpose of this study is to evaluate the effectiveness and safety of RFA under CEUS guidance in the treatment of HCC.

METHOD AND MATERIALS

Total 15 isoechic HCCs on gray-scale ultrasound from 15 patients were included in this study. Nine patients were male, 6 female. Mean age was 61 years old. Mean size of HCCs was 1.8 cm (range, 1.0-4.8). HCC was confirmed by typical imaging findings of arterial enhancement and delay washout on CT and/or MRI. All HCCs were isoechic on gray-scale ultrasound. Targeting of the tumors was performed under CEUS-guidance using sulphur hexafluoride (SonoVue®, Bracco Imaging S.p.A., Milan, Italy). RFA was performed once in 10 cases, twice in 5 cases (mean, 1.3).

RESULTS

Technical success was achieved in all cases (100%). Marginal recurrence was developed in 3 cases. Clinical success rate was 80% (12/15). Mean interval between the RFA and marginal recurrence was 9.7 months (range, 2-20). The mean follow-up period was 17.6 months (range, 5-24). No complication was observed in all cases.

CONCLUSION

Technical success rate of CEUS-guided RFA was 100% and clinical success rate, 80% without any RFA-related complication. CEUS-guided RFA appears an effective and safe treatment modality when a target HCC is isoechic on gray-scale ultrasound.

CLINICAL RELEVANCE/APPLICATION

CEUS-guided RFA appears to be an effective treatment option when ablating isoechic HCC.

PURPOSE

To describe the MDCT features of pancreatic endocrine tumors and correlate them with tumor biology on histopathology.

METHOD AND MATERIALS

We reviewed the multiphasic CTs performed on 118 patients with pancreatic endocrine tumors. For 81 patients, Ki-67/grading based on primary tumor histology was available. We analyzed the following CT features of the lesions: location, size, homogeneity, degree of enhancement in the arterial and venous phases, diameter of the main pancreatic duct, presence of calcifications, vascular invasion, lymph nodes enlargement and liver metastases. The association between MDCT features and pathological findings was associated with Fisher's test.

RESULTS

Mean tumor diameter was 4.12 (range 0.5-14.5 cm). Pathological grading revealed G1 in 44 patients (54.3%), G2 in 29 patients (35.8%) and G3 in 8 patients (9.9%). Tumor diameter and arterial phase vascularization were significantly associated with G1 (p=0.001 and p=0.0334). Vascularization in the venous phase, on the contrary, was not associated with malignancy or with metastases. Heterogeneous enhancement, arterial and venous invasion were correlated with the presence of hepatic metastases (p=0.0073, p=0.0098 and p=0.0078 respectively). In addition, vascular invasion was strongly associated with tumor grade (p<0.001). The remaining features did not associate with malignant behavior.

CONCLUSION

Our findings show that hypovascularity in the arterial phase, larger size, vascular invasion and non-homogeneity are predictors of tumor aggressiveness and poor patient prognosis.

CLINICAL RELEVANCE/APPLICATION

Identification of tumor features at CT predictive of aggressive behavior might improve diagnosis and treatment.

PURPOSE

To test the feasibility of dual contrast enhanced imaging of the liver using simulations of Photon Counting CT Imaging (PCT).
METHOD AND MATERIALS

PCT images of the liver were simulated for an examination performed with two different contrast agents (CA), iodine (CA 1) and gadolinium (CA 2). Image reconstruction was performed for different contrast phases for each CA, and image acquisition was calculated at the time point with portal venous contrast distribution of CA 1 and arterial contrast phase for CA 2. Native, arterial, and portal venous contrast enhanced images were calculated with the spectral separation of PCT.

RESULTS

In simulated PCT images we were able to differentiate between the tissue enhancement of CA 1 and CA 2. The distribution of both CA within the parenchyma of the liver was illustrated with perfusion maps for CA 1 and CA 2. So it was possible to achieve arterial and portal venous phase images at one time point. In addition, virtual non-contrast enhanced image were calculated.

CONCLUSION

Dual contrast PCT offers the possibility to achieve three phases CT imaging of the liver at one time point by a single scan CT examination.

CLINICAL RELEVANCE/APPLICATION

Multi-phase PCT imaging of the liver based on a single scan is a completely new approach for multi-energy CT imaging, offering detailed contrast information in a single scan volume and a significant reduction of radiation dose.

GI344-SD-MOA6

CT after Pancreaticoduodenectomy with Portal Vein and/or Superior Mesenteric Vein Reconstruction: Review of Current Surgical Techniques and Associated Post Surgical Imaging Findings

Station #6

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PURPOSE

To review the current range of PV-SMV reconstruction procedures that may be performed in conjunction with panreaticoduodenectomy, and to establish patterns of imaging findings associated with these vascular procedures in order to more accurately distinguish post-surgical findings from recurrent malignancy, both of which can demonstrate venous attenuation and perivenous induration.

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 recent 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 pancreaticoduodenectomy with venous reconstruction may prevent erroneous diagnosis of recurrent/residual disease.

Hosted Educators

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

GI345-SD-MOA7

Rectal Cancer: Comparison of Diffusion and Perfusion Characteristics between Different Tumor KRAS Mutation Status using Intravoxel Incoherent Motion MR Imaging

To test the feasibility of dual contrast enhanced imaging of the liver using simulations of Photon Counting CT Imaging (PCT).
PURPOSE
To evaluate DW-MRI related parameters characteristics and potential differences among different KRAS mutation status in rectal cancers.

METHOD AND MATERIALS
Fifty-one patients including 29 men and 22 women with histologically proved rectal cancer were enrolled. Diffusion-weighted MR imaging was performed with eight b values. ADCs (including Max-ADC, Min-ADC and Mean-ADC) and IVIM parameters (D, pure diffusion; f, perfusion fraction; D*, pseudodiffusion coefficient) were respectively calculated by mono-exponential and bi-exponential analysis. Patients were stratified into two groups - KRAS wild-type and mutant. According to different mutation locations, patients with KRAS mutant were divided into codon 12 and codon 13 two subgroups. The DW-MRI relative parameters between KRAS wild-type group and KRAS mutant group were compared by using independent samples t test or Mann-Whitney U test. ROC analysis of discrimination between KRAS wild-type and KRAS mutant tumor was performed for Mean-ADC, D and D* values. P<0.05 was considered to indicate a statistically significant difference.

RESULTS
51 patients including 38 KRAS wild-type, 13 KRAS mutant, and the latter group were then divided into 8 of codon 12 mutation and 5 of codon 13 mutation. Mean-ADC, D and D* values were significantly higher in KRAS mutant group (Mean-ADC=[1.43±0.24]×10-3mm2/s, D=[1.13±0.33]×10-3mm2/s, D*=[70.77±67.77]×10-3mm2/s) than in KRAS wild-type group (Mean-ADC=[1.27±0.39]×10-3mm2/s, D=[0.94±0.30]×10-3mm2/s, D*=[32.98±43.74]×10-3mm2/s) (P = 0.008, P = 0.029 and P = 0.025, respectively). However, DW-MRI related parameters showed no significant differences between codon 12 and codon 13 subgroups. According to ROC curve, Mean-ADC, D and D* values showed diagnostic significance with the AUC values of 0.750, 0.704 and 0.710, respectively. The cutoff values for Mean-ADC, D and D* were 1.405×10-3mm2/s, 0.897×10-3mm2/s, 26.502×10-3mm2/s, respectively.

CONCLUSION
Mean-ADC, D and D* values showed significant diagnostic performance in differentiating rectal cancers with different KRAS status, potentially reflecting the possible KRAS status of rectal cancer.

CLINICAL RELEVANCE/APPLICATION
The apparent diffusion coefficient (ADC) and Intravoxel Incoherent Motion (IVIM)-derived parameters are helpful for differentiation of rectal cancer KRAS mutant status. It has potential value to reflect tumor molecular biological characteristics and for making treatment plan.

Incremental Yield of CT/MR Enterography/enteroclysis in Diagnosis and Management of Suspected Inflammatory Small Bowel Disease versus Endoscopic Techniques

PURPOSE
The aim of this retrospective review was to evaluate the incremental yield of CTE/MRE versus endoscopic techniques in a tertiary care setting. The secondary aim was to critically evaluate the practice patterns in a large tertiary care centre vis a vis the current AGA(2012) and ESGAR(2013) recommendations.

METHOD AND MATERIALS
150/750 consecutive patients with suspected IBD and positive CTE/MRE for non malignant bowel wall pathology were included. Histopathological, surgical, endoscopic correlational was sought from relevant records. The images were evaluated by radiologist blinded to the report for: bowel wall enhancement, pattern of enhancement, location, length of involvement, locoregional extramural pathology and extra-intestinal findings. These were than correlated with endoscopy, histopathology and surgical findings. Data on patients with suspected and established inflammatory bowel disease in both remittance, relapse, strictureting and non-stricturing disease were analyzed separately. Weighted incremental yield (IYW) and 95% confidence intervals (CIs) of comparative modalities were calculated. Referral patterns of the referring clinicians were also recorded.

RESULTS
In non-stricturing disease (n=110) endoscopy had a slightly higher diagnostic yield compared to CTE/MRE (IYW 13%; 95%C 9-17%). In n=25 patients extra-intestinal findings were detected by CTE/MRE. In n= 66 patients CTE/MRE were initially used to plan the endoscopic approach. CTE and MRE had comparable results for establishing diagnoses (IYW 5%; 95% CI 1-9%). The pooled sensitivity of CTE and MRE was 87% (95% CI, 82-92%) and 89% (95% CI, 85-93%). MRE scored over CTE (IYW 12%; 95%C 7-17%) in evaluating patients on disease modifying agents (n=10). In n=30 patients CTE/MRE picked extra-intestinal findings which altered diagnosis. In n=20 patients extraintestinal findings allowed for planning of surgical options. There were significant individual variations in referral patterns precluding for optimal evaluation of adherence to guidelines.

CONCLUSION
Endoscopy slightly scores over CTE/MRE in non strictureing disease. MRE/CTE had comparable diagnostic yields. In significant number MRE/CTE positively effected patient management in offering alternative diagnosis, planning endoscopic approach and detecting extra-mural findings. There are wide variations in practice.
**Clinical Relevance/Application**

MRE/CTE are complementary to endoscopic techniques in IBD.

**GI347-SD-MOA9**  

Station #9

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**Purpose**

To investigate the optimal time point for liver function evaluation in normal and cirrhotic livers on gadolinium ethoxybenzyl diethylenetriamine pentaacetic acid (Gd-EOB-DTPA)-enhanced MR imaging.

**Method and Materials**

Sixty-six subjects (cirrhotic liver, n=43; normal liver, n=23) underwent Gd-EOB-DTPA-enhanced MRI. Images were obtained before Gd-EOB-DTPA injection and in the hepatobiliary phase (5, 10, 15 and 20 min) for each subject. Signal intensity of the liver in all phases was measured for relative enhancement (RE) calculation. The differences of RE between normal and cirrhotic livers were compared at all phases, and also the differential diagnostic efficiency for diagnosing cirrhosis and moderate-severe cirrhosis.

**Results**

From 5 to 20 minutes, RE appeared increase in normal liver function and Child-Pugh class A group, plateau in Child-Pugh class B group, and decrease in Child-Pugh class C group. At 15 and 20 minutes, significant differences were found between all groups (P<0.05). The area under the receiver-operator curves of 10, 15 and 20 minutes for diagnosing cirrhosis (0.833, 0.849, 0.842) and moderate-severe cirrhosis (0.957, 0.963, 0.968) had no statistical differences (P>0.05).

**Conclusion**

RE at 15 minutes is useful for differentiating all liver cirrhosis stages, and 10 minutes has equal diagnostic efficiency for diagnosing cirrhosis and moderate-severe cirrhosis.

**Clinical Relevance/Application**

The study demonstrates the optimal time of liver enhancement for differentiating normal-liver and patients in different Child-Pugh groups, and diagnosing cirrhosis and moderate-severe cirrhosis.

**GI133-ED-MOA10**  
**MDCT Evaluation of Early and Late Post-operative Complications of Roux en y Gastric Bypass Surgery and Vertical Sleeve Gastrectomy**

Station #10

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**Teaching Points**

Roux en Y gastric bypass (RYGB) and vertical sleeve gastrectomy (VSG) are two of the most common bariatric surgeries performed at our institution. With increasing frequency of bariatric surgery, an increasing number of patients present for evaluation of suspected post-operative complications, both in the early and late post-operative phases. MDCT is frequently utilized in the workup of these patients. In this exhibit, we will review the surgical procedures of RYGB and VSG and the expected post-operative anatomy on MDCT. Optimal MDCT protocol will be discussed. Through case review, findings of common and uncommon complications in early and late post-operative phases are presented. Some entities, such as gastrogastric fistula are scantily described in CT literature. This exhibits presents an approach to maximize detect rates for subtle MDCT findings, highlighting potential 'hot spots' for complications.

**Table of Contents/Outline**

Introduction  
Teaching Points  
Honored Educators
Finally, pitfalls and limitations of PCI by radiological imaging will be discussed. This exhibition, first, the outline of the CRC with HIPEC procedure will be illustrated. Second, how to obtain the PCI on the basis of radiological imaging, allow surgeons to predict the possibility to perform a radical surgery, thus, to select appropriate patients. In deep, depends on an appropriate patient selection. Quantitative prognostic indicators, such as PCI on the basis of preoperative colorectal cancer. CRS with HIPEC, however, has a relatively high morbidity and mortality. The key to success in CRS with HIPEC deeply depends on an appropriate patient selection. Quantitative prognostic indicators, such as PCI on the basis of preoperative radiological imaging, allow surgeons to predict the possibility to perform a radical surgery, thus, to select appropriate patients. In this exhibition, first, the outline of the CRC with HIPEC procedure will be illustrated. Second, how to obtain the PCI on the basis of radiological imaging will be illustrated, followed by various imaging features for indication and contraindication for CRC with HIPEC. Finally, pitfalls and limitations of PCI by radiological imaging will be discussed.
PURPOSE

For acceleration of imaging time, partially parallel acquisition (PPA) techniques (e.g., SENSE, GRAPPA) utilize the sensitivity differences of the multi-channel RF coil in the intra slice, where multi-band imaging techniques (e.g., CAIPIRINHA) use them in the slice selection direction. As the conventional multi-band imaging and PPA techniques do not fully utilize the sensitivity differences of the multi-channel RF coil, we propose a new multi-band imaging technique, the so-called multi-slice image generation using intra-slice parallel imaging and inter-slice shifting (MAGGULLI).

METHOD AND MATERIALS

MAGGULLI acquires multiple slice images simultaneously using the multi-band RF pulses with inter-slice shifting in the FE direction. To make this inter-slice shifting in the FE direction, we add the inter-slice shifting gradient in the slice-selection direction during the read-out gradient. Thus, aliasing caused by sub-sampling in the phase encoding direction is orthogonal to that by multi-band imaging with the inter-slice shifting, both of which are resolved by using the sensitivity information of the RF coil. To reconstruct the images of MAGGULLI, any PPA and CAIPIRINHA reconstruction techniques can be used. For this work, GRAPPA and slice-GRAPPA are used for resolving intra-slice and inter-slice aliasing, respectively. In contrast to the CAIPIRINHA, the ACS lines for MAGGULLI were acquired without RF phase modulation.

RESULTS

Phantom and in-vivo imaging experiments with the acceleration factors up to 10 were performed to demonstrate that the quality of the images reconstructed by MAGGULLI were better than that of CAIPIRINHA for high acceleration factors in the qualitative and quantitative analysis. In addition, the results of g-factor analysis using the simulated sensitivity maps showed that the proposed method produced a better g-factor than CAIPIRINHA for a reasonable slice distance.

CONCLUSION

The proposed multi-band imaging technique accelerates imaging time with an improved image quality and g-factor.

CLINICAL RELEVANCE/APPLICATION

This work can be applied to any MR imaging techniques such as T1-, T2-weighted and FLAIR with multi-band RF pulses.

PURPOSE

Compared with other interventional radiology and cardiology procedures, data are limited on eye lens doses for medical staff performing the non-vascular interventional procedures, which include endoscopy and X-ray. The aim of this study was to measure eye lens doses for the medical staff engaged in these procedures.

METHOD AND MATERIALS

Five medical doctors (two gastroenterologists and three pulmonologists) and three nurses engaged in non-vascular endoscopic interventional procedures wore protective glasses equipped with small dosimeters during the procedures for a month, after which their absorbed doses for the eye lens were obtained from the dosimeters. The types and number of procedures, total fluoroscopy time, and total dose-area product values were recorded for each participant. The participants also wore personal monitors above the apron at their neck for determining the average X-ray energy received in the procedures for calibrating small dosimeters. Further, a small dosimeter was pasted on each personal monitor for measuring the absorbed dose at the neck. The annual absorbed
doses for the eye lens were evaluated by converting monthly values into annual values.

RESULTS
The maximum absorbed doses obtained from small dosimeters attached to the protective glasses were 2.59 and 7.36 mGy for the two gastroenterologists, 0.32, 0.27, and 0.14 mGy for the three pulmonologists, and 1.09, 4.16, and 0.11 mGy for the three nurses. Although the absorbed doses for the eye lens increased with total fluoroscopy time and dose-area product values, the reported total fluoroscopy time was almost the same between the two gastroenterologists (10,144 and 10,115 s). Moreover, the estimated annual absorbed doses for the eye lens for the two gastroenterologists and one of the nurses exceeded 20 mGy. The ratio of absorbed doses between the eye lens (maximum value) and neck greatly varied between the participants (0.55-1.85).

CONCLUSION
Eye lens doses for medical staff performing gastroenterology interventional procedures, which include endoscopy and X-ray, have the potential to exceed the revised occupational equivalent dose limit.

CLINICAL RELEVANCE/APPLICATION
A reduction in the dose limit to the eye lens was recommended in 2011. The measurement of the eye lens dose for medical staff is essential for the optimization of radiation protection.

PH220-SD- MOA3 Evaluation of Mandibular Cortex Erosion using Texture Features for Estimating Osteoporotic Risk
Station #3

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PURPOSE
It has been suggested that the mandibular cortical width measured on dental panoramic radiographs (DPRs) is correlated with bone mineral density, and it can potentially be an effective means of screening osteoporosis for unsuspecting patients through dental examinations. An automatic measurement of the cortical width can assist dentists who are generally not paying attention to extraoral regions to recognize the sign and suggest patients for further examinations. The sign of osteoporotic progression not only appears as a decrease in cortical width, but also as a cortical erosion characterized by endosteal residue. In this study, we investigated a new computerized scheme to evaluate the cortical bone erosion by use of texture analysis to improve the sensitivity in detecting patients with osteoporotic risk.

METHOD AND MATERIALS
Our training database consisted of 99 DPRs including 26 osteoporotic cases obtained with a CR system. The test database consisted of 99 DPRs including 12 osteoporotic and 16 osteopenia cases obtained with a photon counting system. For each case, an experienced dental radiologist rated the cortical erosion degree on a continuous scale from 0 to 1. The regions of interest including cortical bone below the right and left mental foramen were automatically extracted using the result of automatic segmentation of the mandibular contour. The linear structures along the cortical edges were extracted by the line convergence filter. Image features characterizing the linear structures and the textural features based on the co-occurrence matrix were determined. Using these features, the cortical erosion degree was estimated by a support vector regression.

RESULTS
The correlation between the cortical erosion degrees by the dental radiologist and the proposed method was 0.64. The area under the receiver operating characteristic curve for detecting the patients with osteoporotic risk was 0.86 by the proposed scheme, which is comparable with that using the erosion degrees by the dental radiologist (0.83).

CONCLUSION
The proposed scheme for evaluation of mandibular cortical erosion can be useful in detecting patients with osteoporotic risk.

PH221-SD- MOA4 Comparison of Myocardial Pathology Detection by Delayed Gadolinium Enhancement Using Phase Sensitive and Conventional Magnitude Inversion Recovery Magnetic Resonance Imaging
Station #4

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CONCLUSION
Optimally timed 3D conventional IR sequence increased detection sensitivity compared to 3D PSIR. Contrary to previous reports, we submit quality degradation in PSIR images compared to IR images. This is suspected secondary to timing dependent changes in signal intensity dynamics, and suggests PSIR may benefit from “optimal” timing as well. Importantly, the implementation of a protocol that allows for optimal IR time selection is essential in 3D conventional IR, and should be evaluated at the individual clinical center.
Background

Differential pattern on late gadolinium enhancement (LGE) is a well-established non-invasive method for characterization of myocardial pathology. Optimal detection of signal abnormality, however, depends on ideal nulling of the myocardium. Conventional inversion recovery (IR) has been criticized due to its stringent requirement for an “optimal” inversion time. Phase sensitive inversion recovery (PSIR) was thus introduced as an alternative approach given its decreased reliance on accurate time of inversion. Although multiple studies have suggested superiority of PSIR over IR in terms of ease of sequence implementation and scar/infarct size quantification, there is limited documentation to support improved image quality in PSIR.

Evaluation

Using a clinical 3 T Philips Achieva MRI scanner, a total of 80 patients were prospectively assessed for LGE by both 3D IR and 3D PSIR sequences. A MOLLI sequence was utilized in selection of optimal inversion time in IR. Definitive pathology was identified in 21 patients. The resultant images underwent blinded evaluations for subjective image quality comparison and detection sensitivity evaluation by 4 board certified thoracic radiologists. Quantitative comparison by means of contrast to noise ratio was made.

Discussion

Image quality was noted to be higher in the IR group. Detection sensitivity was higher in the conventional IR group) vs PSIR.

Honored Educators

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Carlos S. Restrepo, MD - 2012 Honored Educator
Carlos S. Restrepo, MD - 2014 Honored Educator

PH222-SD-MOAS Similar Image Retrieval as a Diagnostic Aid: Comparison of Subjective Similarity Ratings for Breast Masses on Mammography and Ultrasonography

Station #5

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CONCLUSION

Image retrieval precision may be improved by effectively combining the similarities by two imaging modalities.

Background

Retrieval of reference images that are similar to a new case can be useful in the diagnosis, reporting, and treatment planning. It is important that the retrieved images are visually similar and relevant, i.e., pathologically correspondent. The previous studies suggested that the similarity measures determined using radiologists’ subjective similarity by a machine learning method can be effective in selecting such images. However, it is not easy to determine subjective similarities for radiologic images because radiologists are not used to the task, and they are susceptible to intra and inter-reader variations. In this study, reliability and usefulness of radiologists’ subjective similarity ratings for breast masses for image retrieval were studied, and the similarity ratings on mammograms (MG) and ultrasound (US) images were compared.

Evaluation

This study includes 25 masses which are consisted of 8 masses with 3 benign pathologic types and 17 masses with 6 malignant pathologic types. Each mass was compared with all the other masses, and the similarity ratings for 300 pairs of images were obtained individually on MG and US. During the reading on MG, regions of interest including masses as well as whole breast MG were presented. For US, single slices or two images of perpendicular planes, if available, around the centers of masses were provided. Eight and nine radiologists or breast surgeons who are certified for breast image diagnosis participated in the reading studies on MG and US, respectively. The observers were asked to provide the similarity rating for a pair on a continuous scale between 0 and 1 corresponding to not similar and very similar on the overall impression considering their diagnosis.

Discussion

In general, the observers considered the masses with same pathology more similar than those with different pathologies on both MG and US. The correlation coefficient between the average similarity ratings for the 300 pairs on MG and US was 0.52. These results indicate the similarity and contrast in information provided by two modalities.
CONCLUSION

In dose comparison studies it is crucial that CTDI values are based on the same standard. Manufacturers should clearly communicate the applied CTDI method, and strive to implement the most recent standard. Although promising, the IEC3.1 method has not yet proven to be applicable for systems with larger minimal collimations and it also needs an approach to regularize the underestimated CTDI towards CTDI_full.

Background

The introduction of beam widths >4cm in CT deteriorates the paradigm of the standard CTDI_100 measurements with a 10cm pencil ionization chamber. Extension of the former CTDI definition for large beam widths is unpractical as it requires much larger phantoms. Several solutions have been published and two new standards have been recommended (IEC3.0 2009, IEC3.1 2010).

Evaluation

We assess the accuracy and differences between wide beam dosimetry methods for a 256-slice system (Revolution CT, GE Healthcare) and compare to the indicated values of the scanner. Weighted CTDI measurements were acquired in a body phantom for all available combinations of collimation (NxT=5-40-80-120-140-160 mm) and kVp (70-80-100-120-140): CTDI_full (=true CTDI): CTDI obtained by 30 cm dose integration in two CTDI phantoms with 35cm length. IEC3.0: adapts the standard CTDI_100 definition for NxT=10cm by replacing the denominator NxT with the actual chamber length (10cm). IEC3.1: determines the CTDI for any NxT by multiplying the CTDI_100 of a reference collimation with the quotient of free-in-air CTDI measurements of NxT and reference collimation. All methods yield lower values than CTDI_full; the IEC 3.1 method provides a more constant deviation from CTDI_full than the IEC3.0 method. Deviations up to 23% for large beam widths are found between IEC methods. The indicated values of the scanner appear to follow the IEC 3.0 standard.

Discussion

The recent IEC3.1 method is a promising replacer for CTDI_full measurements. As manufacturers have not yet adopted IEC3.1, and also national legislations may not yet have implemented any wide beam CTDI standard, a uniformly used CTDI standard is not yet in sight, potentially resulting in large deviations (up to 25% and more) depending on the CTDI method used.

PH226-SD-MO9  Factors Affecting Inter-rater Agreement of I-123-MIBG Readings

Patients

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PURPOSE

Multiple energy techniques are available to acquire and process I-123-MIBG SPECT data, including use of low energy high resolution (LEHR) or medium energy general purpose (MEGP) collimators, and reconstruction by filtered backprojection (FBP) or ordered subset expectation maximization (OSEM). We performed phantom simulations to evaluate the effect of these parameters on inter-rater agreement of MIBG study interpretation.

METHOD AND MATERIALS

Organ counts from clinical I-123-MIBG studies were tabulated to establish realistic lesion, liver and background counts, based on which we constructed 11 phantoms with two 1-mL simulated lesions containing 0.04-1.2 MBq I-123 fixed to a 500-mL simulated organ. Organ counts from clinical I-123-MIBG studies were tabulated to establish realistic lesion, liver and background counts, based on which we constructed 11 phantoms with two 1-mL simulated lesions containing 0.04-1.2 MBq I-123 fixed to a 500-mL simulated organ. Four acquisition and processing parameters were tested: MEGP collimator SPECT acquisitions reconstructed by FBP (MF), MEGP collimator SPECT acquisitions reconstructed by OSEM (MO), LEHR collimator SPECT acquisitions reconstructed by FBP (LF), and LEHR collimator SPECT acquisitions reconstructed by OSEM (LO). Two experienced readers reviewed images independently without knowledge of collimator type, reconstruction method, or number of lesions. Inter-rater agreement was measured by the kappa statistic. Significance of differences was assessed by the McNemar test.

RESULTS

Confidence readings correlated with actual simulated tumor contrast as r = 0.56, r = 0.61, r = 0.61 and r = 0.76 for MF, MO, LF and LO readings, respectively, with correlation stronger for LO than MF readings (p = 0.04). Inter-rater agreement kappa values were κ = 0.60 ("moderate agreement"), 0.70 ("good agreement"), 0.67 ("good agreement") and 0.88 ("very good agreement") for MF, MO, LF and LO readings, respectively. Inter-rater agreement was significantly stronger for LO than MF readings (z-statistic = 3.8, p = 0.0001). Differences (Δ) between readers were significant for MF (Δ = 18%, p = 0.002) and LF readings (Δ = 11%, p = 0.05), but not for MO (Δ = 9%, p = 0.07) or LO readings (Δ = 5%, p = 0.25).

CONCLUSION

Both the collimator used for data acquisition and the method used for data reconstruction have significant effects on inter-rater agreement for I-123-MIBG SPECT study interpretation.

CLINICAL RELEVANCE/APPLICATION

Our findings suggest that I-123-MIBG SPECT data should be acquired using LEHR collimators and processed by OSEM to achieve optimal inter-rater agreement.

PH227-SD-MOA10  Newly Developed Model-Based Iterative Reconstruction Technique for Radiation Dose Reduction on Abdominal CT: Comparison of Image Quality Assessment with Hybrid Iterative Reconstruction and...
Filtered Back Projection Techniques in Body Phantom Study

Station #10

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PURPOSE
To investigate the utility for radiation dose reduction on abdominal CT among newly developed model-based iterative reconstruction (i.e. forward projected model-based iterative reconstruction solution: FIRST) method, hybrid iterative reconstruction (i.e. adaptive iterative dose reduction using three-dimensional processing: AIDR 3D) and filtered back projection (FBP) techniques in body CT phantom study.

METHOD AND MATERIALS
Body phantom was scanned by 64-detector CT with applying automatic exposure control and reconstructed by FBP, AIDR 3D and FIRST. According to CTDIvol, all CT data were divided into three different radiation dose levels; low (4.5-5.9mGy), medium (6.6-10.9mGy), high (13.7-30.8mGy) groups. For quantitative assessments, ROIs were drawn at simulated organs and fat tissue to measure image noise. For qualitative assessment, the clarity of organ margin, visibility of vessel, image contrast, absence of streak artifact and objective image noise and overall image quality were independently evaluated by two radiologists by 5-point visual score, and final scores were determined in consensus. To compare image noise among three techniques in each group, Wilcoxon signed-rank tests were performed. To assess inter-observer agreements, kappa statistics were performed. Finally, each visual score was also compared among three techniques by Wilcoxon signed-rank test.

RESULTS
Image noise of each CT with FIRST was significantly lower than that with AIDR 3D and FBP in all groups (p<0.05). As compared with FBP applied to image noise of routine CT protocol included high dose group, the radiation dose reduction rate could be decreased at 44.5% and 55.9% on low-dose CT with AIDR 3D and FIRST. Agreements of all visual evaluations were determined as substantial or almost perfect (0.70)

CONCLUSION
Newly developed model-based iterative reconstruction method (i.e.FIRST) is considered as more useful than AIDR 3D and FBP techniques for radiation dose reduction of abdominal CT.

CLINICAL RELEVANCE/APPLICATION
Newly developed model-based iterative reconstruction method (i.e.FIRST) is considered as more useful than AIDR 3D and FBP techniques for radiation dose reduction of abdominal CT.

PH114-ED-MOA12 Dual-Energy X-ray Absorbiometry Precision Assessment - The Why, the How, and Pearls and Pitfalls

Station #12

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TEACHING POINTS
Teaching Points: Illustrate an important process in dual-energy x-ray absorbiometry (DXA) quality control (QC) How to calculate DXA precision error (PE) and least significant change (LSC) and how these values are clinically applied Explain the DXA precision assessment process at our institution: our consent wording, our standard report template and adjustments for patients who volunteered Pearls and pitfalls gained during our precision assessment: impact on workflow for both the technologist and radiologist, optimization of scheduling, patient concerns

TABLE OF CONTENTS/OUTLINE
Table of Contents/Outline:1. Brief overview of DXA Measurement of bone mineral density (BMD) Clinical indications2. Brief overview of QC for DXA Baseline BMD with phantom Daily QC Cross-calibration Precision assessment3. Why precision assessment is performed Definition of PE and LSC Factors affecting precision How these data are applied clinically 4. How precision assessment is performed How to calculate PE and LSC How to set up an excel spreadsheet for analysis5. Pearls and Pitfalls Our consent process Our reporting process Workflow issues due to increased time to perform examinations Patient concerns

PH008-EB-MOA

Artifact in Head CT Images Due to Air Bubble in X-Ray Tube Oil

Hardcopy Backboard

Participants
A pathology-like artifact in head CT images is reported. This artifact is caused by the air-bubble in the x-ray tube oil. A specific QC procedure to detect the amount of air-bubble is routinely performed to prevent this from occurring again.

**FIGURE (OPTIONAL)**

**Background**

There are two types of x-ray tube arcing. The first type is caused by the accumulation of tungsten gas build up over the years. The tungsten gas attracts the high voltage electron beam as it travels toward the rotating anode. This artifact appears to be streak like pattern. The second type of tube arcing is caused by the air-bubble in the x-ray tube oil. If there is too much of air-bubble, the x-ray tube would not fire at all. However, when the air-bubble still small, x-ray tube may still function but produces artifact in image. However, to our knowledge, this artifact in CT head image has not been reported. In our hospital, we have observed this kind of artifact in multiple times, at least in 4 patients. It presented as attenuated subcortical white matter of the supratentorial brain, similar to the appearance caused by leukoariosis or leukoencephalopathy.

**Evaluation**

Several actions were taken in order to better understand this artifact. First, the patient was sent for follow up MRI. All demonstrated normal brain parenchyma. Secondly, to rule out the influence of skull, the skull density and width of these patients with artifact were measured and compared to other non-artifact patients. No significant difference was found either. Thirdly, the CT manufacturer was contacted for consultation. The manufacturer recognized that it came from the air-bubble in the x-ray tube and an air-purging procedure was arranged.

**Discussion**

The artifact caused by air-bubble in the x-ray tube oil may bring misdiagnosis or confusion. And the manufacture (GEMS, Milwaukee, WI) acknowledged that it is a problem in there Light Speed VCT model.
CA217-SD-MOB1  Self-Gated CMR (Cardiac MRI) Using Phase Information  

**PURPOSE**
To obtain high spatiotemporal resolution cardiac MR images from a novel self-gating method, which extracts the motion information of the heartbeat and breathing from the phase of the projection data.

**METHOD AND MATERIALS**
The proposed method uses the phase information of the projection data. In general, the phase of the MR signal is affected by the time-varying gradient field and the location of spins. The proposed method obtains the projection data for self-gating. Because the x-(left-right) directional projection data is more sensitive to the breathing motion, the readout gradient is applied in the y-(anterior-posterior) direction. Bi-polar gradients are also applied in the z-(head-foot) direction utilizing the aortal blood flow which is correlated with the heartbeat motion. Then, cardiac motions due to the heartbeat and breathing are represented as the phase variation on the projection data. The breathing motion is estimated from the whole phase of the projection data whereas the heartbeat motion is estimated from the phase of the projection data passing through the aortal region. The difference between the maximum and the minimum velocity of the aorta can be calculated from the phase variation. In the proposed method, the number of repetitions for high-frequency components of the k-space is less than those of low-frequency components to reduce the imaging time for the retrospective gating. The in-vivo studies which were approved by IRB were performed with five healthy volunteers using a 3.0 T MRI scanner.

**RESULTS**
Using the proposed self-gating method, the motion information of the heartbeat and breathing was precisely extracted as compared with the results from the ECG gating and respiratory belt. The averaged heart beat cycle was about 915 ms/cycle, and the averaged respiratory cycle was about 3.82 s/cycle. The difference between the maximum and the minimum velocity of the aorta was about 27.1 cm/s. From the proposed method, high-spatiotemporal resolution cardiac MR images were successfully obtained with imaging time of 2 min. 48 sec. The spatial resolution was 1×1×6 mm³ and there were total 80 cardiac phases.

**CONCLUSION**
The proposed method provides reliable information of the cardiac motions from the phase of the projection data, which allows obtaining high spatiotemporal resolution cardiac MR images.

**CLINICAL RELEVANCE/APPLICATION**
The clinical application of the proposed method is cardiac anatomic/functional imagings.

CA218-SD-MOB2  Myocardial T1 and Extracellular Volume Fraction Related to Cardiac Functional Parameters in Dilated Cardiomyopathy

**PURPOSE**
Modified Look-Locker inversion recovery (MOLLI) in cardiac magnetic resonance (CMR) provides T1 mapping of the left ventricular (LV) myocardium and quantify the T1 value and extracellular volume fraction (ECV). The objective of this study was to determine the interval, by analyzing the correlations between T1 value before or after enhancement or ECV and the cardiac functions in dilated cardiomyopathy (DCM) cases.

**METHOD AND MATERIALS**
24 DCM patients underwent CMR using a 3.0 T. As cardiac functional parameters, we measured LV ejection fraction (LVEF), end...
METHOD AND MATERIALS

Forty-five coronary plaques from 24 patients underwent CTA were analyzed. All CTAs were performed with single-source DECT (Discovery CT750HD, freedom edition, GE) using rapid kV switching dual energy scan (80kV, 140kV, 600mA). Spectral HU curve, signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), and noise index were analyzed across multiple segments at varying monochromatic energy levels (40-140keV) for each component of coronary artery plaque as follows: lumen, calcified plaque (CP), non-calcified plaque (NCP), adjacent surrounding tissue of coronary artery and distant pericardial fat from coronary artery. Normalized spectral HU curves were calculated using luminal CT number as reference. Friedman rank sum test and Wilcoxon signed rank test were then used to determine significance.

RESULTS

In a total of 45 plaques, maximal SNRs were observed at 40keV, 70keV, 130keV and 140keV for plaque, lumen, fat and surrounding tissue, respectively (p<0.05). Maximal CNRs were observed at 70keV for CP (18.36), NCP (15.23) and fat (30.39) comparison with lumen (p<0.05), 120keV for NCP (3.31) comparison with surrounding tissue (p<0.05), 70keV and 120keV for NCP (12.03 and 11.68) comparison with fat (p=0.144). Normalized CT number of CP obtained highest 227.43% at 140keV and surrounding tissue obtained lowest -37.03% at 140keV, NCP ranged from 16.64% to 24.16%.

CONCLUSION

VMI demonstrates maximal image quality in different energy levels for each component of coronary artery plaque.

CLINICAL RELEVANCE/APPLICATION

VMI in different energy level demonstrates different image quality of plaque component. Optimized energy level enables to obtain higher image quality for evaluating coronary artery plaque on DECTA.
Infarct size on LGE images was at BL 23±11 %LV and decreased to 19±12 %LV, 20±11 %LV, 18±10 %LV and 19±12 %LV at FU1.

RESULTS

METHOD AND MATERIALS

CMR of 321 HCM patients were included in this IRB-approved study. All CMR were performed on a 1.5T scanner, including standard steady-state free precession cine, late gadolinium enhancement (LGE), and post-gadolinium Look-Locker inversion recovery sequences (TI scout). CMR images were post-processed to quantify maximal left ventricular (LV) wall thickness, LGE mass, and T1 values using dedicated software. Echocardiography exams were reviewed to determine LV outflow tract (LVOT) pressure gradient and diastolic function. Relationships between myocardial T1 time and LGE%, and structural and functional features were analyzed using Pearson correlation coefficient. p-value < 0.05 was considered significant.

RESULTS

CMR of 321 HCM patients (220 M, mean age 51.8 years) were reviewed. Mean maximal LV wall thickness was 20.1±5.4mm. Mean 12 min post gadolinium myocardial T1 time was 383.0±58.8 msec. Mean LGE% was 10.1±12.9%. Myocardial T1 time showed significant correlation with LGE%, a measure of replacement fibrosis (p < 0.01). LGE% showed significant correlation with structural features such as maximal wall thickness (p < 0.01) and LV mass normalized to body surface area (p < 0.01). Myocardial T1 time showed no significant correlation with these structural features. With functional features, both myocardial T1 and LGE% were related to ejection fraction (r = 0.12 and r = -0.18, respectively). LGE% was correlated with E/e' (r = 0.12). Other functional measures were not related to myocardial T1 times.

CONCLUSION

In this large HCM cohort, both markers of diffuse interstitial fibrosis and replacement fibrosis were related to EF. LGE% was more closely correlated with other structural and functional features reflective of HCM severity than myocardial T1 times.

CLINICAL RELEVANCE/APPLICATION

The extent of LV replacement fibrosis, as measured by LGE%, is related to global measures of HCM severity, whereas interstitial fibrosis, as reflected by myocardial T1 times, appears for the most part independent of these features. Clinical utility of T1 mapping in management of HCM patients remains uncertain.

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Ihab R. Kamel, MD, PhD - 2015 Honored Educator
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Stefan L. Zimmerman, MD - 2015 Honored Educator

CA221-SD- MOB5

Ability of Extracellular Volume Imaging to Serially Measure Infarct Size Compared to LGE within Six Months after Acute Myocardial Infarction

Station #5

Participants

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PURPOSE

T1 mapping and extracellular volume (ECV) imaging are promising tools to quantify increased extracellular distribution volume of contrast media after myocardial damage. We evaluated the ability of ECV imaging to measure infarct size compared to late gadolinium enhancement (LGE) after acute myocardial infarction (AMI). Additionally, the amount of cellular damage was serially measured by ECV imaging.

METHOD AND MATERIALS

CMR (1.5 Tesla Philips Achieva) was performed in 25 patients four times after reperfused AMI at baseline (BL) at 9.4±5.6 days after infarction and at 6.9±1.3 weeks (follow-up 1, FU1), 3.6±0.5 months (FU2) and 6.5±0.7 months (FU3), respectively. 8 out of 25 Patients underwent an fourth follow-up (FU4) after 23.1±10.7 months. T1 quantification was performed before (T1pre) and 15 minutes after (T1post) administration of 0.075 mmol/kg gadolinium BOPTA on 3 short-axes for ECV calculation using the modified Look- Locker inversion-recovery (MOLLI) sequences. T2 and ECV maps were calculated with a dedicated plug-in written for the OsiriX software. Two experienced observers independently evaluated LGE-CMR as well as ECV and T2 mapping using the HeAT-Software applying a threshold method. Size of infarction and areas of prolonged T2 or increased ECV was measured using a cutoff >2SD of remote normal myocardium.

RESULTS

Infarct size on LGE images was at BL 23±11 %LV and decreased to 19±12 %LV, 20±11 %LV, 18±10 %LV and 19±12 %LV at FU1.
Five minipigs underwent transcatheter embolization of coronary using gelatin sponge to produce acute myocardial infarction.

**PURPOSE**

To evaluate the diagnostic accuracy of "one-step" dual-energy combined coronary CT angiography and first-pass myocardial perfusion imaging for the detection of acute myocardial infarction by using the second generation dual-source CT compared with conventional digital subtraction angiography and histopathological findings in a porcine model.

**METHOD AND MATERIALS**

Retrospective analysis of 20 consecutive patients who underwent pre-TAVI assessment using a 3GDS CT system (13 men, 78±9.3 yrs) and 20 consecutive patients imaged on a 1GDS CT system (13 men, 78.4±10.1 yrs). The 3GDS pre-TAVI CT protocol included a retrospectively gated cardiac scan followed by a high-pitch FLASH CT angiogram with coverage from the groin to the thoracic inlet. The 1GDS protocol included a retrospectively gated thoracic acquisition followed by a helical CTA of the abdomen and pelvis. Tube current modulation was identical between systems. kVp selection for the 1GDS was dependent on patient body mass index (BMI); automatic kVp selection was used for 3GDS scans. Angular tube current modulation was applied to both groups. Sinogram-based iterative reconstruction (SAFIRE) was employed for the 1GDS scanner; model based iterative reconstruction (ADMIRE) was employed for the 3GDS scanner. Scan parameters (kVp), radiation dose metrics (CT dose index volume (CTDIvol), Dose Length Product (DLP)), contrast volume (mL), and patient body mass index (BMI, kg/m2) were recorded. The student’s t-test assessed between group differences.

**RESULTS**

3GDS patients had significantly greater BMI (32.5±7.1 vs 26.9±4.9, p=0.047). There was a significantly greater CTDIvol for cardiac scans on the 3GDS (65.3±32.2 vs 41.4±25.8, p=0.01); CTDIvol for CT angiography was similar between the 3GDS and 1GDS systems (10.3±4.3 vs 11.4±6.5, p=0.54). 120 kVp was more frequently utilized on the 3GDS system (45% vs 25% and 65% vs 20%) of cardiac and aortoiliac acquisitions. DLP was similar between 3GDS and 1GDS scans (1853.3±884.7 vs 1501.4±530.2 (p=0.14)). There was a trend towards lower contrast volumes for 3GDS scans (80.7±27.3 vs 95.3±30.6 (p=0.12)).

**CONCLUSION**

TAVI treatment planning using a 3GDS CT scanner demonstrates comparable radiation doses to those on a 1GDS system despite greater z-axis coverage, a higher proportion of scans utilizing 120 kVp, and a patient cohort with a greater BMI.

**CLINICAL RELEVANCE/APPLICATION**

Further optimization of the TAVI scanning protocol on the 3rd generation dual source CT system is necessary to fully realize potential radiation and contrast dose savings.

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**ECV measurement additionally gives information about the magnitude of cellular damage, which slightly increases with in the first 3 Months after AMI and then remains constant.**

**CONCLUSION**

Acute after AMI infarct size measurement by ECV overestimates infarct size and represents size of edema. However, after resorption of edema within 7 weeks after infarction EVC accurately measures infarct size comparable to LGE.
Arterial-phase myocardial DECT imaging were performed prior to and immediately and 24 hours after the procedure. A colour-coded iodine map was used for evaluation of myocardial perfusion defect using the 17-segment model. Two radiologists in consensus interpreted all iodine map imaging studies at DECT and coronary CT angiography images that were acquired during the DECT-acquisition. Statistical analysis for diagnostic accuracy was performed.

**RESULTS**

Following the coronary embolization, DECT iodine maps showed 45 infarcted segments and 40 noninfarcted segments. Based on the per-segment analysis, the sensitivity, specificity, positive predictive value and negative predictive value were 93%, 95%, 95% and 93%, respectively. The corresponding values to per-territory analysis were 100%, 86%, 89% and 100% using histopathological findings as the reference standard. The average DLP was $219.4 \pm 60.9 \text{ mGy.cm} (172-321 \text{ mGy.cm})$.

**CONCLUSION**

Our experimental study demonstrates that "one-step" dual-energy combined coronary CT angiography and first-pass myocardial perfusion imaging provides high diagnostic accuracy for detecting acute myocardial infarction and a comprehensive image quality of coronary artery with a relatively low dose of radiation dose in a porcine model.

**CLINICAL RELEVANCE/APPLICATION**

DECT can provide a one-stop imaging that offers information about the coronary morphology as well as the myocardial blood supply

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**CA109-ED-MOBB**  
**Beyond the EKG: Radiologic Imaging is at the Heart of Life-Preserving Cardiac Therapy**

Station #8

Participants
- Valerie D’Aurora, MD, Newark, NJ (Abstract Co-Author) Nothing to Disclose
- Michael A. Sadler, MD, Newark, NJ (Abstract Co-Author) Nothing to Disclose
- Vadim Spektor, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
- Yair Levy, Jerusalem, Israel (Presenter) Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is to: 1. Demonstrate the critical role of multimodality imaging in the management of patients receiving life-preserving cardiac therapy including transcatheter aortic valve replacement (TAVR), ventricular assist devices (VADs), and heart transplantation. 2. Provide examples of the utility of radiologic imaging to pre-operatively identify surgical challenges and assist in the surgical planning for TAVR procedures. 3. Showcase various prosthetic aortic valvular and cardiac assist devices prior to and after implantation. 4. Illustrate the efficacy of radiologic imaging for both peri-procedural and long-term surveillance of cardiac device malfunction and complications related to heart failure therapy.

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Classification and Treatment Guidelines for Heart Disease Aortic Stenosis Prevalence and Prognosis Pre-Procedural Multimodality Imaging Goals for TAVR Selection of the Vascular Access Site Assessment of the Aortic Annulus Surgical Implantation of VADs Review of the Multimodality Appearances of VADs Radiologic Diagnosis of Peri-Operative and Late Post-Operative Complications Related to TAVR and VADs Case Review and Self-Assessment
**Prospective Evaluation of Local Recurrence after Radiofrequency Ablation (RFA) of Liver Tumors: Effectiveness of Immediate Second-Look Evaluation after Procedure using Pre-RFA MRI and Post-RFA CT Registration**

**Station #1**

**Purpose**
To evaluate the clinical impact of second look radiofrequency ablation (RFA) using prototype software allowing registration of pre- and post-RFA images.

**Method and Materials**
This prospective study was approved by institutional review board and informed consent was obtained. A total of 77 patients (M:F=61:16, mean age, 63.1± 9.7 years) with 99 liver tumors (89 hepatocellular carcinoma, 1 cholangiocarcinoma, 9 metastases) who underwent RFA were enrolled. Pre-RFA magnetic resonance imaging (MRI) and post-RFA computed tomography (CT) images were analyzed for evaluating sufficient safety margin, with either side-by-side visual comparison by attending radiologist or with registration software. Accordingly, patients were classified into sufficient and insufficient margin groups. Additional RFA was performed depending on technical feasibility in an insufficient group, and safety margin was re-assessed. Finally, local tumor progression (LTP) and progression free survival (PFS) were assessed in sufficient or insufficient safety margin groups.

**Results**
The second RFA session was done in five patients who showed insufficient margin on registration software only, considering technical feasibility. All showed sufficient safety margin in reassessment done by visual and software inspection. After reassessment, insufficient margin was observed in five patients on both method, 13 patients on visual inspection only, and 10 patients on registration software only. During follow-up period (median, 33 months), insufficient margin group classified by registration software showed significantly higher LTP rate (53.3% [8/15] vs. 14.3% [12/84]) and shorter PFS (20.5 months [95% CI, 11.3-29.8] vs. 36.5 months [95% CI, 31.7-36.5], P=0.0001) than sufficient margin group. However, Sufficient (n=86) and insufficient (n=13) margin groups classified by visual inspection did not show significant difference of LTP (P=0.86).

**Conclusion**
Safety margin assessment using registration software is able to provide information regarding LTP prediction than visual inspection, by assessing safety margin accurately.

**Clinical Relevance/Application**
Additional RFA session following immediate second look safety margin evaluation using automatic registration software may reduce local tumor recurrence after RFA.

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**Pancreatic Metastases from Renal Neoplasms and Neuroendocrine Pancreatic Tumors: Differential Diagnosis at CT**

**Station #2**

**Participants**
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**Purpose**
To evaluate the clinical impact of second look radiofrequency ablation (RFA) using prototype software allowing registration of pre- and post-RFA images.

**Method and Materials**
This prospective study was approved by institutional review board and informed consent was obtained. A total of 77 patients (M:F=61:16, mean age, 63.14.97 years) with 99 liver tumors (89 hepatocellular carcinoma, 1 cholangiocarcinoma, 9 metastases) who underwent RFA were enrolled. Pre-RFA magnetic resonance imaging (MRI) and post-RFA computed tomography (CT) images were analyzed for evaluating sufficient safety margin, with either side-by-side visual comparison by attending radiologist or with registration software. Accordingly, patients were classified into sufficient and insufficient margin groups. Additional RFA was performed depending on technical feasibility in an insufficient group, and safety margin was re-assessed. Finally, local tumor progression (LTP) and progression free survival (PFS) were assessed in sufficient or insufficient safety margin groups.

**Results**
The second RFA session was done in five patients who showed insufficient margin on registration software only, considering technical feasibility. All showed sufficient safety margin in reassessment done by visual and software inspection. After reassessment, insufficient margin was observed in five patients on both method, 13 patients on visual inspection only, and 10 patients on registration software only. During follow-up period (median, 33 months), insufficient margin group classified by registration software showed significantly higher LTP rate (53.3% [8/15] vs. 14.3% [12/84]) and shorter PFS (20.5 months [95% CI, 11.3-29.8] vs. 36.5 months [95% CI, 31.7-36.5], P=0.0001) than sufficient margin group. However, Sufficient (n=86) and insufficient (n=13) margin groups classified by visual inspection did not show significant difference of LTP (P=0.86).

**Conclusion**
Safety margin assessment using registration software is able to provide information regarding LTP prediction than visual inspection, by assessing safety margin accurately.

**Clinical Relevance/Application**
Additional RFA session following immediate second look safety margin evaluation using automatic registration software may reduce local tumor recurrence after RFA.
Pancreatic metastases from renal-cell carcinoma (PRCC) and neuroendocrine pancreatic tumors (PNET) are both hypervascular, and the differential diagnosis can be difficult. Purpose of this study is to compare the multiphasic CT features of these two lesions.

**METHOD AND MATERIALS**

We retrospectively compared the CTs performed on 28 patients with PRCC with 28 patients with PNETs matched by size. All patients underwent multiphasic CT: unenhanced, late-arterial and portal-venous images were available for review. In patients with multiple PRCCs, the largest lesion was analyzed. One reader evaluated the site, margins, enhancement intensity and homogeneity (subjective comparison to normal parenchyma) in the arterial and venous phases, vascular invasion and main pancreatic duct (MPD) dilatation.

**RESULTS**

No significant difference was observed in lesion distribution. In the arterial phase 26/28 PRCC and 24/28 PNET were hypervascular, while in the venous phase 17/28 PRCC and 17/28 PNET were hyperattenuating; enhancement was homogeneous in 14/28 PRCC and in 17/28 PNET (all: p=n.s.). Homogeneous PNETs were smaller than inhomogeneous PNET (21±4.2mm vs 43.18±6.92mm, p=0.0073), while the difference was not significant for PRCCs (22.64±5.56mm vs 38.64±6.75mm). All lesions had well-defined margins in both populations; vessel invasion was noted in 3/28 PRCC and 6/28 PNET. MPD was dilated in 5/28 cases in both populations.

**CONCLUSION**

Both RCC and PNET are well-defined hypervascular lesions, usually without MPD dilatation or vessel infiltration. We did not find CT features helpful for a differential diagnosis. The best diagnostic clue for PRCC is a history of renal cell carcinoma.

**CLINICAL RELEVANCE/APPLICATION**

The CT features of pancreatic metastases from renal cell carcinoma and endocrine tumors of the pancreas overlap significantly. Patient history is therefore fundamental for an accurate diagnosis.

**G1350-SD-MOB3** CT Diagnosis of Internal Hernia in Patients Post Laparoscopic Roux-en-Y Gastric Bypass: Validation of CT Signs in a Large Cohort

Station #3

**Participants**

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- Joseph Mamazza, Ottawa, ON (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The determine frequency of nine CT signs of internal hernia in patients who have had laparoscopic Roux-en-Y gastric bypass (LRYGB) surgery.

**METHOD AND MATERIALS**

We identified a consecutive retrospective cohort of 78 post LRYGB patients (from 2011-2014), who had a surgically confirmed internal hernia and a computer tomography (CT) study of the abdomen performed within 30 days of the surgery date. Two fellowship trained abdominal radiologists were asked to assess for the presence of each of the following signs on each CT study: 1) swirled mesenteric fat/vessels 2) criss cross of mesenteric vessels (meaning that the orientation of the SMV and SMA is reversed) 3) mushroom shape of bowel 4) tubular distal mesenteric fat surrounded by bowel 5) small bowel obstructions 6) clustered loops of small bowel 7) bowel other than duodenum posterior to the SMA 8) right sided location of the distal jejunal anastomosis and 9) ‘beaking’ or compression of the SMV. Inter-reader agreement was assessed using kappa statistics.

**RESULTS**

The most frequent sign determined by readers 1 and 2 was mesenteric swirl, which was present in 76 (97%) and (81%) of cases, respectively (K=0.199). The least frequent sign was small bowel obstruction: 17 (22%) and 11 (14%), respectively (K=0.741). The frequencies for the remaining signs were: criss cross: 75 (96%) and 45 (56%) (K=0.044), mushroom: 60 (77%) and 54 (69%) (K=0.353), tubular mesenteric fat: 48 (62%) and 61 (78%) (K=0.027), clustered loops of small bowel: 24 (31%) and 34 (44%) (K=0.299), bowel posterior to the SMA: 59 (76%) and 44 (54%) (K=0.015), right sided location of the distal anastomosis: 15 (19%) and 16 (21%) (K=0.557), and SMV beaking/compression: 65 (83%) and 63 (81%) of cases, respectively (K=0.391).

**CONCLUSION**

The best CT indicators of internal hernia post LRYGB are mesenteric swirl, mushroom shape of bowel, right-sided positioning of the distal jejunal anastomosis, and SMV beaking/compression.

**CLINICAL RELEVANCE/APPLICATION**

The prompt diagnosis of internal hernia in post LRYGB patients is currently based on a CT study.

**G1352-SD-MOBS** Intra-individual Comparison between Reduced and Standard Dose Body CT Imaging in Patients Undergoing Follow-up Imaging: Image Quality and Lesion Conspicuity

Station #5

**Participants**

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- Lior Molvin, Stanford, CA (Abstract Co-Author) Speakers Bureau, General Electric Company
- Aya Kamaya, MD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
- Isabelle Boulay-Coletta, MD, Paris, France (Abstract Co-Author) Nothing to Disclose
PURPOSE
To assess whether reduced dose (RD) CT with Model-Based Iterative Reconstruction (MBIR) provides equal or better diagnostic image quality and lesion conspicuity compared to standard dose (SD) CT in patients undergoing oncological follow-up imaging.

METHOD AND MATERIALS
In this IRB-approved, HIPAA compliant study, 44 cancer patients (mean age, 59 years; mean weight, 170 pounds) who had undergone a staging SD CT within 12 months (mean, 106 days) were prospectively included to undergo a weight-based RD CT of the chest, abdomen, and pelvis on a 64-slice CT scanner (GE Discovery 750 HD) with MBIR technique. Radiation dose was recorded and tissue attenuation and image noise of four tissue types was measured objectively at a predetermined site by one reader. Image quality was evaluated subjectively by three readers by assessing image sharpness, image noise, overall quality, and artifacts utilizing 4 or 5-point grading scales. Lesion conspicuity of up to 5 target lesions per patient were analyzed objectively by one reader by repeated target lesion size measurements. Lesions were also analyzed subjectively by three readers using a 3-point grading scale.

RESULTS
Mean radiation dose reduction for RD CT was 44% (range, 6-69%, mean dose=8 mGy) compared to SD CT imaging (P<0.01). Mean image noise across all measured tissue types was significantly (P<0.01) lower in RD CT than in SD CT (mean percent reduction: fat=33%, aorta=53%, liver=50%, muscle=48%). Subjective image quality for RD CT was significantly (P<0.01) higher than for SD CT in regards to image noise and overall image quality; however, there was no statistically significant difference in regards to image sharpness (P=0.59). Additionally, there were subjectively less artifacts on RD CT (P<0.01) than on SD CT. Lesion conspicuity was subjectively better in RD CT compared to SD CT (P<0.01). Repeated target lesion size measurements were highly reliable both on SD CT (ICC=0.987) and RD CT (ICC=0.97).

CONCLUSION
RD CT imaging with MBIR provides diagnostic imaging quality in follow-up exams while allowing dose reduction by an average of 44% compared to SD CT imaging.

CLINICAL RELEVANCE/APPLICATION
RD CT imaging using MBIR or other dose reducing techniques can be used in patients undergoing multiple follow-up exams to reduce radiation exposure without compromising image quality.

G353-SD-MOB6 Sweeping and Positioning Auto-registration for Image Fusion of Real Time Ultrasound with Magnetic Resonance Images: A Prospective Comparison of the Two Methods

Station #6

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PURPOSE
To compare the accuracy of and the time required for image fusion between real-time ultrasonography (US) and pre-procedural magnetic resonance (MR) images using sweeping auto-registration with those of positioning auto-registration, respectively, both of which are newly developed automatic fusion imaging techniques from Samsung Medison.

METHOD AND MATERIALS
The study protocol was approved by the institutional review board in our institution and all patients gave written informed consent before being enrolled. This prospective study consisted of 22 patients who were referred for planning US to assess the feasibility of radiofrequency ablation for focal hepatic lesions. The accuracy, evaluated by measuring the registration error, the number of point locks used and the time spent for image fusion for both methods were recorded using in-house softwares and were compared respectively using Wilcoxon signed rank test.

RESULTS
Image fusion was successful in all 22 patients. The number of point lock required for image fusion was statistically lower in sweeping auto-registration than positioning auto-registration (median, 1 point lock; range, 1 - 2 point locks; mean, 1.4 point locks; standard deviation, 0.5 point locks vs. median, 2 point locks; range, 1 - 3 point locks; mean, 2.0 point locks; standard deviation, 0.4 point locks, p = 0.001). The time required for image fusion was significantly shorter with positioning auto-registration than with sweeping auto-registration (median, 28.5 seconds; range, 18 - 47 seconds vs. median, 44.5 m; range, 29 - 74 m, p < 0.001).

The registration error was not significantly different between the two methods (median, 3.75 mm; range, 1.0 - 15.8 mm vs. median, 4.15 mm; range, 1.8 - 9.9 mm, p = 0.808).

CONCLUSION
Positioning auto-registration offers faster image fusion between real-time US and pre-procedural MR images than sweeping auto-registration while providing similar degree of accuracy but requiring higher number of point locks.
**GI354-SD-MO87 Variability in Tissue Attenuation Measurements with Dual Energy Spectral CT at Different Table Heights**

Station #7

Participants
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**PURPOSE**
To determine if table height alters the measured attenuation values on calculated monoenergetic images from dual energy spectral CT datasets.

**METHOD AND MATERIALS**
An anthropomorphic phantom was imaged using Discovery HD 750 with gemstone spectral imaging (GE Healthcare; Waukesha, WI). The phantom was imaged in centered position and mis-centered positions (3, 6 and 9 cm above, and 3, 6 and 9 cm below center). Attenuation values were recorded in the center of phantom for soft tissue and posterior phantom for bone at different virtual monoenergetic energies (VME) (40, 52, 70 and 140 keV). For each table position and VME, eight soft tissue and eight bone attenuation values were recorded. Attenuation was measured at the same locations in the phantom regardless of table height. ANOVA analysis was performed to determine if mean soft tissue and bone attenuation values differ at various table heights.

**RESULTS**
For VME of 40, 52 and 70 keV, mean soft tissue attenuation values were lowest at -3 cm table position [mean(SD) of 46(20), 44(12) and 43(8) HU, respectively], and highest at +9 cm table position [mean(SD) of 71(21), 60(13) and 51(8) HU, respectively] and +9 cm table position [mean(SD) of 73(16), 61(8) and 52(7) HU, respectively]. For 140 keV monoenergetic images, mean soft tissue attenuation was lowest at -3 cm table position [42(8) HU] and highest at +6 cm table position [46(6) HU]. Mean soft tissue attenuation values were significantly different at different table heights for 40 and 52 keV (p < 0.05), but not for 70 and 140 keV.

**CONCLUSION**
Vendor formulae used to compute simulated monoenergetic energy levels resulted in significantly different attenuation values based on the table height during the scan. Differences were greatest for lower monoenergetic images and at extremes of table positioning (+9 cm and -9 cm).

**CLINICAL RELEVANCE/APPLICATION**
Tissue attenuation measurements with dual energy spectral CT vary with table height, especially for lower virtual monoenergetic energy levels. Thus, consistent centering in the CT gantry is important if absolute attenuation values are used for clinical decision making.

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**GI355-SD-MO88 Acute Gastrointestinal Vaso-occlusive Ischemia in Sickle Cell Disease: Incidence, CT Imaging Features, and Clinical Outcome**

Station #8

Participants
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**PURPOSE**
To determine the incidence, specific imaging features, and outcome of gastrointestinal vaso-occlusive ischemia (GVOI) in sickle cell patients undergoing CT for acute abdominal pain.

**METHOD AND MATERIALS**
This HIPAA-compliant, IRB-approved retrospective study evaluated sickle cell patients with an abdominal pain crisis and acute gastrointestinal abnormalities on CT from 1/2006 to 1/2014. CT findings were divided into those compatible and incompatible with bowel ischemia or GVOI. Two abdominal radiologists (1, 13 years’ experience) reviewed the CTs for specific imaging features of ischemia. Clinical laboratory values (lactate, WBC) and outcome were recorded. Descriptive statistics and Wilcoxon-Mann-Whitney two-sample rank-sum test were performed.

**RESULTS**
Of 217 CTs, 33 had acute gastrointestinal abnormalities: 75% (25/33) consistent with ischemia. Complications of ischemia occurred in 16% (4/25): ileus (50%), perforation (25%), pneumatosis (25%). In uncomplicated cases, all had bowel wall thickening:
segmental 52% (11/21) or diffuse 48% (10/21). The colon was commonly involved (76%, 16/21), particularly the ascending (57%, 12/21). Most abnormalities (52%, 11/21) were in the superior mesenteric artery distribution. Average lactate (4.3±4.0 mmol/L, p=0.02) and WBC count (20.1±10.4, x1000 cells/microliter, p=0.01) were significantly higher in GVOI. Overall mortality in patients with GVOI was 17% (3/18).

CONCLUSION

GVOI is an important feature of the acute abdominal crisis in patients with sickle cell disease and can be seen in up to 75% of patients with abnormal bowel findings on CT.

CLINICAL RELEVANCE/APPLICATION

The diagnosis should be strongly considered in sickle cell patients with CT findings of diffuse or segmental bowel wall thickening, particularly involving the colon.

GII134-ED-MOB9  A Primer of the Fluoroscopic Examination of the Post Surgical Gastrointestinal Tract

Station #9

Awards

Certificate of Merit

Participants

Alberto I. Carbo, MD, Shreveport, LA (Presenter) Nothing to Disclose
Dean D. Maglinte, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

Fluoroscopic examination of the post operative (PO) gastrointestinal (GI) tract has remained essential despite advances in cross sectional imaging. Teaching points of the exhibit are: To describe the most common operations performed on the GI tract. To detail the rationale for each surgery. To provide basic knowledge of contrast agents, patient positioning, anatomic areas and radiologic features to evaluate these patients properly tailored to the operations they have had. To illustrate the normal PO appearance, as well as the most common early and late complications.

TABLE OF CONTENTS/OUTLINE


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/

Alberto I. Carbo, MD - 2015 Honored Educator

GII187-ED-MOB10  A Pattern-based Approach to the Differential Diagnosis of Biliary Dilatations

Station #10

Participants

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Andreí S. Purysko, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
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Erick S. Hollanda, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

- Biliary dilatation is a frequent indication for MR and MRCP examination. The most frequent causes are choledocolithiasis, malignancy and iatrogenic disease. However, a range of differential diagnoses includes other diseases, such as primary sclerosing cholangitis, recurrent pyogenic cholangitis, bile duct cysts, portal biliopathy, pancreaticobiliary malignancy and IgG4-related cholangiopathy. The pattern and distribution of biliary dilatation can help on narrowing the differential diagnosis. The authors propose an algorithm for differential diagnosis of biliary duct dilatation, in accordance with MRCP findings of pattern and distribution.

TABLE OF CONTENTS/OUTLINE

- MRCP: protocols, tips and tricks. Biliary tract dilatation patterns at MRCP: a didactic algorithm: diffuse vs. segmental vs. focal. Symmetric vs. Asymmetric Regular vs. Irregular Peripheral vs. Central Fusiform vs. Saccular. Classifying the main lesions that present with biliary duct dilatation: Choledocolithiasis iatrogenic and post-surgical stenosis Pancreatic malignancy Klatskin’s tumor Peripheral cholangiocarcinoma Liver metastasis Primary sclerosing cholangitis IgG4-related cholangiopathy Eosinophilic cholangitis Caroll disease Acute cholangitis Recurrent pyogenic cholangitis
Gadoxetic Acid-enhanced Magnetic Resonance Imaging of the Liver: Differential Diagnosis of Hyperintense Observations on Hepatobiliary Phase

Station #11

Participants
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Ana Livia G. Brum, MD, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The aims of this review are to:- To review the utility of Gadoxetic Acid-enhanced MR Imaging of the Liver.- To illustrate several hepatic observations that may show hyperintensity on hepatobiliary phase (HBP) images on Gadoxetic Acid-enhanced Magnetic Resonance Imaging of the Liver.- To describethe advantages of the HBP in detection and characterization of liver observations.

TABLE OF CONTENTS/OUTLINE
Gadoxetic Acid is a contrast agent with combined properties of a conventional non-specific extracellular and a hepatocyte-specific contrast agent. Use of Gadoxetic Acid improves both detection and characterization of focal hepatic observations. Hyperintense Liver Observations on Hepatobiliary phase (HBP) are Hepatocyte-containing lesions. Most benign hepatocellular observations, such as Focal Nodular Hyperplasia, Nodular Regenerative Hyperplasia and Transient Hepatic Intensity Differences are characterized by iso to hyperintensity on HBP images. Cirrhosis-related nodules, such as Regenerative Nodules and Dysplastic Nodules are typically iso to hyperintense on HBP images, since uptake and excretion of the contrast agent are preserved. Most malignant lesions, such as Hepatocellular Carcinoma and metastases are hypointense on HBP images, although hyperintense HCCs are also sometimes encountered.

Cytoreductive Surgery (CRS) with Hyperthermic Intraperitoneal Chemotherapy (HIPEC) and Peritoneal Carcinomatosis Index (PCI) Part 2: What Surgeons Want To Know, Critical Spreading Features of Peritoneal Metastases of Beyond Colorectal Cancer

Awards
Identified for RadioGraphics

Participants
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Gabriella Palmer, MD, PhD, Stockholm, Sweden (Abstract Co-Author) Nothing to Disclose
Lennart Blomqvist, Stockholm, Sweden (Abstract Co-Author) Patent agreement, Bayer AG

TEACHING POINTS
To illustrate the specific tumor spreading pathways with critical impact for CRS with HIPEC. To illustrate pearls and pitfalls in the evaluation of peritoneal metastases of various primary organs other than colorectum. To discuss limitations and future perspectives of radiological imaging of peritoneal metastases in cases of CRS with HIPEC.

TABLE OF CONTENTS/OUTLINE
CRS with HIPEC has been recognized as an effective treatment for patients with peritoneal carcinomatosis from primary or recurrent colorectal cancer. To achieve the maximum efficacy of this procedure, complete cytoreductive surgery is essential. Specific tumor spreading features such as carcinomatosis in the liver hilum and extensive small bowel involvement, may have critical negative impact on CRS because of surgical difficulties. Extensive knowledge about pattern of tumor spreading on various primary tumors other than colorectum may improve diagnostic accuracy. In this exhibition, first, specific tumor spreading pathways that may have critical impact on surgery will be illustrated. Second, pearls and pitfalls in evaluation of peritoneal metastases will be illustrated. Finally, limitations and future perspectives of preoperative radiological imaging will be discussed.
Dementia: An Automated Method to Compute Evans’ Index for Diagnosis of Idiopathic Normal Pressure Hydrocephalus on Brain CT Images

Participants
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Srinivas C. Kappadath, PhD, Houston, TX (Moderator) Research Grant, General Electric Company

PURPOSE
The diagnosis of idiopathic normal pressure hydrocephalus (iNPH) considered as a treatable dementia is becoming increasingly important. Evans’ index, one of the diagnostic imaging criteria, is used as an index of ventricular enlargement and its value greater than 0.3 is a hallmark for iNPH. However, manual measurement of Evans’ index for radiologists is time-consuming and it may have low reliability. We propose an automated method to compute Evans’ index to assist the diagnosis of iNPH on CT images.

METHOD AND MATERIALS
Evans’ index is defined as the ratio of the maximal width of the frontal horns (FH) to the maximal width of the inner skull (IS). The algorithm of the method consisted of standardization to an atlas, segmentation of FH and IS regions, the search for the outmost points of bilateral FH regions, determination of the maximal widths of both the FH and the IS, and calculation of Evans’ index. The normalization to the atlas was performed by using linear affine transformation and non-linear wrapping techniques. The FH and the IS regions were segmented by using a three dimensional region growing technique. CT scans from 20 subjects with ventricular enlargement varying in size, including four iNPH patients, were used for computation of Evans’ index by use of the proposed method. In order to evaluate the computed results, Evans’ indexes were also manually determined by a neuroradiologist (gold standard).

RESULTS
The mean Evans’ index value of the proposed method and the gold standard was 0.316 (range, 0.208 - 0.397) and 0.325 (range, 0.246 - 0.419), respectively, and the average difference in Evans’ index between the proposed method and the gold standard was 0.01 (3.3%) in the 20 subjects.

CONCLUSION
This computerized method has the potential to accurately calculate Evans’ index for the diagnosis of iNPH on CT images.

CLINICAL RELEVANCE/APPLICATION
This automated method may assist radiologists to diagnosis iNPH on CT images.

Optimizing MR Parameters for Attenuation Correction in PET/MR Hybrid System

Participants
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PURPOSE
To investigate MR parameter effects on tissue segmentation and MR sequences for PET/MR hybrid imaging attenuation correction.

METHOD AND MATERIALS
Five healthy volunteers were examined on the Ingenuity TF PET/MR (Philips, Cleveland, OH) system with six three-dimensional (3D) turbo-field-echo (TFE) sequences for attenuation correction by modifying the echo time (TE), k-space trajectory in the phase-encoding direction, and image contrast. MR images for attenuation correction were obtained from six MR sequences in each session; each volunteer underwent four sessions. Two radiologists assessed the attenuation correction maps generated from the MR images with respect to segmentation errors and ghost artifacts on a 5-point scale, and the scores were decided by consensus. Segmentation accuracy and reproducibility were compared. A multiple regression analysis was performed to determine the effects of
each MR parameter.

RESULTS

The two 3D-TFE sequences with an in-phase TE and radial k-space sampling showed the highest total scores in segmentation accuracy with high reproducibility. In the multiple regression analysis, the score was significantly decreased with the shortest TE (-3.40, P < 0.0001) and with Cartesian sampling in the anterior/posterior phase-encoding direction (-2.25, P = 0.047) when compared with in-phase TE and the right/left phase-encoding direction. Radial k-space sampling provided a significantly higher score (+5.45, P < 0.0001) than Cartesian sampling. Radial sampling also improved the intra-subject variation of the segmentation score (-8.07%, P = 0.0081). Image contrast had no significant effect on total score or reproducibility.

CONCLUSION

3D-TFE MR sequences with an in-phase TE and radial k-space sampling can improve MR-based attenuation correction maps.

CLINICAL RELEVANCE/APPLICATION

Optimizing MR parameters for attenuation correction in a PET/MR hybrid scanner can improve segmentation accuracy and could provide more accurate SUV measurement.

PH232-SD-MOB4 Evaluation of Systolic and Diastolic Phase Motion Artifacts at Various Heart Rates During ECG Gated CT Acquisitions with a Novel Reconstruction Algorithm

Station #4

Participants

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CONCLUSION

Our results showed that the phase at which FBP images had less motion was HR dependent, which is consistent with known clinical scenario today. However for the TEVR images, motion artifacts were much lower at all HRs resulting in a more stable HU in the vessels. No phase dependency was also observed. Selecting either a systolic or diastolic phase provided similar motion artifact reduction at all HR using the new technique.

Background

Motion during cardiac CT imaging can potentially cause coronary arteries and other structures to appear blurred in the images. This could hamper the reliable assessment of the images. Precise selection of a relevant phase of R-R cycle based on patient heart rate (HR) is necessary but is not guaranteed to provide diagnostic images in all cases. A novel temporal enhanced volume reconstruction (TEVR) has been recently developed that aims to reduce any motion artifacts in cardiac images. In this study we looked at the impact of TEVR for a range of HRs.

Evaluation

A vessel phantom was attached to a coronary motion simulating phantom (MOCOMO, Fuyo Corp, JP) and scanned on a 128 slice CT scanner with 250 ms gantry rotation. Data was acquired at HR settings of 0 and 65-115 BPM. Images at each HR were reconstructed at 45% and 75% phases using half scan filtered back projection (FBP) and TEVR. Modulation transfer function (MTF) measurements were done on the vessel edges in the images. The amount of motion blur in vessels was also quantified by center to edge (CED) distance method. Images at different HRs were compared to static scan to determine the %error in measurement.

Discussion

The overall error in MTF values for TEVR images at all HR ranged from +3.8% to -4.8%. The FBP images consistently underestimated the MTF. The % error for 75 phase was -11, -5, -28, -47, -66 and -55 at HR of 65,75,85,95,105 and 115 resp; while for 45 phase it was -43, -30, -12, -23, -16, -15. For CED, the error in FBP ranged between [126.1%-203%] at 45 and [54.9%-264.9%] at 75 while it was [0.5%-41.9%] and [5.2%-81.2%] resp. for TEVR images. Mean vessel HU in the static scan was 250 and 253 resp for FBP and TEVR. For motion scans, it showed a larger variation [158-221 HU] for FBP compared to a much stable [246-252 HU] for TEVR images.

PH233-SD-MOBS A Method to Measure Slice Sensitivity Profile of Recent Non-linear CT Images at Low Contrast-to-Noise Ratio Condition

Station #5

Participants

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CONCLUSION

By our method, reliable SSP measurement was possible at a CNR as low as 1.5. The assessment of longitudinal resolution of CT images by recent IR-type methods, at clinical conditions, is possible.

Background

In-plane image quality of recent iterative reconstruction (IR) methods is being fervently assessed. But, the behavior of longitudinal resolution or slice sensitivity profile (SSP) is not known. Non-linear nature of IR does not allow the use of ordinary SSP
measurement method. We need a method to assess SSP of low-contrast object at high-noise reflecting clinical condition.

Evaluation

We use thin low-contrast disks of a finite size as a test object. SSP is defined by tracing CT number within an ROI along z-direction. We use finite size of ROI to combat with noise. SSP error due to cone-beam helical artifact was evaluated by simulation, using a typical cone-beam helical reconstruction algorithm, with parameters such as disk size, number of detector rows (or cone-angle) and longitudinal disk position. We tested SSP measurement using Toshiba Aquilion 64 with 64-row 0.5mm helical scan, and 1 second rotation. The test phantom consisted of 4 plastic disks, having contrast from 15 to 150 HU, in an acrylic cylinder. It was immersed in water of 240 mmØ. Consecutive two helical scans were performed so that their time interval corresponds to (integer+0.5) rotations, then their helical orbits interleave each other (anti-phased scan).

Discussion

Larger the disk, more the number of rows, deviation of measured profile from ground truth worsened. Effect of disk size was quadratic. We judged 25 mm may be adequate to use for 64-row CT. Using 25 mm, the noise tolerance was acceptable, such that the fluctuation of SSP width due to noise was +3% (3 sigma) at CNR=2. The measurement error depended on the longitudinal disk position. It was synchronous with helical scan orbit. Use of a pair of anti-phased scan reduced the error to half or lower. The error of SSP width was within +2.8% to +5.5% for disks having 15 to 150 HU peak contrast at noise SD 10 HU. Mean error (or repeatable error) was correctable and remaining error was within +2%. Without use of anti-phased scan, the error was double or more.

PH234-SD-MOB6 Scan Time Reduction for 3D TOF MR Angiography of the Brain Using Single Slab at 3.0 T

Station #6

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CONCLUSION

A single slab MRA had reduced scan time for 3D TOF MR angiography of the brain. The shorter TR (16 msec) can be employed together with lower flip angle (8-10-12 deg with TONE) to increase depth penetration.

Background

The multi slab MR Angiography (MRA) improved the depiction of the peripheral artery of the brain. However, all of the slabs need to overlap by 20-50% to avoid venetian blind effects in between the slabs. The protocol cause long scan time by the overlapping. In order to reduce scan time, we investigated the method using a single slab of 3D time of flight (TOF) MRA of the brain.

Evaluation

Our work was performed on a 3.0 T MR system (Achieva 3.0T TX, Philips). The optimal repetition time (TR), flip angle and tilt angle) and longitudinal disk position. We tested SSP measurement using Toshiba Aquilion 64 with 64-row 0.5mm helical scan, and 1 second rotation. The test phantom consisted of 4 plastic disks, having contrast from 15 to 150 HU, in an acrylic cylinder. It was immersed in water of 240 mmØ. Consecutive two helical scans were performed so that their time interval corresponds to (integer+0.5) rotations, then their helical orbits interleave each other (anti-phased scan).

PH235-SD-MOB7 Quantitative Evaluation of Developmental Retardation Based On Brain Morphometry PCA Analysis in Neonatal MRI

Station #7

Participants
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PURPOSE

This study aims to estimate brain growth age based on brain morphometry change for the purpose of evaluating brain development in neonates.

METHOD AND MATERIALS

15 neonates with normal development and 4 neonates with abnormal development were involved in this study. The revised age was 33.7±40.7 days. T2-weighted images of MRI were obtained from all subjects. Our method evaluates the brain morphometry using
anatomical landmarks; inferior extremity of genu corporis callosi, inferior extremity of splenium corporis callosi, interpeduncular cistern at the longitudinal fissure section, and cross point of superior frontal and precentral sulci, anterior extremity of temporal lobe, anterior extremity of frontal lobe, and posterior extremity of occipital lobe at the each of the right and left hemispheres. The method consists of learning and estimation stages. The learning stage constructs a brain age estimation formula using a training data with N healthy neonates. First, it calculates Euclidean distances between all combinations of landmarks. The measured M distances are a set of feature vector. Secondly, it applies principal component analysis (PCA) to a matrix of N subjects by M features. PCA calculates eigenvectors and principal component (PC) scores of each subject. Thirdly, it derives a regression model whose dependent variable is revised age, and independent variables are PC scores. The estimation stage first obtains the feature vector of evaluating brain. The feature vector is transformed into PC scores using eigenvectors. Finally, the method estimates the brain age using the trained regression model.

RESULTS

11 normals were used to train the regression model. The figure shows the estimated brain age for normals in the training data, and normals and abnormals in evaluation data. The absolute error for normals are 15.5±11.8 days in training data and 46.3±37.2 in evaluation data. And, the estimated brain age of abnormals was different from their real age.

CONCLUSION

The brain growth age can be estimated by using landmarks, and it may be effective to diagnose the brain development. Future works are to evaluate the proposed method in a large dataset, and to optimize the set of landmarks. Because the method only requires some landmarks, it can be easily installed in the clinical routine work.

CLINICAL RELEVANCE/APPLICATION

Brain growth age can be estimated from a limited number of anatomical landmarks.

PH236-SD-MOB8 Assessment of CT Dose Reduction using a New Organ-based Tube Current Modulation Technique; Comparison with Standard Dose and Bismuth-shielded Acquisitions

Station #8

Participants
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Robert G. Gould, Dsc, San Francisco, CA (Abstract Co-Author) Research Grant, Koninklijke Philips NV

PURPOSE

To evaluate the radiation dose and image noise resulting from use of organ-based tube current modulation (ODM), recently available on a Revolution CT scanner (GE Healthcare). This ODM program reduces tube current across an x-ray source angle of either 100° or 150° centered above the table, while maintaining the standard modulated tube current throughout the remaining angular positions. This implementation, which results in a reduction of overall mAs, is different to existing ODM that increases posterior mA to compensate for the anterior reduction.

METHOD AND MATERIALS

Three types of tube current modulated-scan; reference, ODM, and reference + bismuth shield were acquired at 120 kVp with 14 cm long CTDI phantoms placed on the patient table. 100° ODM was evaluated using a 16 cm phantom, and 150° ODM using both 16 and 32 cm CTDI phantoms. These combinations of phantom and ODM angle represent the scanning of the head, neck and chest regions respectively and while imperfect, can provide rough estimates of any dose savings to radiosensitive organs, eyes, thyroid and breast. Dose measurements were acquired at a central and eight peripheral locations using a 10 cm long pencil ionization chamber. Image noise was measured at the same regions, and also at eight locations closer to the phantom center.

RESULTS

Anterior near-surface dose reductions were 18%, 24% and 27% for the ODM protocol in scans representing the head, neck and chest regions respectively, compared to 41%, 41% and 40% for the reference + bismuth shield protocol. Anterior image noise increased by 11% 10% and 9% for head, neck and chest regions respectively, compared to 728%, 456% and 73% for the bismuth shield. The ODM protocol resulted in measured CTDIvol reductions from the reference protocol of 9%, 15% and 13% for the head, neck and chest regions respectively, compared to 41%, 41% and 40% for the reference + bismuth shield protocol. Anterior image noise reductions were 18%, 24% and 27% for the ODM protocol in scans representing the head, neck and chest regions respectively and while imperfect, can provide rough estimates of any dose savings to radiosensitive organs, eyes, thyroid and breast.

CONCLUSION

Net dose reducing organ-based tube current modulation provides more modest dose reduction to the anterior organs than bismuth shielding, but is not associated with the large increase in image noise observed with these shields. The reduction in overall CTDIvol is similar between the two techniques.

CLINICAL RELEVANCE/APPLICATION

Organ-based tube current modulation during CT scanning reduces dose to radiosensitive anterior organs, but requires evaluation to ensure that diagnostic image quality is maintained.

PH237-SD-MOB9 Automatic Detection and Correction of Misaligned SPECT Quality Assurance Phantom Data

Station #9

Participants
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Fitzgerald Leveque, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Christopher J. Palestro, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose

CONCLUSION

Standardized phantom data are sufficiently predictable to permit accurate misalignment measurement, enabling automated post-acquisition software corrections, even for extremely misaligned data.
Background

Laboratory accreditation agencies specify a minimum number of spheres that should be visible in transaxial sections passing through the middle of the largest sphere of standardized SPECT phantoms consisting of 6 spheres (9.5 mm - 31.8 mm) and 6 rod sectors (4.8 mm - 12.7 mm) immersed in a 7-liter radioactive cylindrical water bath. The degree to which phantom misalignment with the axis of rotation artifactually degrades apparent system response is unknown. We investigated the minimum misalignment angle that causes SPECT QA misinterpretation and prevalence of phantom misalignment.

Evaluation

Algorithms were written to detect, quantify and correct misalignment of standardized phantoms. Data were processed retrospectively for 28 SPECT phantom data sets routinely collected for quarterly QA tests (12 1-detector systems and 16 2-detector systems), as well as 7 phantoms purposefully misaligned by -9° to +9°. Phantoms were collected as 128x128 matrices for 128 projections using 740-814 MBq Tc-99m in water for 30-34 million counts, reconstructed by filtered backprojection with Hamming post-filter (cutoff = 1.0), with Chang method attenuation correction ($\mu = 0.11$), and examined for numbers of visible rods and spheres before and after automated realignment.

Discussion

Detected misalignment angles correlated with actual angles ($r = 0.99$, $p < 0.0001$), with similar magnitude (4.6±3.4° versus 4.3±3.7°, $p = 0.79$). For 9° misalignment simulations, only 2 spheres had contrast > 2 standard deviations above mean background contrast and were deemed visible in the section through the 31.8 mm sphere. Following automated reorientation, 4 spheres had contrast > 2 standard deviations above mean background contrast and were deemed visible. For angles ≤ 6°, 4 spheres and 4 rods were visible regardless of misalignment. In data collected for routine QA, mean misalignment angles were larger for 1-detector than 2-detector systems (4.8°± 0.7° versus 0.7°±0.3°, $p = 0.002$), with a 2.1° maximum observed in 1-detector data, well below the 9° threshold for misinterpreting image quality.

RESULTS

The visual inspection shows that the texture of the OBIR images enhanced by the method proposed in this work mimics that of the FBP images. The NPS analysis quantitatively confirms the visual inspection results.

CONCLUSION

It is shown that, enabled by the proposed method, the texture of images reconstructed by the OBIR algorithm from sparse projection views can mimic that of the images by the FBP algorithm.

CLINICAL RELEVANCE/APPLICATION

The OBIR method proposed by us with texture enhancement produces images that are visually similar to the gold standard FBP views in the same manner. With 984 such generated noise views, we reconstruct an image with the FBP algorithm and add it into the OBIR image for texture enhancement. A water phantom is used for performance evaluation via visual inspection and quantitative assessment of noise power spectrum (NPS). The method is also tested for texture enhancement using a humanoid head phantom.

PURPOSE

In order to reduce radiation dose in clinical CT applications, the optimization-based image reconstruction (OBIR) from sparse views has been proposed. However, the OBIR usually produces images with a texture that is quite different from a reconstruction by the FBP algorithm. Recognizing the fact that a beam forming device (bowtie) exists in a clinical CT scanner to make the x-ray intensity incident on each detector cell relatively even, we propose and evaluate an adaptive noise injection method for texture enhancement in the OBIR.

METHOD AND MATERIALS

Given each of the sparse (e.g., 246) projections, we acquire the magnitude of noise as square root of the inter-cell variance that is calculated over the detector cells without the object to be imaged attenuating the x-ray. The noise of each detector cell, i.e., a view of noise, is generated by multiplying the noise magnitude with a Gaussian random variable with zero mean and unit variance. Supposing a clinical CT scanner acquire 4 times more projection views (e.g., total 984 views) in a full scan, the noise magnitude of view of noise, is generated by multiplying the noise magnitude with a Gaussian random variable with zero mean and unit variance.

RESULTS

The visual inspection shows that the texture of the OBIR images enhanced by the method proposed in this work mimics that of the FBP images. The NPS analysis quantitatively confirms the visual inspection results.

CONCLUSION

It is shown that, enabled by the proposed method, the texture of images reconstructed by the OBIR algorithm from sparse projection views can mimic that of the images by the FBP algorithm.

CLINICAL RELEVANCE/APPLICATION

The OBIR method proposed by us with texture enhancement produces images that are visually similar to the gold standard FBP images, while the radiation dose is significantly reduced.
CONCLUSION

On conventional SECT images contrast enhancement decreased as the object size increased. Monochromatic image using DECT scan data may reduce BHEs and preserve the accuracy of the CT number of iodine-enhanced structures even in larger subjects.

FIGURE (OPTIONAL)


Background

Theoretically, beam-hardening effects (BHEs) are reduced on virtual monochromatic images (VMIs) generated from dual energy CT (DECT). The enhancement of iodine contrast agents is decreased especially larger subjects although if BHEs are corrected the accuracy of the CT number of enhanced structures is maintained. Using a phantom we compared the CT number of iodine-enhanced structures on single-energy CT (SECT)- and DECT images.

Evaluation

We scanned 3 cylindrical phantoms (200 - , 250 - , 300 mm in diameter and 60 mm in length along the z-axis, see figure) using a 320-detector row scanner (Aquilion ONE VISION Edition, Toshiba Medical Systems, Tokyo, Japan). The phantoms were made from acrylic, and were able to insert test tubes. In this study, we inserted test tubes filled with various densities of iodine contrast enhanced agent solutions (iomeprol) and various densities of sucrose solutions. The scan parameters for SECT were 120 kVp and 440 mA (20.2 mGy); for DECT they were 135 kVp at 140 mA and 80 kVp at 800 mA (total 20.1 mGy). The monochromatic images were generated using raw data-based DECT analysis (Toshiba Medical Systems), the energy of the monochromatic images was set to 65 keV. We compared the contrast and the CNR of the iodine contrast agent and the 15% sucrose solution that simulated soft tissue.

Discussion

On SECT images the contrast decreased as the phantom size increased because the degree of the BHE depends on the size of the imaged object, indicating that contrast enhancement is weaker in larger- than small patients (see attached graphs). On the monochromatic 65-keV images generated from DECT scans the contrast was constant irrespective of the phantom size, indicating that on these images BHEs are reduced. As the CNR calculated for monochromatic- was higher than for SECT images, the diagnostic performance of monochromatic images may be superior to SECT images.
Cardiac CT Mentored Case Review: Part III (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, Nov. 30 1:30PM - 3:00PM Location: S406A

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
FDA
Discussions may include off-label uses.

Participants
Pamela K. Woodard, MD, Saint Louis, MO (Director) 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; ; ;
Harold I. Litt, MD, PhD, Philadelphia, PA (Moderator) Research Grant, Siemens AG ; Research Grant, Heartflow, Inc; U. Joseph Schoepf, MD, Charleston, SC, (schoepf@musc.edu) (Moderator) Research Grant, Bracco Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; ; ;

LEARNING OBJECTIVES
1) Identify cardiac and coronary artery anatomy. 2) Recognize cardiac disease processes, including coronary atherosclerosis, as diagnosed on CT. 3) Understand methods of cardiac CT and coronary CT angiography post-processing.

Sub-Events
MSMC23A Pulmonary Veins and Pericardial Disease

Participants
Jacobo Kirsch, MD, Weston, FL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe normal versus anomalous pulmonary venous anatomy. 2) Understand the imaging findings of complications of ablation for atrial fibrillation. 3) Describe abnormalities of the pulmonary veins identifiable on routine CT. 4) Identify the most common pericardial abnormalities evaluated with 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/

Jacobo Kirsch, MD - 2013 Honored Educator

MSMC23B Coronary Atherosclerosis III

Participants
Elliot K. Fishman, MD, Owings Mills, MD (Presenter) Research support, Siemens AG Advisory Board, Siemens AG Research support, General Electric Company Advisory Board, General Electric Company Co-founder, HipGraphics, Inc

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
The goal of this session is to learn how to interpret pathology involving the coronary arteries beyond the detection of coronary artery stenosis. Focus on exam acquisition protocols, study interpretation protocols, and minimizing radiation dose are addressed. Specific topics addressed will also include coronary artery aneurysm, myocardial bridging, anomalous coronary arteries as well as vasculitis. Potential pitfalls will be addressed and pearls for study optimization will also be discussed.

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/

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

**Participants**

- **Jonathon A. Leipsic, MD, Vancouver, BC (Moderator)** Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesiences 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

**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

**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
- **Akos Varga-Szemes, MD, PhD, Charleston, SC (Abstract Co-Author)** Nothing to Disclose
- **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
Patients with severe aortic valve stenosis (AS) who are at high surgical risk are commonly evaluated for transcatheter aortic valve replacement (TAVR) with CT angiographic imaging (CTA) of relevant anatomy and coronary angiography (CC). Many of these patients have increased serum creatinine (Scr), increasing the risk of acute contrast induced nephropathy (CIN). Thus, the incidence of CIN in patients undergoing workup needs to be assessed.

METHOD AND MATERIALS
Between 2012 and 2014, 258 patients underwent workup for TAVR with CTA at a single academic medical center. Patients who underwent both CTA and CC with Scr values measured 24 hours before and within 48 hours after contrast exposure were included in the analysis (n=123). All CTA and CC exams were performed utilizing iopamidol 370mg I/mL via intravenous and intra-arterial administration, respectively, with average contrast volume 110ml ±21ml and 124 ±65ml, respectively. Fifty-five patients had Scr increased on average 0.057 (4.9%, p=0.053), 0.054 (4.3%, p=0.039) and 0.079 (6.6%, p=0.068) for patient groups who had CTA+CC within 24 hours, within 48 hours and greater than 48 hours, respectively. CIN developed in 12.7%, 11.9% and 12.5% of patients who had CTA+CC within 24 hours, 48 hours and greater than 48 hours, respectively. Patients with pre-existing chronic kidney disease had an increase in Scr of 0.075 (5.1%, p=0.041) and a CIN rate 12.5% when CTA+CC were within 48 hours. Patients with DMII had an increase in Scr of 0.145 (9.76%, p=0.002) and increased rate of CIN at 20.7% when CTA+CC were within 48 hours. No patients required dialysis.

CONCLUSION
Work up for TAVR includes significant contrast loads with accompanying risks for CIN. There was a degree of CIN in all groups; however, patients with DMII are the most susceptible when contrast loads occur less than 48 hours apart.

CLINICAL RELEVANCE/APPLICATION
Incidence of CIN for all patient cohorts ranged from 11.9% to 12.5%. Patients with DMII are most susceptible to develop CIN when undergoing TAVR evaluation.
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**

Computed Tomography Angiography (CTA) is used in the work-up for transcatheter aortic valve implantation (TAVI) to assess cardiovascular anatomy, annulus size and to determine the optimal access route. However, in the elderly TAVI population, CTA frequently reveals incidental findings that potentially change patient management and prognosis. We aim to determine the effect of incidental findings on the clinical course of patients in TAVI work-up.

**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
Philipp Blanke, MD, Vancouver, BC (Abstract Co-Author) Consultant, Edwards Lifesciences Corporation; Consultant, Neovasc Inc
Chenral Dey Areppalli, MD, Burnaby, BC (Abstract Co-Author) Nothing to Disclose
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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.
SSE05 - Microwave Ablation (MWA), Radiofrequency Ablation (RFA) and Laser-induced Interstitial Thermotherapy (LITT) in Patients with Primary and Secondary Lung Tumors: Evaluation of Tumor Volume and Recurrence Rate

**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.

SSE05-02 - Thermal Ablation of Colorectal Lung Metastases: Retrospective Comparison of LITT, RFA and MWA Concerning Local Tumor Control Rate, Time to Progression, and Survival Rates

**PURPOSE**
To retrospectively evaluate local tumor control, time-to-progression, and survival in patients with CRC lung metastases who received laser-induced thermotherapy (LITT), microwave ablation (MWA), or radiofrequency ablation (MWA).
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 6 (p=0.004) and 18 (p=0.01) 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-, 3-, 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
Nour-Eldin A. Nour-Eldin, MD, PhD, Frankfurt Am Main, Germany (Presenter) Nothing to Disclose
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Stefan Zangos, 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 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
Assuming all PN observed in cancer patients as being metastatic disease will lead to high rates of inaccurate diagnosis and conclude that tissue sample is still essential for accurately diagnosing and treating pts with solid tumors presenting with PNs. However, a high rate of non-metastatic disease was found in this group of pts. Given that procedural complications were low, we confirmed in 63.1%. Lung primaries were found in 26.3%. Other findings included infectious diseases (7.4%) and benign lesions (2.6%).

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.

**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%, 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 0.005 in non-coaxial group and 0.001 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=0.003 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

**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
inappropriate subsequent treatments. Tissue sampling is still fundamental for accurately diagnosing and treating cancer patients.

**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
SSE06

Emergency Radiology (Emergent Musculoskeletal and Spine Imaging)

Monday, Nov. 30 3:00PM - 4:00PM Location: N227

Participants
Sujit Vaidya, MD, London, United Kingdom (Moderator) Nothing to Disclose
Bharti Khurana, MD, Boston, MA (Moderator) Nothing to Disclose

Sub-Events

SSE06-01  CT for Thoracic and Lumbar (T- and L-) Spine Fractures: Can CT Findings Accurately Predict Posterior Ligament Complex (PLC) Disruption?

Participants
Bharti Khurana, MD, Boston, MA (Presenter) Nothing to Disclose
Luciano M. Prevedello, MD, MPH, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Heidi Miracle, Boston, MA (Abstract Co-Author) Nothing to Disclose
Erwin Lin, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Steven T. McCormack, MD, Weston, MA (Abstract Co-Author) Nothing to Disclose
Christopher M. Bono, MD, Boston, MA (Abstract Co-Author) Advisory Panel, UnitedHealth Group; Royalties, Wolters Kluwer nv;
Mitchell A. Harris, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Aaron D. Sodickson, MD, PhD, Boston, MA (Abstract Co-Author) Research Grant, Siemens AG; Consultant, Bracco Group

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 OR 5.4-8.1 (all p<0.002) for PLCD, with sensitivity 75-90%, specificity 37-63%. Multivariate regression analysis showed similar results, with FPL as the most predictive individual CT finding, with sensitivity 30-57%, specificity 75-92%.

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.

SSE06-02  Accuracy of the NEXUS-criteria for CT

Participants
R. S. Smit, MD, Almelo, Netherlands (Presenter) Nothing to Disclose
Jb Egbers, Almelo, Netherlands (Abstract Co-Author) Nothing to Disclose
A. F. Hoogerwaard, Almelo, Netherlands (Abstract Co-Author) Nothing to Disclose
J. J. van Netten, Almelo, Netherlands (Abstract Co-Author) Nothing to Disclose
PURPOSE

Purpose: The NEXUS-criteria** are validated criteria to identify adult patients who need conventional radiography of the cervical spine after blunt trauma. Despite the fact that CT is internationally seen as the 'golden standard' when cervical spine injury is suspected, the NEXUS-criteria have never been validated for CT. We tested the accuracy of the NEXUS-criteria for CT with simultaneously implementation of the Dutch guidelines for blunt trauma (CBO, 2009) of the cervical spine after high-energy trauma.

**Hoffman et al. NEJM 2000:94-99

METHOD AND MATERIALS

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

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

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.

SSE06-03 Comparison of Radiation Dose-equivalent Radiography, Multidetector Computed Tomography and Cone Beam Computed Tomography for Fractures of the Wrist

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.

METHOD AND MATERIALS

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.

SSE06-04 Diagnosis of Acute Fractures of the Thoracic Spine Using Bone Marrow Edema Detected by Dual-Energy CT
**Diagnostic Value of CT in Patients with Suspected Thoracic Spine Fractures Due to Minor Trauma**

**Participants**
Dennis Parhar, BSc, Vancouver, BC (Presenter) Nothing to Disclose
Teresa I. Liang, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Ismail T. Ali, MBCHB, MD, 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**
The assessment of bone marrow edema is limited in conventional CT. Dual-energy CT (DECT) with virtual non-calcium (VNCa) images allows subtraction of bone mineral to better reveal the fluid attenuation of bone marrow. The purpose of this study is to describe our clinical experience with DECT VNCa images for the detection of bone marrow edema in acute fractures of the thoracic spine.

**METHOD AND MATERIALS**
In this retrospective study, 397 thoracic vertebral bodies from 36 consecutive patients were assessed for the presence of bone marrow edema in acute fractures. Each of these patients underwent DECT of the thoracic spine (100kV-Sn140kV, 255refmAs, 40x0.6mm) using a dual source 128-slice CT scanner (Definition FLASH, Siemens Healthcare, Germany) between November 9, 2014 and March 31, 2015. The DECT data was post-processed using a 3-tissue algorithm to create VNCa images on a multimodality CT workspace. Each vertebral body was independently evaluated by two readers for the presence or absence of abnormal bone marrow edema on greyscale and color-coded maps. Attenuation of each of the vertebral bodies was then obtained. This data was then subjected to receiver operating characteristic (ROC) curve analysis to determine the sensitivity, specificity, and accuracy of using bone marrow edema to diagnose acute fractures of the thoracic spine.

**RESULTS**
Vertebrae positive for acute fracture demonstrated a statistically significant increase in the attenuation of abnormal bone marrow edema (114.2 ±15.06HU in acute fractures compared to -2.118 ±1.699HU in non-fractures, p<0.0001). Inter-reader agreement for the presence of abnormal bone marrow edema was excellent (κ=0.865). The ROC analysis of the CT attenuation values demonstrated an area under curve (AUC) of 0.987 with an optimal cutoff value of 43.5 HU. This resulted in a sensitivity of 100%, specificity of 93.8%, and an accuracy of 92.9% for detection of acute fractures of the thoracic spine.

**CONCLUSION**
Findings from this study show that bone marrow edema and using a cut-off value of 43.5HU in virtual non-calcium images reconstructed from dual-energy CT can be useful in the diagnosis of acute fractures of the thoracic spine.

**CLINICAL RELEVANCE/APPLICATION**
Virtual non-calcium images derived from DECT allow detection of bone marrow edema and, therefore, provide a convenient and accurate modality for detection and characterization of acute fractures.

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**SPEECH**

**Diagnostic Value of CT in Patients with Suspected Thoracic Spine Fractures Due to Minor Trauma**

**Participants**
Murat Karul, MD, Hamburg, Germany (Presenter) Nothing to Disclose
Amelie Hoffmann, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Jin Yamamura, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

**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, 450refmAs, 40x0.6mm) 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

Participants
Jeong Min Lee, MD, Seoul, Korea, Republic Of (Moderator) 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-Seo Medical Industrial Col, Ltd
Avinash R. Kambadakone, MD, Boston, MA (Moderator) Nothing to Disclose

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 hepatocellular carcinoma (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.

CONCLUSION

Not allow quantification of liver fibrosis.

In phase-contrast images fibrous tissue shows high signal intensity and delineates from surrounding liver tissue. Visual evaluation of hepatic fibrosis is subjective and limited to classification of certain stages.

RESULTS

Fibrosis. Results of visual and software-based staging of hepatic fibrosis were compared to histology.

METHOD AND MATERIALS

Sets were visually graded according to fibrotic stage using a 5-point scale. Additionally, a software-based method was used for tissue decomposition and quantification. Specimens were sliced and stained for histological analysis including classification of fibrosis.

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).

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.

SSE07-03 Quantification of Liver Fibrosis in Human Specimens using Grating-based Phase Contrast Computed Tomography

Monday, Nov. 30 3:20PM - 3:30PM Location: E353A

Participants

Alexander A. Fingerle, MD, Munchen, Germany (Presenter) Nothing to Disclose
Marian Willner, Munchen, Germany (Abstract Co-Author) Nothing to Disclose
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Florian Fischer, MD, Munich, Germany (Abstract Co-Author) Research support, Fumedica AG
Daniele Muenzel, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
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Franz Pfeiffer, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the potential of grating-based phase contrast computed tomography (gbPCCT) for the quantification of fibrosis in human liver specimens and to correlate with histological diagnosis.

METHOD AND MATERIALS

IRB approval was obtained. Thirty human liver specimens with varying degrees of fibrosis were prospectively collected during autopsy at the institute of forensic medicine. Tissue samples were fixed in 4% formalin solution and imaged using a Talbot-Lau interferometer with a rotating-anode X-ray tube and a photon-counting detector. Phase-contrast and attenuation-contrast image sets were visually graded according to fibrotic stage using a 5-point scale. Additionally, a software-based method was used for tissue decomposition and quantification. Specimens were sliced and stained for histological analysis including classification of fibrosis. Results of visual and software-based staging of hepatic fibrosis were compared to histology.

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.

CONCLUSION

Grating-based phase contrast computed tomography allows ex vivo quantification of liver fibrosis in human specimens.

CLINICAL RELEVANCE/APPLICATION

In a clinical setup a gbPCCT scanner may have the potential to improve diagnostics and therapy monitoring of chronic liver disease.
**SSE07-04 Evaluation of the Recently Transplanted Liver with Computed Tomography Perfusion Imaging and Correlation with Clinical Outcome**

**Participants**
Nicholas Hilliard, MBChir, Cambridge, United Kingdom (Presenter) Nothing to Disclose
Andrew B. Gill, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose
David Bowden, MBChir, 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, MBChir, 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, MBCh, 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.

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**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) was 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 ΔH= 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.
**CLINICAL RELEVANCE/APPLICATION**

DSCE CT can accurately grade patients with clinically significant hepatic-iron accumulation. It might be used to guide iron chelation therapy and to monitor chelation effect.

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**SSE07-06 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

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**PURPOSE**

To investigate the role of textural analysis (CTTA) in distinguishing bland thrombus from neoplastic thrombus in the portal venous system.

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**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.

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**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.

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**CONCLUSION**

A simple software based texture analysis can reliably stratify bland and neoplastic thrombus in the portal venous system on CECT images.

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**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)**

Monday, Nov. 30 3:00PM - 4:00PM 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 dependence 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
Reto 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 reviewed 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 etiologies (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 intestinal ischemia (p=0.003). 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=7.48e-10). 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 (5FU, oxapliatin) FOLFOX (5FU, oxapliatin) + bevacizumab irinotin cisplatin +gemcitabine pemetrexed, carboplatin + bevacizumab, then erlotinib + bexavalumab rituximab-ChOP docetaxel + bevacizumab chemoradiation + temozolomide rituximab +methylprednisolone alentrzumab ara-C + DLI afatinib + metforin 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.

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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

**Monday, Nov. 30 3:30PM - 3:40PM Location: E353C**

**Participants**
Frank Oliver G. Henes, MD, Hamburg, Germany (Presenter) Nothing to Disclose
Perry J. Pickhardt, MD, Madison, WI (Abstract Co-Author) Co-founder, VirtuCTC, LLC; Stockholder, Collectar Biosciences, Inc;
Research Consultant, Bracco Group; Research Consultant, KIT; Research Grant, Koninklijke Philips NV
Utaroh Motosugi, MD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose
Meghan G. Lubner, MD, Madison, WI (Abstract Co-Author) Grant, General Electric Company; Grant, NeuWave 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<0.001) 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

**Monday, Nov. 30 3:40PM - 3:50PM Location: E353C**

**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, Grant, Siemens AG
Savvas Nicolaou, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
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% (46.8-97.8) 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.
SSE10

**ISP: Genitourinary (GU Intervention)**

Monday, Nov. 30 3:00PM - 4:00PM Location: E351

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Participants
Douglas S. Katz, MD, Mineola, NY (Moderator) Nothing to Disclose
Cary L. Siegel, MD, Saint Louis, MO (Moderator) Nothing to Disclose

Sub-Events

**SSE10-01 Genitourinary Keynote Speaker: Renal Tumor Ablation-Current Status and Future Directions**

Monday, Nov. 30 3:00PM - 3:10PM Location: E351

Participants
Ronald J. Zagoria, MD, San Francisco, CA (Presenter) Nothing to Disclose

**SSE10-02 Real-time MR-guided Renal Cryoablation: Technical Feasibility, Complications and Outcomes**

Monday, Nov. 30 3:10PM - 3:20PM Location: E351

Participants
Georgia Tsoumakidou, MD, Strasbourg, France (Presenter) Nothing to Disclose
Herve Lang, Strasbourg, France (Abstract Co-Author) Nothing to Disclose
Guillaume Koch, MD, MSc, Strasbourg, France (Abstract Co-Author) Nothing to Disclose
Julien Garnon, MD, Strasbourg, France (Abstract Co-Author) Proctor, Galil Medical Ltd
Xavier Buy, MD, Bordeaux, France (Abstract Co-Author) Proctor, Galil Medical Ltd
Afshin Gangi, MD, PhD, Strasbourg, France (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

At present, major improvements in device development, as well as modern special designed MR-suites (with MR-compatible life support and anesthesia equipment) have made the performance of MR-guided percutaneous procedures not only feasible, but also attractive. We retrospectively reviewed our single institution experience with percutaneous MR-guided cryoablation of renal tumours for technical feasibility, complications and outcomes (oncologic, renal function).

**METHOD AND MATERIALS**

Between April 2009 and March 2015, 68 patients underwent percutaneous MR-guided renal cryoablation. All procedures were performed in an MR-interventional unit, using a 1.5T large bore, supra-conductive system. Real-time BEAT IRTTT (3-simultaneous-plane sequence) and high-resolution T2-Blade/HASTE sequences were used for probe positioning and ice-ball monitoring.

**RESULTS**

A total of 79 lesions in 68 patients were treated. Four patients were excluded because of less than 3 month follow-up. Twenty-one patients had a history of renal cancer (15 and 2 treated with total and partial nephrectomy, respectively, 4 with cryoablation). Mean maximal tumour diameter was 22mm (min 5, max 42). Biopsy results were available in 61 patients. Procedure related data (time, number-type of cryoprobes, ice ball size) were collected. Two freeze-thaw cycles were systematically performed. Hydrodissection was used in 37 patients. All procedures were technically successful. Local recurrent tumour was identified in six patients during the first six months of imaging follow-up. The local primary tumour control rate was 92%. One patient developed a late local recurrence at 3 years follow-up. Five out of six early and the late recurrence were treated percutaneously. Peri-operative major complication rate was 4.6% (one active bleeding necessitating embolization, one asymptomatic subcapsular hematoma, and one urothelial damage treated with ureteric catheter insertion). There was no procedural related death. Mean follow-up was 18 (3-70) months.

**CONCLUSION**

Percutaneous renal cryoablation can be performed with high technical and clinical success under MR-guidance. The real-time probe placement, high soft tissue contrast, multi-planar imaging, and the lack of ionizing radiation are some of the advantages of MR vs the CT-guidance.

**CLINICAL RELEVANCE/APPLICATION**

Percutaneous cryoablation of T1a renal tumours can be performed safely and with high technical success under MR-guidance.

**SSE10-03 Single Institution Review of Percutaneous Cryoablation in the Horseshoe Kidney: An Initial Experience**

Monday, Nov. 30 3:20PM - 3:30PM Location: E351

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

SSE10-04 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

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 premedication, 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.

SSE10-05 Percutaneous Embolization of Varicocele By Steel and Platinum Coils

Monday, Nov. 30 3:40PM - 3:50PM Location: E351

Participants
Syed Muhammad Faq, 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
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.
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.

SSE11-02  Low-dose Abdominal Computed Tomography for Urinary Stone Disease - Impact of Additional Spectral Shaping on Image Quality and Dosage

PURPOSE

To evaluate a novel tin filter based abdominal CT technique for urolithiasis in terms of image quality and 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 (CTDIvol) 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. 127 mGycm; p<0.002). CTDIvol 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 Wolfsgruber, 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 cystine, 3 struvite, 1 brushite stones, mean size 6.43 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
Virtual Non-enhanced Images Generated from Spectral CT: Determinants of Detection of Urinary Calculi in the Renal Collecting System

Geraldine Stadelmann, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Sebastian T. Schindera, MD, Basel, Switzerland (Abstract Co-Author) Research Grant, Siemens AG; Research Grant, Ulrich GmbH & Co KG; Research Grant, Bayer AG

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 tomodensicographic (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). At threshold values on CaB, WB, MSI images, size larger than 2.68 mm, 3.01 mm, and 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 hypopattenuating 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.
**SSE16**

**Nuclear Medicine (Endocrine and Gastrointestinal Imaging)**

Monday, Nov. 30 3:00PM - 4:00PM Location: S505AB

**Sub-Events**

**SSE16-01** Parathyroid Imaging with Simultaneous Acquisition of Tc-99m-Sestamibi and I-123: The Relative Merits of Pinhole Collimation and SPECT-CT.

**Participants**
M. Elizabeth Oates, MD, Lexington, KY (Moderator) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Birmingham, AL (Moderator) Nothing to Disclose

**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.

**SSE16-02** Influence of Multigland Parathyroid Disease on Tc-99m-Sestamibi SPECT/CT Sensitivity

**Participants**
Kenneth Nichols, PhD, New Hyde Park, NY (Presenter) Royalties, Syntermed, Inc;
Gene G. Tronco, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose
Christopher J. Palestro, MD, New Hyde Park, NY (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Tc-99m-sestamibi (MIBI) imaging is a mainstay for preoperative parathyroid lesion localization in pts with primary hyperparathyroidism (PHP). Decreased sensitivity in multigland disease (MGD) compared to single gland disease (SGD) is a well recognized phenomenon for planar and SPECT protocols, but few data are available on the effect of MGD on the sensitivity of MIBI parathyroid SPECT/CT.
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±941 mg for 1 lesion, 436±570 mg for 2 lesions, 395±686 mg for 3 lesions, 89±120 mg for 4 lesions, ρ = -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, ρ < 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, ρ = -0.51, p < 0.0001). Sensitivity was significantly lower for MGD than SGD lesions (64% versus 98%, ρ < 0.0001); sensitivity decreased progressively with increasing lesion numbers (67% for 2 lesions, 65% for 3 lesions, 25% for 4 lesions, ρ = -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 lesions 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

Monday, Nov. 30 3:20PM - 3:30PM Location: S505AB

Participants
Kunihiro Nakada, Sapporo, Japan (Presenter) Nothing to Disclose
Hiroki Sugie, MD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Yusushi Furuta, MD, PhD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Hiromasa Takahashi, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Naoya Hattori, MD, PhD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Masayuki Sakurai, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
Postsurgical papillary thyroid cancer (PCA) with thyroglobulin elevation and negative iodine scintigraphy (TENIS) generally show resistance to high-dose 1-131 therapy. However, prognostic factors for PCA with the TENIS syndrome have not been well established. The aim of the study was to determine whether FDG uptake is linked with clinical behavior of the tumor in the TENIS syndrome.

METHOD AND MATERIALS
93 patients with PCA, who had previously undergone total thyroidectomy and remnant tissue ablation and were diagnosed as the TENIS syndrome, underwent FDG-PET/CT. Serum Tg levels at PET/CT ranged 2.9-225.4(ng/ml). Uptake of FDG was visually assessed and classified as positive or negative. When FDG uptake was positive, semi-quantitative analysis (SUVmax) was performed. If a patient had multiple tumors, average of SUVmax in the 2 largest tumors were used for evaluation. Patients were followed up for 28-83 months (median 46). Tg levels were measured at least 5 times or more after imaging of FDG-PET/CT. to determine Tg doubling time (Tg-DT). As a rule, changes in the tumor size were evaluated based upon RECIST1.1.

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 < 1yr. 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). 5 pts. died of PCA. In contrast, all patients in the FDG negative group had Tg-DT of either >= 3yrs. or minus value regardless of baseline Tg value. 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
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 external radiation, local ablation therapy such as RFA or PEI, or chemotherapy using sorafenib or lenvatinib may improve their prognosis. In contrast, the majority of patients with negative FDG uptake do not require aggressive additional treatments.

SSE16-04 Effectiveness of Semi-quantitative Analysis in I-123 Metaiodobenzylguanidine Scintigraphy for Diagnosing Pheochromocytoma

Monday, Nov. 30 3:30PM - 3:40PM Location: S505AB

Participants
Yoshiyuki Kitamura, Fukuoka, Japan (Presenter) Nothing to Disclose
In low risk patients with thyroid cancer, our findings may support low dose consideration prior to radioiodine ablation.

**CLINICAL RELEVANCE/APPLICATION**

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.

**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).

**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.

**CLINICAL RELEVANCE/APPLICATION**

Semi-quantitative method using SPECT/CT was more sensitive and specific than visual evaluation in the diagnosis of pheochromocytoma in patients with adrenal tumor.

**SSE16-05 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 MIBG scintigraphy and adrenal SPECT/CT was performed in all patients. Twelve pheochromocytomas and 14 cortical adenomas 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, adrenal 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.

**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).

**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**

**METHOD AND MATERIALS**

In this retrospective study, one nuclear medicine physician and one neuroradiologist reviewed SPECT/CT findings to assess accuracy of radioiodine uptake localization on planar whole-body images in the central neck region. Inclusion criteria included thyroid carcinoma patients who underwent postablation planar and SPECT/CT I-131 scintigraphy from October 1, 2013 to June 1, 2014. Radioiodine dose was 50-200 mCi.

**RESULTS**

44 consecutive patients were included in the study (10 male, 34 female). Age range was 20 - 74. Most of the patients, 40 (91%) had obvious foci of radioiodine uptake in the central neck on planar and SPECT imaging, while remaining 4 patients had no significant radioiodine uptake in the neck. 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**

The anatomic CT correlation with planar and SPECT images demonstrated the majority of the focal radioiodine uptake to be located exclusively within the thyroid bed and thyroglossal duct remnant.

**CLINICAL RELEVANCE/APPLICATION**

In low risk patients with thyroid cancer, our findings may support low dose consideration prior to radioiodine ablation.
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 (Stroke and Recovery)

Monday, Nov. 30 3:00PM - 4:00PM Location: N229

PARTICIPANTS

David J. Mikulis, MD, Toronto, ON (Moderator) Stockholder, Thornhill Research Inc; Research Grant, General Electric Company; Pina C. Sanelli, MD, Manhasset, NY (Moderator) Nothing to Disclose

Sub-Events

SSE18-01 Magnitude of Predictive Error When Employing ASPECTS Methodology for Core and Penumbra Estimation Towards Diagnosis and Prognostication in Acute Ischemic Stroke: A Paradigm Challenge of Imaging-Based Approaches to Therapy Selection

Participants

Meredith Bowen, BA, Atlanta, GA (Presenter) Nothing to Disclose
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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 > 6 s. 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 > 6 s 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 > 6 s 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 = 0.06), while at-risk volumes, Tmax > 6 s 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

Wolfgang G. Kunz, MD, Munich, Germany (Presenter) Nothing to Disclose
Lukas Havia, Munich, Germany (Abstract Co-Author) Nothing to Disclose
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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

Participants
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Zepa Yang, MS, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jong H. Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Martin Wiesmann, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To examine the influence of radiation dose reduction on image quality and sensitivity of Volume Perfusion CT (VPCT) maps regarding the detection of ischemic brain lesions.

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

Participants
Omar N. Kallas, MD, New York, NY (Presenter) Nothing to Disclose
Jana Ivanidze, MD, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
CONCLUSION
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 to 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
Peipei Wang, Beijing, China (Abstract Co-Author) Nothing to Disclose
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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, caudate culmen, 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 precuneus 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).

CONCLUSION
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**

**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 homonymic 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/PREDICTION**

ADC values of DTI at 3 month after onset of stroke patients may be used to predict the motor outcome.
**SSE19**

**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

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**Participants**

Steven M. Stufflebeam, MD, Charlestown, MA *(Moderator)* Nothing to Disclose
Roland R. Lee, MD, San Diego, CA *(Moderator)* Nothing to Disclose

**Sub-Events**

**SSE19-01 A Novel Electrocorticography Grid Using Conductive Nanoparticles in a Polymer Thick Film on an Organic Substrate Improves CT and MR Imaging**

Monday, Nov. 30 3:00PM - 3:10PM Location: N230

**Participants**

Emad Ahmadi, MD, Boston, MA *(Presenter)* Nothing to Disclose
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Martin Y. Villeneuve, PhD, Charlestown, MA *(Abstract Co-Author)* Nothing to Disclose
Emad N. Eskandar, MD, Boston, 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

**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 post-operative complications.

**SSE19-02 A Novel Electrocorticography Grid Using Conductive Nanoparticles in a Polymer Thick Film on an Organic Substrate Causes less MRI Heating Compared to Conventional Grids**

Monday, Nov. 30 3:10PM - 3:20PM Location: N230

**Participants**

Emad Ahmadi, MD, Boston, MA *(Presenter)* Nothing to Disclose
Reza Atefi, PhD, Charlestown, MA *(Abstract Co-Author)* Nothing to Disclose
Martin 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 might cause significant heating during MR imaging. This study compares MRI heating, at a 3T scanner, caused by a conventional ECoG grid with that caused by a grid developed by deposition of conductive nanoparticles in polymer thick film on an organic substrate (PTFOS).

**METHOD AND MATERIALS**

A 64-contact electrocorticography grid was developed in a PTFOS construct via deposition of silver and carbon nanoparticles on denaturized collagen. We placed the developed PTFOS grid over a head phantom and measured the temperature changes around the grid during 30 minutes of MRI at a 3T scanner. The phantom had MRI heating properties similar to human tissues. Temperature was measured using eight optical sensors placed within the phantom. For comparison purposes, we also studied temperature changes during MR imaging in the cases of the head phantom with no grid and with a conventional platinum grid.

**RESULTS**

The maximal temperature increase among the eight sensors during 30 minutes of MR images was 4, 11, and 4.5 degrees Celsius for the cases of the phantom without any grid, with the platinum grid, and with the PTFOS grid, respectively (Figure 1).

**CONCLUSION**

Conventional platinum grids might cause considerable heating during MR imaging, while the newly developed PTFOS grid causes minimal, if any, heating during MR imaging.

**CLINICAL RELEVANCE/APPLICATION**

Diagnosis of surgical complications of electrocorticography grids implantation is largely dependent on MR imaging. Our results raise the concern that conventional electrocorticography grids might not be safe for MR imaging at the field strength of 3T, because they might cause considerable MRI heating. On the other hand, the newly developed PTFOS grid showed favorable MRI heating profile at the field strength of 3T.

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**SSE19-03  Language Reorganization in Temporal Lobe Epilepsy - A Task Based fMRI Connectome Study**

Monday, Nov. 30 3:20PM - 3:30PM Location: N230

**Participants**

Clarissa Gillmann, PhD, Erlangen, Germany (Presenter) Nothing to Disclose
Roland Coras, MD, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose
Karl-Roessler, MD, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose
Andi Dorfer, Erlangen, Germany (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.

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**SSE19-04  Ultra High Field MR-microscopy for Diagnosis of Hippocampal Sclerosis in Patients with Mesial Temporal Lobe Epilepsy**

Monday, Nov. 30 3:30PM - 3:40PM Location: N230

**Participants**

Clarissa Gillmann, PhD, Erlangen, Germany (Presenter) Nothing to Disclose
Roland Coras, MD, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose
Karl-Roessler, MD, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose
Andi Dorfer, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose
PURPOSE
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 (ClnScan, 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

Monday, Nov. 30 3:40PM - 3:50PM Location: N230

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

Abstract Co-Author
Michael Uder, MD, Erlangen, Germany (Abstract Co-Author) Speakers Bureau, Bracco Group; Speakers Bureau, Siemens AG; Research Grant, Siemens AG; Ingrid Blumcke, MD, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose
Tobias Baeuerle, MD, Erlangen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

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).
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.
**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 adaption 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
Marcel Beister, Erlangen, Germany (Abstract Co-Author) Employee, CT Imaging GmbH
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
Performance of a Novel Third Generation Adaptive Statistical Iterative Reconstruction-V (ASiR-V) for Dose Reduction in MDCT: Task-specific Quantitative and Qualitative Evaluation

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 CTD\text{vol} range of 0.75 - 6.0 mGy compared to FBP technique.

**SSE22-06  A Method for Cross-platform Comparison of Reconstruction Kernels in CT**

**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.
Cardiac CT Mentored Case Review: Part IV (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, Nov. 30 3:30PM - 5:30PM Location: S406A

Participants
Pamela K. Woodard, MD, Saint Louis, MO (Director) Research Consultant, Bristol-Myers Squibb Company; Research Grant, Astellas Group; Research Grant, F. Hoffman-La Roche Ltd; Research Grant, Bayer AG; Research agreement, Siemens AG; Research Grant, Actelion Ltd; Research Grant, Guerbet SA;
David A. Bluemke, MD, PhD, Bethesda, MD (Moderator) Research support, Siemens AG
Vincent B. Ho, MD, MBA, Bethesda, MD (Moderator) In-kind support, General Electric Company

LEARNING OBJECTIVES
1) To understand the clinical indications for retrospective ECG gated cardiac CT. 2) To illustrate methods to assess myocardial function from cine cardiac CT images. 3) To illustrate methods to assess normal and abnormal valvular function from cine cardiac CT images.

ABSTRACT
The mentored case review provides the opportunity for the attendees to learn the image acquisition, post-processing, and diagnosis for a wide variety of cardiac diseases commonly encountered in CT.

Sub-Events
MSMC24A  Coronary Artery Disease and Incidental Noncardiac Findings

Participants
Frank J. Rybicki III, MD, PhD, Ottawa, ON (Presenter) Research Grant, Toshiba Corporation;

LEARNING OBJECTIVES
1) To review coronary CTA principles, including details related to image acquisition. 2) Demonstrate examples of CAD as depicted by CT. 3) Discuss strategies to assess the hemodynamic significance of individual coronary lesions. 4) Illustrate non-cardiac findings on coronary CTA images.

ABSTRACT
CT Angiography (CTA) is a guideline endorsed strategy to assess symptomatic patients with low to intermediate risk of coronary artery disease in both the non-emergent and emergent settings. Coronary CTA uses ECG gating to freeze cardiac motion and enables assessment of the lumen for stenosis. Coronary CTA has a high negative predictive value, but suffers when a lesion is detected with a moderate stenosis. Emerging CT methods are also exploring the role of CT to assess individual lesions, including ones that have been problematic, for hemodynamic significance. The clinical relevance relates to the fact that only lesions that are hemodynamically significant should undergo intervention, for example with balloon angioplasty and stenting. In addition, each coronary CTA should include images reconstructed "skin to skin" over the entire craniocaudal field of view that encompasses the heart. Thus, incidental lesions can and should be reported for all coronary CTA studies.

MSMC24B  Congenital Heart Disease

Participants
Dianna M. Bardo, MD, Seattle, WA (Presenter) Speaker, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Author, Thieme Medical Publishers, Inc

LEARNING OBJECTIVES
1) Recognize the most common congenital heart disease (CHD) findings found in adults with unsuspected CHD. 2) Recognize and understand findings of CHD in patients with known CHD and the findings which may trigger surgical intervention. 3) Recognize the CT findings of commonly performed surgical procedures for palliation of CHD. 4) Develop an organized pattern for search and reporting of CHD findings. 5) Understand why CT is chosen as the advanced imaging modality over MR.

ABSTRACT
Adults with congenital heart disease (CHD) now outnumber children with CHD two to one. This phenomenon is due to the success of surgical palliation and medical management of patients with even the most severe forms of CHD. Surgical intervention is often performed at the time of diagnosis and in patients with residual hemodynamic lesions is often required throughout life. Though echocardiography is typically the initial imaging modality of choice, diagnosis and imaging surveillance of complex hemodynamic and anatomic CHD lesions is now most often accomplished with CT and MR. CT and CTA imaging techniques may be used to show detailed anatomic and functional images of the heart, postoperative changes and long term consequences of CHD. An organized, reproducible approach to identify cardiac anatomy of CHD lesions and surgical palliation should be adopted in order to accurately and thoroughly describe findings.

Active Handout: Dianna M. Ehrhart Bardo

MSMC24C  Coronary Atherosclerosis and Bypass Grafts
Participants
Gautham P. Reddy, MD, Seattle, WA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify focal areas of stenosis in the coronary arteries on CT. 2) Describe the appearance of bypass graft stenosis on coronary CT. 3) Review the diagnosis of aneurysms in the native coronary arteries and in bypass grafts.

ABSTRACT

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/

Gautham P. Reddy, MD - 2014 Honored Educator
Case-based Review of Nuclear Medicine: PET/CT Workshop-Head and Neck Cancers (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Dec. 1 8:30AM - 10:00AM Location: S406A

Participants
Janis P. O'Malley, MD, Birmingham, AL (Director) Nothing to Disclose
Jonathan E. McConathy, MD, PhD, Saint Louis, MO (Presenter) Research Consultant, Eli Lilly and Company; Research Consultant, Blue Earth Diagnostics Ltd; Research Consultant, Siemens AG; Research support, GlaxoSmithKline plc

LEARNING OBJECTIVES

1) Participants will use FDG-PET/CT more effectively in their clinical practice through better understanding of the anatomy, clinical scenarios, and differential diagnoses relevant to the diagnostic imaging of head and neck cancers.
Participants

Sub-Events

MSES31A  **Large Airway Disease**

Participants
Phillip M. Boiselle, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Accurately identify normal large airway anatomy, variants, and common forms of pathology on MDCT scans. 2) Employ a pattern-based approach to facilitate accurate diagnosis of congenital and acquired causes of large airways disease on MDCT scans. 3) Recognize the overlap of MDCT airway findings between health and disease states.

ABSTRACT

1. Accurately identify normal large airway anatomy, variants, and common forms of pathology on MDCT scans. 2. Employ a pattern-based approach to facilitate accurate diagnosis of congenital and acquired causes of large airways disease on MDCT scans. 3. Recognize the overlap of MDCT airway findings between health and disease states.

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Phillip M. Boiselle, MD - 2012 Honored Educator

MSES31B  **Pleural Disease**

Participants
Travis S. Henry, MD, San Francisco, CA (Presenter) Spouse, Medical Director, F. Hoffmann-La Roche Ltd

LEARNING OBJECTIVES

1) Identify pleural thickening and differentiate the appearance from normal pleura on imaging. 2) Differentiate different causes of unilateral and bilateral pleural effusions to help narrow a differential diagnosis or provide a specific diagnosis. 3) Identify different manifestations of asbestos-related pleura disease. 4) Provide a differential diagnosis for pleural tumors.

ABSTRACT

1) Identify pleural thickening and differentiate the appearance from normal pleura on imaging. 2) Differentiate different causes of unilateral and bilateral pleural effusions to help narrow a differential diagnosis or provide a specific diagnosis. 3) Identify different manifestations of asbestos-related pleura disease. 4) Provide a differential diagnosis for pleural tumors.

MSES31C  **HRCT Reticular Pattern**

Participants
Susan J. Copley, MD, FRCR, London, United Kingdom, (sue.copley@imperial.nhs.uk) (Presenter) Consultant, Boehringer Ingelheim GmbH; Consultant, InterMune, Inc

LEARNING OBJECTIVES

1) Accurately identify the Reticular pattern on HRCT. 2) List the differential diagnosis for the reticular pattern. 3) Recognize distinguishing features of particular entities that may result in this pattern.

ABSTRACT

1) Accurately identify the Reticular pattern on HRCT. 2) List the differential diagnosis for the reticular pattern. 3) Recognize distinguishing features of particular entities that may result in this pattern.
Participants
Jeffrey R. Galvin, MD, Baltimore, MD (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the range of lung injury resulting from the inhalation of cigarette smoke. 2) Explain the general mechanisms of cigarette smoke injury. 3) List the currently accepted diagnostic categories. 4) Identify the key imaging features of smoking related lung disease.

ABSTRACT
Symptomatic cigarette smokers are a common source of referral for diagnostic imaging. Radiologists are regularly confronted with an array of findings on plain radiography and computed tomography that mirror varying combinations of emphysema, airway inflammation, airway fibrosis and the changes of pulmonary Langerhans' cell histiocytosis (PLCH). In addition, there is growing acceptance of a link between cigarette smoke and alveolar wall fibrosis. The radiologist is confronted with an extensive list of smoking-related diagnostic categories including: emphysema, obstructive bronchitis, respiratory bronchiolitis-interstitial lung disease (RB-ILD), desquamative interstitial pneumonia (DIP), PLCH and acute eosinophilic pneumonia. These injuries are best understood through correlation of the imaging with pathology and physiology.

Active Handout: Jeffrey R. Galvin

Sub-Events
RC301A Introduction

Participants
Jeffrey R. Galvin, MD, Baltimore, MD (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1. Describe the range of lung injury resulting from the inhalation of cigarette smoke. 2. Explain the general mechanisms of cigarette smoke injury. 3. List the currently accepted diagnostic categories.

ABSTRACT
Symptomatic cigarette smokers are a common source of referral for diagnostic imaging. Radiologists are regularly confronted with an array of findings on plain radiography and computed tomography that mirror varying combinations of emphysema, airway inflammation, airway fibrosis and the changes of pulmonary Langerhans' cell histiocytosis (PLCH). In addition, there is growing acceptance of a link between cigarette smoke and alveolar wall fibrosis. The radiologist is confronted with an extensive list of smoking-related diagnostic categories including: emphysema, obstructive bronchitis, respiratory bronchiolitis-interstitial lung disease (RB-ILD), desquamative interstitial pneumonia (DIP), PLCH and acute eosinophilic pneumonia. These injuries are best understood through correlation of the imaging with pathology and physiology.

RC301B CT Definable Subtypes of COPD

Participants
Alexander A. Bankier, MD, PhD, Boston, MA (Presenter) Author with royalties, Reed Elsevier Consultant, Olympus Corporation

LEARNING OBJECTIVES
1) Describe the current Fleischner classification of chronic obstructive pulmonary disease (COPD). 2) Identify the different categories of emphysema and associated abnormalities on computed tomography. 3) Explain the relationship between image derived assessment of COPD and clinical assessment including pulmonary function.

ABSTRACT
Symptomatic cigarette smokers are a common source of referral for diagnostic imaging. Radiologists are regularly confronted with an array of findings on plain radiography and computed tomography that mirror varying combinations of emphysema, airway inflammation, airway fibrosis and the changes of pulmonary Langerhans' cell histiocytosis (PLCH). In addition, there is growing acceptance of a link between cigarette smoke and alveolar wall fibrosis. The radiologist is confronted with an extensive list of smoking-related diagnostic categories including: emphysema, obstructive bronchitis, respiratory bronchiolitis-interstitial lung disease (RB-ILD), desquamative interstitial pneumonia (DIP), PLCH and acute eosinophilic pneumonia. These injuries are best understood through correlation of the imaging with pathology and physiology.

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Inflammatory Lung Disease in Smokers

Participants
Seth J. Kligerman, MD, Denver, CO (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the categories of cigarette smoke related lung inflammation. 2) Classify the smoking-related inflammatory disorders including: respiratory bronchiolitis, desquamative interstitial pneumonia, pulmonary Langerhans cell histiocytosis and acute eosinophilic pneumonia. 3) Identify the key imaging features of smoking-related inflammatory disease on imaging. 4) Understand how pathologic changes mirror findings on imaging.

ABSTRACT
Smoking Related Lung Disease: Radiologic-Pathologic Correlation
Symptomatic cigarette smokers are a common source of referral for diagnostic imaging. Radiologists are regularly confronted with an array of findings on plain radiography and computed tomography that mirror varying combinations of emphysema, airway inflammation, airway fibrosis and the changes of pulmonary Langerhans’ cell histiocytosis (PLCH). In addition, there is growing acceptance of a link between cigarette smoke and alveolar wall fibrosis. The radiologist is confronted with an extensive list of smoking-related diagnostic categories including: emphysema, obstructive bronchitis, respiratory bronchiolitis-interstitial lung disease (RB-ILD), desquamative interstitial pneumonia (DIP), PLCH and acute eosinophilic pneumonia. These injuries are best understood through correlation of the imaging with pathology and physiology.

Fibrotic Lung Disease in Smokers

Participants
Jeffrey R. Galvin, MD, Baltimore, MD (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the categories of cigarette smoke related lung fibrosis. 2) Identify the key imaging features that indicate the presence of lung fibrosis. 3) Explain the importance of imaging in the interpretation of pulmonary functions.

ABSTRACT
Symptomatic cigarette smokers are a common source of referral for diagnostic imaging. Radiologists are regularly confronted with an array of findings on plain radiography and computed tomography that mirror varying combinations of emphysema, airway inflammation, airway fibrosis and the changes of pulmonary Langerhans’ cell histiocytosis (PLCH). In addition, there is growing acceptance of a link between cigarette smoke and alveolar wall fibrosis. The radiologist is confronted with an extensive list of smoking-related diagnostic categories including: emphysema, obstructive bronchitis, respiratory bronchiolitis-interstitial lung disease (RB-ILD), desquamative interstitial pneumonia (DIP), PLCH and acute eosinophilic pneumonia. These injuries are best understood through correlation of the imaging with pathology and physiology.
RC303
Cardiac Series: Imaging of Coronary Artery Disease
Tuesday, Dec. 1 8:30AM - 12:00PM Location: S405AB
CA CT MR
AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 4.00
FDA Discussions may include off-label uses.

Participants
Arthur E. Stillman, MD, PhD, Atlanta, GA (Moderator) Nothing to Disclose
Robert M. Steiner, MD, Philadelphia, PA (Moderator) Consultant, Educational Symposia; Consultant, Johnson & Johnson
Suhny Abbara, MD, Dallas, TX (Moderator) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

Sub-Events
RC303-01 MRI of Coronary Ischemia (Coronary MRA, Stress Perfusion)
Tuesday, Dec. 1 8:30AM - 9:10AM Location: S405AB

Participants
David A. Bluemke, MD, PhD, Bethesda, MD (Presenter) Research support, Siemens AG

LEARNING OBJECTIVES
1) Describe the role of CMR for evaluation of myocardial perfusion. 2) Describe the results of CMR for evaluation of myocardial ischemia. 3) Indicate potential uses and methods for coronary artery evaluation by CMR.

ABSTRACT
Cardiac MRI (CMR) is an established modality for evaluation of ischemic myocardial disease; appropriateness criteria increasingly recognize the role of CMR in this role. CMR has outstanding temporal resolution allowing for accurate representation of myocardial volumes and function. Excellent soft issue contrast for myocardial ischemia evaluation is achieved with the use of a gadolinium contrast agent. Stress perfusion CMR during adenosine infusion compares favorably to nuclear medicine methods but can additionally assess volumes and mass very accurately. Stress CMR is used in combination with late gadolinium enhancement (LGE) techniques to depict viable myocardium to improve the specificity of the method. Coronary artery imaging with CMR is best performed at 1.5 T and is useful to assess for anomalous coronary artery imaging and confirm perfusion results. This session will describe the techniques, indications, results and interpretation of CMR for evaluation of ischemic disease of the myocardium.

Active Handout:David A. Bluemke

RC303-02 Evaluation of Obstructive Coronary Artery Disease in Patients with Agatston Score More than 500: Comparison of Computed Tomographic Angiography and Magnetic Resonance Angiography
Tuesday, Dec. 1 9:10AM - 9:20AM Location: S405AB

Participants
Makoto Amanuma, MD, Takasaki, Japan (Presenter) Nothing to Disclose
Takeshi Kondo, Takasaki, Japan (Abstract Co-Author) Nothing to Disclose
Hideyuki Matsutani, Takasaki, Japan (Abstract Co-Author) Nothing to Disclose
Takako Sekine, Takasaki, Japan (Abstract Co-Author) Nothing to Disclose
Tomoko Miyata, Saitama, Japan (Abstract Co-Author) Employee, Toshiba Corporation
Shigehide Kuhara, MS, Otawara, Japan (Abstract Co-Author) Nothing to Disclose
Shinichi Takase, Takasaki, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
One of the limitations of coronary computed tomographic angiography (CCTA) is poor diagnostic accuracy for segments with severe calcification. On the other hand, the effect of calcification is considered limited on coronary magnetic resonance angiography (CMRA). The purpose of this study was to compare clinical feasibility of CCTA and CMRA for evaluation of obstructive coronary artery disease in patients with severe calcification.

METHOD AND MATERIALS
Written informed consent was obtained from all patients. In 29 patients(72±12 years, M:F=21:8) with high grade calcification (Agatston score>500) CCTA and CMRA findings were compared with the ICA findings as a reference standard. A 320-row area detector CT system (Aquilion ONE/VISION Edition, Toshiba) was used for CCTA and a 1.5T MR unit (Vantage Titan, Toshiba) was used to obtain CMRA. For CCTA prospective one or two-beat scanning targeted at mid diastole was performed with the cardiac phase for scanning set to R-R 75%. For CMRA non-contrast 3D steady-state gradient echo technique with ECG gating and respiratory navigation technique was used. The coronary arteries were divided to 7 proximal segments (#1-#3, #5-#7, #11) based on the AHA classification and evaluated. Luminal stenosis (>50%) was judged both on CCTA and CMRA by consensus of two experienced readers with the ICA findings as a reference standard.

RESULTS
The mean Agatston score of the 29 patients was 1763 (SD: 1092, Range: 502-4674, median: 1348). With non-assessable segments considered to be stenotic, the diagnostic accuracy of CCTA and CMRA was 76.6% and 83.6% on a per-segment basis. When non-assessable segments were considered to be an incorrect diagnosis, the diagnostic accuracy of CCTA and CMRA was 72.1% and
CONCLUSION
CMRA provides a higher diagnostic accuracy than does CCTA in patients with severe calcification.

CLINICAL RELEVANCE/APPLICATION
Coronary MRA provides a high diagnostic accuracy and recommended for evaluation of obstructive coronary arterial disease in patients with severe calcification.

RC303-03 Rosuvastatin Effect on Coronary Atherosclerosis Plaques Evaluated by 64-detector CT in Patients with Stable Coronary Heart Disease and Hyperlipidemia

Tuesday, Dec. 1 9:20AM - 9:30AM Location: S405AB

Participants
Jian-Xing Qiu, MD, Beijing, China (Presenter) Nothing to Disclose
Xiaoying Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
Xiaochao Guo, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the coronary atherosclerosis plaque changes by 64-detector CT on the follow-up examination of the patients, who treated by rosuvastain, with stable coronary heart disease and hyperlipidemia.

METHOD AND MATERIALS
The study included 30 patients, (27 males and 3 females), with stable coronary heart disease (stable angina for more than one month) and hyperlipidemia (LDL-C≤130 mg/dl without treatment, LDL-C≤100 mg/dl with treatment). Every patient underwent 64-detector CT coronary angiography twice before and after 76 weeks treatment with Rosuvastatin 20 mg q.d. The initial CT angiography at least detected one or more soft plaques with lumen stenosis ≥25%. We detected 35 target plaques totally. The volume of target plaques, the maximum sectional area(MASA) of plaques, the mean CT value(MCTV),the stenosis degree caused by the target plaques were measured on the initial and the follow-up CT examinations using the semi-automatic atherosclerosis plaque analysis software. The paired-samples t test was used to analyze the measurements in SPSS 10.0.

RESULTS
After Rosuvastatin treatment for 76 weeks, the volume of target plaques decreased significantly from 53.8±38.9 mm³ to 41.5±27.4 mm³(p=0.011)after Rosuvastatin treatment, the MASA of target plaques decreased from 7.56±3.86 mm² to 6.11±2.81 mm² (p=0.038). the MCTV of target plaques had nonsignificant decrease from 66.42±28.62 Hu to 60.99±39.18 Hu (p=0.687), the stenosis degree caused by the target plaques decreased significantly from 55% to 46%.

CONCLUSION
The measurement change of target plaques demonstrated by 64-detector CT coronary angiography for the patients with stable coronary heart disease and hyperlipidemia include a decrease of the plaque volume, the maximum sectional area, and the stenosis degree.

CLINICAL RELEVANCE/APPLICATION
The 64-detector CT coronary angiography could analyze the effect of Statin for coronary atherosclerosis plaque.

RC303-04 Late Gadolinium Enhancement

Tuesday, Dec. 1 9:30AM - 10:10AM Location: S405AB

Participants
Scott D. Flamm, MD, Cleveland, OH, (flamm@ccf.org) (Presenter) Medical Director, Precision Image Analysis, Inc; Board of Directors, Precision Image Analysis, Inc;

ABSTRACT
Learning Objectives: 1. Understand the distinct advantages of late gadolinium enhancement imaging by cardiac MRI. 2. Articulate the mechanisms responsible for the increased signal intensity in irreversibly damaged myocardium. 3. Recognize the clinical situations appropriate for cardiac MRI late gadolinium enhancement imaging. Abstract: CMR has the unique ability to evaluate several markers of myocardial viability that are of proven value. Reliable and accurate assessment of myocardial scar burden, coronary perfusion, and contractile reserve by CMR are all well established. Direct imaging of myocardial fibrosis has been possible for well over a decade using an inversion-recovery prepared T1-weighted sequence following the intravenous administration of a gadolinium-chelate (Gd). This CMR technique has been named "late gadolinium enhancement" (LGE) and demonstrates non-viable tissue as "hyperenhanced" or bright. Both interstitial and replacement fibrosis enhance similarly with LGE for reasons described below. The hyperenhancement of interstitial fibrosis is more commonly seen in infiltrative entities such as hypertrophic cardiomyopathy and amyloidosis, where the issue of viability is less prominent. The excellent spatial resolution and tissue characterization afforded by CMR makes it ideal for both: 1) quantification of significant areas of viable myocardium, and 2) defining discrete regions of non-viability. Accurate quantification of areas of scar and viable tissue is clearly important in predicting mortality as the benefits of revascularization rise steeply when the area of dysfunctional but viable myocardium reaches a critical size. Further, characterization of non-ischemic patterns of LGE allows differentiation of the breadth of non-ischemic cardiomyopathies, and quantification may similarly provide prognostic information. This presentation will review the LGE technique in its various forms, define evaluation of both ischemic and non-ischemic cardiomyopathies, and address where LGE fits within the diagnostic and prognostic pathways in patients with cardiovascular diseases.
Participants
U. Joseph Schoepf, MD, Charleston, SC, (schoepf@musc.edu) (Presenter) Research Grant, Bracco Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; ; ;

LEARNING OBJECTIVES
1) Identify suitable CT techniques for the comprehensive assessment of ischemic heart disease. 2) Discuss different CT approaches for evaluating myocardial perfusion. 3) Compare CT to other modalities for determining the hemodynamic significance of coronary artery stenosis.

ABSTRACT
Appropriate non-invasive evaluation of patients with suspected coronary artery disease (CAD) has traditionally rested on the two pillars of morphological assessment for coronary artery stenosis and functional evaluation for determining the downstream hemodynamic significance of lesions. This approach has been informed by the fundamental realization that morphological assessment of coronary artery stenoses rarely reflects the actual level of myocardial ischemia. Further, patient evaluation, prognostication, and management are more reliable and effective when functional and morphological assessments are used in concert. Due to recent advancements in CT technology, coronary CTA (cCTA) has become an integral part of the non-invasive diagnostic work-up for the anatomic evaluation of the coronary arteries of patients with suspected CAD. According to the current appropriate use criteria, cCTA is the method of choice for the exclusion of significant coronary artery stenosis in patients with low and intermediate CAD risk profiles. The diagnostic accuracy of cCTA has been demonstrated by its high sensitivity (96%) and specificity (86%). Furthermore, cCTA can provide global and regional functional evaluation if acquired with an ECG-synchronization technique. In addition to its role in assessing coronary morphology and left ventricular function, cCTA has been utilized in the evaluation of a third aspect in the diagnostic algorithm of ischemic heart disease - myocardial perfusion. As cCTA may provide diagnostic information for each of these three cornerstones of ischemic heart disease management, this emerging technology has the potential to become the stand-alone method for the evaluation of patients with suspected CAD with a single modality, and within a single imaging session. The purpose of this presentation is to review the growing body of evidence on the CT assessment of myocardial perfusion and provide a systematic overview of presently available techniques.

RC303-06 Reduced-Dose Dual-Source Coronary Computed Tomography Angiography (CCTA): Is Raw-Data-Based Iterative Reconstruction Able to Maintain the Diagnostic Confidence?

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S405AB

Participants
Francois Pontana, MD, PhD, Lille, France (Abstract Co-Author) Nothing to Disclose
Isabel A. Castellano, PhD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Tevfik F. Ismail, PhD,MRCP, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Natalie Gartland, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Michael B. Rubens, MBBS, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Edward Nicol, MBBS, London, United Kingdom (Presenter) Nothing to Disclose

PURPOSE
To evaluate image quality and diagnostic confidence of a raw-data-based iterative reconstruction technique (SAFIRE) in reduced-dose CCTA images in comparison with standard-dose filtered back projection (FBP) images.

METHOD AND MATERIALS
107 consecutive patients (72 males; 35 females), referred for a CCTA were prospectively included using a dual source CT system in a high pitch (n=51) or a sequential prospective gating scanning mode (n=56) according to the heart rate (mean DLP value = 204.6 mGy.cm). From each acquisition 4 series of images were reconstructed: (a) standard-dose images, reconstructed with FBP (Group 2) and SAFIRE with a preset strength of 3 (Group 3) and 5 (Group 4). Two readers blindly evaluated each series for (a) objective noise and CNR; (b) coronary border sharpness, lesion detection and (c) diagnostic confidence level using a 5-point scale.

RESULTS
In Group 2, there was a significant increase in the mean level of objective noise compared to Group 1 (36.8 ±6.7 vs 30.4 ±5.2; p<0.0001) and an impairment of the CNR (15.6 ±4.3 vs 18.7 ±4.5; p=0.0001), which hampered the detection of 9 plaques. In Group 3 and 4, despite the 30% dose reduction, all the lesions depicted in Group 1 were seen and SAFIRE restored or improved the objective image quality respectively: (a) mean noise= 31.1 ±5.4; p=0.1 and 22.3 ±4.2; p<0.0001, and (b) CNR= 18.5 ±5.0; p=0.9 and 25.8 ±7.0; p<0.0001. However the diagnostic confidence was altered when compared with Group 1 (p<0.0001), mainly rated as moderate with a blurred aspect of the coronary borders (81/107; 75.7% and 103/107; 96.3%)(p<0.0001) and a significant number of artefactual non stenosing soft plaques described in vessels considered as normal in Group 1 (105/222; 47.3% and 194/222; 87.4%)(p<0.0001).

CONCLUSION
Raw-data-based iterative reconstruction allowed significant image noise reduction but may be associated with blurring of the coronary luminal borders, which can decrease diagnostic confidence.

CLINICAL RELEVANCE/APPLICATION
When reporting reduced-dose CCTA with iterative reconstruction, blurred-border and false smooth plaque artifacts must be considered in diagnostic assessment and subsequent patient management.

RC303-07 Prognostic Value of CT Coronary Angiography in Asymptomatic Patients with Suspected Coronary Artery Disease. Meta-Analysis of Observational Studies

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S405AB

Participants
PURPOSE

To assess the prognostic value of CCTA as a screening tool in asymptomatic patients with suspected coronary artery disease (CAD).

METHOD AND MATERIALS

A meta-analysis of observational coronary computed tomographic angiography (CCTA) imaging studies was conducted, by means of search in electronic scientific databases for studies investigating the use of CCTA in asymptomatic patients with suspected CAD. The endpoints were the incidence of acute coronary syndrome (ACS) requiring hospitalization, revascularization and cardiac death. Exclusion criteria were composite outcomes and duplicated data. Odds ratio (OR) with 95% confidence interval [CI 95%] was used as summary statistic.

RESULTS

A total of 7,931 asymptomatic patients from 6 studies received a CCTA for suspected CAD. The proportion of patients without CAD, with CAD<50% and with CAD>50% was 78%, 14% and 8%, respectively. After a median follow-up of 27.1 months [22.0-31.2], patients without CAD did not show any of the endpoints. Compared to patients with CAD>50%, patients with CAD<50% showed a similar risk of ACS (0.16 [0.02-1.50]; P=0.11) but a lower risk of revascularization (0.04 [0.02-0.10]; P<0.001) and death (0.05 [0.01-0.44]; P=0.007).

CONCLUSION

Two-third of asymptomatic patients receiving CCTA for suspected CAD had no evidence of disease and no events at follow-up. The presence of CAD>50% significantly increases the risk of revascularization and death as compared to CAD<50%, although the percentage is quite low. Nevertheless, patients with CAD>50% have a risk of ACS comparable to those with CAD<50%.

CLINICAL RELEVANCE/APPLICATION

In asymptomatic patients there is not evidence of the utility of CCTA as a screening tool.
**Neuroradiology Series: Stroke**

Tuesday, Dec. 1 8:30AM - 12:00PM Location: N230

**RC305-01 Imaging for Stroke Triage: Where Do We Stand?**

participants: Howard A. Rowley, MD, Madison, WI, (hrowley@uwhealth.org) (Moderator) Research Consultant, Bracco Group; Research Consultant, Guerbet SA; Research Consultant, General Electric Company; Consultant, F. Hoffmann-La Roche Ltd; Consultant, W.L. Gore & Associates, Inc; Consultant, Lundbeck Group; ; ; ; ; Albert J. Yoo, MD, Newton, MA (Moderator) Research Grant, Penumbra, Inc; Research Grant, Terumo Corporation; Research Consultant, Medtronic, Inc;

**LEARNING OBJECTIVES**

1) We will review the most common neuroimaging modalities and treatment algorithms used in the evaluation of acute stroke patients.

**ABSTRACT**

Neuroimaging has become essential in the evaluation of the acute stroke patient. CT and MRI are used to confirm the diagnosis of acute stroke, exclude stroke mimics, and triage patients for intravenous t-PA and endovascular revascularization therapies. Advanced neuroimaging techniques, including CT-angiography, MR-angiography, CT-perfusion and MR-perfusion further inform acute stroke treatment decisions and are increasingly used in the acute setting. We will review the most common neuroimaging modalities and treatment algorithms used in the evaluation of acute stroke patients.

**RC305-02 Feasibility Of Improving Detection Of Early Ischemic Infarction on Head CT Using Continuity-Based Correlative Enhancement.**

participants: Max Wintermark, MD, Lausanne, Switzerland, (max.wintermark@gmail.com) (Presenter) Advisory Board, General Electric Company;

**PURPOSE**

Recognition of early signs of brain infarction may influence patient management, but can be difficult on head CT. Using custom software (patent pending) that manipulates images based on correlation between intensities of continuous pixels, we aimed to assess the feasibility of improving the detection of brain infarction with head CT images.

**METHOD AND MATERIALS**

35 head CT images through the region of proven infarction and 20 control images across brain tissue without infarction were post-processed using a custom software (patent pending). Three readers, evaluated the baseline and enhanced images in a masked manner, and marked the location of infarction whenever suspected, while using a 5-point scale to rate their confidence for the presence of infarction. In a separate session, readers rated the comparative ease-of-recognition of signs of infarction for baseline and enhanced images on a 7-point scale, while evaluating these images simultaneously along with the follow-up imaging indicating the infarct distribution. Infarct identification data were analyzed with jackknife, alternative, free-response receiver operating characteristic (JAFROC) weighted software. Comparative ease-of-recognition was assessed using the one-sided Wilcoxon signed rank test for differences > a value of 4.

**RESULTS**

For infarct localization, JAFROC analysis revealed figure-of-merit values of 0.56 and 0.67 for baseline and enhance images respectively (p=0.03). Corresponding values for infarct localization within 6 hours of symptom onset were 0.49 and 0.63 (p = 0.04). Comparative ease-of-recognition was significantly higher than the equivalent value of 4 for all three readers (p <0.01, 0.03, <0.01), tilted favorably towards the enhanced images.

**CONCLUSION**

Continuity-based correlative enhancement improves conspicuity and accurate detection of early changes of brain infarction on non-contrasted head CT.
Intracranial Vessel Imaging at 1.5 Tesla versus 3 Tesla versus 7 Tesla: A Comparison Trial

Tuesday, Dec. 1 9:15AM - 9:25AM Location: N230

Participants
Lale Umutlu, MD, Essen, Germany (Presenter) Consultant, Bayer AG
Oliver Kraff, MSc, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Anja Fischer, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Stefan Maderwald, PhD, MSc, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Mark E. Ladd, PhD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Thomas C. Lauenstein, MD, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Maximilian F. Reiser, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Louisa von Baumgarten, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Straube, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Marc U. Schlamann, Essen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
The increase of the magnetic field strength is associated to an increase in SNR that can be transitioned into imaging at higher spatiotemporal resolution. With the successful implementation of 7T neuro MRI, the aim of this study was to investigate and intraindividually compare non-enhanced MR imaging of intracranial arteries and veins at 1.5 Tesla, 3 Tesla and 7 Tesla utilizing TOF-MRA and susceptibility-weighted imaging.

METHOD AND MATERIALS
10 healthy volunteers were each examined on a 1.5 T (Magnetom Aera, Siemens), a 3T (Magnetom Skyra, Siemens) and a 7T MR system (Magnetom 7T, Siemens) utilizing 32-channel head coils. TOF-MRA and SWI were optimized to achieve best spatial resolution for each field strength while preserving comparable acquisition times. All datasets were read by two radiologists utilizing a 5-point scale (5= excellent vessel delineation to 1= non-diagnostic). All TOF-MRA datasets were assessed for delineation of the intracranial arteries, subdivided into 8 segments (ICA, A1/2, M1,M2,M3,PCA, P1/2, basilar artery). SWI datasets were read for delineation of 14 different smaller and larger veins. Additionally, overall image quality, vessel sharpness, vessel to background contrast and image impairment due to artifacts was assessed. For statistical analysis, a Wilcoxon Rank Test was used.

RESULTS
With increasing magnetic field strength, all sequences could be obtained at higher spatial resolution at comparable acquisition...
times, enabling improved vessel delineation. TOF-MRA at 7T enabled a significantly better delineation particularly of small peripheral vessel segments compared to 3T and 1.5T (mean M3 TOF7T=4.3; TOF3T=3.8; TOF1.5T=2.9). 7 Tesla SWI imaging demonstrated its superiority in the highly-detailed delineation of larger and smaller veins with statistical significance to lower field strengths (p=0.03) (e.g. average mean value larger veins: SWI7T =4.5, SWI3T =3.3, SWI11.5T =2.7). Overall image quality was rated comparably high for all three field strengths (7T=4.6; 3T=4.7; 1.5T=4.7).

CONCLUSION
Our results demonstrate the benefits of an increase of magnetic field strength from 1.5T to 7T, offering improved and highly-detailed delineation of the intracranial arterial and venous vasculature.

CLINICAL RELEVANCE/APPLICATION
The excellent delineation of non-enhanced vascular structures in 7T neuro MRI may lead to a more accurate diagnosis of vascular disease, such as aneurysms or cavernomas using 7T MRI.

RC305-05 High Resolution Intracranial Vessel Wall Imaging of Atherosclerotic Plaque Characteristics: Correlation with Patient Symptoms
Tuesday, Dec. 1 9:25AM - 9:35AM Location: N230

Participants
Aaron M. Rutman, MD, Seattle, WA (Presenter) Nothing to Disclose
Chun Yuan, PhD, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; ;
William D. Hwang, 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
Niranjana Balu, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Thomas S. Hratskarni, MD, Seattle, WA (Abstract Co-Author) Research Grant, Koninklijke Philips NV
David Tirschwell, MD, MSc, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Adam de Havenon, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Mahmud Mossa-Basha, MD, Seattle, WA (Abstract Co-Author) Research support, General Electric Company

PURPOSE
High resolution intracranial vessel wall imaging (VWI) has recently gained attention for its ability to evaluate and differentiate various intracranial arteriopathies, including atherosclerosis (ICAD), inflammatory vasculopathy, arterial dissection, and reversible cerebral vasospastic syndrome. VWI also allows for atherosclerotic plaque characterization, depicting potential vulnerable plaque features. The aim was to compare the VWI plaque characteristics between symptomatic and asymptomatic intracranial atherosclerotic lesions using a multi-contrast VWI protocol.

METHOD AND MATERIALS
Cases of ICAD imaged with VWI were collected and retrospectively analyzed from our database between the dates 12/20/12-12/5/13. The imaging protocol included T2, T1 pre and post contrast, 3D T2 SPACE VWI and TOF MRA sequences. Symptomatic plaques were those upstream from an infarct within 6 months of VWI. Lesions with symptoms greater than 6 months prior were excluded. Each plaque was assessed for presence/absence of a fibrous cap, presence of fibrous cap thinning/disruption, cap:necrotic core ratio, and remodeling ratio (total vessel area of diseased segment)/(total vessel area of reference segment). Characteristics were compared by Fisher's exact test (fibrous cap presence, thinning/disruption) and unpaired t-test (cap:necrotic core ratio, remodeling ratio).

RESULTS
48 intracranial atherosclerotic plaques were included from 22 patients. Assessment for fibrous capsule was possible in 18/21 symptomatic and 25/27 asymptomatic plaques. 18/18 symptomatic and 11/25 asymptomatic lesions either did not have a visible fibrous cap, or had apparent disrupted luminal surface or thinning of a visible fibrous cap (p<<0.01). There was no significant difference in the cap:lipid core ratio or the remodeling ratio between symptomatic and asymptomatic lesions.

CONCLUSION
VWI allows for evaluation of ICAD characteristics which may indicate plaque vulnerability, and be associated with symptoms. These features might serve as biomarkers for assessing risk, as well as indicate culprit lesions. Our study shows a significantly increased likelihood of absent fibrous cap or fibrous cap rupture/thinning in the setting of symptoms.

CLINICAL RELEVANCE/APPLICATION
VWI of intracranial atherosclerotic plaque can demonstrate characteristics of vulnerable, symptom-associated plaque.

RC305-06 Potential Applications for Intracranial Vessel Wall Imaging
Tuesday, Dec. 1 9:35AM - 10:00AM Location: N230

Participants
David J. Mikulis, MD, Toronto, ON (Presenter) Stockholder, Thornhill Research Inc; Research Grant, General Electric Company;

LEARNING OBJECTIVES
1) Understand the issues concerning clinical implementation of intra-cranial vessel wall imaging. 2) Understand how vessel wall imaging can aid in differentiating vasculopathies that have similar angiographic appearances. 3) Understand pitfalls related to arterial wall image interpretation.

ABSTRACT
Modern high field MRI systems with increased multi-element coil design have enabled higher resolution by providing greater overall signal. This in turn has paved the way for imaging smaller parts including the walls of smaller and smaller vascular structures. For example, current technology is capable of generating 3D images with 0.4 x 0.4 x 0.4 mm isotropic voxels using 3T MRI. This has
enabled characterization of circle of Willis vessels out to secondary branches (A2,M2, and P2). Not only has analysis of vasculopathies with identical angiographic appearances been made possible thereby increasing specificity of diagnosis, it has also provided insight into disease pathophysiology. An example of this is the strong relationship found between ischemic stroke and gadolinium enhancing intra-cranial atherosclerotic plaques. The purpose of this presentation therefore is to summarize the current status of arterial wall imaging in clinical neuroradiology.

RC305-07 Update on Acute Stroke Intervention

Tuesday, Dec. 1 10:20AM - 10:45AM Location: N230

Participants
Colin P. Derdeyn, MD, Saint Louis, MO, (colin-derdeyn@uiowa.edu) (Presenter) Consultant, Terumo Corporation; Consultant, Penumbra, Inc; Consultant, Silk Road Medical; Stock options, Pulse Therapeutics, Inc; ;

LEARNING OBJECTIVES

1) Describe the current indications for endovascular stroke intervention. 2) Describe the available mechanical devices currently used in these cases.

ABSTRACT

The last 12 months have seen the publication of more positive pivotal clinical trials (n = 4) for the treatment of acute ischemic stroke than the last 20 years combined (n = 6). Endovascular stroke treatment (EVT) is now proven effective for a large subgroup of patients presenting with acute ischemic stroke. We will carefully review the data from the four recently published trials of endovascular treatment (EVT) for acute ischemic stroke: MR CLEAN (Multicenter Randomized Clinical Trial of Endovascular Treatment for Acute Ischemic Stroke in the Netherlands), ESCAPE (Endovascular Treatment for Small Core and Anterior Circulation Proximal Occlusion with Emphasis on Minimizing CT to Recanalization Times), and EXTEND-IA (Extending the Time for Thrombolysis on Emergency Neurological Deficits) and SWIFT PRIME (Solitaire With the Intention For Thrombectomy as Primary Endovascular Treatment for Acute Ischemic Stroke). We will examine the implications of these trials for current practice and future studies. In particular, we will focus on procedural details such as patient selection, devices, adjunctive therapies, treatment time windows and performance metrics.

Active Handout: Colin P. Derdeyn


RC305-08 Carotid Intraplaque Hemorrhage is Associated with Accelerated Progression in Patients with Acute Ischemic Stroke: A Prospective Multicenter-Study on Carotid Plaque Imaging in Patients with Acute Stroke

Tuesday, Dec. 1 10:45AM - 10:55AM Location: N230

Participants
Andreas Schindler, MD, Munich, Germany (Presenter) Nothing to Disclose
Anna Bayer-Karpinska, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Tilmann Obenhuber, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Florian Schwarz, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Clemens C. Cyran, MD, Munich, Germany (Abstract Co-Author) Research Grant, Bayer AG Research Grant, Novartis AG Speakers Bureau, Bayer AG
Tobias Saam, MD, Munich, Germany (Abstract Co-Author) Research Grant, Diamed Medizintechnik GmbH; Research Grant, Pfizer Inc
Andreas D. Helic, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Harloff, Freiburg, Germany (Abstract Co-Author) Speaker, Boehringer Ingelheim GmbH Speaker, Bayer AG
Holger Poppert, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Martin Dichgans, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To prospectively evaluate whether carotid plaque hemorrhage - as detected by high-resolution carotid plaque MRI - is associated with an accelerated progression rate of atherosclerosis.

METHOD AND MATERIALS

58 consecutive patients (76.3±9.8 years; 45 male) with acute ischemic stroke in the anterior circulation and non-stenosing carotid plaque in any carotid artery were included in the ongoing multi-center trial (which is also registered on ClinicalTrials.gov). Patients underwent MRI of both carotid arteries at baseline and at 12 months. Carotid plaques were characterized by the American Heart Association (AHA) classification system and plaque burden as well as components such as the lipid-rich/necrotic core, calcifications, and hemorrhage were identified and quantified. Annualized changes for each item were analyzed for both arteries combined on a patient basis for the whole cohort, as well as depending on the status of intra plaque hemorrhage (IPH) at baseline (IPH+ vs. IPH-). Unpaired t-test and one-sample t-test vs. 0 were performed.

RESULTS

A total of 14 patients had complicated AHA-LT6 plaques with IPH at baseline; no new IPH was detected at follow-up. During follow-up a total of four re-events occurred (all IPH+ at baseline). For all patients no significant changes in plaque burden or component size were measurable after one year, with a non-significant increase of mean wall area of 2.3%/year. IPH+ vs. IPH- subjects had a significantly higher progression of the normalized wall index (3.5% vs. 0.5%; p<0.05), and an accelerated progression of mean wall area (7.3% vs. 0.8%; P=n.s. for IPH+ vs. IPH-; P=0.037 for IPH+ vs. 0). No significant quantitative changes for all plaque components were measurable, although mean necrotic core area increased from 6.2 to 7.1 mm² in IPH+ patients (+16%) and remained unchanged in IPH- patients.

CONCLUSION

Intraplaque hemorrhage is associated with an accelerated atherosclerotic plaque progression rate in patients with acute ischemic stroke.

CLINICAL RELEVANCE/APPLICATION
This multi-center study provides further evidence that IPH is a good marker of plaque vulnerability; further studies are needed to test if patients with IPH could profit from more intensive therapy.

**RC305-09  Dual-Energy Head CT Can Accurately Distinguish Intraparenchymal Hemorrhage from Calcification in Emergency Department Patients**

**Participants**
Laleh Daftarbesheli, MD, Boston, MA (Presenter) Nothing to Disclose
Ranilang Hu, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Joseph Y. Young, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Markus Y. Wu, MD, Boston, 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
Rajiv Gupta, PhD, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Stuart R. Pomerantz, MD, Boston, MA (Abstract Co-Author) Research Grant, General Electric Company

**PURPOSE**
Conventional head CT and MRI with gradient-echo susceptibility scanning are limited in their ability to distinguish hemorrhage from calcification, a critical distinction in the selection of stroke patients for IV-thrombolytic and endovascular therapies. Dual energy CT (DECT) scanning, however, may be able to better discriminate calcium from hemorrhage based on the differing proportions of X-ray attenuation of these materials at different scanning energies. The purpose of this study is to evaluate the ability of DECT for differentiation of calcification from acute hemorrhage.

**METHOD AND MATERIALS**
In this IRB approved study, all unenhanced DECT head exams performed in our emergency department in November and December 2014 were retrospectively reviewed. Patients with at least one focus of intra-parenchymal hyperdensity were included and material decomposition images were post-processed. Virtual non-calcium and calcium overlay images were reviewed for the presence of calcification versus hemorrhage. Relevant prior and follow-up imaging and clinical data were used to determine the reference standard.

**RESULTS**
Of 399 DECT head exams, 83 (21%) contained at least one intraparenchymal hyperdensity on the corresponding simulated single energy CT (SECT) image; 64/83 (77%) with reference standard proof of diagnosis were included. Mean age was 67 years; 39/64 (61%) were male. 68 distinct intraparenchymal hemorrhage lesions were identified, of which 41/68 (60%) were calcification and 27/68 (40%) were hemorrhage. Sensitivity, specificity and accuracy of DECT for the detection of hemorrhage were 96% (CI 81-99%), 100% (CI 91-100%) and 99% (CI 90-100%), respectively. Seven of 27 (26%) of hemorrhages were incorrectly classified by SECT alone, compared to 1/27 (4%) for DECT.

**CONCLUSION**
DECT post-processed images can distinguish intraparenchymal hemorrhage from calcification rapidly and with very high accuracy in emergency department patients. Conventional gradient-echo MRI and CT scanning are unable to make this distinction accurately. This may have important implications for patient care, most notably in excluding stroke patients with intracranial hemorrhage from IV-thrombolytic and endovascular stroke therapies.

**CLINICAL RELEVANCE/APPLICATION**
Ability of DECT for differentiation of calcification from hemorrhage has important implications for patient care, most notably in excluding stroke patients with hemorrhage from IV-thrombolytic.

**RC305-10  Favorable Outcomes Following Endovascular Treatment in Anterior Circulation Stroke Patients Defined Prospectively Using MRI and Clinical Criteria**

**Participants**
Ramon G. Gonzalez, MD, PhD, Boston, MA (Presenter) Nothing to Disclose
Thabele M. Leslie-Mazwi, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Pamela W. Schaefer, MD, Boston, 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
Natalia Rost, Boston, MA (Abstract Co-Author) Nothing to Disclose
Lee Schwamm, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Joshua A. Hirsch, MD, Boston, MA (Abstract Co-Author) Shareholder, Intratech Medical Ltd

**PURPOSE**
To evaluate the clinical efficacy of major anterior circulation stroke thrombectomy in patients prospectively classified by specific MRI and clinical criteria.

**METHOD AND MATERIALS**
72 patients with MCA or terminal ICA occlusion by CTA, followed by core infarct volume determination by MRI, underwent thrombectomy after meeting institutional criteria: DWI lesion volume <70ml, age < 80, stroke onset to procedure initiation < 6 hours and baseline mRS ≤1. Thirty two were prospectively classified as Uncertain to Benefit (UTB) if one or more of the clinical criteria were not met or if the DWI lesion was 70-100 ml. Outcomes were based on 90-day modified Rankin score (mRS). Favorable outcomes were defined as 90 day mRS of 0, 1 or 2.

**RESULTS**
Sensitivity for mRS 0-1 was 99% (CI 92-100%) and specificity for mRS 2 or more was 88% (CI 71-96%). Favorable outcomes were strongly associated with favorable outcomes for CTA and DWI lesion volume <70 ml.
Reperfusion (mTICI 2b or 3) and prospective categorization as LTB were strongly associated with favorable outcomes (p<0.001 and p<0.005, respectively). Successful reperfusion had a significant positive impact on the distribution of mRS scores of the LTB cohort (p<0.0001). Intervention resulted in successful reperfusion in 68% of the LTB patients and 75% of UTB patients (not significant). Favorable outcomes were obtained in 53% and 25% of LTB and UTB patients that were treated, respectively (p= 0.016; Fisher exact test). In considering the effect of successful intervention, favorable outcomes were observed in 74% of LTB patients that had successful reperfusion compared to 33% of successfully reperfused UTB patients (p=0.004; Fisher exact test).

CONCLUSION

Patients prospectively classified as Likely to Benefit based on MRI and clinical criteria have a high likelihood of favorable outcome after thrombectomy, particularly if reperfusion is successful.

CLINICAL RELEVANCE/APPLICATION

This work demonstrates how to achieve high levels of favorable outcomes in severe ischemic stroke patients by using imaging for selection of appropriate patients for endovascular therapy.

RC305-11 Body Temperature Fluctuations Modulate Infarct Expansion, Penumbral Rescue, and Clinical Outcome in Acute Ischemic Stroke Following Successful Endovascular Reperfusion: Impact of Subclinical Temperature Changes on Ischemic Progression

Tuesday, Dec. 1 11:25AM - 11:35AM Location: N230

Participants
Seena Dehkargarhi, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Meredith Bowen, BA, Atlanta, GA (Presenter) Nothing to Disclose
Diogo C. Haussen, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Michael Frankel, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Adam B. Prater, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Andrey Lima, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Tyler Gleason, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Raul G. Negueira, MD, Boston, MA (Abstract Co-Author) Consultant, Stryker Corporation Consultant, Medtronic, Inc Consultant, CoAxia, Inc

PURPOSE

The exquisite temperature sensitivity of neuronal substrate has been thoroughly expounded in past studies. The effect of systemic temperature changes on stroke progression, and its impact upon the fate of at-risk tissues remains unknown. We undertook the analysis of temperature fluctuations and their interaction with rescue of penumbral tissues in a cohort of successfully revascularized acute stroke patients, hypothesizing greater relative infarct expansion as a function of sub-clinical systemic temperature changes.

METHOD AND MATERIALS

129 patients with acute stroke presenting within 12 hours were culled from our prospective registry. CT perfusion was obtained, with perfusion analysis undertaken in a user- and vendor-independent processing environment (RAPID). Automated lesion segmentation and thresholding of CTP data produced core, penumbral, and mismatch volumes. Final infarct volumes (FIV) were measured from DWI, and relative infarct growth (FIV-core/mismatch) computed. Systemic temperatures were recovered from medical records for the duration of hospitalization (up to q15 minutes), with minima, maxima, and ranges collected. All patients underwent successful endovascular reperfusion (mTICI IIb/III). Kendall’s tau correlation was prescribed to assess the association between temperature change from baseline and both relative infarct growth (RIG) and favorable clinical outcome (FCO) as 90d mRS<=2.

RESULTS

59 men and 70 women (age 63±14 yrs) with acute stroke (NIHSS median[IQR]=19[9]; time to groin puncture median[IQR]=330[301]) were examined. All patients exhibited an occlusive lesion of the anterior circulation (ICA/MCA) with successful reperfusion (mTICI IIb/III). Median core (rCBF), penumbral (Tmax), and FIV (median[IQR]) were 9.6cc[25], 131cc[125], and 21cc[37], respectively. Mean temperature minima=35.1°C and maxima=37.9°C. Correlational analysis demonstrated significant associations between temperature fluctuation from baseline and both RIG (P=0.01) and FCO (P<0.001).

CONCLUSION

The impact of sub-clinical temperature changes had not previously been reported as a driving factor in penumbral rescue, however the present findings suggest that neuronal fate may be affected by even minor temperature changes.

CLINICAL RELEVANCE/APPLICATION

Sub-clinical temperature dysregulation may potentiate neuronal injury following acute ischemic stroke, compelling further investigation into the mechanistic relationship.

RC305-12 Impact of the Implementation of Thrombectomy with Stent Retrievers on the Frequency of Hemicraniectomy in Patients with Acute Ischemic Stroke

Tuesday, Dec. 1 11:25AM - 11:35AM Location: N230

Participants
Peter Sporns, MD, Munster, Germany (Presenter) Nothing to Disclose
Jens Minnerup, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Tarek Zoubi, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Lutz Hanning, MD, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Walter L. Heindel, MD, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Wolfram Schwindt, MD, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Niederstadt, MD, Munster, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

Intervention resulted in successful reperfusion in 68% of the LTB patients and 75% of UTB patients (not significant). Successful reperfusion had a significant positive impact on the distribution of mRS scores of the LTB cohort (p<0.0001). Intervention resulted in successful reperfusion in 68% of the LTB patients and 75% of UTB patients (not significant). Favorable outcomes were obtained in 53% and 25% of LTB and UTB patients that were treated, respectively (p= 0.016; Fisher exact test). In considering the effect of successful intervention, favorable outcomes were observed in 74% of LTB patients that had successful reperfusion compared to 33% of successfully reperfused UTB patients (p=0.004; Fisher exact test).
The increasing use of endovascular treatments has led to higher recanalization rates and better clinical outcomes compared to intravenous thrombolysis alone. Stent retrievers represent the latest development for recanalization of large vessel occlusions. Decompressive hemicraniectomy has proved beneficial in patients suffering from rising intracranial pressure after malignant stroke. We investigated the effect of the implementation of stent retriever treatment on the frequency of hemicraniectomy as a surrogate marker for infarct size and thus for poor neurological outcome.

**METHOD AND MATERIALS**

Patients with acute ischemic stroke were retrospectively studied. We compared the frequency of hemicraniectomy following proximal artery occlusion of the internal carotid artery and middle cerebral artery main stem in the years before (2009 and 2010) and after (2012 and 2013) introducing stent retrievers.

**RESULTS**

Overall, 497 patients with proximal arterial occlusion were included in the study. Of 253 patients admitted in the years 2009 and 2010 44 (17.4 %) and of 244 patients admitted in 2012 and 2013 20 (8.2 %) received a hemicraniectomy. This decrease in the proportion of hemicraniectomies was statistically significant (p<0.01).

**CONCLUSION**

The findings in this study illustrate a significantly reduced rate of hemicraniectomies in patients with proximal artery occlusions after implementation of thrombectomy with stent retriever. Hereby we could show a significant reduction of malignant infarctions after thrombectomy with stent retriever.

**CLINICAL RELEVANCE/APPLICATION**

Stent retriever is a safe and effective device and improves clinical outcome.

**RC305-13** **Hallmarks of Pediatric Ischemic Stroke**

Tuesday, Dec. 1 11:35AM - 12:00PM Location: N230

Participants
Arastoo Vossough, MD, PhD, Philadelphia, PA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Define the epidemiological features and risk profiles of stroke in different pediatric patient populations. 2) Classify the types of pediatric stroke and features of vasculopathies leading to stroke. 3) Identify major mimickers of pediatric arterial ischemic stroke. 4) Specify current approved treatment options available for pediatric stroke 5) Identify recent and ongoing clinical trials in pediatric stroke.
Participants
Douglas S. Katz, MD, Mineola, NY (Moderator) Nothing to Disclose
Michael N. Patlas, MD, FRCP, Hamilton, ON, (patlas@hhsc.ca) (Moderator) Nothing to Disclose
Hani H. Abujudeh, MD, MBA, Boston, MA (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Assess the relative advantages and disadvantages for CT and MR imaging in the setting of suspected appendicitis. 2) Compare the diagnostic performance of CT and MR for both appendicitis and alternative conditions. 3) Describe the increasing use of MR for abdominal imaging in the ED setting.

ABSTRACT
N/A

Honored Educators
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Perry J. Pickhardt, MD - 2014 Honored Educator

Sub-Events
RC308-01 CT and MR of Acute Appendicitis
Tuesday, Dec. 1 8:30AM - 8:55AM Location: N228

Participants
Perry J. Pickhardt, MD, Madison, WI (Presenter) Co-founder, VirtuoCTC, LLC; Stockholder, Cellectar Biosciences, Inc; Research Consultant, Bracco Group; Research Consultant, KIT; Research Grant, Koninklijke Philips NV

METHOD AND MATERIALS
This retrospective study included 125 pregnant women with suspected appendicitis who underwent MRI, including axial T2WI with/without fat saturation, coronal and sagittal T2WI, and 3D T1WI. Total of 22 patients were surgically confirmed as acute appendicitis. T1 bright appendix sign was defined as T1 high signal intensity (SI) material filling more than half length of appendix while this T1 high SI did not result from appendicolith on 3D T1WI. MR images were reviewed by two experienced radiologists in consensus and visibilities of the appendices were evaluated. The maximal diameter of visible appendix with presence or absence of T1 bright appendix sign was evaluated from MR. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of T1 bright appendix sign were calculated

RESULTS
In patients with acute appendicitis (n=22), appendix was visualized in all patients and the mean diameter of the appendix was 9.4 ± 2.7 mm (range, 6.0-14.6 mm). In patients with a normal appendix (n=103), appendix was not visualized in 14 patients (13.6%). The mean diameter of the visualized normal appendix was 5.0 ± 0.7 mm (range, 3.1-6.8 mm). Among patient without appendicitis, T1 bright appendix sign was seen in 40 patients (45%), whereas it was noted in only 1 patient with acute appendicitis (4.5%). Fourteen patients had borderline sized appendix (appendix diameter between 6 - 7 mm) and 4 out of 14 patients were diagnosed as appendicitis. Among them, T1 bright appendix sign was seen in 4 patients without appendicitis. The sensitivity, specificity, PPV and NPV of T1 bright appendix sign for the diagnosis of normal appendix were 45%, 96%, 98%, and 30% for all patients and 60%, 100%, 100%, and 50% for patients with borderline sized appendix

CONCLUSION
T1 bright appendix sign was a specific finding for the diagnosis of normal appendix in pregnant women suspected of acute appendicitis

CLINICAL RELEVANCE/APPLICATION
If T1 bright appendix sign is seen in pregnant women with suspected appendicitis, the probability of acute appendicitis might be low
If told appendix sign is seen in pregnant women with suspected appendicitis, the probability of acute appendicitis might be low.

**OPTIMIZATION OF MR PROTOCOLS IN PREGNANT WOMEN WITH SUSPECTED ACUTE APPENDICITIS**

**Tuesday, Dec. 1 9:05AM - 9:15AM Location: N228**

**Participants**
Ilah Shin, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Yong Eun Chung, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Myeong-Jin Kim, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To investigate the optimal MR protocols in pregnant women who were suspected of acute appendicitis

**METHOD AND MATERIALS**
This retrospective study included 125 pregnant women (mean IUP, 21.6; range, 16-30 weeks) with suspected appendicitis. MR images were reviewed by two experienced radiologists in consensus in 3 separate sessions. On session 1, axial single shot(SSH) T2WI, respiratory gated fat saturated T2WI, 3D T1 weighted images (set 1) were reviewed. In session 2 and 3, set 1 + coronal T2WI (set 2) and set 2 + sagittal T2WI were reviewed respectively. The visibility of appendix (1: not identified - 5: entirely visualized) and probability of appendicitis (1: not appendicitis - 5: definite appendicitis) were evaluated in each session. If diseases other than appendicitis were suspected, reviewers were asked to provide specific diagnosis with a 5-point scale confidence level. Visualization score and diagnostic performance were compared by ANOVA and chi-square test. Area under the curve (Az) value was compared with DeLong methods.

**RESULTS**
Visualization scores of appendix were slightly increased in both set 2 (4.5±1.3) and set 3 (4.5±1.3) compared to set 1 (4.2±1.3) without statistical significance (ANOVA, P=0.214). There was no significant differences in confidence level among three groups, in both patients with appendicitis (4.9 in all sets, P=0.999) and without appendicitis (1.2 in all sets, P=0.914). Eighteen patients had been diagnosed to other diseases including urerter stone (1), obstruction (3), torsion (7), acute pyelonephritis (2), hemoperitoneum (2), colon cancer (2), and terminal ileitis (1). Sensitivity and accuracy were increased in set 2 (77.8%, 96.8%) and set 3 (83.3%, 97.6%) compared to set 1 (66.7%, 95.2%) for the diagnosis of other disease. Az value was significantly higher in set 3 (Az, 0.917) compared to both set 2 (Az, 0.889) and set 1 (Az, 0.833, P < 0.05)

**CONCLUSION**
Axial T2WI with/without fat saturation and 3D T1WI were sufficient for the diagnosis of acute appendicitis. However, additional coronal and sagittal SSH T2WI were required for the accurate diagnosis of disease other than appendicitis in pregnant women.

**CLINICAL RELEVANCE/APPLICATION**
Although axial T2WI and 3D T1WI is sufficient for the diagnosis of appendicitis, coronal and sagittal T2WI might be needed for the accurate diagnosis of diseases other than acute appendicitis in pregnant women who are suspected of acute appendicitis.

**SAVING TIME WITHOUT SABOTAGING DIAGNOSIS**

**Tuesday, Dec. 1 9:15AM - 9:25AM Location: N228**

**Participants**
Memento Mian, MD, FRCP, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Ismail T. Ali, MBCHB, MD, Vancouver, BC (Presenter) Nothing to Disclose
Teresa I. Liang, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Patrick D. McClaughlin, FFRCSI, Cork, Ireland (Abstract Co-Author) Speaker, Siemens AG
Savvas Nicolaou, MD, Vancouver, BC (Abstract Co-Author) Institutional research agreement, Siemens AG
Thona M. Walshe, FFR(RCSI), Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Silvia D. Chang, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Acute appendicitis is a major concern especially in young females presenting to ER with right iliac fossa pain. Prompt diagnosis/exclusion has major implications in the urgent care setting. Due to concerns for radiation exposure with CT scan, MR is gaining popularity as the imaging of choice given the low yield of ultrasound in such cases. In this study, we assess the diagnostic performance of FAST MR protocol comprising T2 HASTE and DW imaging for investigating such patients in the Emergency department.

**METHOD AND MATERIALS**
50 patients (49 Females; mean age 25.4 +/-5.2 yrs) with MR imaging between July 2017 and March 2015 for possible acute appendicitis were reviewed. MR abdomen/pelvis performed on 1.5 T MR per departmental protocol included axial T1 gradient echo in-out of phase, transverse FSE T2 with fat sat/motion correction, axial/coronal T2 HASTE and axial DWI images. In a randomized blinded fashion, two independent radiologists with > 5 years' experience in acute imaging reviewed both protocols for presence/absence of acute appendicitis with interpretation confidence on a five point scale(5 : highly confident to 1: non-diagnostic). Mean acquisition and interpretation times for both protocols were calculated. Sensitivity, specificity and accuracy for the FAST protocol was calculated, using clinical disposition of the patient as gold standard.

**RESULTS**
Mean scan time for FAST and FULL protocol was calculated to be 21.1 min and 40.5 min respectively. Mean interpretation time for FAST protocol for reader one and two was 4.1 +/-1.5 min and 4.5 +/-1.4 min and for FULL protocol was 8.1 +/-1.8 min and 7.1 +/-1.4 min respectively. The appendix was not confidently identified in 3 scans which were considered negative for the purpose of this study given the absence of indirect signs of inflammation like fat standing, free fluid. Sensitivity, specificity and accuracy for the FAST protocol were calculated to be 100% each for reader one and 75%, 100% and 94% respectively for reader two.
CONCLUSION
The FAST MR protocol with high diagnostic accuracy in detecting/excluding appendicitis and significant reduction in scan/interpretation time can be a valuable tool for assessing patients with possible acute appendicitis in the ER setting.

CLINICAL RELEVANCE/APPLICATION
FAST MR protocol significantly reduces scan/read times without sabotaging diagnostic accuracy for evaluating acute appendicitis, thus is an efficient and cost-effective technique in the ER setting.

RC308-05  **CT Angiography for Gastrointestinal Hemorrhage**

Participants
Jorge A. Soto, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To review an appropriate algorithm for the evaluation of patients presenting with overt lower intestinal bleeding, with emphasis on CT angiography. 2) To describe the proper CT angiographic technique for overt gastrointestinal bleeding. 3) Illustrate with multiple examples the CT angiographic findings of active gastrointestinal bleeding, as well as potential pitfalls in interpretation.

ABSTRACT
Overt gastrointestinal bleeding is a common and serious condition that may threaten a patient’s life depending on the severity and duration of the event. Precise identification of the location, source and cause of bleeding are the primary objectives of the diagnostic evaluation. The diagnostic algorithm implemented in these acutely ill patients include various imaging modality options, as well as upper endoscopy and colonoscopy. For patients presenting with hematochezia, implementation of colonoscopy in the emergency setting poses multiple challenges, especially the inability to adequately cleanse the colon and poor visualization owing to the presence of intraluminal blood clots. Scintigraphy with technetium 99m-labeled red blood cells is highly sensitive but also has some limitations, such as imprecise localization of the source of bleeding. CT angiography offers logistical and diagnostic advantages in the detection of active hemorrhage. A three-phase examination (non-contrast, arterial and portal venous) is typically performed. Potential technical and interpretation pitfalls should be considered and will be explained. The information derived from CT angiography helps direct therapy and select the most appropriate hemostatic intervention (when necessary): endoscopic, angiographic, or surgical. Precise anatomic localization of the bleeding point also allows a targeted endovascular embolization. The high diagnostic performance of CT angiography makes this test a good alternative for the initial emergent evaluation of patients with acute lower intestinal bleeding.

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Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator

RC308-06  **The Association of the Hypovolemic Shock Complex and Patient Mortality in Patients with Acute Internal Hemorrhage of the Abdomen and Pelvis**

Participants
Benjamin Fritz, MD, Freiburg, Germany (Presenter) Nothing to Disclose
Jan Fritz, MD, Baltimore, MD (Abstract Co-Author) Research Grant, Siemens AG; Research Consultant, Siemens AG; Speaker, Siemens AG
Philippe A. Dovi-Akue, MD, Freiburg, Germany (Abstract Co-Author) Nothing to Disclose
Maximilian Russe, MD, Freiburg, Germany (Abstract Co-Author) Nothing to Disclose
Mathias F. Langer, MD, PhD, Freiburg, Germany (Abstract Co-Author) Nothing to Disclose
Elmar C. Kotter, MD, MSc, Freiburg, Germany (Abstract Co-Author) Editorial Advisory Board, Thieme Medical Publishers, Inc

PURPOSE
The hypovolemic shock complex (HSC) constitutes computed tomography (CT) signs that are believed to be related to hypovolemic shock; however, its association with patient prognosis is unclear. We, therefore, sought to determine the frequency of HSC signs in patients with acute internal hemorrhage of the abdomen and pelvis and their association with patient mortality.

METHOD AND MATERIALS
A retrospective search of our hospital database between 2012 and 2014 derived 197 patients with clear contrast-enhanced MDCT demonstration of acute internal hemorrhage of the abdomen and pelvis. Experienced observers evaluated the CT studies for 10 different radiological signs of HSC. The frequencies of HSC signs were correlated with death during hospitalization.

RESULTS
44/197 (22.3%) of the patients died. The mortality group showed an average of 3.0 HSC signs, whereas the survival group showed 1.1 (p<0.001). Mortality and survival groups showed differences of the frequency of hyperenhancing adrenal glands (70.5% (31/44) vs. 19.0% (29/153), p=0.001), halo sign (54.5% (24/44) vs. 32% (48/150), p=0.01), splenic hypoperfusion (37.2% (16/43) vs. 4% (6/151), p=0.0001), altered renal enhancement (15.9% (7/44) vs. 3.3% (5/153), p=0.033), shock bowel (22.7% (10/44) vs. 3.3% (5/150), p=0.005), liver hypoperfusion (15.9% (7/44) vs. 3.3% (5/153), p=0.004), and hyperenhancement/edema of the gallbladder...
(12.1% (4/33) vs. 0% (0/137), p=0.044). No significant differences existed for a flat IVC (59.1% (26/44) vs. 45.1% (69/153), p=0.103), small diameter aorta (9.5% (4/42) vs. 6.5% (10/153), p=0.516) and pancreatic hyperenhancement/edema (6.8% (3/44) vs. 0% (0/153), p=0.083). 10% (7/73) of patients with no signs of HSC died compared to 11% (5/44) with 1, 27% (9/33) with 2, 33% (8/24) with 3, 67% (4/6) with 4, 44% (4/9) with 5, 67% (2/3) with 6, 100% (2/2) with 7, 100% (2/2) with 8 and 100% (1/1) with 9 HSC signs.

CONCLUSION

HSC signs are common in patients with acute internal hemorrhage. Patient mortality significantly increases if 2 or more signs are present. While several signs are associated with increased mortality, inferior vena cava, aorta and pancreas signs have the weakest association.

CLINICAL RELEVANCE/APPLICATION

Timely MDCT diagnosis and reporting of the HSC can contribute to appropriate management of the acute patient care and prognosis.

RC308-07  Question and Answer

Tuesday, Dec. 1 10:00AM - 10:15AM Location: N228

Participants

RC308-08  Imaging of Bowel Ischemia

Tuesday, Dec. 1 10:15AM - 10:40AM Location: N228

Participants

Participants

Vincent M. Mellnick, MD, Saint Louis, MO, (mellnickv@mir.wustl.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To apply protocols for CT and MRI that are best for identifying and characterizing bowel ischemia. 2) To compare the underlying causes and imaging findings of bowel ischemia, including nonocclusive ischemia, arterial and venous occlusion, vasculitis, and obstruction. 3) To differentiate the CT and MRI findings of bowel ischemia due in various stages of chronicity. 4) To use this information to better detect bowel ischemia in clinical practice and recommend appropriate management.

ABSTRACT

N/A

RC308-09  CT for Acute Nontraumatic Abdominal Pain - Is Oral Contrast Really Required? Initial Conclusions

Tuesday, Dec. 1 10:40AM - 10:50AM Location: N228

Participants

Rivka Kessner, Tel Aviv, Israel (Presenter) Nothing to Disclose
Sophie Barnes, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Pinhas Halpern, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Vadim Makrin, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose
Arye Blachar, MD, Tel Aviv, Israel (Abstract Co-Author) Nothing to Disclose

PURPOSE

To compare the diagnostic performance of abdominal CT performed with and without oral contrast, in patients presenting to the ED with acute nontraumatic abdominal pain.

METHOD AND MATERIALS

Our prospective study was conducted on a sample of adult patients presenting with nontraumatic abdominal pain to the ED of a large tertiary medical center. 250 patients with acute abdominal pain that underwent IV contrast-enhanced abdominal CT were enrolled over a 9-month period. 125 patients were recruited for the study group using convenience sampling, and underwent CT without oral contrast. A control group of 125 patients who underwent additional scan in order to establish the correct diagnosis. Among the 125 patients of the study group, no patient had to undergo additional scan in order to establish the correct diagnosis. There was no significant difference between the groups regarding the history of the patients and the technique of the studies. The reviewers also determined specific technical and imaging findings, including the presence of oral contrast in the pathological area and the influence of the technique on some radiological findings.

RESULTS

Each group consisted of 67 males and 58 females. The average age of the two groups was 46.9 years. The main diagnoses were appendicitis (20%), diverticulitis (8.4%), colitis (6.4%) and a normal CT exam (40.4%). There was no significant difference between the groups regarding the history of the patients and the technique of the studies. Among the 125 patients of the study group, no patient had to undergo additional scan in order to establish the correct diagnosis. In only 1 patient from each group (0.8%), contrast material was considered to be necessary. In 8 patients from the study group (6.4%) and 5 patients from the control group (4%) oral contrast was considered helpful.

CONCLUSION

Our study indicates that examination of patients with acute nontraumatic abdominal pain with CT scans without oral contrast material - are diagnostic and have comparable performance to scans performed after oral contrast administration.

CLINICAL RELEVANCE/APPLICATION

Our study indicates that patients presenting to the ED with acute nontraumatic abdominal pain, may be examined with CT without
Assessing the Prevalence and Clinical Relevance of Positive Abdominal and Pelvic CT Findings in Senior Patients Presenting to the Emergency Department.

Tuesday, Dec. 1 10:50AM - 11:00AM Location: N228

Participants
Abdullah Alabousi, MD, Hamilton, ON (Abstract Co-Author) Nothing to Disclose
Michael N. Patlas, MD, FRCP, Hamilton, ON (Abstract Co-Author) Nothing to Disclose
Malek Meshki, MD, Hamilton, ON (Presenter) Nothing to Disclose
Sandra Monteiro, PhD, Hamilton, ON (Abstract Co-Author) Nothing to Disclose
Douglas S. Katz, MD, Mineola, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
To retrospectively evaluate the prevalence and clinical relevance of positive abdominal and pelvic CT(A/P CT) findings for patients ages 65 and older, when compared with all other Emergency Department (ED) patients undergoing A/P CT during the same time period.

METHOD AND MATERIALS
An IRB-approved retrospective review of all adult patients who underwent an emergency 64-MDCT of the abdomen and pelvis for acute non-traumatic abdominal complaints over a two-year period at a single institution was performed. The prevalence and clinical relevance of positive CT findings was assessed for patients <65 and >65. Statistical comparisons were made with Student t-tests.

RESULTS
2102 patients between 10/1/2011 and 9/30/2013 were reviewed. 1009 patients were excluded as their CT was performed to assess for trauma, for post-operative changes, or because the patients had a known diagnosis or the CT examination was performed for cancer staging. 631 patients were included in the <65 group (298 men and 333 women; mean age 46, age range 18-64), and 462 were included in the >65 group (209 men and 253 women; mean age 78, age range 65-99). Overall, there were more positive CT findings explaining the abdominal/pelvic pain for patients <65 (388 positive cases, 61.5%), compared with the >65 group (258 positive cases, 55.8%), which was a statistically significant difference (p<0.03). However, patients >65 were more likely to have clinically/surgically relevant findings. 50% of patients >65 presenting with appendicitis had complications evident on the initial CT, compared with 27% of those <65 (p<0.05). In addition, bowel obstruction (41 vs 27 patients, p<0.05), ruptured abdominal aortic aneurysm (7 vs 2 patients, p<0.05) and malignancy (19 vs 12 patients, p<0.05) were all more common in individuals presenting to the ED >65 years of age.

CONCLUSION
The findings of our retrospective study refute the hypothesis that there is increased prevalence of positive abdominal and pelvic CT findings in patients >65. However, older patients in our series were more likely to present with clinically/surgically relevant findings, and a lower threshold for ordering imaging examinations in this patient population should be considered.

CLINICAL RELEVANCE/APPLICATION
64-MDCT shows more clinically/surgically relevant findings in individuals older than 65 than in younger patients presenting to the Emergency Department with acute non-traumatic abdominal complaints.

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Douglas S. Katz, MD - 2013 Honored Educator
Douglas S. Katz, MD - 2015 Honored Educator

MR of the Acute Abdomen

Tuesday, Dec. 1 11:00AM - 11:25AM Location: N228

Participants
Stephan W. Anderson, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To overview the current utilization of MR of the acute abdomen, with an emphasis on protocol optimization, and correct interpretation, using case examples. 2) To examine potential pitfalls in the interpretation of MR of the acute abdomen. 3) To review the current literature of MR of the acute abdomen.

The "Onyx Rim" Sign in Pelvic MRI: Perifollicular Hemorrhage as a Potential Predictor of Viability in the Setting of Ovarian Torsion

Tuesday, Dec. 1 11:25AM - 11:35AM Location: N228

Participants
Iva Petkovska, MD, Tucson, AZ (Presenter) Nothing to Disclose
Zeenia Irani, MD, MS, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Bobby T. Kalb, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Christopher Geffre, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Janiel Cragun, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
James R. Costello, MD, PhD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Hina Arif Tiwari, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
To correlate noncontrast MRI features of perifollicular hemorrhage with ovarian viability in the clinical setting of torsion.

**METHOD AND MATERIALS**

This is an IRB-approved retrospective review of 8 patients with ovarian torsion MRI confirmed with intraoperative exam. Preoperative MR exams were performed on either a 1.5T/3.0T system (Siemens Magnetom Aera/Skyra) using 18-channel anterior abdominal and pelvic surface coils. Images were acquired without breath holding using multiplanar T2-weighted Half-Fourier Single-shot Echo-train (HASTE) sequences, repeated with fat-suppression using SPectral Adiabatic Inversion Recovery (SPAIR). All MRIs were retrospectively reviewed in a blinded fashion separately by two radiologists for the presence or absence of a T2-hypointense perifollicular rim. This finding, when present, was utilized as a predictor of nonviability of the torsed ovary. Each torsed ovary was categorized as either a) viable or b) nonviable based on presence/absence of a perifollicular T2-hypointense rim. Clinical outcomes were determined by either a) histopathologic correlation, or b) imaging follow-up and review of the patient’s medical records.

**RESULTS**

Of 8 patients with ovarian torsion on MRI, 5 were categorized as non-viable on MRI due to the presence of a perifollicular T2 hypointense rim, and 3 as viable due to a lack of perifollicular T2-hypointense rim. Using the reference standards of pathology (n=5) and medical chart review and imaging follow-up (n=3), MRI demonstrated a sensitivity of 100 %, and specificity of 100 % for predicting viability of a torsed ovary based on presence of a perifollicular T2-hypointense rim. Histopathological correlation demonstrated perifollicular hemorrhage separating the theca interna and externa in every patient with non-viable ovaries, corresponding to the perifollicular T2-hypointensity identified on preoperative MRI.

**CONCLUSION**

Preoperative noncontrast MRI may hold promise for the prediction of ovarian viability in clinical setting of torsion.

**CLINICAL RELEVANCE/APPLICATION**

Preoperative MRI for the diagnosis of ovarian torsion may provide a biomarker for prediction of ovarian viability, with potential impact on preoperative planning and management.

**RC308-13** Diagnostic Performance of Individual and Combined MR Signs of Acute Cholecystitis

**PURPOSE**

To determine the performance of individual and combined MR signs of acute cholecystitis, and to propose a rapid non-contrast MR protocol for emergency diagnosis of right upper quadrant pain.

**METHOD AND MATERIALS**

The institutional review board approved this HIPAA-compliant retrospective study. Informed consent was waived. 288 patients presenting to the emergency department with acute right upper quadrant pain between 10/3/2010 and 11/28/2012 undergoing MR within 48 hours of US were included. MR was performed in all included patients due to equivocal US and persistent symptoms. Individual MR signs were graded in a blinded fashion using single shot T2, diffusion (b=0, b=600) and 3D GRE post contrast sequences. Sensitivity and specificity values for individual and combined imaging signs were calculated using surgical diagnosis as the reference standard for acute cholecystitis.

**RESULTS**

Of 288 patients, 128 were treated conservatively and excluded from analysis. 160 underwent cholecystectomy and 77 were diagnosed with acute cholecystitis at surgery. Sensitivities of the MR findings of gallstones, distention, wall thickening, pericholecystic fluid, gallbladder fossa restricted diffusion, wall restricted diffusion, gallbladder fossa hyper enhancement and wall hyper enhancement for the detection of acute cholecystitis were 96%, 59.7%, 72.7%, 49.4%, 47.3%, 26.7%, 55% and 11%, respectively. Corresponding specificities were 24.6%, 71%, 55.9%, 78.2%, 74.8%, 88.3%, 83.2% and 98.4%. Combining stones, distention, pericholecystic fluid and gallbladder fossa restricted diffusion yielded sensitivity of 35% and specificity of 92.7%, and these findings were identifiable using single shot T2 and diffusion sequences only. The combination of stones, distention and gallbladder fossa hyper enhancement was 43.8% sensitive and 89.6% specific for acute cholecystitis.

**CONCLUSION**

Individual and combined MR features show high specificity for acute cholecystitis. Most signs can be detected by diffusion and single shot T2 weighted sequences only. Gallbladder fossa restricted diffusion is a novel imaging sign, and when combined with the presence of gallstones, pericholecystic fluid and distention yields a specificity of 92.7% for acute cholecystitis.

**CLINICAL RELEVANCE/APPLICATION**

A highly specific, rapid non-contrast MR protocol consisting of diffusion and single shot T2 weighted sequences can be effective for the diagnosis of acute cholecystitis when US findings are equivocal.

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Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator

**RC308-14  Question and Answer**

Tuesday, Dec. 1 11:45AM - 12:00PM Location: N228

Participants
Participants

Sub-Events

RC309A  Pitfalls in Bowel Imaging

Participants
David H. Kim, MD, Madison, WI (Presenter) Consultant, Viatronix, Inc; Co-founder, VirtuoCTC, LLC; Medical Advisory Board, Digital ArtForms, Inc; Stockholder, Cellectar Biosciences, Inc

LEARNING OBJECTIVES
1) List the advantages/disadvantages of positive and negative oral contrast 2) Recognize common pitfalls that mimic disease 3) Devise practical approaches to manage common bowel imaging scenarios

RC309B  Atypical Liver Lesions

Participants
Rendon C. Nelson, MD, Durham, NC, (rendon.nelson@duke.edu) (Presenter) Consultant, General Electric Company Consultant, Nemoto Kyorindo Co, Ltd Consultant, VoxelMetrix, LLC Research support, Bracco Group Research support, Becton, Dickinson and Company Speakers Bureau, Siemens AG Royalties, Wolters Kluwer nv

LEARNING OBJECTIVES
1) To understand the typical imaging appearance of various focal liver lesions on CT and MR and how they can present in an atypical fashion (i.e. the imaging spectrum).

ABSTRACT
Active Handout: Rendon C. Nelson

RC309C  Pitfalls in Hepatic Doppler Sonography

Participants
Jonathan B. Kruskal, MD, PhD, Boston, MA, (jkruskal@bidmc.harvard.edu) (Presenter) Author, UpToDate, Inc

LEARNING OBJECTIVES
1) Discuss the common technical pitfalls that occur when performing the liver Doppler examination, and how these can be mitigated. 2) Discuss the perceptual and interpretive errors that occur when performing the liver Doppler examination, and how these can be minimized. 3) Describe the clinical impact of technical and interpretive errors.

ABSTRACT

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Jonathan B. Kruskal, MD, PhD - 2012 Honored Educator

RC309D  Pearls and Pitfalls in Pancreatic Diseases

Participants
Khaled M. Elsayes, MD, Ann Arbor, MI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe most commonly encountered imaging pitfalls of the pancreas. 2) Describe relevant technical background, pathophysiology and hemodynamics of these pitfalls. 3) Discuss tips to avoid erroneous diagnosis and pearls to reach correct diagnosis.

ABSTRACT
There is a wide range of common pitfalls in pancreas imaging, which can lead to frequent incorrect diagnoses mainly because many radiologists are not completely familiar with anatomical, morphological, physiological, hemodynamic and biological principles as well as deficiency of modern clinical and radiological knowledge. This leads to common misinterpretations which would further results in
wrong management with potentially negative outcome. In this course, we will review important typical features of common pancreatic pathologies and mimics of these pathologies that may require different treatment and improved prognosis.

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Khaled M. Elsayes, MD - 2014 Honored Educator
RC313

Pediatric Series: CV/Chest

Tuesday, Dec. 1 8:30AM - 12:00PM Location: E353A

Participants
Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (Moderator) Research collaboration, General Electric Company; Consultant, Arterys; Research Grant, Bayer AG;
Lorna Browne, MD, FRCR, Denver, CO (Moderator) Nothing to Disclose
Rajesh Krishnamurthy, MD, Houston, TX (Moderator) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation
R. Paul Guillerman, MD, Houston, TX (Moderator) Nothing to Disclose

Sub-Events

RC313-01 Imaging of Aortopathies

Tuesday, Dec. 1 8:30AM - 8:50AM Location: E353A

Participants
Cynthia K. Rigsby, MD, Chicago, IL, (crigsby@luriechildrens.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Define aortopathy. 2) Describe the imaging features of common aortopathies. 3) Show potential complications associated with aortopathies.

RC313-02 4D flow MRI Based Volumetric Aortic Peak Velocity Quantification: Efficiency, Observer Variability and Comparison to 2D Phase Contrast MRI

Tuesday, Dec. 1 8:50AM - 9:00AM Location: E353A

Participants
Michael Rose, Chicago, IL (Presenter) Nothing to Disclose
Kelly Jarvis, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Varun Chowdhary, MD, BS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Alex Barker, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Bradley D. Allen, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Joshua D. Robinson, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Susanne Schnell, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Cynthia K. Rigsby, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

PURPOSE
Standard methods for measuring peak blood flow velocity include Doppler echocardiography and 2D CINE phase contrast (PC) MRI. Due to their reliance on single-direction velocity encoding and regional flow analysis (2D planes) both methods can underestimate peak velocities, especially in cases of complex flow jets as commonly seen in patients with abnormal aortic valves. The aim of this study was to test the feasibility and efficiency of a new method for volumetric peak velocity quantification of aortic peak systolic blood flow velocities in a cohort of pediatric BAV patients using 4D flow MRI and velocity maximum intensity projections (MIPs).

METHOD AND MATERIALS
51 pediatric BAV patients (age = 14 ± 5, range = 3-24 years, 18 female) underwent aortic 4D flow MRI (1.5T Aera, Siemens, Germany). After pre-processing (velocity anti-aliasing, phase offset correction) and 3D segmentation of the aorta, velocity MIPs were generated to determine peak velocities in the ascending aorta, arch, and descending aorta by two independent observers. 4D flow derived peak velocities were compared to results from 2D CINE PCMRI from the same study for 36 BAV patients.

RESULTS
4D flow peak systolic velocities were significantly higher than 2D CINE PC MRI (2.02±0.72 m/s vs 1.72±0.81 m/s, p = 0.0001, Wilcoxon signed-rank test). Bland-Altman analysis of peak velocity assessment showed excellent inter-observer variability (mean difference = -0.005 m/s, limits of agreement = ± 0.192 m/s) with low average inter-observer error 2.0 %. The estimated time for 4D flow MRI pre-processing and segmentation was 20 min. Average analysis time (calculation of velocity MIP, ROI analysis) was 92 ± 49 s.

CONCLUSION
4D flow MRI in combination with 3D segmentation of the aorta and velocity MIP analysis can be used to determine aortic peak systolic velocity with high efficiency and low observer variability. The full volumetric coverage and 3-directional velocity of 4D flow MRI fully captures complex aortic flow patterns and is thus better suited to identify the highest velocity in an entire aortic segment compared to 2D CINE PC MRI, which underestimated peak velocities in our BAV cohort by 15%.

CLINICAL RELEVANCE/APPLICATION
In patients with aortic valve disease such as bicuspid aortic valve (BAV), the severity of valve disease is characterized using peak blood velocity to estimate the peak transvalvular pressure gradient (via the simplified Bernoulli equation).
METHOD AND MATERIALS

Angiography of the chest was performed using a second and third generation Dual-Source CT in 54 patients (median age 7 days, range 1-348 days) with a high-pitch protocol (p=3.2-3.4) at low tube voltages (70-80 kV). The margins of the VSDs were classified into four different types by CT. With the exception of apical septal defects the size of the defects seems not to correlate with a specific location. Median radiation dose was as low as 0.37 mSv (range 0.12 - 2.00 mSv).

RESULTS

Mean deviation of the CT-measurements compared to the intraoperative findings was not statistically significant (3.5 ± 3.0 mm, p=0.21), while the mean difference compared to echocardiography was significantly higher (7.4 ± 4.8 mm, p<0.01). The VSDs can be classified into four different types by CT. With the exception of apical septal defects the size of the defects seems not to correlate with a specific location. Median radiation dose was as low as 0.37 mSv (range 0.12 - 2.00 mSv).

CONCLUSION

High Pitch Computed Tomography Angiography of the thorax provides precise measurements of VSDs in pediatric patients with congenital heart disease younger than one year.

CLINICAL RELEVANCE/APPLICATION

Preoperative High Pitch Computed Tomography Angiography of the thorax, besides the advantages in imaging of the coronaries and great intrathoracic vessels, provides precise measurements of VSDs at reasonable low radiation dose.

RC313-04 Image Quality and Accuracy of a Prototype Self-Navigated 3D Whole-heart Sequence for the Assessment of Coronary Artery Anomalies in a Pediatric Patient Population

Tuesday, Dec. 1 9:10AM - 9:20AM Location: E353A

Participants

Giuseppe Muscogiuri, MD, Charleston, SC (Presenter) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Carlo N. De Cecco, MD,PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Pal Suranyi, MD, PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Julian L. Wichmann, 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; ; Paola Maria Cannao, MD, San Donato Milanese, Italy (Abstract Co-Author) Nothing to Disclose
Stefanie Mangold, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Davide Piccini, Lausanne, Switzerland (Abstract Co-Author) Employee, Siemens AG
Wolfgang Rehwald, Erlangen, Germany (Abstract Co-Author) Employee, Siemens AG
Anthony M. Hlavacek, MD, Charleston, SC (Abstract Co-Author) Investigator, Siemens AG Research Grant, Siemens AG
Ami C. Nutting, MD, Charleston, SC (Abstract Co-Author) Research Grant, Siemens AG

PURPOSE

The aim of this study was to assess the feasibility, image quality, and diagnostic performance of a prototype non-contrast enhanced self-navigated 3D (SN3D) whole-heart MRA acquisition in comparison with coronary CT angiography (cCTA) for delineating the coronary artery origin and proximal course in pediatric patients with suspected coronary artery anomalies.

METHOD AND MATERIALS

Seven patients (13±3 years) with suspected coronary artery anomalies underwent a reference standard cCTA (SOMATOM Flash, Siemens Healthcare, Forchheim, Germany) and a research non-contrast cardiac MRA (MAGNETOM Avanto 1.5T, Siemens Healthcare, Erlangen, Germany) for the assessment of the origin and proximal course of the coronary arteries. The steady-state free precession based SN3D MRA was performed using the following parameters: TR/TE 3.1/1.5ms, flip angle 115°, FOV 220mm, voxel size: 1.1mm3, and 12064 radial views distributed over 377 heartbeats. Subjective image quality of the SN3D MRA and cCTA was evaluated using a 4-grade scale (1, nondiagnostic; 2, sufficient; 3, good; 4, excellent). Visualization of the left main, left anterior descending (LAD), circumflex (LCX) and right coronary arteries (RCA), as well as the time of acquisition and signal to noise...
ratio (SNR), were assessed. Wilcoxon test was used to compare subjective image quality between cCTA and MRA.

RESULTS
The acquisition time of the SN3D MRA was 5.9±1.4min with an average heart rate of 81bpm, while the mean SNR was 27±4. MRA and cCTA image quality ratings were 2.3±0.7 and 3.3±0.7, respectively (p>0.05). SN3D MRA allowed the visualization of the left main, the LAD and the RCA with good agreement to cCTA in all cases, but failed to visualize the LCX in a single case.

CONCLUSION
In this preliminary study there was good agreement for the evaluation of coronary artery anatomy between SN3D MRA and cCTA. The novel radial SN3D sequence allows for the acquisition of an isotropic volume in a free-breathing fashion in about half the time as a standard respiratory-navigated coronary MRA, with an improved ease of use, without penalties in image quality, and without radiation exposure, contrast agent administration or the need for general anesthesia.

CLINICAL RELEVANCE/APPLICATION
This non-contrast self-navigated MRA sequence provides relatively rapid, free-breathing radiation-free evaluation of anomalies of the coronary artery origin and proximal course in children.

PURPOSE
While 3D CT angiography (CTA) images are useful for evaluating the complex anatomy in patients with congenital heart disease, they require higher contrast enhancement to identify blood vessels and soft tissues. However, the thin pediatric vessel wall imposes an injection pressure limit and can result in poor CT enhancement. As the gauge of the fenestrated- is smaller than of the conventional nonfenestrated catheter, optimal enhancement can be achieved by controlling the injection pressure. We compared the injection rate, aortic enhancement, and injection pressure when intravenous contrast material was injected with fenestrated- and conventional non-fenestrated catheters.

METHOD AND MATERIALS
We randomly divided 34 pediatric patients seen between December 2014 and March 2015 into two groups. Group A consisted of 18 children (age one week to 8 months, body weight 3.6 ± 1.2 kg) and group B of 16 (age one week to 12 months, body weight 3.3 ± 0.9 kg). In group A we delivered the contrast medium via a 22-gauge conventional non-fenestrated catheter and in group B we used a 24-gauge fenestrated catheter. Whole-heart helical CTA scans were performed on a 64-detector scanner (GE VCT, tube voltage 80 kVp, detector configuration 64 x 0.625 mm, rotation time 0.4s/r, helical pitch 1.375, preset AEC noise index 12) and the injection rate, aortic enhancement, and injection pressure were compared in groups A and B.

RESULTS
The mean injection rate and aortic enhancement were 0.9 ± 0.1 ml/sec and 468 ± 45.0 HU in group A and 0.87 ± 0.3 ml/sec and 444 ± 63.5 HU in group B. There was no significant difference in the injection rate and aortic enhancement (p = 0.34, p = 0.38). The maximum injection pressure was significantly lower in group B than group A (0.33 vs. 0.55 kg/cm2, p < 0.05).

CONCLUSION
Use of the fenestrated catheter decreases the injection pressure limit while retaining the injection rate and aortic enhancement of conventional catheters.

CLINICAL RELEVANCE/APPLICATION
With use of the fenestrated catheter, pediatric CT angiography obtains the optimal aortic enhancement by changing injection rate in safety.

PURPOSE
To evaluate the effect of dual-source parallel RF transmission on the B1 homogeneity, the image quality (image contrast and off-resonance artifacts) in the cine b-SSFP sequence and the repeatability of left-ventricle cardiac function in 3.0T CMR of children.
FUNCTIONAL LUNG CAPACITY AND CORRELATION WITH THE RESULTS OF INFANT PULMONARY FUNCTION TEST AND QUANTITATIVE CT ASSESSMENT IN INFANTS WITH POSTINFECTIOUS BRONCHIOLITIS OBLITERANS

PURPOSE
To investigate the possibility for estimating functional lung capacity from ventilation inhomogeneity using infant pulmonary function test (iPFT) and quantitative CT assessment for air trapping in infants with postinfectious bronchiolitis obliterans (BO).

METHOD AND MATERIALS
This prospective study included infants with clinically and radiologically proven BO since 2009. We performed iPFT in these patients and measured tidal volume (TV), functional residual capacity (FRC) and lung clearance index (LCI) by sulphur hexafluoride multiple breath washout using an ultrasonic flow meter. From chest CT, we calculated total lung volume (CT-TLV) and imaging functional lung volume (CT-FLV) which showed higher attenuation than the mean attenuation of the grossly normal and air trapping areas. We compared iPFT and CT parameters using Spearman correlation analysis.

RESULTS
Thirteen infants (M:F = 11:2) were included in this study. The age was 3–17 months with the mean of 10.4 ± 4.5 months. The mean body weight and height were 9.4 ± 1.7 kg and 75.9 ± 8.0 cm. The values of TV, FRC and LCI were 82.0 ± 19.9 ml, 184.1 ± 49.1 ml and 8.2 ± 1.3, respectively. For chest CT, the effective radiation dose was 0.2-1.8 mSv with the mean of 0.66 ± 0.86. A high level inter-observer agreement for cardiac function with RF shimming was acquired both in NBH scanning (CV: 1.91-%11.84%; ICC, 0.83-0.98) and BH scanning (CV: 0.52-%4.44%; ICC, 0.98-0.99)

CONCLUSION
Dual-source parallel RF transmission could significantly improve the B1 homogeneity and image quality and is suitable for the 3.0T cardiac magnetic resonance in children.
**RC313-09 Dynamic Airway Imaging**

**Participants**
Rajesh Krishnamurthy, MD, Houston, TX (Presenter) Research support, Koninklijke Philips NV; Research support, Toshiba Corporation

**LEARNING OBJECTIVES**
1) Discuss indications and protocols for dynamic airway imaging in children using CT and MRI, with emphasis on advantages offered by new generation CT scanners. 2) Learn appropriate use of common post-processing tools and measurement metrics for the pediatric airway that correlate well with bronchoscopy. 3) Understand imaging findings that distinguish between intrinsic and extrinsic airway pathology. 4) Review common applications for dynamic airway imaging, including tracheobronchomalacia, vascular mediated airway compromise, complete tracheal rings, mediastinal masses, and airway tumors.

**ABSTRACT**
This talk will provide an overview of indications and protocols for dynamic airway imaging in children using CT and MRI, with emphasis on advantages offered by new generation CT scanners, and post-processing tools that allow derivation of metrics similar to bronchoscopy. We will review examples of intrinsic and extrinsic airway pathology in children, including tracheobronchomalacia, vascular mediated airway compromise, complete tracheal rings, mediastinal masses, and airway tumors.

**METHOD AND MATERIALS**
DCE-MRI was performed in 30 children (24.3±1.8 month) after CDH repair using a 3D TWIST sequence (Siemens Healthcare, Germany). 0.05 mmol/kg body weight of contrast agent (Dotarem, Guerbet, France) were administered. Pulmonary blood flow (PBF) was calculated based on a pixel-by-pixel deconvolution approach. For ROI-based quantification, three circular ROIs (apical, middle and basal) per lung were used both in the ventral and dorsal lung. Propagation of those circular ROIs through five adjacent slices generated 6 cylindrical ROIs in the ventral and dorsal lung respectively. For whole-lung analysis, the whole lung was contoured. In both techniques larger vessels were excluded from analysis (Fig. A).

**RESULTS**
In the ROI-based approach, PBF was significantly reduced on the ipsilateral side (74.5±30.3 ml/100ml/min) in comparison to the contralateral side (113.1±40.4 ml/100ml/min; p<0.0001). Also in the whole lung based approach ipsilateral PBF was significantly lower (73.9±25.5 ml/100ml/min) than in the contralateral lung (102.3±31.8 ml/100ml/min; p<0.0001). In the ipsilateral lungs, quantification results of the ROI-based and the whole-lung segmentation based approach were equal (p=0.50). In the contralateral lungs, the ROI-based approach significantly overestimated PBF in comparison to the whole-lung approach by approximately 9.5% (p=0.0013; Fig. B).

**CONCLUSION**
MR lung perfusion in 2-year children after CDH is significantly reduced ipsilaterally, both when quantified by a ROI-based and a whole-lung based approach. In the contralateral lung, the ROI-based approach significantly overestimates perfusion results and therefore whole lung segmentation should be preferred.

**CLINICAL RELEVANCE/APPLICATION**
With MR lung perfusion imaging, perfusion deficits after congenital diaphragmatic hernia can be depicted. Whole-lung segmentation for quantification is advisable, as a ROI-based approach can overestimate results.

**RC313-10 Comparison of a ROI-based and a Whole-lung Segmentation Based Approach for MR Lung Perfusion Quantification in Two-year Old Children after Congenital Diaphragmatic Hernia Repair**

**Participants**
Meike Weidner, Mannheim, Germany (Presenter) Nothing to Disclose
Verena Sommer, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Frank G. Zoellner, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Claudia Hagelstein, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Schaible, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
Wolfgang Neff, MD, PhD, Alzey, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
By the means of a region-of-interest (ROI) based approach it has been demonstrated that 2-year old children after congenital diaphragmatic hernia (CDH) repair show reduced MR lung perfusion values on the ipsilateral side. As ROI-based approaches only cover parts of the lung tissue, this study aimed to evaluate if results can be reproduced by segmentation of whole lung, whether there are differences between both approaches and as a consequence which technique should be applied.

**METHOD AND MATERIALS**
DCE-MRI was performed in 30 children (24.3±1.8 month) after CDH repair using a 3D TWIST sequence (Siemens Healthcare, Germany). 0.05 mmol/kg body weight of contrast agent (Dotarem, Guerbet, France) were administered. Pulmonary blood flow (PBF) was calculated based on a pixel-by-pixel deconvolution approach. For ROI-based quantification, three circular ROIs (apical, middle and basal) per lung side were used both in the ventral and dorsal lung. Propagation of those circular ROIs through five adjacent slices generated 6 cylindrical ROIs in the ventral and dorsal lung respectively. For whole-lung analysis, the whole lung was contoured. In both techniques larger vessels were excluded from analysis (Fig. A).

**RESULTS**
In the ROI-based approach, PBF was significantly reduced on the ipsilateral side (74.5±30.3 ml/100ml/min) in comparison to the contralateral side (113.1±40.4 ml/100ml/min; p<0.0001). Also in the whole lung based approach ipsilateral PBF was significantly lower (73.9±25.5 ml/100ml/min) than in the contralateral lung (102.3±31.8 ml/100ml/min; p<0.0001). In the ipsilateral lungs, quantification results of the ROI-based and the whole-lung segmentation based approach were equal (p=0.50). In the contralateral lungs, the ROI-based approach significantly overestimated PBF in comparison to the whole-lung approach by approximately 9.5% (p=0.0013; Fig. B).

**CONCLUSION**
MR lung perfusion in 2-year children after CDH repair show reduced MR lung perfusion values on the ipsilateral side. As ROI-based approaches only cover parts of the lung tissue, this study aimed to evaluate if results can be reproduced by segmentation of whole lung, whether there are differences between both approaches and as a consequence which technique should be applied.

**CLINICAL RELEVANCE/APPLICATION**
With MR lung perfusion imaging, perfusion deficits after congenital diaphragmatic hernia can be depicted. Whole-lung segmentation for quantification is advisable, as a ROI-based approach can overestimate results.

**RC313-11 Functional Lung MRI for Non-invasive Monitoring of Regional Effects of Inhaled Hypertonic Saline in Children with Cystic Fibrosis**

**Participants**
Till F. Kaireit, Hannover, Germany (Presenter) Nothing to Disclose
Julius Renne, MD, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Christian O. Schoenefeld, MD, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Voskoboez, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Marcel Gutberlet, Dipl Phys, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Angela Schulz, Hannover, Germany (Abstract Co-Author) Nothing to Disclose
Gesine Hansen, Hannover, Germany (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**
Children with Cystic Fibrosis (CF) benefit from inhaled hypertonic saline as part of their treatment protocol. Acute and chronic respiratory effects of inhaled hypertonic saline can be measured by functional lung MRI. However, the region-of-interest (ROI) approach used to date suffers from the problem that ROI sizes are fixed and pre-defined. This study investigates the feasibility of a whole-lung based approach to quantify regional effects of inhaled hypertonic saline in children with CF. Whole-lung MRI was performed in 12 children (9.9±3.7 years, 24.2±1.4 month) with CF after inhaling 3 L of 3% saline using a 3D breath-hold SPACE sequence (Siemens Healthcare, Germany). A 3D T2*-weighted GRE sequence (400/35) was acquired for oxygen saturation measurements (Zeiss, Germany). A 3D T1-weighted FLASH sequence (450/2) was acquired for lung perfusion measurements (Zeiss, Germany). The whole lung was contoured manually using a semiautomatic method (Fig. A). Pulmonary blood flow (PBF) was calculated based on a pixel-by-pixel deconvolution approach. For ROI-based quantification, three circular ROIs (apical, middle and basal) per lung side were used both in the ventral and dorsal lung. Propagation of those circular ROIs through five adjacent slices generated 6 cylindrical ROIs in the ventral and dorsal lung respectively. For whole-lung analysis, the whole lung was contoured. In both techniques larger vessels were excluded from analysis (Fig. A).

**RESULTS**
In the ROI-based approach, PBF was significantly reduced on the ipsilateral side (74.5±30.3 ml/100ml/min) in comparison to the contralateral side (113.1±40.4 ml/100ml/min; p<0.0001). Also in the whole lung based approach ipsilateral PBF was significantly lower (73.9±25.5 ml/100ml/min) than in the contralateral lung (102.3±31.8 ml/100ml/min; p<0.0001). In the ipsilateral lungs, quantification results of the ROI-based and the whole-lung segmentation based approach were equal (p=0.50). In the contralateral lungs, the ROI-based approach significantly overestimated PBF in comparison to the whole-lung approach by approximately 9.5% (p=0.0013; Fig. B).

**CONCLUSION**
MR lung perfusion in 2-year children after CDH is significantly reduced ipsilaterally, both when quantified by a ROI-based and a whole-lung based approach. In the contralateral lung, the ROI-based approach significantly overestimates perfusion results and therefore whole lung segmentation should be preferred.

**CLINICAL RELEVANCE/APPLICATION**
With MR lung perfusion imaging, perfusion deficits after congenital diaphragmatic hernia can be depicted. Whole-lung segmentation for quantification is advisable, as a ROI-based approach can overestimate results.
Comparison of Lung Ultrasound and Chest Radiography in Estimating Lung Edema after Surgery for Congenital Heart Disease in Children

Tuesday, Dec. 1 11:10AM - 11:20AM Location: E253A

Participants
- Laura Martellus, Helsinki, Finland (Presenter) Nothing to Disclose
- Anu Kaskinen, Helsinki, Finland (Abstract Co-Author) Nothing to Disclose
- Kiri Lauherma, MD, Helsinki, Finland (Abstract Co-Author) Nothing to Disclose
- Paula Rautiainen, Helsinki, Finland (Abstract Co-Author) Nothing to Disclose
- Sture Andersson, Helsinki, Finland (Abstract Co-Author) Nothing to Disclose
- Olli Pitkanen, Helsinki, Finland (Abstract Co-Author) Nothing to Disclose

PURPOSE
Lung edema is a frequent complication after surgery for congenital heart disease in children. A readily available accurate measure for lung edema is lacking. Chest radiographs (CXR) are commonly used for this purpose. CXR, however, is inaccurate especially in intensive care when portable supine radiographs are used. In lung ultrasound (US) vertical artifacts known as B-lines have been shown to correlate with lung liquid. In adults with congestive heart disease B-lines in US correlates with lung edema scored from CXR. Our aim was to compare lung US and CXR in estimating lung edema in children after surgery for congenital heart disease.

METHOD AND MATERIALS
Lung US was performed on 50 children 1-6 h postoperatively using a high-frequency linear transducer. Videoclips from three anterolateral intercostal spaces on both sides were stored. An observer blinded to the patient data and CXR scored the abundance of B-lines on each videoclip using a 5-step scale (0 = no artefact, 1 = B-lines in <25% of surface area, 2 = <50%, 3 = <75%, and 4 = >75%). The postoperative CXR were evaluated for lung edema at the right and left upper and lower lobes, the middle lobe and lingula using a 4-step scale (0 = normal lung, 1 = minimal opacity, 2 = opacity partially obscuring lung vessels, 3 = opacity totally obscuring lung vessels). For each patient a mean score for lung US (B-line score), and for CXR (CXR LE score) was calculated.

RESULTS
Comparing the BF group to healthy controls, mean values of T1(21) (1176ms vs. 1246 ms, p < 0.01) and FV (0.67 vs. 0.95, p <0.001) were significantly lower and the CoV significantly higher (CoV T1(21) 0.08 vs. 0.40; CoV FV 0.73 vs. 0.37, p <0.001) for all. In BF group receiving treatment, mean values in the whole lung of OTF (pre 16.1/post 12.7 10-4/s/%O2), FV (pre 0.69/post 0.76), PBF (pre 98/post 102ml/100 ml/min), LCI (pre 12.1/post 13.1) and the morpho-functional score (pre 15 / post 17) did not show a significant difference between pre and post treatment measurements (p > 0.05). Also data on a lobar level in the treatment group as well as measurements in the CF-control group did not show any significant differences between the 2 MRI exams (p > 0.05).

CONCLUSION
Compared to healthy controls functional lung MRI detects significantly increased ventilation heterogeneity in CF patients. After a single treatment with inhalation of hypertonic saline (7% NaCl) neither functional lung MRI nor LCI detected a significant change in CF patients.

CLINICAL RELEVANCE/APPLICATION
This study shows the feasibility of functional lung MRI, as a non-invasive, radiation-free tool for visualization and quantification of potential regional treatment effects in patients with CF.
RESULTS

There were 24 metastatic pulmonary nodules and 18 non-metastatic pulmonary lesions. Pulmonary metastases and non-metastatic lesions exhibited significant differences in various histograms and volumetric parameters (P<.05). Multivariate analysis revealed that higher mean Hounsfield units (HU) (adjusted odds ratio (OR), 1.02) and larger effective diameter (OR, 17.03) are significant differentiators (P<.05). The subgroup analysis with non-calcified pulmonary nodules (13 metastases and 18 non-metastases) revealed significant differences between metastases and non-metastases in various parameters. Multivariate logistic regression analysis revealed that lower entropy (OR, 0.01) and larger effective diameter (OR, 38.92) are significant predictors of non-calcified pulmonary metastases (P<.05). The established logistic regression model of subgroup showed excellent discriminating performance in ROC analysis (AUC, 0.927).

CONCLUSION

Metastatic pulmonary nodules from osteosarcoma can be accurately differentiated from non-metastatic pulmonary lesions by using computerized texture analysis. High HU and larger effective diameter were the significant predictors for pulmonary metastases, while lower entropy and larger effective diameter were for non-calcified pulmonary metastases from non-metastatic lesions.

CLINICAL RELEVANCE/APPLICATION

The computerized 3D texture analysis can accurately differentiate pulmonary metastases from non-metastatic pulmonary lesions in pediatric osteosarcoma patients.

Extraalbar pulmonary sequestration: initial CT findings predicting spontaneous regression in neonates

PURPOSE

In general, it is accepted that extralobar pulmonary sequestration (EPS) may spontaneously regress. However, radiologic features associated with spontaneous regression of EPS have not been well documented. Therefore, we tried to find the CT features predicting spontaneous regression of EPS.

METHOD AND MATERIALS

A total of 51 patients were included in our study with the following inclusion criteria: (a) antenatally diagnosed with EPS, (b) underwent a CT scan within 1 month after birth, and (c) had more than one follow-up CT without treatment. Spontaneous regression of EPS was determined by percent decrease of volume (PDV) and decrease in diameter of feeders. Volume of EPS and diameters of feeding systemic arteries (FSA) were evaluated on all 148 CT. For the enhancement degree of EPS, CT attenuation number of EPS and the back muscle were measured on initial CT and the ratio of EPS-to-back muscle was calculated. The PDV and the changes in diameter of FSA between initial and follow-up CT scans were calculated. Univariate and multivariate linear regression analysis were performed to assess factors related to PDV and decrease in diameter of FSA.

RESULTS

PDV more than 50% (PDV≥50%) was noted in 20 patients (38.5%) within one year, in other 12 patients (23.1%) between one and two years, and in 6 patients after two years. The enhancement degree of EPS was significantly different between 38 patients with PDV≥50% and 13 patients with PDV<50% (1.0±5.4 vs 2.1±1.1, respectively, p<0.001). Enhancement degree of EPS was the only significant factors predicting PDV≥50% (B=-26.227, p<0.001), and the decrease in diameter of FSA (B=-21.476, p=0.009). In addition, PDV showed significant correlation with decrease in the diameter of the FSA (r=0.602, p<0.001).
CONCLUSION
The volume of EPS had spontaneously decreased more than 50% within 2 years without treatment in 63% of patients. The most important factor predicting spontaneous regression of the EPS was the enhancement degree on initial CT scan. Therefore, a significant volume regression and decrease in diameter of FSA can be expected without any treatment in a neonate with EPS showing hypoenhancement on initial CT scan.

CLINICAL RELEVANCE/APPLICATION
The enhancement degree of EPS on initial CT scan is significantly associated with spontaneous regression of EPS during follow-up. Based on this result, we can more confidently predict spontaneous regression of EPS in neonates.

RC313-15  Pediatric Chest Interventions
Tuesday, Dec. 1 11:40AM - 12:00PM Location: E353A

Participants
Kamlesh U. Kukreja, MD, Bellaire, TX (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1. Describe different types of chest interventions for children.
**RC321A**  
**Medical Physics 2.0: Computed Tomography**

**Tuesday, Dec. 1 8:30AM - 10:00AM Location: N229**

**Participants**  
Ehsan Samei, PhD, Durham, NC (Director) Nothing to Disclose  
Douglas E. Pfeiffer, MS, Boulder, CO (Director) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the current recommendations for computed tomography testing and quality control. 2) To understand impact of accreditation and regulation on CT quality assurance. 3) To understand current dosimetry and dose-reporting considerations.

**ABSTRACT**

Many organizations have contributed to the methodology for testing computed tomography scanners. These have included state regulatory agencies, the Food and Drug Administration, the American Association of Physicists in Medicine, and the American College of Radiology, among many other groups and individuals. These contributions have included many good ideas, but also much confusion as to what is required. Further, the complexity of modern CT scanners has rendered some tests obsolete or difficult to implement. This presentation focuses mainly on the testing delineated by the 2012 American College of Radiology Computed Tomography Quality Control Manual and that required under the Intersocietal Accreditation Commission. Recommended and required tests will be identified but not described in detail.

**Sub-Events**

**RC321A**  
**Computed Tomography Perspective**

**Participants**  
Mahadevappa Mahesh, MS, PhD, Baltimore, MD (Presenter) Author with royalties, Wolters Kluwer nv

**LEARNING OBJECTIVES**

1) To reflect on MDCT technology enabling volumetric data acquisition. 2) To evaluate new innovations enabling dose reductions in CT.

**ABSTRACT**

This talk will provide brief overview on the innovations that has led to the development of CT technology (single slice (SDCT) to multiple slices (MDCT)). Past decade saw the rapid evolution in the capability to obtain multiple slices per gantry rotation (4-320 slices). Having achieved the capability to acquire volumetric data (covering entire cardiac anatomy in half of gantry rotation), the race is currently towards acquiring CT images at optimal radiation dose. Volume CT, dual energy CT, Iterative reconstruction, quantitation are some of the new challenges that will be discussed in this talk.1. CT Technology  
1a. MDCT detector configuration  
1b. Volume CT - Wide detector and dual source CT  
2. New Challenges  
2a. Iterative reconstruction  
2b. Dual energy  
2c. Dose check

**RC321B**  
**Computed Tomography 1.0**

**Participants**  
Douglas E. Pfeiffer, MS, Boulder, CO (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the current recommendations for computed tomography testing and quality control. 2) To understand impact of accreditation and regulation on CT quality assurance. 3) To understand current dosimetry and dose-reporting considerations.

**ABSTRACT**

Many organizations have contributed to the methodology for testing computed tomography scanners. These have included state regulatory agencies, the Food and Drug Administration, the American Association of Physicists in Medicine, and the American College of Radiology, among many other groups and individuals. These contributions have included many good ideas, but also much confusion as to what is required. Further, the complexity of modern CT scanners has rendered some tests obsolete or difficult to implement. This presentation focuses mainly on the testing delineated by the 2012 American College of Radiology Computed Tomography Quality Control Manual and that required under the Intersocietal Accreditation Commission. Recommended and required tests will be identified but not described in detail.

**RC321C**  
**Computed Tomography 2.0**

**Participants**  
Ehsan Samei, PhD, Durham, NC (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To become familiar with the major new developments of physics support for clinical CT operations. 2) To understand the need and the definitions of the new CT performance metrics for dose and quality. 3) To understand the testing implications of new CT technologies. 4) To understand the need for operational optimization of CT systems.

**ABSTRACT**
Participants
Michael F. McNitt-Gray, PhD, Los Angeles, CA (Director) Institutional research agreement, Siemens AG; Research support, Siemens AG; ; ; ;

Sub-Events

**RC325A  The Role of Physical Phantoms in Quantitative Imaging**

Participants
Paul E. Kinahan, PhD, Seattle, WA (Presenter) Research Grant, General Electric Company; Co-founder, PET/X LLC

**LEARNING OBJECTIVES**

1) To understand the definitions and requirements of quantitative medical imaging. 2) To learn the role of phantoms and tradeoffs in comparison with simulations and patient studies. 3) To review the classes of phantoms available: Commercial, experimental, and virtual (digital reference objects).

**ABSTRACT**

This lecture will familiarize the audience with digital reference objects (DROs) and their place in the development of quantitative imaging biomarkers (QIBs). To determine whether a quantitative imaging study is measuring a pathological or physiological process in an unbiased way, the quantitative imaging result would need to be compared to an independently ascertained unbiased measurement in the imaged subject or animal. Unfortunately, obtaining a precise and unbiased measurement (also known as ground truth) is generally impractical or impossible. Frequently there are several software packages that can be used to create maps reflecting the spatial distribution of the QIB. Because different software packages often give different quantitative results, the choice of software contributes to the variability of the result. Without ground truth data, it can be difficult to determine which softwares calculate the underlying biomarker with sufficient precision and lack of bias to be applicable for a particular use case. DROs are synthetic images whose pixel values are partially or completely determined by mathematical equations. Although these images may be designed to mimic real imaging data, their content is ultimately determined by mathematical models. Even though DROs do not perfectly simulate real data, they are useful because they are created assuming particular underlying parameter values, which can be regarded as ground truth for these objects. DROs can be particularly valuable for evaluation of software packages. Because they are created using known ground truth, they can be used to determine whether a particular image analysis strategy introduces biases when used to extract a QIB. (This is not possible with real data if the ground truth is not known). Assuming that realistic image noise and/or artifact can be included in the DRO, they can also be used to estimate how precisely a software package is deriving quantitative metrics in real images. This lecture will describe how DROs are used in the RSNA Quantitative Imaging Biomarker Alliance (QIBA) process. Topics that will be discussed include: 1) the variety of metrics that can be used to evaluate software performance with DROs; 2) the differences between aggregated and disaggregated measures of performance, and the relevance of this for determining whether software complies with a standard; and 3) best practices for creation of DROs.

**Honored Educators**

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Daniel P. Barboriak, MD - 2013 Honored Educator

**RC325B  Digital Reference Objects**

Participants
Daniel P. Barboriak, MD, Durham, NC (Presenter) Advisory Board, General Electric Company

**LEARNING OBJECTIVES**

1) Explain why digital reference objects are useful for evaluation of software packages used to derive quantitative imaging biomarkers. 2) State the difference between bias and precision, and describe how aggregate and disaggregate measures of software performance differ.

**ABSTRACT**

This lecture will familiarize the audience with digital reference objects (DROs) and their place in the development of quantitative imaging biomarkers (QIBs). To determine whether a quantitative imaging study is measuring a pathological or physiological process in an unbiased way, the quantitative imaging result would need to be compared to an independently ascertained unbiased measurement in the imaged subject or animal. Unfortunately, obtaining a precise and unbiased measurement (also known as ground truth) is generally impractical or impossible. Frequently there are several software packages that can be used to create maps reflecting the spatial distribution of the QIB. Because different software packages often give different quantitative results, the choice of software contributes to the variability of the result. Without ground truth data, it can be difficult to determine which softwares calculate the underlying biomarker with sufficient precision and lack of bias to be applicable for a particular use case. DROs are synthetic images whose pixel values are partially or completely determined by mathematical equations. Although these images may be designed to mimic real imaging data, their content is ultimately determined by mathematical models. Even though DROs do not perfectly simulate real data, they are useful because they are created assuming particular underlying parameter values, which can be regarded as ground truth for these objects. DROs can be particularly valuable for evaluation of software packages. Because they are created using known ground truth, they can be used to determine whether a particular image analysis strategy introduces biases when used to extract a QIB. (This is not possible with real data if the ground truth is not known). Assuming that realistic image noise and/or artifact can be included in the DRO, they can also be used to estimate how precisely a software package is deriving quantitative metrics in real images. This lecture will describe how DROs are used in the RSNA Quantitative Imaging Biomarker Alliance (QIBA) process. Topics that will be discussed include: 1) the variety of metrics that can be used to evaluate software performance with DROs; 2) the differences between aggregated and disaggregated measures of performance, and the relevance of this for determining whether software complies with a standard; and 3) best practices for creation of DROs.

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Daniel P. Barboriak, MD - 2013 Honored Educator

**RC325C  CT Image Analysis and Sources of Variation**

Participants
Binsheng Zhao, DSc, New York, NY (Presenter) License agreement, Varian Medical Systems, Inc; License agreement, Keosys SAS; License agreement, Hinacom Software and Technology, Ltd; License agreement, ImBio, LLC; License agreement, AG Mednet, Inc

**LEARNING OBJECTIVES**

1) To familiarize the audience with the basic image analysis methods such as segmentation and feature extraction, using tumor
quantification in oncology as an example. 2) To discuss sources of variation in image analysis, using both phantom and in-vivo tumors as examples. 3) To raise awareness of the need for harmonization of imaging and quantification techniques in quantitative radiology.
RC350

CTA from Head to Toe

Tuesday, Dec. 1 8:30AM - 10:00AM Location: S404AB

CA CT VA IR

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

Participants
Alison Wilcox, MD, Los Angeles, CA (Moderator) Speaker, Toshiba Corporation

Sub-Events

RC350A Cardiac CT- Pre, Peri and Post Procedural Management

Participants
Cameron Hassani, MD, Los Angeles, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Review pre-procedural patient preparation including appropriate patient selection, beta blockade, contraindications and alternatives to beta blockers 2) Discuss how to manage non-standard scenarios (atrial fibrillation, pacemaker, young adults) 3) Peri-procedural issues including vasodilation, continued heart rate control, and breathholding requirements. 4) Image acquisition including radiation dose reduction techniques, technique choice, and post CABG patient. 5) Postprocedural complications include contrast reactions and their management.

ABSTRACT

Cardiac CTA involve slightly more preparation than the standard CT acquisition. Heart rate control is the most important aspect that needs to be addressed prior to the patient arriving in the radiology department. Periprocedural issues mostly involved how to optimize technique while having the lowest radiation dose especially in the new age of dose reduction. Almost as important as heart rate management is how to treat postprocedural complications especially contrast reactions. This presentation will discuss these aspects and include treatment options as well as their alternatives.

RC350B TEVAR/EVAR- Pre, Post and Periprocedural Evaluation

Participants
Alison Wilcox, MD, Los Angeles, CA (Presenter) Speaker, Toshiba Corporation

LEARNING OBJECTIVES

1) What are some clinical indications for acute aortic imaging. 2) What are some CT parameters that can aid in various diagnosis? 3) What are some of common complications seen in TEVAR and EVAR? 4) What are the important measurements and vessel variants that help guide surgical approach. 5) New suggestions for type B management. 6) What are some imaging problems and pitfalls and some methods to assist. 7) Briefly discuss TAVR acquisition.

ABSTRACT

The acute aorta is part of a syndrome of diseases affecting the aorta with significant overlap of findings and clinical presentations. Clinically the diagnosis is difficult as there is overlap between patients with suspected coronary disease, pulmonary embolism and acute aortic syndrome. In the past several years, minimally invasive surgery with Thoracic Endovascular Aortic Repair (TEVAR) or Endovascular Aortic Repair (EVAR) have become increasingly popular. The images choices include gated vs non gated studies, non-contrast imaging, and delayed imaging. The literature is mixed on how and when to use these modalities. The complications of these procedures is often complex and subtle as well. Knowledge of these vascular complications is imperative for patient management. In addition, these patients often have significant atherosclerotic disease elsewhere that might be limiting factors for stent placement, including renal insufficiency. Newer scanners and imaging techniques can reduce radiation dose, and limit the amount of contrast delivery to preserve renal function while preserving image quality. TAVR is an example of another minimally invasive technique gaining popularity that has imaging challenges. Again, newer scanning techniques with limited contrast delivery can provide excellent image quality while limiting radiation dose and preserving renal function.

RC350C Peripheral CTA-A How-to

Participants
Ilya Lekht, MD, Los Angeles, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Enhance knowledge of normal and abnormal coronary and cardiac anatomy, with an emphasis on differentiating benign from significant variants. 2) Demonstrate the spectrum of nonatherosclerotic congenital and acquired diseases that may affect the coronary arteries. 3) Demonstrate the spectrum of non-atherosclerotic congenital and acquired diseases that may affect the heart.

ABSTRACT

A variety of non-atherosclerotic conditions are detectable on cardiac CT scans, including diseases of the heart, and disease processes which may affect the coronary arteries, or other vascular structures. Cardiac CT has a number of unique advantages in detecting non-atherosclerotic conditions, including congenital and acquired diseases. The focus of this presentation will be non-atherosclerotic conditions of the coronary arteries and of the heart. Variants of normal and abnormal anatomy of the coronary arteries will be discussed, including tips for identifying when coronary anatomic variants are significant. Acquired, non-atherosclerotic diseases of the coronary arteries will also be discussed. This presentation will also discuss the spectrum of non-
atherosclerotic diseases of the heart which may be detected at cardiac CT, including congenital and acquired valvular and cardiac diseases. At the end of this exhibit, the viewer will have a better appreciation for abnormal coronary and cardiac anatomy and the broad spectrum of non-atherosclerotic cardiovascular diseases which may be seen at cardiac CT.
Case-based Review of Nuclear Medicine: PET/CT Workshop-Cancers of the Thorax (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, Dec. 1 10:30AM - 12:00PM Location: S406A

Participants
Janis P. O'Malley, MD, Birmingham, AL (Director) Nothing to Disclose
Katherine A. Zukotynski, MD, Toronto, ON (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Apply basic anatomic, pathologic, and physiologic principles to the interpretation of PET/CT with emphasis on cancers of the thorax. 2) Identify artifacts that can influence interpretation of PET/CT studies and analyze factors that can improve image quality while minimizing patient risk. 3) Demonstrate understanding of issues on current and future practice patterns.

ABSTRACT
Cardiac (MRI/CT Outcomes and Risk Stratification)

Tuesday, Dec. 1 10:30AM - 12:00PM Location: S504AB

SSG02-01 Predictive Value of Cardiovascular Magnetic Resonance-Derived Myocardial Strain for Poor Outcome in Patients with Acute Myocarditis

Tuesday, Dec. 1 10:30AM - 10:40AM Location: S504AB

Participants
Minkyu Kwak, MD, Busan, Korea, Republic Of (Presenter) Nothing to Disclose
Ji Won Lee, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yeon Joo Jeong, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Geewon Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jin You Kim, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ki Seok Choo, MD, Yangsan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

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.

SSG02-02 Characterization of the Right Ventricle by T1-mapping and T2-mapping in Patients with Pulmonary Arterial Hypertension

Tuesday, Dec. 1 10:40AM - 10:50AM Location: S504AB

Participants
Celia P. Corona-Villalobos, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Yan Zhang, MD, PhD, Jinan, China (Abstract Co-Author) Nothing to Disclose
Kristin Porter, MD, PhD, Baltimore, MD (Abstract Co-Author) Stockholder, Pfizer Inc
Paul M. Hassoun, MD, Baltimore, MD (Abstract Co-Author) Scientific Advisory Board, Gilead Sciences, Inc
Stephen M. Mathai, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Jhab R. Kamei, MD, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Stefan L. Zimmerman, MD, Baltimore, MD (Presenter) Nothing to Disclose
Rachel Damico, MD, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Todd Kolb, MD, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

PURPOSE
To characterize the right ventricle by T1-mapping and T2-mapping in patients with pulmonary arterial hypertension.
CONCLUSION

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). 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). However, the addition of CACS on CCTA with FRS did not add the prediction power correlated significantly with outcome (all p<0.01). For the prediction of both cardiac events and major adverse cardiac events (MACE; cardiac death, myocardial infarction and unstable angina requiring hospital stay, or revascularization later than 90 days after CCTA).

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 artery hypertension.

Honored Educators

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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
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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
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.

**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 detector-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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Namik 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 Angiography 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
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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
Celia P. Corona-Villalobos, MD, Baltimore, MD (Presenter) Nothing to Disclose
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Todd Kolb, MD, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Ihab R. Kamel, 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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Stefan L. Zimmerman, MD - 2012 Honored Educator
Stefan L. Zimmerman, MD - 2015 Honored Educator

S504A

Clinical Significance of Coexistent Coronary Artery Disease in Hypertrophic Cardiomyopathy Using Coronary CT Angiography

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S504AB

Participants

Yoon Joo Shin, MD, Seongnam, Korea, Republic Of (Presenter) Nothing to Disclose
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Sang Il Choi, MD, Seongnam-Si, 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

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.

S504A

Association between Late Gadolinium Enhancement and Three Types of Ventricular Tachyarrhythmia in Patients with Hypertrophic Cardiomyopathy
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.
PURPOSE

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.

SSG03-03 Correlations of Iodine Uptake and Perfusion Parameters in Lung Cancer with Dual-Energy CT and First-pass Dual-input Perfusion CT

Participants

Xiaoliang Chen, Beijing, China (Abstract Co-Author) Nothing to Disclose
Hongliang Sun, MD, Beijing, China (Presenter) Nothing to Disclose
Clinical Relevance/Application

The iodine uptake of lung cancer estimated from 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.

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.

Results

There are significant correlations between $\lambda$, $\Delta HU$ and $AF$, $PF$. 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.

Conclusions

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.

Methods 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 ($\lambda$) and the slope ($\Delta HU$) 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

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 feature values of all classes 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.

Conclusions

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  
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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, FFR(RCSI), 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 nuclear 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 lucent 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.

**Honored Educators**

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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, FRCP, 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.
The iodine-density images of enhanced ssDECT imaging provides a sensitive approach for identifying benign and malignant serous cavity effusion. The malignant and benign effusion shows different NIC and D-I in the iodine-density images of enhanced ssDECT imaging.

**CONCLUSION**

(P=0.00). The D-I between delayed phase and plain scan of benign group (19.48) was also lower than that of malignant group (39.62) with statistical difference. The D-I between venous phase and plain scan of benign group (20.91) was also lower than that of malignant group (39.05) with statistical difference (P=0.00). The D-I between arterial phase and plain scan of malignant group was also lower than that of benign group (36.90, 23.87 vs. 38.00, respectively) with statistical difference (P=0.03, P=0.02, P=0.00).

1) The NIC of benign group in the three-phase enhanced images all lower than those of malignant group (26.13 vs. 36.76, 25.87 vs. 36.90, 23.87 vs. 38.00, respectively) with statistical difference (P=0.03, P=0.02, P=0.00). 2) D-I between arterial phase and plain scan of benign group (21.96) was lower than that of malignant group (39.05) with statistical difference (P=0.00). The D-I between venous phase and plain scan of benign group (20.91) was also lower than that of malignant group (39.62) with statistical difference (P=0.00). The D-I between delayed phase and plain scan of benign group (19.48) was also lower than that of malignant group (40.40) with statistical difference (P=0.00).

**RESULTS**

For N-P 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, 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.

**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/

Joannis Vlahos, MRCP, FRCR - 2015 Honored Educator

**SSG03-07  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

Allan 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

Lingxin 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 ssDECT imaging. The iodine-based material density images were reconstructed. The iodine concentration (M-IE) in the effusion was measured at plain and three-phase enhanced iodine-based material density images, and the iodine concentration (M-IA) in the artery was also measured. The normalized iodine concentration (NIC = M-IE /M-IA) was calculated. The difference of normalized iodine concentration (D-I) was also calculated. The difference of these parameters was evaluated statistically by Mann-Whitney Test.

**RESULTS**

1) The NIC of benign group in the three-phase enhanced images all lower than those of malignant group (26.13 vs. 36.76, 25.87 vs. 36.90, 23.87 vs. 38.00, respectively) with statistical difference (P=0.03, P=0.02, P=0.00). 2) D-I between arterial phase and plain scan of benign group (21.96) was lower than that of malignant group (39.05) with statistical difference (P=0.00). The D-I between venous phase and plain scan of benign group (20.91) was also lower than that of malignant group (39.62) with statistical difference (P=0.00). The D-I between delayed phase and plain scan of benign group (19.48) was also lower than that of malignant group (40.40) with statistical difference (P=0.00).

**CONCLUSION**

The malignant and benign effusion shows different NIC and D-I in the iodine-density images of enhanced ssDECT imaging.

**CLINICAL RELEVANCE/APPLICATION**

The iodine-density images of enhanced ssDECT scanning provides a sensitive approach for identifying benign and malignant serous cavity effusion.

**SSG03-08  Xenon Ventilation CTs Using Dual-Energy CT and Subtraction CT Methods versus Krypton Ventilation CTs Using Dual-Energy CT and Subtraction CT Methods**

**Tuesday, Dec. 1 11:40AM - 11:50AM Location: S404CD**

Participants

Xiaojun Ju, Dalian, China (*Presenter*) Nothing to Disclose

Yinping Sun, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

Keqin Kong, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To compare the differences of PE between the two CT methods in the same patient and to explore the clinical relevance of the results.

**METHOD AND MATERIALS**

From August 2012 to February 2015, totally 47 patients were identified from a 3yr retrospective review of all patients undergoing more than one DECT for suspected PE (100/Sn140kVp, refmAs 150/128, 100 mls 5ml/s iohexol 300mgI/ml, Definition FLASH, Siemens). Excluding patients with known pulmonary hypertension or technical failures 61 patients (mean age 62, 27 male) had a pair of normal examinations (N-N). 47 patients (mean age 60, 18 male) had one normal and one PE positive examination (N-PE). Mean interval was 6.5 months. On a both lung, individual lung or 6 standardized volumetric region basis automated PBV measurements (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**

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.

**CONCLUSION**

In patients undergoing repeated DECT, PBV measures are reproducible with a high degree of concordance within individual patients when normal, with significant reduction and variability in all lung regions when PE is present.
SPECT/CT: Capability for Regional Ventilation and Pulmonary Functional Loss Assessments in Smokers

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S404CD

Participants
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PURPOSE
To compare the capability for regional ventilation and pulmonary functional loss assessments among xenon ventilation CT (Xe-CT) obtained by dual-energy CT (DECT) and subtraction CT (Sub-CT) methods, and krypton ventilation SPECT/CT in smokers.

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 DECT at 320-detector row CT. In addition, all smokers were also performed SPECT/CT and pulmonary function test. In each smoker, unenhanced and xenon-enhanced CT data were subtracted by commercially available software to generate Xe-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.

SPECT/CT: Capability for Regional Ventilation and Pulmonary Functional Loss Assessments in Smokers

Tuesday, Dec. 1 11:50AM - 12:00PM Location: S404CD

Participants
Sachiko Miura, MD, Kashihara, Japan (Presenter) Nothing to Disclose
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Takashi Tojo, Kashihara, Japan (Abstract Co-Author) Nothing to Disclose
Kimihiko Kichikawa, MD, Kashihara, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
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
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.
**Predictive Value of MRI Combined with MR Cholangiography in the Preoperative Assessment of Perihilar Cholangiocarcinoma**

**Participants**
- Claudio Sallemi, 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 Aldighetti, MD, Milano, Italy (Abstract Co-Author) Nothing to Disclose
- Alessandro Del Mascio, MD, Milano, Italy (Abstract Co-Author) Nothing to Disclose
- Francesco A. De Cobelli, MD, Milano, 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\(R_0\) - tumor-involved margins \(R_1\) 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 \(R_0\) - \(R_1\) 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 \(R_0\) - \(R_1\) 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 \(R_0\) - \(R_1\) resection in perihilar cholangiocarcinoma. In case of \(R_1\), it can lead to a focused neo adjuvant therapy or change of the treatment strategy.
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 10:30AM - 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.
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.

SSG04-06 Hypoenhancement on Delayed Phase Contrast-enhanced MRI is a More Sensitive Sign of Malignancy in Colorectal Cancer Patients with Intravascular Contrast Agent, Gadofosveset, Than with Extracellular Contrast Agent, Gadobutrol

Tuesday, Dec. 1 11:20AM - 11:30AM Location: E350

Participants
Krishan Ramsaransing, MD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Roy S. Dwarkasing, MD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Francois Willemssen, MD, Hoogstraten, Belgium (Presenter) Nothing to Disclose
Marianne De Vries, MD, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose

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.
 PURPOSE

Hypoenhancement on delayed phase contrast-enhanced MRI using extracellular contrast agents, such as gadobutrol, is often used as a sign to diagnose colorectal liver metastases. Some studies have suggested that MRI with intravascular contrast agent, gadofosveset, may be useful in diagnosing focal liver lesions. The goal of this study is to determine the diagnostic accuracy of this sign using gadofosveset 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 gadofosveset-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 gadofosveset 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: 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 gadofosveset is a more sensitive sign of malignancy in colorectal cancer patients than with gadobutrol.

CLINICAL RELEVANCE/APPLICATION

Delayed phase gadofosveset-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.

Cinthia Cruz, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Joseph R. Grajo, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Mukesh G. Hingshinghani, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Sanjay Saini, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Peter F. Hahn, MD, PhD, Belmont, MA (Abstract Co-Author) Stockholder, Abbott Laboratories Stockholder, Medtronic, Inc Stockholder, CVS Caremark Corporation Stockholder, Kimberly-Clark Corporation Stockholder, Landauer, Inc

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 hemangioma patients 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, 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
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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.
SSG05

Gastrointestinal (CT Dose Reduction)
Tuesday, Dec. 1 10:30AM - 12:00PM Location: E352

Participants
William P. Shuman, MD, Seattle, WA (Moderator) Research Grant, General Electric Company
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Sub-Events
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
Tuesday, Dec. 1 10:30AM - 10:40AM Location: E352

Participants
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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.

SSG05-02 Assessment of Sinogram-affirmed Iterative Reconstruction Techniques for Reduced Dose Abdomen CT
Tuesday, Dec. 1 10:40AM - 10:50AM Location: E352

Participants
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FDA
Discussions may include off-label uses.
Venkatesh Anumugam Murugan, MBBS, Somerville, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To assess the different settings of Sinogram-affirmed iterative reconstruction (Safire, Siemens Healthcare, Germany) techniques for reduced dose (RD) abdomen CT to the standard dose (SD) CT.

**METHOD AND MATERIALS**

In an IRB approved retrospective study, 20 patients (age 68 ± 6 years, M:F 11:9) undergoing SD abdominal CT on 128-MDCT (Definition Edge with Stellar detectors) scanner gave informed consent for acquisition of an additional RD CT. The RD series were acquired with reduced tube current but identical scan length compared to the SD CT. The sinogram data of RD CT were reconstructed with three settings of Safire (S1, S3, S5) and SD CT reconstructed with Safire (S3) (n= 4*20=80 series). 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 9.43 mGy and 1.440.1 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 clinical 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.

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Subba R. Digumarthy, MD - 2013 Honored Educator

**SSG05-03 Contrast Enhanced CT Exams of the Abdomen Obtained at Low kVp: Impact on Radiation Dose and Image Quality**

**Tuesday, Dec. 1 10:50AM - 11:00AM Location: E352**

Participants

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**PURPOSE**

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 prospective 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 (Stellar 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.

**RESULTS**

Low kVp (≤110 kVp ) was applied in 78%(281) CT exams [80 kVp=4(1%);90 kVp=22(6%);100kVp=251(70%); 110kVp=4(1%)] while 22% of exams (n=81) were obtained at high kVp [120kVp=78(21%);140kVp=3(1%)]. The radiation doses showed a strong correlation with kVp (CTDI(mGy)): 80=6.1;90=6.3;100=8.1;110=10.9; 120=14.1;140=22.9; r²=0.46,p<0.001. For patients ≤91 kg, 80% of exams were performed at low kVp corresponding to 49% lower radiation doses (mGy;≤110 kVp =6.5,120kVp=12.6;p<0.001). For >91kg, 69% of exams were obtained at low kVp (mGy;≤110 kVp =9.6,≥120kVp=17.2, 44% reduction; p<0.001). The CNR showed a linear decrease with an increase in the kvp with highest values noted for exams obtained at low kvp (r²=0.18,p<0.001). All 85 exams received high subjective image quality ratings.

**CONCLUSION**

A substantial (78%) of abdominal CT exams are obtained at low kvp [80% (≤91 kg) and 69% (>91kg)]. Regardless of the patient body weight, CT exams obtained on new generation scanners with automated kVp selection option results in a significant reduction
in radiation doses (44-49%) while preserving objective and subjective IQ.

**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**

*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.

**SSG05-05 Can 3rd Generation Dual-source CT Achieve 70kV-imaging for Routine Contrast-enhanced Body CT?**

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**PURPOSE**

Low kV CT can dramatically reduce contrast media (CM) volume with maintaining sufficient contrast enhancement thanks to...
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 (CTDInvol) 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 [CTDInvol; 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.
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Naoki Takahashi, MD - 2012 Honored Educator

**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**

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**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 ≤ 0.0285) 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 Reconstruction 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**

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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-rows 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.
**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
Andreas Bockisch, Essen, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate the clinical relevance of small pulmonary nodules missed by 18F-fluorodesoxyglucose 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

**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,
This prospective study was approved by the institutional review board and by national government authorities. In this study, sequential contrast-enhanced PET/CT-MR was performed in 27 patients (median age 66, 16 males) with newly diagnosed head and neck cancer. MR sequences were: LAVA-Flex (whole body); axial T2-weighted, axial T1-weighted with and without contrast, sagittal and coronal T1-weighted with contrast, and DWI (head and neck). PET/CT and PET/MR were evaluated separately, and the TNM stage and factors that could impact on the potential resectability were assessed. Wilcoxon signed-ranks test was used.

RESULTS
The T/N/M staging by PET/CT was correct in 17 patients (63.0%) / 19 (70.4%) / 22 (81.5%), equivocal in 8 patient (29.6%) / 3 (11.1%) / 3 (11.1%), and incorrect in 2 patients (7.4%) / 5 (18.5%) / 2 (7.4%). The T/N/M staging by PET/MR was correct in 20 patients (74.1%) / 21 (77.8%) / 26 (96.3%), equivocal in 6 patients (22.2%) / 2 (7.4%) / 1 (3.7%), and incorrect in 1 patient (3.7%) / 4 (14.8%) / 0 (0%). Consistently, the TNM staging by PET/MR was comparable to PET/CT (T: p = 0.331, N: p = 0.453, M: p = 0.034). The sensitivity/specificity/accuracy of resectability-defining factors by PET/CT and PET/MR were 0.68/0.93/0.97, and 0.80/1.00/0.99, respectively.

CONCLUSION
Whole-body staging with PET/MR yields equal diagnostic accuracy as PET/CT in determining the stage of head and neck cancer.

CLINICAL RELEVANCE/APPLICATION
Patients with newly diagnosed head and neck cancer may be effectively staged with contrast-enhanced PET/MR instead of contrast-enhanced PET/CT.

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.

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 [18F-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.

**SSG11-05**  
**Evaluation of a FAST-protocol for Simultaneous 18F-FDG PET/MR Imaging for the Evaluation of Patients with Lymphoma**

**Tuesday, Dec. 1 11:10AM - 11:20AM Location: S505AB**

Participants

Johannes Grueneisen, Essen, Germany (Presenter) Nothing to Disclose
Lino Sawicki, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Saravanabavaan Suntharalingam, Essen, Germany (Abstract Co-Author) Nothing to Disclose
Christian Buchbender, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
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.
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.

[18F]-FDG-PET/MR versus [18F]-FDG-PET/CT for the Assessment of Lymphoma: A Prospective Study in 30 Patients

Participants
Chiara Giraudo, MD, Vienna, Austria (Presenter) Nothing to Disclose
Michael Weber, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Georgios Karanikas, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Matthias Pones, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
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Barbara Kiesewetter, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Markus Raderer, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Marius E. Mayerhoefer, MD, PhD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess and compare the diagnostic performances of [18F]-FDG-PET/MR and [18F]-FDG-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.

PET/MRI versus PET/CT: Qualitative and Quantitative Assessment of Bone Lesion Conspicuity

Participants
Tyler J. Fraum, MD, Saint Louis, MO (Presenter) Nothing to Disclose
Kathryn J. Fowler, MD, Chesterfield, MO (Abstract Co-Author) Research support, Bracco Group
Because standard MRI-based attenuation correction (AC) does not account for the effects of cortical bone on PET photons, PET/MRI may have reduced sensitivity for FDG-avid focal bone lesions (FFBLs). In contrast, the CT-based AC used in PET/CT does correct for cortical bone attenuation. This study evaluates whether MRI-based AC compromises detection of FFBLs, by comparing their conspicuity on PET/MRI versus PET/CT.

**METHOD AND MATERIALS**

190 general oncology patients underwent whole-body PET/CT followed by whole-body PET/MRI, utilizing the same FDG dose. Thirteen patients with a total of 50 FFBLs were identified. Using auto-contouring software, a region of interest (ROI) was generated for each FFBL and for an adjacent region of normal background bone (BB). For each ROI, SUV-max and SUV-mean were determined. Lesion-to-background SUV ratios served as quantitative metrics of conspicuity. Additionally, two blinded readers evaluated the relative conspicuity of FFBLs on PET images derived from MRI-based AC versus CT-based AC. The visibility of FFBLs on corresponding CT and MR images was also assessed.

**RESULTS**

As expected, the average SUV-mean was lower on PET/MRI for both FFBLs (-8.8%, p = 0.009) and BB (-22.7%, p < 0.001). The average SUV-max was lower on PET/MRI for BB (-14.3%, p = 0.002) but not for FFBLs (-7.4%, p = 0.068). On average, the ratio of FFBL SUV-mean to BB SUV-mean was higher for PET/MRI (+29.5%, p < 0.001). 40 of 50 lesions (80%) were visually deemed to be of equal or greater conspicuity on PET images derived from PET/MRI. 35 of 50 FFBLs (70%) had CT correlates, while 40 of 50 FFBLs (80%) had correlates on at least one MRI sequence. The mean tracer-to-image time was longer (p < 0.001) for PET/MRI (127 v. 62 min).

**CONCLUSION**

Both FFBLs and BB had lower mean SUVs on PET/MRI. This discrepancy was likely due to differences in the handling of cortical bone by MRI-based AC versus CT-based AC. Despite this systematic bias, FFBLs had greater conspicuity on PET/MRI, when assessed both qualitatively and quantitatively. This difference was at least in part due to the longer tracer-to-image time for PET/MRI, which allowed for more tracer accumulation by FFBLs and more tracer washout from BB.

**CLINICAL RELEVANCE/APPLICATION**

Our results suggest that whole-body PET/MRI and PET/CT provide comparable sensitivity for detection of FDG-avid focal bone lesions.
**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**

**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.

**Motion Compensation from Short-Scan Data in Cardiac CT**

**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.
**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

**Abstract Co-Author**

Liangzhong Xiang, PhD, Norman, OK (Abstract Co-Author) Nothing to Disclose

**Presenter**

Shanshan Tang, PhD, Norman, OK (Presenter) Nothing to Disclose

**Participants**

Hong Liu, PhD, Norman, OK (Abstract Co-Author) Nothing to Disclose

**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 demonstrate the X-ray induced acoustic signals. 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.
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 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 (15mg I/cm²) in the center, were used for measurements. Four different scan acquisitions at matched dose (CTDvol) 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 AG, 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 CTDvol 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 CTDvol 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

Participants
Shiyu Wang, Dalian, China (Presenter) Nothing to Disclose
Yijun Liu, Dalian, China (Abstract Co-Author) Nothing to Disclose
Ailian Liu, MD, Dalian, China (Abstract Co-Author) Nothing to Disclose
Renwang Pu JR, MBCh, FRCP, Dalian, China (Abstract Co-Author) Nothing to Disclose
Xin Fang, Dalian, China (Abstract Co-Author) Nothing to Disclose

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 contrast medium concentration was 350mgI/ml, the injection volume and speed was 100ml and 5ml/s respectively. Group B (n=34) underwent plain CT scanning using AEC with BMI based NI setting (BMI<23,NI=10;23≤BMI≤26,NI=12;BMI>26,NI=14). According the maximum mA and average mA, choosing corresponding GSI protocols with approximate CTDvol. The maximum mA corresponded CTDvol approximate GSI protocol was used for arterial phase and vein phase. The average mA corresponded CTDvol approximate GSI protocol was used for parenchyma phase. Monochromatic images at 60kV 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 (0.89±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 testbench 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**

**Participants**
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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; ; ;
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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.

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.

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.

PURPOSE
Added beam-shaping filtration such as the use of a tin filter may improve the dose efficiency of an x-ray beam by removing some of the low-energy photons that do not contribute to image quality. The purpose of this study was to evaluate the radiation dose reduction potential of a 100 kV beam with an added tin filter for different patient sizes.

METHOD AND MATERIALS
An anthropomorphic chest phantom (Lungman, Kyoto Kagaku) with 2 additional attenuation layers was used to simulate small (35 x 20 cm), medium (40 x 26 cm), and large (47 x 31 cm) adult patients. These phantoms were scanned on a 192-slice CT scanner (Force, Siemens) at 100 and 120 kV without tin filtration, and 100 and 150 kV with tin filtration (100Sn and 150Sn), each at 5
different 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.

**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±7.81HU, respectively. The MSI images demonstrated similar CT values as plain scan (40.25±6.19HU, 39.14±9.27HU, 40.11±11.01HU, and 50.41±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.

CLINICAL RELEVANCE/APPLICATION
None

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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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
None
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**
- Andreas Stratis, Leuven, Belgium (Presenter) Nothing to Disclose
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- Guozhi Zhang, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
- Reinhilde Jacobs, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
- Ria Bogaerts, Herestraat 49, Belgium (Abstract Co-Author) Nothing to Disclose
- Hilde Bosmans, PhD, Leuven, Belgium (Abstract Co-Author) Co-founder, Qaelum NV Research Grant, Siemens AG

**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 phantoms. 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**
- Xochitl Lopez-Rendon, MSc, Leuven, Belgium (Presenter) Nothing to Disclose
- Guozhi Zhang, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
- Walter Coudyzer, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
- Wim Develder, 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 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). CT Dose vol was matched to the patient specific CT Dose vol 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

CT PH

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
FDA Discussions may include off-label uses.

Participants
Yulei Jiang, PhD, Chicago, IL (Moderator) Consultant, Quantitative Insights, Inc; Research Agreement, QView Medical, Inc

Sub-Events

SSG16-01 Multi-material Electronic Cleansing for Non-cathartic Ultra-Low-Dose Dual-Energy CT Colonography

Tuesday, Dec. 1 10:30AM - 10:40AM Location: S502AB

Participants
Nadja Kohlhase, Niederaula, Germany (Presenter) Nothing to Disclose
Jann J. Nappi, PhD, Boston, MA (Abstract Co-Author) Royalties, Hologic, Inc; Royalties, MEDIAN Technologies;
Junko Ota, Suita, Japan (Abstract Co-Author) Nothing to Disclose
Daniele Regge, MD, Candiolo, Italy (Abstract Co-Author) Speakers Bureau, General Electric Company
Hiroyuki Yoshida, PhD, Boston, MA (Abstract Co-Author) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;
Toru Hironeaka, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To develop and evaluate accuracy of a novel multi-material electronic cleansing (MUMA-EC) scheme for non-cathartic ultra-low-dose dual-energy CT colonography (DE-CTC).

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.

SSG16-02 Deep-Learning-based Bladder Segmentation in CT Urography

Tuesday, Dec. 1 10:40AM - 10:50AM Location: S502AB

Participants
Kenny H. Cha, MSc, Ann Arbor, MI (Presenter) Nothing to Disclose
Lubomir M. Hadjiiski, PhD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Heang-Ping Chan, PhD, Ann Arbor, MI (Abstract Co-Author) Institutional research collaboration, General Electric Company
Ravi K. Samala, PhD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Richard H. Cohan, MD, Ann Arbor, MI (Abstract Co-Author) Consultant, General Electric Company; ;
Elaine M. Caoli, MD, MS, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

PURPOSE

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 Conjunctive 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%, 8.6±15.0%, 3.1±1.6 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.

SSG16-03 Automated Pancreas Segmentation in CT Using Multi-Level Deep Convolutional Networks

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S502AB

Participants

Holger R. Roth, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Le Lu, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Amal Farag, PhD, Louisville, KY (Abstract Co-Author) Nothing to Disclose
Hoo-Chang Shin, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Jiamin Liu, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Lauren M. Kim, MD, Bethesda, MD (Presenter) Nothing to Disclose
Ronald M. Summers, MD, PhD, Bethesda, MD (Abstract Co-Author) Royalties, iCAD, Inc; Research funded, iCAD, Inc;

PURPOSE

Automated segmentation is an important yet challenging problem for medical imaging. Segmentation of the pancreas could help assess diabetes and detect pancreatic cancer. While segmentation of other organs in computed tomography (CT) achieves good performances (Dice Similarity Coefficients (DSC) >90% for liver, heart or kidneys), methods for the pancreas achieve only 47% to 69% DSCs due to its greater variation in shape, size and location. In this work, we describe a new "deep learning" method using convolutional neural networks (CNN) for segmentation of the pancreas on CT images.

METHOD AND MATERIALS

The task is modelled in a bottom-up fashion: from dense labeling of image patches, to regions, and to the entire organ. Given an abdominal CT, superpixel regions are generated by random forest classifiers. These superpixels then serve as candidate regions with high sensitivity (97%) but low precision, achieving an initial DSC of 27%. Next, we propose several CNNs for segmentation refinement (or pruning): 1.) P-CNN labels axial-coronal-sagittal patches, generating a probability response map P. 2.) Regional CNN (R1-CNN) samples a set of bounding boxes covering each image superpixel at multiple scales on the CT intensity. A second stacked regional R2-CNN is also learned to leverage the joint features of CT intensities and probability maps P with structured prediction for post-processing.

RESULTS

Our methods are evaluated on CT scans of 82 patients in a hard-split of 62 for training and 20 for testing. Results indicate that we advance the current state-of-the-art performance to a DSC of 75.8±5.4% in testing. We furthermore provide an extensive evaluation of minimal surface distance between the ground truth and our proposed segmentation, achieving 0.94±0.57mm on average. The segmentation performance slightly degrades when only the tip of pancreatic head or tail is visible in a CT slice.

CONCLUSION

We present a bottom-up, coarse-to-fine approach for pancreas segmentation in abdominal CT scans. Multi-level deep CNNs are employed on both image patches and regions. The proposed deep learning based approach advances the state-of-the-art in pancreas segmentation.

CLINICAL RELEVANCE/APPLICATION

The method could also be applied as multi-organ segmentation since CNNs naturally support this. Segmentation problems with large variations and pathologies (such as in tumors) could be solved by similar deep learning methods.

SSG16-04 Semi-Automatic Assessment of Carotid Artery Using 3D Magnetic Resonance Imaging

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S502AB

Participants

Ronald M. Summers, MD, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
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Holger R. Roth, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Lu, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose

PURPOSE

Semi-Automatic Assessment of Carotid Artery Using 3D Magnetic Resonance Imaging

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S502AB

Participants

Ronald M. Summers, MD, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
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Holger R. Roth, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Lu, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose

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 Conjunctive 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%, 8.6±15.0%, 3.1±1.6 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 MR (Philips). Two image sets were acquired using: 1) a rapid 3D Time of Flight sequence in the axial orientation, and 2) MRIPH sequence (a T1weighted 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 transferred 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.
The mean error was 0.61±0.37 cm with a range from 0.1 cm to 1.06 cm.

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 element size of 9-15 mm depending on the breast size. Because BCT is acquired in prone position without compression, the gravity loading of the BCT volume in the anterior-posterior direction is compensated before the compression model is applied. The compression in the superior-inferior direction is modeled as a contact problem between two parallel plates and the breast using surface displacements. 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.

RESULTS

for validation. Participants

Jean-Paul Charbonnier, Nijmegen, Netherlands (Presenter) Nothing to Disclose
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Francesco Ciompi, PhD, Nijmegen, Netherlands (Abstract Co-Author) Nothing to Disclose
Ernst T. Scholten, MD, Haarlemmerliede, Netherlands (Abstract Co-Author) Nothing to Disclose
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Eva M. Van Rikxoort, PhD, Nijmegen, Netherlands (Abstract Co-Author) Stock holder, Thirona BV Co-founder, Thirona BV

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 uncompress 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
Xiufang 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 choce 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, 0.6400, 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 0.7612.

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 recommend 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
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Marco Cami, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Andrea Fiorelli, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Marco Franccone, MD, Rome, Italy (Abstract Co-Author) Speakers Bureau, Bracco Group
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][S]) before and 15-20min after injection of gadobenate dimeglumine (Gd-BOPTA) on a 1.5T MR scanner (Magnetom Avanto). Imaging parameters: matrix 218×256, voxel size 1.41x1.41x8mm³, TR/TE 1.44/1.12 ms, minimum T1 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 $\Delta R_{\text{blood}} = (1/T_{\text{blood-post}}) - (1/T_{\text{blood-pre}})$ were calculated automatically creating a mask on the T1 pre contrast map applying a threshold, then applied on T1 post contrast map to calculate the mean $T_{\text{blood-post}}$.

**RESULTS**

We compare the ECV myocardium values obtained manually drawing ROI in the myocardium and blood of T1 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 then 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.
Computed Tomography Coronary Angiography versus Stress Cardiac Magnetic Resonance for the Management of Symptomatic Revascularized Patients: A Cost-Effectiveness Study (STRATEGY Study)

Station #1

Computed tomography coronary angiography (CTCA) and stress cardiac magnetic resonance (stress-CMR) are both suitable for diagnosing obstructive coronary artery disease (CAD) in symptomatic patients for chest pain with previous history of revascularization. The aim of this study is to compare the clinical and economic outcomes of using anatomical (CTCA) versus a functional strategy (stress-CMR) in revascularized symptomatic patients for chest pain.

METHOD AND MATERIALS

Four-hundred revascularized symptomatic patients for chest pain were addressed to CTCA (n: 200, mean age 68±10 yo, male 168) or stress-CMR (n: 200, mean age 66±9 yo, male 177) and followed-up in terms of downstream non-invasive tests, invasive coronary angiography (ICA) and revascularization procedure, medical costs for CAD management, cumulative effective radiation dose and major adverse cardiac events (MACEs) defined as composite endpoints of non fatal myocardial infarction and cardiac death.

RESULTS

All patients performed both tests successfully. The mean follow-up for CTCA and stress-CMR groups were similar (772±398 vs. 794±345 days, p:ns). Compared with stress-CMR strategy, CCTA was associated with an increased likelihood of subsequent mean number of further non-invasive test (1.04 vs. 0.81, p<0.01), cardiac catheterization (40% vs. 30%, p<0.05). No differences were found in terms of subsequent percutaneous coronary interventions (PCI) (30% vs. 26%, p:0.37) but stress-CMR group was associated with a favorable trend of PCI/ICA rate (86% vs. 75%, p: 0.08) and MACEs (4% vs. 8.5%, p:0.06). Moreover, CTCA strategy showed a higher mean cost per patient [2329.46 vs. 2617.47 Euro (-11%), p<0.05] and a lower mean effective radiation dose [22 vs. 4.4 mSv (-80%), p<0.01].

CONCLUSION

Despite similar or risk profiles, revascularized patients initially evaluated with CTCA after PCI had more downstream non invasive and invasive testing, higher CAD-related spending and effective radiation exposure as compared to patients evaluated with stress-CMR with comparable MACEs.

CLINICAL RELEVANCE/APPLICATION

Patients evaluated with CTCA after PCI had more downstream non invasive and invasive testing, higher CAD-related spending and effective radiation exposure as compared to patients evaluated with stress-CMR with comparable MACEs.
Aim of this study is to assess whether the distribution of the calcification and image reconstruction methods influence the ability of the in-stent lumen visibility by subtraction CCTA (SCCTA).

METHOD AND MATERIALS

We evaluated 127 patients with 400 or more Agatston units or STENT treatment history using area detector CT scanner. Single breath-hold method was used to obtain pre- and post-contrast image. These image sets were reconstructed by use of the half or full data. If a motion artifact did not appear, full data reconstruction was adopted. Coronary subtraction was performed using the scanner's embedded software. The image quality (IQ) was assessed using 4-point scale (1: uninterpretable, 2: poor, 3: moderate, 4: good) in the calcification (CALC) segment (calcified plaque distribution more than 90 degree in the short axis) and STENT implantation segment.

RESULTS

206 CALC segments and 187 STENT implantation segments (with CALC; 134, without CALC; 53) were registered. IQ score of SCCTA in all segments was significantly higher than conventional CCTA (3.6±0.6 vs. 2.5±1.0: p<0.0001). Each IQ score of CALC, STENT with CALC and STENT without CALC were 2.4±1.0, 2.3±1.0 and 3.4±0.9 in conventional CCTA, respectively, and those were 3.6±0.5, 3.6±0.6 and 3.7±0.6 in SCCTA, respectively. The improvement of IQ score of STENT segment with CALC and CALC segment was highest than STENT segment without CALC. Also the IQ score of S1 using full data reconstruction was significantly higher than that using half data reconstruction (3.7±0.5 vs. 3.4±0.5: p<0.001).

CONCLUSION

SCCTA improved IQ of STENT segment like CALC segment compared to conventional CCTA, and its effect was higher of STENT with calcification. Moreover, there is a possibility that use of full data reconstruction contributes to improvement of the IQ score.

CLINICAL RELEVANCE/APPLICATION

CCTA provides the essential information for stenotic lesions with high diagnostic accuracy. However, extensive calcified lesion and in-stent lumen visibility remain problematic.

CA226-5D-TUA3 The Impact of Computational Fluid Dynamic (CFD) Boundary Conditions (BCs) on Coronary Computed Tomography Angiography (CCTA) - Derived Endothelial Shear Stress (ESS) Calculations for the Prediction of Coronary Plaque Progression

Station #3

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PURPOSE

Low ESS is associated with coronary plaque progression and high-risk plaque features. It is often modeled from CCTA using various CFD BC assumptions, eg, commonly excluding side branches. We assessed whether typical BC assumptions alter determination of the arterial regions subjected to low ESS.

METHOD AND MATERIALS

Coronaries of 5 human hearts were filled with 3% contrast (Isovue 370) methylcellulose mixture and imaged <10hrs postmortem using 64-row CT (GE Discovery 750HD). Vessels > 1mm diameter were automatically segmented (Toshiba Cardiac Analysis Package) and left/right coronary trees were reconstructed (Matlab 2013b) with and without side branches. CFD analysis was performed using commercial software (Fluent 15, ANSYS) with BCs of no-slip walls, physiologic inlet flow rate (156 ml/min for left, 113 ml/min for right trees), zero-gauge outlet pressures, and steady laminar flow. ESS was calculated for 3 models: a) the entire coronary tree (with branches) and non-Newtonian blood (power law model for HCT=45); b) the entire tree and Newtonian blood (fixed viscosity for HCT=45), and c) major coronaries only (no branches) and non-Newtonian blood. The 10% of endoluminal surface with the lowest ESS values in each major artery (LAD, LCX, RCA) was used to assign each 3mm segment a binary outcome depending on whether it contained a low ESS region or not. Sensitivity and specificity to identify low ESS segments in the reference standard model (a) were calculated for the two simplified models (b, c).

RESULTS

With no side branches, sensitivity and specificity to identify low ESS segments were 78% and 88%. Sensitivity was lowest for LADs (67%) and highest for RCAs (85%); specificity was lowest for RCAs (81%) and highest for LADs (92%). With Newtonian blood and branches, sensitivity and specificity were 89% and 98%, with sensitivity lowest for RCAs (83%) and highest for LCXs (96%), and specificity lowest for LADs (98%).

CONCLUSION

ESS is typically modeled from CCTA excluding side branches and often assuming blood a Newtonian fluid as non-Newtonian models present difficulties in modeling turbulence. We found that side branches are important for identifying areas of low ESS while the blood model has negligible effect.

CLINICAL RELEVANCE/APPLICATION

CTA-derived fluid dynamic simulations used to associate blood flow characteristics such as ESS with high-risk plaques in coronary arteries should include side branches.
New Imaging Method for the Detection of Coronary Vasospasm: Double Acquisition of CCTA in the Presence or Absence of IV Nitrate Infusion

PURPOSE
Limited data exists regarding the efficacy of multidetector CT for CCTA diagnosis in patients with vasospastic angina. The purpose of our study was to evaluate the feasibility of double acquisition of coronary CT angiography (CCTA) for the diagnosis of vasospastic angina.

METHOD AND MATERIALS
This study included 20 consecutive patients with a high clinical probability of vasospastic angina. All subjects underwent CCTA ('baseline CT') without a vasodilator early in the morning before the ergonovine provocative spasm test. Within 1 week after baseline CCTA, all patients underwent another CCTA ('IV nitrate CT') during which a continuous injection of intravenous vasodilating agent was administered. We analyzed the results of the provocative spasm test and CCTA images for each patient, with vessel and segment stratification to compare the diagnostic accuracy.

RESULTS
Fifteen patients had positive results in the spasm provocation test. Among them, 11 patients showed positive results and 4 patients showed false negative results in the CCTA findings. All 5 patients who showed negative results in the spasm provocation test also had negative results on the CCTAs. The diagnostic accuracy of CCTA 'per patient' showed a sensitivity of 73%, specificity of 100%, positive predictive value (PPV) of 100%, and negative predictive value (NPV) of 56%. A total of 36 coronary vessels were compared, and the diagnostic accuracy 'per vessel' showed a sensitivity of 71%, specificity of 95%, PPV of 92%, and NPV of 78%. The diagnostic accuracy 'per segment' (n=154) showed a sensitivity of 53%, specificity of 94%, PPV of 91%, and NPV of 81%.

CONCLUSION
The double acquisition CCTA showed a relatively superior detection rate for coronary spasm than prior reported studies and 100% specificity and PPV in the per patient analysis.

CLINICAL RELEVANCE/APPLICATION
It is still insufficient to diagnose coronary spasm using CCTA without the provocation test, and additional radiation exposure and contrast media is required. We speculate that the double acquisition of CCTA can be selectively used in patients who are highly suspected of having vasospastic angina and who do not wish to go invasive coronary angiography, or who have previous history of insignificant coronary artery narrowing.

Is Bypass Grafting Beneficial for the Older Adult with an Anomalous Coronary Artery Demonstrating an Interarterial Coronary Course

PURPOSE
An anomalous coronary artery with an interarterial course (IAC) is a recognized cause of sudden death in children and young adults. Surgical interventions, including coronary bypass grafting (CABG) is often recommended, especially for a left IAC. However, the largest published review evaluated 54 subjects with an IAC and failed to demonstrate a long-term benefit from CABG (Krasuski et al. Circ. 2011;123(2):154-62). Given the increasing number of older adults with an IAC seen on coronary CT angiography (cCTA), we evaluated the association of IAC +/- CABG with subsequent cardiac events in adults over age 35.

METHOD AND MATERIALS
Retrospective review of cCTA and conventional arteriograms from our institution identified 173 patients (mean age: 64.9 years; range: 37-96) with an anomalous coronary artery origin from the opposite coronary sinus, including 80 patients with an IAC (mean age: 64.4 years). Chart review provided a mean follow-up time of 4.9 years. Outcome data was evaluated for hard outcomes (myocardial infarction or cardiac death) and soft outcomes (persistent angina).

RESULTS
Although the frequency of coronary artery disease (CAD) was lower among patients with an IAC vs those without an IAC (43% vs 59%, p<0.05), the frequency of CABG was marginally higher among those with an IAC (21/80) 26% vs without an IAC (16/93) 17%
Gadolinium enhancement. 20 age-matched healthy volunteers (HV) served as a control. Analysis of global longitudinal, patients demonstrated inconspicuous CMR findings without any wall motion abnormalities, signs of edema or early and late CMR data of 16 patients clinically diagnosed with ACM according to the current guidelines were retrospectively analyzed. All participants

**METHOD AND MATERIALS**

To evaluate the diagnostic value of cardiac magnetic resonance (CMR) feature tracking (FT) derived strain-analysis of the left and right ventricle in patients with clinically suspected acute myocarditis (ACM) but inconspicuous CMR.

**CONCLUSION**

The frequency of adverse cardiac outcomes in our adult population was not related to the presence of an IAC. In patients with an IAC, CABG was not associated with lower risk of cardiac death or nonfatal myocardial infarction.

**CLINICAL RELEVANCE/APPLICATION**

As an increasing number of IAC's are identified with cCTA, it is important to recognize that CABG does not have a proven benefit for the treatment of an IAC in the older adult patient.

**CA229-SD-TU46**

**Pressure Gradient using Phase Contrast MR at Three Different Aortic Valve Levels in Patients with Aortic Stenosis: Compared with Transthoracic Doppler Echocardiography**

**Participants**

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**PURPOSE**

The purpose of our study was to compare pressure gradient (PG) using phase-contrast (PC) MR at three different aortic valve levels with the mean pressure gradient of transthoracic echocardiography (TTE).

**METHOD AND MATERIALS**

This study included 55 patients with severe AS and normal left ventricular ejection fraction who underwent TTE and cardiovascular magnetic resonance (CMR) including PC sequence. PC imaging was performed at three aortic valve levels (level 0 mm at aortic leaflets, level +6 mm at distal to the level 0 mm, and - 6 mm at proximal to the level 0 mm). Peak velocity, peak PG and mean PG were calculated using PC imaging. Peak estimates at each level were collected as a combined group. Peak velocity and mean PG from TTE were used as a reference standard. CMR parameters in each levels and the combined group were compared with estimates of TTE.

**RESULTS**

The combined group was consisted of 26 estimates (level 0 mm), 24 estimates (level + 6 mm), and 5 estimates (level - 6 mm). In comparison of peak velocity, the estimates of CMR were correlated with that of TTE as follows: level 0 mm, r = 0.673; level + 6 mm, r = 0.535; level - 6 mm, r = 0.447; combination group, r = 0.734; all ps < 0.001. In comparison of peak PG, the estimates of CMR were correlated with mean PG of TTE as follows: level 0 mm, r = 0.692; level + 6 mm, r = 0.560; level - 6 mm, r = 0.499; combination group, r = 0.780; all ps < 0.001. In comparison of mean PG, the estimates of CMR showed weak correlation with mean PG of TTE as follows: level 0 mm, r = 0.346, p < 0.01; level + 6 mm, r = 0.069, p = 0.614; level - 6 mm, r = 0.420, p = 0.001; combination group, r = 0.394, p = 0.003.

**CONCLUSION**

Among the three valve levels, peak velocity and peak PG of PC imaging at leaflets level showed higher correlation with peak velocity and mean PG of TTE. The combination group showed better correlation than the leaflets level.

**CLINICAL RELEVANCE/APPLICATION**

Our findings supports that it is useful to obtain the velocity and gradient of PC imaging at three valve levels.

**CA230-SD-TU47**

**Diagnostic Implications of Magnetic Resonance Feature Tracking Derived Myocardial Strain Parameters in Patients with Clinically Suspected Acute Myocarditis but Inconspicuous CMR**

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**PURPOSE**

To evaluate the diagnostic value of cardiac magnetic resonance (CMR) feature tracking (FT) derived strain-analysis of the left and right ventricle in patients with clinically suspected acute myocarditis (ACM) but inconspicuous CMR.

**METHOD AND MATERIALS**

CMR data of 16 patients clinically diagnosed with ACM according to the current guidelines were retrospectively analyzed. All patients demonstrated inconspicuous CMR findings without any wall motion abnormalities, signs of edema or early and late gadolinium enhancement. 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 Wilcoxon rank-sum-test, one-way robust ANOVA with bootstrapped post-hoc tests, multiple and multinominal logistic regression analyses, and ROC-analyses.

RESULTS

ACM patients showed significantly reduced LV longitudinal strain (-12.6 ± 1.6 vs. -16.8 ± 1.3 %, p = .024) and LV circ. strain (-22.3 ± 1.8 vs. -27.8 ± 1.0, p = .014) compared to HV. Conversely, they showed a non-significant trend towards an improved basal RV circ. SR (-0.63 ± 0.08 vs. -0.47 ± 0.07 s⁻¹, p = .407). 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 0.82 in ROC-analysis. In ACM patients with preserved LV-EF (60%), all three strain parameters showed a trend towards similarly reduced LV and RV strain compared to HV, although this trend proved not significant at the 5% level. In multinominal logistic regression analysis, again LV circ. strain and RV basal circ. SR proved to be the best independent predictors of ACM even with preserved LV-EF with an AUC of 0.83 in ROC-analysis.

CONCLUSION

LV circ. strain and RV basal circ. SR are the best predictors for the presence of ACM when other CMR findings of ACM are lacking, even in patients with preserved LV-EF. These observations point to the potential of CMR-based strain analysis as a novel noninvasive diagnostic tool in the setting of ACM.

CLINICAL RELEVANCE/APPLICATION

The diagnostic problems of ACM have led to an increasing importance of CMR, but the traditional CMR-criteria often tend to be false-negative. Strain analysis potentially could overcome these problems.

TABLE OF CONTENTS/OUTLINE

Pathophysiology of coronary artery fistula - Epidemiology and common variants - Clinical features Diagnostic Methods - Echocardiography - Coronary catheterization - Coronary CT Angiography Treatment options Sample cases Future Direction and Summary

TEACHING POINTS

The purpose of this exhibit is: 1. To review the pathophysiology of coronary artery fistulas. 2. To provide multiple examples of coronary artery fistulas, all demonstrating different abnormalities of termination. 3. To illustrate the superior ability of coronary CT angiography over echocardiography and coronary catheterization in the evaluation of coronary artery fistulas and in treatment planning. 4. To describe treatment options and provide examples of post-treatment imaging.
**4th Generation Iterative Reconstruction Algorithm: Image Quality and Diagnostic Accuracy of Low Dose Abdominal CT Study in the Assessment of Cystic Pancreatic Lesion**

**PURPOSE**
To evaluate the diagnostic performance and the radiation dose exposure of the iterative reconstruction algorithm (iDose4) in MDCT studies of patients with pancreatic cystic lesions.

**METHOD AND MATERIALS**
A total of 88 patients (52 men; mean age 72.2 ± 10.1 years) were retrospectively reviewed. They underwent low-dose (120 kV, mAs determined by x-, y- and z-axis dose modulation) abdominal MDCT study on a 256-slice scanner (iCT; Philips) with iDose4 modulation and a standard MDCT examination (120 kV; 200-400 mAs) on a 16-row scanner (Brilliance, Philips). For each cystic lesion the following parameters were evaluated: location in the pancreas (head, uncinate process, neck, body, tail), number and size, communication with the main pancreatic duct (MPD), maximum MPD diameter, presence of septa, mural enhancing nodules and wall thickening. Radiation dose information in terms of dose-length product (DLP, mGy*cm) and CT dose index (CTDI, mGy) were also recorded. Image quality, noise and sharpness were also evaluated using a 4-point scale.

**RESULTS**
A total of 157 cystic pancreatic lesions in 88 patients were evaluated. 54 lesions were located in the head, 17 in the uncinate process, 8 in the neck, 29 in the body and 49 in the tail. The mean size was 12.9±8.6 mm and the mean MPD diameter was 2.7±0.7 mm. 85 (54%) cystic lesion had a communication with MPD, 50 (32%) presented wall thickening, 46 (30%) inner septa and 18 (11%) mural nodules. The radiation dose in low kV protocol was significantly lower (DLP 583.3±273.6 mGy*cm; CTDI 9.8±4 mGy) as compared to the control group (DLP 1024.9±362 mGy*cm; CTDI 21.1±3.6 mGy). Diagnostic quality and image sharpness in low-dose group was almost similar (2.5±0.7; 2.6±0.8) as compared to the control group (2.4±0.7; 2.7±0.7) and noise too (2.2±0.8 vs 2.2±0.8).

**CONCLUSION**
The iDose4 reconstruction algorithm offers high quality MDCT images useful in assessment of pancreatic cystic lesions, also significantly reducing radiation dose exposure (about 44%).

**CLINICAL RELEVANCE/APPLICATION**
iDose4 iterative reconstruction algorithm represents an effective technique for proper evaluation of pancreatic cystic lesions, with a significant reduction in radiation dose maintaining high diagnostic quality.

**Can Functional Parameters from Hepatobiliary Phase of Gadoxetate MRI Predict Clinical Outcomes in Liver Disease?**

**PURPOSE**
To determine if functional parameters measured using MRI with gadoxetate disodium (Eovist, Bracco Diagnostics, Monroe, NJ) may be used as an adjunct to clinical models in predicting outcomes in patients with liver disease.
**METHOD AND MATERIALS**

This retrospective HIPAA-compliant, and IRB-approved study reviewed the clinical and radiological data in patients who had a gadoxetate MRI scan between January 2011 and December 2013. 98 patients (mean age 56.6 years, males=52) had enhancement-ratio of liver at 15 minutes (ER 15) [(liver SI @ 15 min-liver SI precontrast)/(liver SI precontrast)] and contrast enhancement index at 15 minutes (CEI 15) [(liver SI @ 15 min/muscle SI @ 15 min)/(liver SI precontrast/muscle SI precontrast)] measured by two independent reviewers by drawing 1-2 cm2 regions-of-interest in right lobe of liver and right paraspinal muscle away from blood vessels. Clinical outcomes recorded were onset of GI bleeding (GIB) or encephalopathy ("enceph"), major nonfatal event in first year (GIB, enceph, liver transplantation), survival less than 1 and 2 years.

**RESULTS**

26 patients had no known diffuse liver disease and were scanned for characterizing benign liver lesions. The remaining 72 had chronic fibrosis of varying severity. On multivariate logistic regression analysis, the only parameter that predicted survival of < 1 year was MELD score (p=0.05). Less than 2-year survival correlated only with ER 15 (p=0.04). Major 1-year nonfatal event and onset of "enceph" correlated with CEI 15 (p=0.01 and 0.04, respectively). On ROC curve analysis, ER 15 of less than 0.57 had sensitivity and specificity of 80% and 63% in predicting a major 1-year event.

**CONCLUSION**

ER 15 and CEI 15 are functional parameters of gadoxetate imaging which predict important outcomes in patients with liver disease.

**CLINICAL RELEVANCE/APPLICATION**

ER15 and CEI 15 may be useful to predict outcomes in liver patients and should be included in MRI reports.

**Honored Educators**

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**PURPOSE**

To evaluate the clinical feasibility, and accuracy of ARFI elastography for detection of liver fibrosis in patients of chronic viral hepatitis.

**METHOD AND MATERIALS**

ARFI based US elastography was performed in 69 patients of CLD of viral etiology. Fifty eight patients of CLD underwent a liver biopsy as well.

**RESULTS**

ARFI was feasible in all 69 CLD patients while valid measurements could be obtained in 65 patients (95.6%). A gradual increase in mean SWVs was noted from F0 to F6 grades of fibrosis (Ishak's score) and a high positive correlation was found between the mean SWV on ARFI and fibrosis scores on liver biopsy (rho=0.789). The difference between the mild (F1 and F2) vs significant fibrosis (F3 and F4) groups was also statistically significant (p<0.001). The difference in the SWV measurements obtained from consecutive groups (i.e. F1vsF2, F2vsF3 and F3vsF4) was not statistically significant. Using area under ROC, the best calculated cutoff SWV for presence of fibrosis (>=F1), significant fibrosis (>=F3), severe fibrosis (>=F4) and cirrhosis (F6) were found to be 1.207m/s, 1.347m/s, 1.513m/s and 1.920m/s respectively. In cirrhotic patients, ARFI gave significantly higher values than in the other patients (p < 0.001).

**CONCLUSION**

ARFI elastography allows valid and non invasive evaluation of liver stiffness and may help in distinguishing between no/mild fibrosis and significant fibrosis and guiding management decisions.

**CLINICAL RELEVANCE/APPLICATION**

ARFI can correctly and non invasively detects and quantitate fibrosis to prognosticate and plan therapeautic decisions and avoid complications and limitations of liver biopsy.
To evaluate the role of growth kinetics in differentiating between untreated hepatocellular carcinoma (HCC) and mass-forming intrahepatic cholangiocarcinoma.

METHOD AND MATERIALS
This Health Insurance Portability and Accountability Act compliant retrospective study was approved by the institutional review board. Eighteen patients with HCC and sixteen patients with cholangiocarcinoma imaged at two different time points before treatment were evaluated. Tumor growth kinetics was obtained by calculating the reciprocal of doubling time (RDT). Unpaired t-test was used for analysis. Significance was set at 0.05.

RESULTS
Mean age of patients with HCC and cholangiocarcinoma was comparable (64.9 ± 10.0 years for HCC vs. 63.6 ± 13.4 years for cholangiocarcinoma, P=0.745). Mean interscan interval was 105 and 141 days for HCC and cholangiocarcinoma, respectively. HCC and cholangiocarcinoma had a mean diameter of 48.5 ± 31.2 mm and 60.2 ± 43.5 mm, respectively on initial CT scan. Mean RDT was significantly lower for HCC when compared with cholangiocarcinoma (1.91 ± 1.36 for HCC vs. 3.81 ± 2.74 for cholangiocarcinoma, P=0.02), reflecting significantly slower growth rate of HCC.

CONCLUSION
Tumor growth kinetics of untreated HCC and intrahepatic mass forming cholangiocarcinoma are significantly different.

CLINICAL RELEVANCE/APPLICATION
Compared to cholangiocarcinoma, HCC is a relatively slow growing tumor with approximately 50% slower growth rate. Our results suggest that more than 50% growth rate in 6 months as a diagnostic feature of OPTN class 5G lesion may need to be re-evaluated.

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Vahid Yaghmai, MD - 2012 Honored Educator
Vahid Yaghmai, MD - 2015 Honored Educator
Frank H. Miller, MD - 2012 Honored Educator
Frank H. Miller, MD - 2014 Honored Educator

Purpose:
To investigate and evaluate the quantitative and subjective quality of the portal vein images combining monochromatic spectral CT with adaptive statistical iterative reconstruction (ASiR).

METHOD AND MATERIALS
90 patients with tumor history routinely receiving abdomen CT scans were randomly divided into three groups. Group A (optimal monochromatic group) included 30 patients who underwent fast kVp-switching dual-energy abdominal enhanced CT, from which 101 sets of portal phase recombinant monochromatic (40~140 keV) images were generated, and the optimal monochromatic set with the highest contrast to noise ratio (CNR) were obtained. Group B (60keV+40%ASiR group) included 30 patients who underwent fast kVp-switching dual-energy abdominal enhanced CT, and portal phase 60keV recombinant monochromatic images were obtained and reconstructed with 40% ASiR. Group C (conventional multi-detector CT group) included 30 patients who underwent traditional abdominal enhanced multi-detector CT, whose portal phase images were obtained. The average CT values of the portal vein and the hepatic parenchyma, as well as the portal-hepatic HU difference, the image noise and the CNR, were obtained and compared among the three groups using the single factor analysis of variance. 2 board-certified radiologists interpreted the selected image sets independently for image quality scores.

RESULTS
The monochromatic images were found to yield the optimal CNR for portal vein at 55.87 keV. In group A, B and C, the CNR were 6.81±1.87, 8.09±2.29 and 3.30±1.08, and the image quality scores were 4.28±0.58, 4.35±0.56 and 3.58±0.46, respectively. The CNR and image quality scores of group A and B were significantly higher than group C (all p<0.001).

CONCLUSION
Compared to conventional CT imaging, the 60keV monochromatic spectral CT imaging with 40%ASiR and the optimal monochromatic CT imaging both can significantly improve the image quality of portal vein.

CLINICAL RELEVANCE/APPLICATION
Both of the 60keV monochromatic spectral CT imaging with 40%ASiR and the optimal monochromatic CT imaging can be applied to clinic for great manifestation of portal vein.

**GI361-SD-TUA6**

**High Radiation Exposure in Symptomatic Crohn’s Disease Patients and the Need for Reduction in Utilization of CT Imaging**

Station #6

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**PURPOSE**

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 and average 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**

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Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
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**GI362-SD-TUA7**


Station #7

Participants
Matthew H. Kulzer, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Amir Borhani, MD, Pittsburgh, PA (Presenter) Nothing to Disclose
Alessandro Furlan, MD, Pittsburgh, PA (Abstract Co-Author) Author, Reed Elsevier; Research Grant, General Electric Company
Anish Ghodadra, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Mark A. Sparrow, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Negar Iranpour, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Mitchell E. Tublin, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Virtual Unenhanced (VUE) is a new material decomposition method allowing creation of noncontrast-like images based on single-source rapid kv-switching dual-energy CT (SS-DECT) acquisition. The purpose of this study is to compare the attenuation values of intra-abdominal organs obtained on true nonconstrast (TNC) and VUE studies.
Metastatic disease may be present with locoregional adenopathy and hepatic disease locations, in order of decreasing frequency.

TEACHING POINTS

- Elliot K. Fishman, MD, Owings Mills, MD
- Ralph H. Hruban, Baltimore, MD
- Franco
- Participants

**METHOD AND MATERIALS**

43 consecutive patients who underwent non-contrast single-kvp CT and postcontrast dual-energy CT of the abdomen in the same session, using a SS-DECT scanner (HD750 GE), were retrospectively studied. Post-contrast CT was obtained during late arterial and portal venous phases. VUE images were reconstructed from both arterial and venous-phase series. Attenuation values (HU) of the liver, spleen, pancreas, kidneys, adrenal glands, aorta, IVC, portal vein, paraspinal muscle, and subcutaneous fat were measured on TNC, arterial phase VUE (VUE-art), and venous phase VUE (VUE-ven) studies using a similar ROI. BMI and hemoglobin level were also recorded. Virtual and true HU were compared using Pearson correlation and Bland-Altman plot. The effect of BMI and hemoglobin was assessed using multi-variable linear regression. The portion of cases with >10 HU error (an arbitrary threshold) between VUE and TNC attenuation values were calculated for each organ.

**RESULTS**

The $R^2$ for the correlation between VUE and TNC attenuation values ranged from 0.01 (IVC, RMSE = 6.8) to 0.77 (central liver, RMSE = 7.1), with the median $R^2$ being 0.42 (RMSE = 7.6) and 0.39 (RMSE = 7.9) for VUE-art and VUE-ven, respectively. These results were unchanged when corrected for BMI and hemoglobin. The VUE attenuation was significantly different from TNC attenuation for left kidney ($p<0.006$) and muscle ($p<0.001$). There was significant difference between VUE-art and VUE-ven for liver, muscle, subcutaneous fat, and aorta ($p<0.05$). The percentage of cases which had a >10HU difference between VUE and TNC ranged from 16% (central liver and kidneys) to 39% (IVC).

**CONCLUSION**

There was large variability in correlation between TNC and VUE attenuation values. The portion of cases with >10 HU error between VUE and TNC attenuation values varied by organ and ranged between 16% and 38%. VUE-ven generally offered a better estimate of TNC attenuation.

**CLINICAL RELEVANCE/APPLICATION**

VUE is a less-than-optimal technique for quantitative assessment of attenuation of abdominal organs.

**G1363-SD-TUA8**

**The Efficacy of MRI in the Diagnostic Workup of Cystic Fibrosis-Associated Liver Disease**

**Station #8**

Participants

- Sarah Poetter-Lang, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
- Dina Muin, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
- Nina Bastati, MD, Vienna, Austria (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
- Ahmed Ba-Ssalamah, MD, Vienna, Austria (Presenter) Nothing to Disclose

**PURPOSE**

To evaluate the morphologic features of hepatobiliary disease in cystic fibrosis (CF) patients on gadoxetic acid-enhanced MRI.

**METHOD AND MATERIALS**

Forty-six CF patients, 24 females and 22 males (mean age 30.8), who underwent gadoxetic acid-enhanced MRI were included. Two radiologists assessed in consensus the MRI findings including the presence of fatty infiltration, liver fibrosis or cirrhosis, gallbladder and bile duct alterations. Furthermore, the volume of the liver and spleen, the signal intensity (SI) of the liver on in- and opposed-phase were measured. On post-contrast images, liver uptake intensity, contrast distribution and excretion were scored. These findings were compared to a control group of 30 age- and gender-matched patients. Additionally laboratory tests as well as clinical data, and when available histopathological results, were correlated with MRI findings.

**RESULTS**

The splenic volume was significantly higher in the CF-group compared to the control-group ($p<0.05$) while the liver volume did not differ significantly. The degree of steatosis, as well as periportal fat deposition, were significantly higher in the CF-group ($p<0.05$). Additionally, periportal tracking and bile duct abnormalities were detected significantly more often in the CF-group. Furthermore the number of gallbladder alterations was significantly higher in the CF-group. However the liver uptake of the gadoxetic acid as well as the hepatobiliary excretion did not differ significantly between the groups and in the majority of CF patients the laboratory parameters were not elevated.

**CONCLUSION**

Gadoxetic acid-enhanced MRI is an emerging tool to detect early hepatobiliary involvement in CF patients.

**CLINICAL RELEVANCE/APPLICATION**

Early detection of cystic fibrosis-associated liver disease (CFLD) is crucial since it impacts patient management and prognosis.

**G1363-ED-TUA9**

**Small Bowel Gastrointestinal Stromal Tumors: Imaging and Clinical Correlates**

**Station #9**

Participants

- Franco Verde, MD, Baltimore, MD (Presenter) Nothing to Disclose
- Ralph H. Hruban, Baltimore, MD (Abstract Co-Author) Royalties, Myriad Genetics, Inc
- 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

**TEACHING POINTS**

Gastrointestinal Stromal Tumors (GIST) are uncommon mesenchymal neoplasms with predilection for duodenal, jejunal and ileal locations, in order of decreasing frequency. Malignant GIST must be suspected when greater than 5 cm and demonstrate necrosis. Metastatic disease may be present with locoregional adenopathy and hepatic disease.
Small Bowel Gastrointestinal Stromal Tumors (SB-GIST)A. History a. various terminology b. recent namingB. Histopathology a. understanding the pathology report b. significance of histologic grade c. assigning risk assessmentC. MDCT a. Optimizing protocol b. Examples of duodenal GISTs c. Examples of jejunal GISTs d. Examples of ileal GISTsD. Surgical approach per siteE. Prognosis a. according to risk assessment b. compared to gastric GISTs

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

GIZ03-ED TUA10 Nodular Regenerative Hyperplasia of the Liver: A Regenerative Response to Longstanding Ischaemia-induced Injury

Station #10

Participants
Kelvin Cortis, MD, FRCR, Msida, Malta (Presenter) Nothing to Disclose
Sarah Aquilina, Naxxar, Malta (Abstract Co-Author) Nothing to Disclose
Adrian Mizzi, MD, Glasgow, United Kingdom (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

This educational exhibit aims to: Define Nodular Regenerative Hyperplasia (NRH) in radiological and histological terms Outline the underlying causes and possible complications Depict the radiological findings of NRH on various imaging modalities, including ultrasound, CT, MRI, and PET-CT. Compare and contrast NRH to the regenerative nodules seen in cirrhosis Present a differential diagnosis for NRH

TABLE OF CONTENTS/OUTLINE

A. Pathogenesis of NRH B. Histological criteria for diagnosis: Wanless Criteria C. Underlying causes classified into: Pre-sinusoidal: large congenital porto-systemic shunts (including the Abernethy malformation), chronic portal vein thrombosis, portal vein agenesis Sinusoidal: veno-occlusive disease, congenital hepatic fibrosis, rheumatological and autoimmune conditions, myeloproliferative and lymphoproliferative disorders, drugs (including chemotherapeutic agents) Post-Sinusoidal: chronic Budd-Chiari syndrome, congestive heart failure D. Multimodality imaging findings - arterialisation of RNH nodules as opposed to lack of arterial enhancement in regenerative nodules seen on a background of cirrhosis E. Distinguishing NRH from focal nodular hyperplasia (FNH), hepatocellular adenoma or carcinoma, and cirrhosis F. Possible complications Non-cirrhotic portal hypertension Hepatocellular carcinoma

GIZ07-ED TUA11 Precancerous Lesions of the Pancreaticobiliary Pract: A Current Comprehensive Update

Station #11

Awards
Certificate of Merit

Participants
Krishna Prasad Shanbhogue, MD, New York, NY (Presenter) Nothing to Disclose
Christine O. Menias, MD, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
Srinivasa R. Prasad, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

To provide an update on epidemiology, natural history/biology, clinical, pathological and imaging findings of precancerous lesions of the pancreaticobiliary tract. To emphasize the current and future role of imaging in triaging the patients to 'surgical resection' versus 'surveillance'.

TABLE OF CONTENTS/OUTLINE

Current update on epidemiology, natural history/biology, and clinical manifestations of precancerous lesions of the pancreaticobiliary tract. Typical pathological and imaging features with emphasis on suspicious and worrisome imaging features of entities including but not limited to biliary and pancreatic intraepithelial neoplasia (BilIN/PanIN), Intraductal papillary neoplasms of bile duct and pancreas (IPNB/PPMN), mucinous cystic neoplasm (MCN), intraductal papillary and intracholecystic papillary tubular neoplasms (IAPN/ICPN), biliary papillomatosis and biliary hamartoma. Review of current international consensus criteria for management. Differential diagnosis and pitfalls in imaging diagnosis.

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Krishna Prasad Shanbhogue, MD - 2012 Honored Educator
Krishna Prasad Shanbhogue, MD - 2013 Honored Educator
Christine O. Menias, MD - 2013 Honored Educator
Christine O. Menias, MD - 2014 Honored Educator
Christine O. Menias, MD - 2015 Honored Educator
Srinivasa R. Prasad, MD - 2012 Honored Educator

GIO15-EB Anatomic Variants of the Biliary Tree and Their Clinical Significance
TEACHING POINTS

1. To review the normal anatomy of the biliary tree.
2. To review common variants of biliary anatomy with a particular emphasis on their clinical relevance.
3. To gain insight into the importance of reporting clinically relevant biliary anatomic variants in order to minimize surgical and procedural complications.

TABLE OF CONTENTS/OUTLINE

1. Normal biliary anatomy
2. Common variants of biliary anatomy and their clinical relevance
   - Incidence of biliary variants
   - MRCP and ERCP examples of the most relevant variants
     - Right posterior duct into common hepatic duct
     - Right posterior duct into left hepatic duct
     - Low insertion and medial course of the cystic duct
     - Accessory bile duct (duct of Luschka)
3. Biliary complications following surgical, endoscopic, or percutaneous intervention
4. Importance of reporting certain variants of biliary anatomy prior to intervention in order to minimize complications
**PHS-TUA**

**Physics Tuesday Poster Discussions**

Tuesday, Dec. 1 12:15PM - 12:45PM Location: PH Community, Learning Center

**PH**

**AMA PRA Category 1 Credit ™: .50**

**FDA**

Discussions may include off-label uses.

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**Participants**
Zheng Feng Lu, PhD, Chicago, IL (*Moderator*) Nothing to Disclose
Xiaohong J. Zhou, PhD, Chicago, IL (*Moderator*) Nothing to Disclose

**Sub-Events**

**PH240-SD-TUA1**

**Evaluation of Simulated Radiation Dose in Chest Examinations Performed Using Super-High-Resolution CT with 0.25-mm Slice Thickness×128 Detector Rows**

Station #1

**Participants**
Keiichi Nomura, MS, Kashiwa, Japan (*Presenter*) Nothing to Disclose
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Shinsuke Tsukagoshi, MS, Otawara, Japan (*Abstract Co-Author*) Employee, Toshiba Corporation
Ryutarou Kakinuma, MD, PhD, Chuo-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose
Noriyuki Moriyama, MD, PhD, Chuo-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

We have reported in previous studies that super-high-resolution CT images are useful for diagnosis in chest examinations (Ultra-High-Resolution CT Images of Adenocarcinomas Obtained Using a Prototype Scanner; RSNA 2013 etc.). The purpose of the present study was to evaluate radiation doses in chest examinations performed using Quarter-pixel Detector CT (QDCT) in which the channel pitch and row pitch of the detector is both one-half that of conventional MDCT.

**METHOD AND MATERIALS**

The simulated CTDIvol, organ doses and effective doses from QDCT were compared with the doses from conventional Multi-Detector row CT (MDCT). Method 1 CTDIvol

The chest scanning conditions for a scan range of 32 cm were 120 kV, 0.25 mm × 128 rows, 40 mA, 0.5 s/rot., and PF 0.80 for QDCT and 120 kV, 0.5 mm × 64 rows, 30 mA, 0.5 s/rot., and PF 0.83 for MDCT. We compared CTDIvol displayed on QDCT and MDCT.

**RESULTS**

Results 1 CTDIvol

The displayed CTDIvol (mGy) values for QDCT and MDCT were 1.9 and 2.2, respectively.

Results 2 Organ and effective doses

The organ dose values for QDCT and MDCT were 4.1 mGy and 4.7 mGy, respectively, for the thyroid, 3.1 mGy and 3.3 mGy for the lung, 2.0 mGy and 2.1 mGy for the breast, 2.8 mGy and 2.9 mGy for the liver, and 2.9 mGy and 3.1 mGy for the stomach. The effective doses defined in ICRP 103 were 1.8 mSv in QDCT and 1.9 mSv in MDCT.

**CONCLUSION**

QDCT provides super-high-resolution images that are useful for diagnosis in the chest with the almost same radiation doses as MDCT.

**CLINICAL RELEVANCE/APPLICATION**

QDCT provides super-high-resolution images for visualizing small structures with radiation exposure comparable to conventional CT, which should lead to new imaging techniques for improved diagnosis.

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**Participants**
Sana Dastgheyb, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
John R. Eisenbrey, PhD, Philadelphia, PA (*Presenter*) Research support, Lantheus Medical Imaging, Inc; Research funded, General Electric Company; Equipment support, General Electric Company
Maria Stanczak, MS, Philadelphia, PA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Toshiba Corporation
Flemming Forsberg, PhD, Philadelphia, PA (*Abstract Co-Author*) Equipment support, Toshiba Corporation; Research Grant, General Electric Company; Research Grant, Toshiba Corporation; Equipment support, Siemens AG; In-kind support, General Electric Company; In-kind support, Lantheus Medical Imaging, Inc
Ji-Bin Liu, MD, Philadelphia, PA (*Abstract Co-Author*) Research Grant, GluMetrics, Inc
Shunxin Zhang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Chunli Zhang, MD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Noreen J. Hickok, PhD, Philadelphia, PA (*Abstract Co-Author*) Researcher, Zimmer Holdings, Inc; Researcher, Synergy Technologies,
PURPOSE

Bacteria often form large biofilm-like aggregates in synovial fluid (SF) making them recalcitrant to antimicrobial therapy and difficult to eradicate. This study explored the use of microbubble cavitation to disrupt these aggregates in synovial fluid, thereby sensitizing the bacteria to antibiotic treatment.

METHOD AND MATERIALS

Staphylococcus aureus strain ATCC 25923 (n = 3 for 6 groups) were incubated overnight in either Trypticase Soy Broth (TSB) or SF with or without antibiotic (100 µg/mL cefazolin) at 37ºC. Bacterial aggregates formed overnight in 1 mL of SF were transferred to Seal-a-Meal bags. Prior to vacuum sealing, 100 µl of activated Definity microbubbles (Lantheus Medical Imaging, N. Billerica, MA) were added. Microbubble cavitation was then generated using a high mechanical index (> 0.6) flash replenishment sequence for 6 minutes on a S9pro ultrasound scanner with a curvilinear probe (SonoScape, Shenzhen, China). Post-treatment, samples were permitted to continue incubation for an additional 12 hours. Survival of bacteria was quantified by manual colony counts after plating the sample onto TSB agar and incubating overnight at 37ºC.

RESULTS

In all groups treated with microbubble cavitation, dispersion of the bacterial clumps was visually observed post treatment. Bacteria combined with ultrasound and microbubbles (without antibiotic) resulted in 7.3 E8 ± 4.6 E8 colony-forming units (CFU)/mL in SF. Bacteria and antibiotic (cefazolin, without microbubbles) resulted in 1.2 E7 ± 1.1 E6 CFU/mL in SF and 0 ± 0 CFU/mL in TSB, demonstrating the antibiotic resistance of Staphylococcus aureus aggregates in SF. However, the combination of microbubbles, ultrasound, cefazolin, and bacteria resulted in 0 ± 0 CFU/mL in SF, establishing the ability of microbubble cavitation to sensitize bacterial aggregates in SF to antimicrobial therapy.

CONCLUSION

The addition of ultrasound contrast agent cavitation appears to disrupt bacterial aggregates in SF. While not lethal to the bacteria, this disruption then returns antibiotic susceptibility to bacterial aggregates.

CLINICAL RELEVANCE/APPLICATION

Ultrasound triggered microbubble cavitation may sensitize bacterial aggregates within synovial fluid to antimicrobial therapy, thereby improving clinician’s ability to treat joint infection.

PH242-SD-TUA3 Verification of Dynamic ADC Change Due to Blood Flow using Cranial MRI-Phantom

Station # 3

Participants
Shota Ishida, BS, Kanazawa, Japan (Presenter) Nothing to Disclose
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Yuki Hiramatsu, RT, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
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Takaaki Ono, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Tosifumi Gabata, MD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

Arterial blood flow into the cranium induces fluctuation of water molecules, ie., indirect effect of blood flow, resulting in apparent diffusion coefficient (ADC)-change of the brain during the cardiac cycle (delta-ADC). However, delta-ADC includes the effect of intravoxel incoherent motion which is mainly caused by perfusion, ie., direct effect of blood flow. Therefore, we assessed the effect of blood flow on delta-ADC using an original cranial MRI-phantom to clarify this mechanism.

METHOD AND MATERIALS

On a 3.0-T MRI, we obtained sagittal diffusion weighted images of the cranial phantom using electrocardiographically (ECG)-triggered single-shot diffusion echo-planar imaging (EPI) with multiple b-values (b=0, 50, 200, 500, and 1000 s/mm²), as simulated total cerebral blood flow (500, 758, 1000, 1250, 1500 mL/s) was pumped into the phantom using a programmable pump. EPI was performed with sensitivity encoding and half-scan techniques to minimize the effect of bulk motion. Then, ADC images of 29 phases during the pulsation period were calculated in combination with b-values. Moreover, we determined delta-ADC in the high-density filter (brain tissue) of the cranial phantom. Finally, these values were compared with the regional simulated cerebral blood flow (rSCBF) obtained by pseudo-continuous arterial spin labeling technique.

RESULTS

Delta-ADCs in combination with very low b-values (eg., delta-ADC0-1000, delta-ADC50-1000) were significantly correlated with rSCBF, indicating the direct effect of blood flow on the delta-ADC. As the higher combination of b-values (eg., delta-ADC200-1000, delta-ADC500-1000), the correlation between delta-ADC and rSCBF became weaker, reducing the direct effect of the blood flow. However, the indirect effect still remained because ADC values change significantly in the pulsation period under these conditions.

CONCLUSION

Our original phantom enabled us to clarify the influence of blood flow on dynamic ADC change, and delta-ADC with higher b-value combination makes it possible to eliminate the direct effect of blood flow.

CLINICAL RELEVANCE/APPLICATION

Delta-ADC with optimized b-value combination makes it possible to obtain accurate functional information on the water-molecule fluctuation of the brain.
CONCLUSION

Q-SPECT/CT has a higher sensitivity, accuracy than Q-SPECT and can provide diagnostic accuracy similar to both CTPA and Q-SPECT/CTPA for PE diagnosis in rabbits. Using Q-SPECT/CT imaging, the diagnosis of two readers has the best consistency.

Background

To evaluate the diagnostic ability of Q-SPECT, CTPA, Q-SPECT/CT, and Q-SPECT/CTPA through establishing PE rabbit models whose final diagnosis was confirmed by pathology.

Evaluation

(1) The PE models were made by injecting Gelfoam into the femoral veins of rabbits. Q-SPECT, CTPA, Q-SPECT/CT and Q-SPECT/CTPA fusion images were obtained by integrated SPECT/CT. (2) All images were evaluated by consensus of two experienced nuclear medicine physicians who were blinded to pathologic findings. The locations and numbers of lung lobes with PE were recorded respectively. (3) Serial sectioning of the lungs was performed and pathologic determination of locations and numbers of lung lobes with PE were recorded. (4) Sensitivity, specificity, and accuracy were compared with the McNemar test; positive predictive value (PPV) and negative predictive value (NPV) were compared with the Pearson χ² test. Kappa analysis was used to determine the agreement between two nuclear medicine physicians. P values < 0.05 regarded as statistically significant.

Discussion

(1) Pathologic analysis revealed PE in 26 of 105 pulmonary lobes. (2) The sensitivity, specificity, accuracy, PPV, and NPV of four imaging methods: Q-SPECT was 53.9%, 93.7%, 83.8%, 73.7%, 86.1%; CTPA was 73.1%, 96.2%, 90.5%, 86.4%, 91.6%; Q-SPECT/CT was 76.9%, 93.7%, 89.5%, 80.0%, 92.5%; Q-SPECT/CTPA was 88.5%, 91.1%, 90.5%, 76.7%, 96.0%. (3) Q-SPECT/CT and Q-SPECT/CTPA had higher sensitivity for the detection of pulmonary embolism than Q-SPECT (P=0.031, 0.004), Q-SPECT/CT had higher accuracy than Q-SPECT (P=0.031).

(4) Kappa values of four imaging methods for readers 1 and 2 were 0.902, 0.915, 0.973, 0.884, respectively.

PH244-SD-TUAS Computerized Detection of Maxillary Sinusitis Using Contralateral Subtraction Technique

CONCLUSION

The proposed method could successfully locate maxillary sinus regions in images with variable positioning. The results indicate that it may be useful for drawing the attention of dentists to extraoral regions.

Background

Dental panoramic radiographs are routinely used in dental clinics for dental checkups, diagnosis and treatment. It not only visualizes the oral regions, but also pictures other sites such as mandibular joint and paranasal regions. Although radiologic information in perioral regions is beneficial, it is often ignored by dentists whose interests lie in oral regions. One such information possibly observed is radiopacity in paranasal sinus caused by maxillary sinusitis. Early detection and treatment of sinusitis are desirable for preventing its becoming chronic. Automated detection of the radiopacity regions can be useful in alerting dentists who are not focused on the perioral regions. Maxillary sinusitis due to dental caries and inappropriate treatment of dental root canal generally appears as unilateral abnormality. In this study, we developed a computerized scheme to detect it using the contralateral subtraction technique.

Evaluation

Our proposed method detects a small difference in radiopacity by subtraction of the original image from its flipped image and comparison of pixel values in regions of interest (ROIs) placed on the right and left maxillary sinuses. The ROIs are set based on the automated search of a hard palate and the average widths of tooth crowns. Preferably, dental panoramic radiographs are obtained with the Frankfort plane aligned horizontally. In order to manage the ROI setting in images with inappropriate positioning, the ROI locations are individually adjusted on the basis of the relationship between the reference line and the alveolar line. The proposed method was evaluated with two databases of 59 and 39 images including 19 cases each of maxillary sinusitis.

Discussion

Based on the visual assessment, the ROI localization was successful in more than 90% of the cases in both databases. By the receiver operating characteristic (ROC) analysis, the areas under the ROC curves for the sinusitis detection were 0.86 and 0.82 for the two databases.
PH245-SD-TUA6

Is CT Attenuation Correction Needed, How It Should be Performed, and Does it Affect Localization of Epileptic Focus in [99mTc]HM-PAO Brain SPECT?

Station #6

Participants

Martti Palonen, MSc, Helsinki, Finland (Presenter) Nothing to Disclose
Toni Halainen, Helsinki, Finland (Abstract Co-Author) Nothing to Disclose
Antti Loimaa, Helsinki, Finland (Abstract Co-Author) Nothing to Disclose
Outi Sipila, DSc, Helsinki, Finland (Abstract Co-Author) Nothing to Disclose

CONCLUSION

Differences were observed between different attenuation correction methods. Their clinical significance should be further evaluated.

Background

Epilepsy patients with unknown ictal-onset zone are continuously monitored in a video-EEG suite. 64 electrodes register brain’s electrical activity. [99mTc]HM-PAO injection is delivered when EEG reveals an epileptic seizure, followed by ictal SPECT-CT. Interictal SPECT-CT is executed when there are no seizures. Due to practical issues, SPECT-CT is done with or without the electrodes. A subtraction image of these two SPECT data may reveal the area of abnormal perfusion (epileptic focus). Brain tissues and metallic electrodes cause attenuation of gamma photons. Attenuation can be corrected with CT or Chang method, which assumes homogenous material inside manually defined elliptic volume. Both methods are in clinical use. We evaluated whether the different attenuation correction methods resulted in equivalent epileptic foci and how the presence of electrodes affected both methods.

Evaluation

9 epilepsy patients were included into the study; 3 patients had electrodes in ictal and interictal SPECT, 3 only in ictal SPECT and 3 in neither acquisition. SPECT data were reconstructed using CT and Chang attenuation correction methods. Interictal and ictal SPECT were normalized. Subtraction images were calculated from the coregistered interictal and ictal SPECT, and compared. In the preliminary evaluation, these two methods gave different results. To evaluate the effect of the combination of electrodes and CT automatic tube current modulation (TCM) on doses, we measured them in various locations in the brain with MOSFET dosimeters. Brain scans of a pediatric anthropomorphic phantom were performed with TCM on and off, with and without the electrodes. Use of TCM increased the dose by 9% when the electrodes were attached, and decreased it by 8% when they were not attached.

Discussion

Even though subtraction images showed different foci, the areas of greatest perfusion differences were equal. Using TCM did not substantially affect the patient dose. As the electrodes occasionally disturbed this function, we de-activated it in the protocol.

PH246-SD-TUA7

Redefining the Lower Statistical Limit in X-ray Phase-contrast Imaging

Station #7

Participants

Mathias Marschner, Garching, Germany (Presenter) Nothing to Disclose
Lorenz Bimbacher, DIPLPHYS, Garching, Germany (Abstract Co-Author) Nothing to Disclose
Marian Willner, Munich, Germany (Abstract Co-Author) Nothing to Disclose
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Peter B. Noel, PhD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Franz Pfeiffer, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

X-ray grating-based phase-contrast computed tomography (gbPC-CT) is currently investigated and developed as a potentially very interesting extension of conventional CT, because it provides high soft-tissue contrast for weakly absorbing samples. A major obstacle towards mainstream application of this technique is that phase retrieval fails for scans with very low dose when using the traditional phase stepping approach. We show that this lower statistical limit can be redefined by using a novel measurement procedure, which allows phase retrieval even in cases with low dose levels. This procedure relies on a linear approximation of the sinusoidal phase stepping curve around the zero crossings instead of sampling the stepping curve completely.

METHOD AND MATERIALS

A Talbot-Lau interferometer consisting of a laboratory X-ray source, three X-ray gratings and a photon counting detector is used to carry out several tomographic scans of biological soft-tissue with varying exposure times. We use this experimental data as well as simulations to compare the results of the linear approximation with the prevalent phase-stepping technique. We also examine the statistical properties of this novel method with regard to the ability to retrieve the phase information at very low photon counts.

RESULTS

We find that the linear approximation gives comparable results to the prevalent phase stepping method for scans of biological soft tissue with high statistics. For low statistics, the linear approximation is superior in the sense that the differential phase signal can be retrieved even with very low photon counts and statistical phase wrapping can be avoided. We demonstrate that this results in an improved image quality in the tomographic reconstructions, which is visible through better feature recognition and a significantly reduced noise level.

CONCLUSION

Our results show that it is possible to obtain good image quality in gbPC-CT using the linear approximation method even with very low photon counts, where the normal phase retrieval breaks down completely. Consequently, this method makes low dose gbPC-CT scans feasible, which was previously deemed impossible.

CLINICAL RELEVANCE/APPLICATION
PH247-SD-TUA8  Interventional Fluoroscopy: KAP and Scatter Reduction Using Eye Controlled Regional Attenuation

Participants
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George Dangas, MD, PhD, New York, NY (Abstract Co-Author) control rad
Haim Melman, Kfar Saba, Israel (Abstract Co-Author) Officer, ControlRad Systems, Inc

CONCLUSION
ECR measurably reduced both KAP and operator exposure by approximately 75% relative to control levels in an interventional radiology animal model without substantially increasing either fluoroscopic or procedure times. Less scatter, produced when ECR is engaged, improved subjective image quality in the ROI.

Background
This paper reports the first dose reduction results obtained using a novel technology (ControlRad Systems) called Eye Controlled Region of Interest (ECR). Its collimator includes a partially X-ray attenuating plate with a non-attenuating aperture. An eye tracker automatically positions the aperture anywhere in the active FOV of the image receptor in real time. Image processing software adjusts brightness and contrast in the aperture and peripheral region.

Evaluation
We measured the effect of applying ECR on ‘patient’ and operator irradiation while performing fluoroscopically guided stent placements in a 50 kg animal model. Experiments were performed using a mobile fluoroscope with a 30 cm image intensifier and fixed X-ray techniques. The factory collimator, operator’s monitor, and image processing software were replaced for this study. Subject irradiation was determined by physical KAP measurements. Operator irradiation was characterized by dose and dose-rate measurements near the operator. Data were collected from three pairs of interventions in each of five subjects. The full 30 cm FOV of the image intensifier was irradiated when ECR was disengaged. When ECR was engaged: Overall fluoroscopy time was increased by 4% (sd 20%), and procedure time by 14% (sd 35%), KAP was reduced by 78% (sd 5%) and operator irradiation by 70% (sd 8%).

Discussion
Measured KAP reduction corresponds to calculations based on 100% irradiation in the aperture and 10-20 % irradiation in the remainder of the 30 cm FOV. The small difference between KAP and operator reduction can be modeled by differences in self-absorption by the subject as the aperture is moved around the FOV. Reducing beam intensity outside of the region of interest reduces the total amount of scatter inside the ROI and thus increases subject contrast within the ROI.

PH248-SD-TUA9  Functional Network Identification in Resting-State Functional MRI Data Using Reduced Dimension Granger Causality

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PURPOSE
To explore the effect of dimension reduction on functional network identification in resting-state functional MRI (rsfMRI) using a reduced dimension Granger Causality (rdGC) analysis approach, and to compare it with conventional multivariate Granger Causality (cmGC) analysis.

METHOD AND MATERIALS
Resting-state fMRI scans through the motor cortex in 4 healthy subjects were acquired (1.5T, EPI-BOLD sequence, TR=0.5s, TE=40ms, 512 acquisitions). A finger tapping motor stimulation task sequence was used to localize the motor cortex (localization aid). Data was motion corrected and detrended. Both rdGC and cmGC were used for functional network identification in rsfMRI. Both approaches do not group voxels in similar anatomical regions; hence the influence of individual voxel time series on every other voxel can be obtained in a multivariate sense. However, they differ in how the influence is obtained. Influence scores in rdGC are obtained using the first N principal components of the time series ensemble, while the cmGC coefficients are obtained from the full time series ensemble without prior dimension reduction. These coefficients form a network whose underlying structure was recovered using spectral clustering. The recovered motor cortex network was quantitatively compared with the localization aid using both Dice Coefficient (DC) and Area under Receiver Operator Characteristic Curve (AUC).

RESULTS
The motor cortex network recovered using rdGC for N=5 (DC=0.50±0.03, AUC=0.79±0.06) and for N=10 (DC=0.53±0.03, AUC=0.80±0.04) components was in close agreement with the localization aid. In contrast, cmGC (DC=0.26±0.029, AUC=0.61±0.034) fails to recover the network, because the fMRI time series are not long enough to provide reliable estimation of network parameters, as prior dimension reduction is not applied to reduce system complexity.

CONCLUSION
The rdGC approach can identify the motor cortex network structure from rsfMRI time series, while cmGC fails to do so. Our findings suggest that rdGC is a powerful method for enabling multivariate Granger causality analysis, where cmGC would require much longer time-series to achieve a comparable performance on functional connectivity analysis in brain networks.
CONCLUSION

A validated empirical model can be established to inform clinical personnel on the distribution of scattered radiation prior to an X-Ray scan. By giving feedback to clinical personnel on the distribution of scattered radiation for an intraoperative X-Ray scan, the position in the intervention room can be chosen accordingly. Hence the dose from scattered radiation to clinical personnel can be reduced significantly.

Background

Clinical personnel working in an intervention room using an intraoperative X-Ray scanners are repeatedly subject to scattered radiation. The accumulated dose can be reduced if, during the scan, a position is chosen in the intervention room where the dose rate is low.

Evaluation

The scattered radiation is measured for typical X-Ray screenings in an intervention room, and a model is created to estimate dose distribution for a range of screening types. The measurements are performed in an experimental intervention room where an "Artis Zeego" scans the Human Whole Body Phantom Type "SET UP-02T". The scattered radiation is measured at various radii and angles from the X-Ray focal point using 24 digital RaySafe i2 Dosimeter. As coordinate system, polar coordinates are used with the longitudinal axis passing vertically through the X-Ray focal point, and the origin on the floor is used. The standard resolution is $5^\circ \times 0.05m \times 0.2m$ (circular x horizontal distance x vertical distance) and the range is $360^\circ \times 2m \times 2m$. For regions of interest the resolution is increased to $1^\circ \times 0.01m \times 0.05m$.

Discussion

The scattered radiation is dependent on the focus of the X-Ray on the patient and the type of screening. Especially dose distribution in the angular dimension has a high variability: A variation of up to 36% of the exposed dose has been measured. The measurement also showed an increase in dose dependent on the height. For a given height, the dose increased, the further away the dosimeter was positioned. Thus, to protect the eyes, it may be better to stand closer to the table, assuming a full lead apron is worn.

CONCLUSION

Baseline thermometry and reference-less thermometry produced similar results in this stationary phantom experiment. The measurements with thermocouples prove these two methods as reliable. As a next step, a moving phantom needs to be used to compare the results. Maximum temperature versus time graphs needs to be provided in the GUI for the surgeon to apply the sonication up to a certain threshold level and sonication should be stopped automatically when this temperature is achieved.

FIGURE (OPTIONAL)


Background

Thermometry methods are utilized to monitor the temperature within the patient during MRgFUS treatment. MR imaging allows thermal mapping. Temperature mapping using the Proton Resonance Frequency (PRF) shift is based on the measurement of the phase differences due to the temperature changes in the resonance frequency. Baseline and referenceless thermometry are common methods to measure temperature. For effective tumour ablation, it is crucial to monitor temperature in real time and to achieve a level of 57-60°C.

Evaluation

In house code written in C++ with reference-less temperature mapping and RTHawk Software (HeartVista Inc., CA, USA) using baseline imaging methodology were used to monitor the temperature. MR imaging was performed on a tissue-mimicking phantom gel using a 1.5T scanner (Signa, HDx, GE Medical Systems, WI, USA). A cardiac coil was used for image acquisition. Axial scans of the phantom and coronal scans of the transducer were loaded on MevisLab software (MevisLab, Germany) to define the co-ordinates of the sonication area. The sonications were performed through the control PC (CPC), with power of 600 J and 1000 J for 20 s. Colour overlapping was used to show the heated area. Fibre optical thermocouples (FOTEMP-4, OPTOCON, Germany) were used as a validation tool to measure the increase in the sonicated region.

Discussion

Temperature measurement with MRI is within the temperature range by the thermocouples. The difference between the measured
temperature by using the baseline and by using reference-les thermometry was less than 1°C. Temperature difference by thermocouples and the MR was less than 2°C. This was due to difficulties in sonicating near to the thermocouples due to practical limitations.
PURPOSE
Cardiac cine Magnetic Resonance (MR) is generally accepted as the gold standard for left ventricular (LV) volume assessment. Recently, Real-Time (RT) cine with sparse sampling technique and iterative reconstruction has been applied to accelerate cine MR. However, in prospective RT cine MR, it may be difficult to capture the true end diastole phase because of the finite time needed to detect the next ECG trigger, which may lead to underestimation of end diastolic volume (EDV), stroke volume (SV), and ejection fraction (EF) when compared with retrospective standard cine MR. We propose an alternative approach to overcome this limitation, by acquiring RT cine data over two heart beats, to capture the complete end diastole between the first and second heart beats. The purpose of this study was to evaluate the diagnostic quality and accuracy of RT-based single-breath-hold cine MR for the quantification of LV function compared with standard multi-breath-hold cine MR.

METHOD AND MATERIALS
Fifty participants (15 healthy volunteers and 35 patients with different LV pathologies) underwent both RT and standard cine MR for the assessment of LV function on 3 Tesla MRI scanner. The cine images (temporal/spatial resolution: 41 ms/1.7x1.7x6 mm3) were obtained in 8 contiguous short axis slices spanning the entire LV. The image quality, EF, EDV, end systolic volume (ESV), SV, and LV mass for RT cine and standard cine were compared.

RESULTS
All RT cine showed acceptable diagnostic image quality. Standard and RT cine showed good agreement: EF (60.3±10.2% vs. 60.2±9.8%; R2=0.89; p=0.78); EDV (132.0±36.6 ml vs. 131.1±35.9 ml; R2=0.94; p=0.44); ESV (54.6±27.2 ml vs. 54.1±25.6 ml; R2=0.95; p=0.53); SV (77.4±16.0 ml vs. 77.0±16.3 ml; R2=0.84; p=0.67); LV mass (87.1±33.7 ml vs. 85.8±33.9 ml; R2=0.97; p=0.15), respectively. The intra- and inter-observer agreement for all parameters was good.

CONCLUSION
The sparse RT cine MR evaluates LV function and volumes with excellent accuracy. The single-breath-hold sparse RT cine MR has the potential to replace the multi-breath-hold standard cine MR.

CLINICAL RELEVANCE/APPLICATION
RT cine MR is expected to reduce motion artifacts in severely ill patients who cannot hold their breath for an extended amount of time, to increase spatial and/or temporal resolution, or simply to shorten the CMR examination.

PARTICIPANTS
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SUB-EVENTS
**CA231-SD-TUB1** Single Breath-Hold Real-time Cardiac Cine MR for Evaluation of Left Ventricular Function, Volumes, and Mass

Station #1

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**CA232-SD-TUB2** Differentiation of Lipid-rich Plaques from Fibrous Plaques using Effective Atomic Number Obtained by Electrocardiography-gated Single-source Dual-energy Coronary Computed Tomography with Fast kVp Switching

Station #2

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PURPOSE

Electrocardiography (ECG)-gated single-source dual-energy coronary computed tomography (CCT) with fast kVp switching (DECT) can provide the effective atomic number (EAN) of noncalcified coronary plaques, which allows more accurate differentiation between lipid-rich and fibrous plaques than use of the CT attenuation value (CT#) obtained by standard CCT. The purpose of this study was to compare EAN and CT# obtained by DECT for accurate differentiation between lipid-rich and fibrous plaques defined by intravascular ultrasound (IVUS) as a reference.

METHOD AND MATERIALS

From October 2013 through November 2014, 5 patients underwent both IVUS and DECT. Based on IVUS, 2 experienced cardiologists classified noncalcified coronary plaques as lipid-rich or fibrous. On DECT reconstructed with the minimal field of view (5 x 5 cm²), regions of interest were placed to measure the EAN and CT# within each plaque at 70 kV. We used unpaired t-test to compare the median and mode EAN and CT# between lipid-rich and fibrous plaques and receiver operating characteristics analysis to compare the area under the curve (AUC) between the median and mode EAN and corresponding CT# to differentiate the plaque types.

RESULTS

By IVUS, we identified 19 noncalcified coronary plaques (10 lipid-rich, 9 fibrous). The median (8.27 ± 0.79) and mode (8.12 ± 0.86) EANs of lipid-rich plaques were significantly lower than those of fibrous plaques (median, 10.03 ± 0.74; mode, 9.95 ± 0.79) (P = 0.0001 and 0.0002). The median (40.9 ± 31.2) and mode (29.0 ± 33.1) CT#s of lipid-rich plaques were significantly lower than those of fibrous plaques (median, 144.7 ± 77.6; mode, 133.2 ± 93.4) (P = 0.0011 and 0.0041). The overlap between the 2 plaque types was smaller with the EANs than with the corresponding CT#. The AUC (Az) was higher with the median (0.97) and mode (0.96) EANs than with the corresponding CT#s (median, 0.92; mode, 0.87).

CONCLUSION

The EAN obtained by DECT was significantly lower for lipid-rich than fibrous plaques, and its use can improve accuracy for differentiating lipid-rich from fibrous plaques.

CLINICAL RELEVANCE/APPLICATION

EAN by DECT allows more accurate differentiation between lipid-rich and fibrous plaques and detection of high risk plaques for acute coronary syndrome than CT attenuation value by conventional CCT.

CA233-SD-TUB3

Myocardial Extracellular Volume Fraction Quantified using Dual-energy Cardiac CT Correlates with the Defect Score Obtained using Nuclear Myocardial Perfusion Imaging

Station #3

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PURPOSE

The myocardial extracellular volume fraction (ECV) quantified using cardiac magnetic resonance imaging (MRI) is useful for the assessment of myocardial fibrosis. Recently, the ECV quantified using computed tomography (CT) has been reported to be comparable to that quantified using MRI. However, no report has described the ECV quantified using dual-energy CT (DECT). This study aimed to evaluate the feasibility of using DECT to quantify the ECV, and to compare the results with the extent and severity of infarctions determined using single-photon emission computed tomography myocardial perfusion imaging (SPECT-MPI).

METHOD AND MATERIALS

We performed delayed iodine enhancement (DIE) scan with DECT and SPECT-MPI in 20 participants (13 patients with old MI and 7 normal participants without MI and with preserved left ventricular ejection fraction). The DIE scan was performed in dual-energy mode with tube voltages of 100 and 80 kV. Using iodine maps generated with the DIE scan, the ECV was determined. The ECV was calculated as follows: ECV = (CM_myocardium/CM_blood) × (1 - hematocrit), where CM is the mean value on the iodine maps generated via 3-material decomposition. SPECT images were evaluated using the visual defect scores (DS) of rest imaging with a 5-point scoring system (0 [normal] to 4 [severe defect]), and a score of 1, 2, 3, or 4 was considered "abnormal." The ECV and DS were estimated according to a 16-segment model based on the 17-segment model proposed by the American Heart Association, with the exclusion of the apical segment.

RESULTS

The mean ECV was significantly higher in the abnormal segments of patients with MI (72 segments, 38.9±10.3%) than in the normal segments of patients with MI (136 segments, 31.9±8.5%; P<0.001) and in all segments of participants without MI (112 segments, 29.8±3.4%; P<0.001). In all 20 patients, there were significant correlations between the mean ECV quantified using DECT and the summed DS obtained using SPECT-MPI (r=0.49, P<0.05).
CONCLUSION
The ECV quantified using DECT significantly correlated with the DS obtained using SPECT-MPI, suggesting that DECT may clarify myocardial tissue characterization.

CLINICAL RELEVANCE/APPLICATION
The ECV quantified using iodine maps generated with DECT has the potential to be used for myocardial tissue characterization in patients with and without old MI.

CA234-SD-TUB4
Discrepancy between Invasive Fractional Flow Reserve and Stress Perfusion CMR: Functionally Significant Coronary Stenosis versus Myocardial Ischemia
Station #4

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PURPOSE
To compare the results between invasive fractional flow reserve (FFR) and stress perfusion cardiovascular magnetic resonance (CMR) imaging and to evaluate characteristics of stenotic lesion which cause discrepancy between two imaging modalities.

METHOD AND MATERIALS
We reviewed our prospective data registry of patients who underwent stress perfusion CT and CMR. They also underwent subsequent invasive coronary angiography with optional FFR depending on physician’s decision. Among them, 53 patients who underwent FFR were included in this study. We compared the values of invasive FFR with territorial perfusion state of stress perfusion CMR (presence or absence of perfusion defects). Quantitative CT measurements of stenotic lesions were performed by using dedicated software. The CT indexes evaluated included the following: plaque morphology, plaque burden, calcification severity, lesion length, minimal luminal area, minimal luminal diameter, diameter stenosis, area of stenosis. We evaluate characteristics of stenotic lesion which cause discrepancy between two imaging modalities. The stenotic lesion with an FFR of 0.8 or less was considered as functionally significant stenosis.

RESULTS
Seventy-five coronary lesions of 53 patients were evaluated. Forty-two coronary lesions (56%) of all 75 lesions had functionally significant stenosis with an FFR of 0.8 or less. Of 42 significant stenoses, 22 lesions (FFR, 0.58 ± 0.13) had matching perfusion defects on stress CMR and 20 lesions (FFR, 0.66 ± 0.14) had no perfusion defects. In the comparison of quantitative CT parameters between perfusion matching and mismatching groups, diameter stenosis, area stenosis, and plaque burden showed significant differences (p = 0.03, p = 0.01, p < 0.01, respectively).

CONCLUSION
Twenty lesions (48%) of 42 functionally significant stenoses did not induce myocardial ischemia. Beside FFR values, diameter stenosis, area stenosis, and plaque burden may affect developing myocardial ischemia.

CLINICAL RELEVANCE/APPLICATION
Functionally significant stenoses with an FFR of 0.8 or less do not always induce myocardial ischemia. Quantitative CT parameters may be also considered in selecting functionally significant coronary stenosis.

CA235-SD-TUB5
Prognostic Significance of MR-tomographic Parameters in Patients with Reperfused ST-elevation Myocardial Infarction and Involvement of Papillary Muscle
Station #5

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PURPOSE
To evaluate the prevalence and size of papillary muscle infarction and its possible effects on global heart function and survival of patients with acute myocardial infarction (AMI) by magnetic resonance imaging (MRI) data and clinical outcome in the course of 5 years.

METHOD AND MATERIALS
Haemodynamic stable patients (n=89) with ST-segment elevation myocardial infarction and successful reperfusion by primary angioplasty (within 3,09±5,77 hours after symptoms onset) were enrolled in this study. Cardiac MRI was performed at baseline (9±4 days after infarction) and at 4-month follow-up (mfu). For all patients clinical 5-year follow-up was completed and adjudicated on major adverse cardiac events (MACE) endpoint.
RESULTS
Prevalence of PapMI was 16.9% (n=15); 20% anterior, 60% posterior, 20% both. PapMI appeared more frequently in occlusion of LCx and RCA (p<0.05). Ejection fraction (EF) at baseline was lower in patients with PapMI than without (44.31% vs 48.39%). Recovery at 4-mfu was better in patients with PapMI (ΔEF 2.09% vs 3.74%; Δventricular scaring -0.53% vs -2.47%;p>0.05). Ventricular scaring was largest in infarction of both muscles (39.66%;p>0.1). EF recovery at 4-mfu was best with infarction of both muscles (13.33%;p>0.1). For cumulative population (n=89) there was strong negative correlation between EF and ventricular scaring at baseline (r=-0.65; p=0.001). At 5-year follow-up 12.4% of patients experienced MACE. At 4-mfu EF in patients with MACE was reduced compared to baseline (-1.23% versus +2.87 without MACE; p=0.091) while ventricular scaring increased significantly (+1.45% versus -1.18% without MACE;p=0.017).

CONCLUSION
The extent of ventricular scaring influences the global heart function rather than the presence of PapMI. At 5-year follow-up PapMI is not a predictor, but rather a side effect of ischemic cardiac disease without affecting directly long-term survival and heart function of patients with AMI.

CLINICAL RELEVANCE/APPLICATION
The PapMI is not a predictor of a negative cardiac event after a 5-year follow-up. A PapMI should be understood as a side effect of ischemic heart disease being present on the vascular anatomy and the closing level of the coronary vessel without direct influence on survival alone.

CA236-SD- TUB6  Congenital Bicuspid Aortic Valve in Pediatric and Early Adulthood: Does Valvular Leaflet Fusion Pattern Affect Other Parameters?

Participants
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PURPOSE
Our aim was to detect if there is a relationship between the leaflet fusion pattern and other functional parameters including valvular regurgite, stenosis and pressure gradient as well as associated findings.

METHOD AND MATERIALS
One hundred patients between 3 months to 26 years were included in the study. They were 78 males and 22 females. BSA for the patients ranged from 0.45-2.27. All patients were subjected to clinical examination, transthoracic echocardiography and CMR on a 1.5T machine. Written consents were taken from the patients or their guardians. CMR protocol included 2 chamber, 4 chamber, short axis, LVOT, Q flow on the aortic valve, MRA on the aorta and delayed enhancement was done in cases suspicious of associated myocardial pathology. We recorded the leaflet fusion pattern, presence of AS, AR, pressure gradient, EF, LVEDV, aortic diameter at the annulus, sinus, arch and ascending aorta levels. Associated findings were all recorded.

RESULTS
Sixty patients had right and left coronary cusps (R-L) fusion showing mean pressure gradient of 23.5±14.8 of those 48% patients showed AS while 52% had AR. Forty patients had right and noncoronary cusps (R-N) fusion with 44.5±31 pressure gradient with P = 0.02, of those 75% had AS while 45% had AR with 20% showing combined lesions. Ejection fraction was within normal range except in patients with associated myocardial lesions. LVEDV ranged from 49-185ml. Aorta was dilated in 38 cases with no predilection for any leaflet fusion type. Associated co-aorctation of the aorta was detected in 22 patients of which 18 had R-L fusion. Other associations were PDA (8 cases), VSD (8 cases), hypoplastic aortic arch (6 cases), DCM and DORV (2 cases each).

CONCLUSION
Our study showed that patients with R-L leaflet fusion had lower pressure gradient and a higher association with co-aorctation of the aorta, while patients with R-N leaflet fusion had higher pressure gradient with higher incidence of aortic stenosis.

CLINICAL RELEVANCE/APPLICATION
Knowing if the pattern of valve leaflet fusion in BAV is important for patient management plan and treatment specially in pediatric age group.

CA114-ED- TUB8  Embryological Approach for Understanding Pulmonary Venous Developmental Anomalies

Participants
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TEACHING POINTS
The purpose of this exhibit is: 1. To learn embryology of pulmonary veins and normal pulmonary venous anatomy 2. To review cardiac CT imaging of pulmonary venous developmental anomalies 3. To learn important findings that should not be missed

TABLE OF CONTENTS/OUTLINE
Contents: 1. Illustrated description of embryonic development of pulmonary veins 2. Cardiac CT imaging of numerous pulmonary venous developmental anomalies, including total anomalous pulmonary venous connection (TAPVC) type Ia, Ib, Ia, IIa, III, IV, partial anomalous pulmonary venous connection (PAPVC), scimitar syndrome, veno-venous bridge, cor triatriatum, in comparison with embryonic development of pulmonary veins 3. Clinical important findings have to be depicted Summary: Cardiac CT is frequently performed for patients who present with suspected congenital heart disease because it is mandatory to describe precise anatomical information and to identify the underlying abnormalities for cardiovascular surgeons. Abnormal embryonic pulmonary vein...
Development may comprise a wide spectrum of anatomical variations and show various clinical presentations. We will let you understand various types of pulmonary venous developmental anomalies using embryological approach.
**Useful CT Findings in the Differentiation between Autoimmune Pancreatitis and Pancreatic Cancer: Comparison of Diagnostic Performance Between Small and Large Lesions**

**PURPOSE**
To investigate the diagnostic performance of CT findings both in small and large lesions.

**METHOD AND MATERIALS**
82 lesions of autoimmune pancreatitis (AIP) in 67 patients and 68 lesions of pancreatic cancer (PC) were selected and classified into 2 groups based on size (small group, ≤ 40 mm; large group, > 40 mm, respectively). The frequency of patchy enhancement area (PEA), capsule-like rim (CLR), homogenous delayed enhancement (HDE), duct-penetrating sign (DPS), enhanced duct sign (EDS) and no main pancreatic duct upstream dilatation (NMPDD), was compared between AIP and PC, and calculated sensitivity, specificity and accuracy.

**RESULTS**
The frequency of PEA, CLR, HDE, and NMPDD was significantly higher in AIP than that in PC independently of lesion size. Accuracy of each finding in the small/large groups were as follows: PEA, 87.8%/95.0%; CPL, 73.3%/68.3%; HDE, 85.6%/91.7%; DPS, 70.0%/30%; EDS, 67.8%/19.0%; NMPDD, 78.9%/95.0%, respectively. Accuracy of PEA, HDE and NMPDD was over 85% independently of lesion size. Accuracy of the combined three findings in the small and large group was 95.6% and 86.7%, respectively.

**CONCLUSION**
PEA, HDE, and NMPDD were useful CT findings for the differentiation both in small and large lesions. In small lesions, combination of the three findings improved accuracy.

**CLINICAL RELEVANCE/APPLICATION**
Radiologists need to know which is the useful finding for differentiating small autoimmune pancreatitis from small pancreatic cancer to eliminate unnecessary surgical resection.

**Quantitative Differential Enhancement Patterns on Dynamic and Hepatobiliary Phase MRI can Discriminate Hepatocellular Adenoma Genotypic Subtypes**

**PURPOSE**
To determine if quantitative contrast-enhanced MR imaging features can discriminate histologically-proven hepatocellular adenoma (HCA) genotypic subtypes.

**METHOD AND MATERIALS**
In this IRB and HIPAA compliant study, we reviewed MR imaging of 49 histologically-proven HCAs from 21 consecutive patients. Quantitative features included the measured lesion-to-liver signal intensity (SI) ratio on the pre-contrast (PC), arterial (art.), portal...
venous (PV), and hepatobiliary (HB) phases. A pathologist reviewed HCA tissues stained with genotypic subtype-specific markers. Imaging data were correlated with pathology findings and compared using student’s t-tests, with two-sided P values<0.017 considered for statistical significance. Data are presented as mean±standard deviation.

RESULTS

49 HCAs were classified into 14 inflammatory (inf.; 9 patients; age 41±13), 21 hepatocyte nuclear factor-1A-mutated (HNF1A; 6; 40±10), 1 β-catenin-activated (BCA; 1; 25), and 14 unclassified lesions (UC; 5; 39±12). Inf. lesions demonstrated a lesion-to-liver SI ratio of 0.95±0.15 (PC), 1.29±0.16 (art.), 1.13±0.10 (PV), and 0.73±0.18 (HB). SI ratios of HNF1A lesions were 0.80±0.17 (PC), 1.10±0.24 (art.), 0.80±0.17 (PV), and 0.47±0.18 (HB). SI ratios of the BCA lesion were 0.71 (PC), 0.89 (art.), 0.88 (PV), and 0.82 (HB). SI ratios of UC lesions demonstrated the least gain in SI ratio (0.15±0.19), compared to 0.33±0.10 (inf.; p=0.005), 0.31±0.19 (HNF1A; p=0.027), and 0.18 (BCA). Between the art. and PV phases, HNF1A lesions lost the most SI (-0.30±0.12), compared to -0.15±0.21 (inf.; p=0.01), -0.31±0.19 (UC; p=0.20), and -0.01 (BCA). Between PV and HB phases, inf. lesions lost the most SI (-0.56±0.35), compared to -0.26±0.08 (HNF1A; p=0.002), -0.40±0.25 (UC; p=0.4), and -0.05 (BCA).

CONCLUSION

HCA subtypes demonstrate phase-specific MRI features, and both their measured lesion-to-liver SI ratio and differential enhancement patterns may help noninvasively discriminate subtypes.

CLINICAL RELEVANCE/APPLICATION

Quantitative MRI may help noninvasively subtype HCAs and determine if patients should undergo imaging surveillance or surgery based on the HCA subtype.

Participants

Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Presenter) Nothing to Disclose
Ahmad Hagar, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Emmanuel C. Mbalisike, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Stefan Zangos, MD, Frankfurt Am Main, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate ablated region volume decrease, progression time, recurrence rates and survival rates in patients with hepatocellular carcinoma (HCC) microwave ablation (MWA) comparing low frequency system (LF-MWA) (Covidien™ (Tyco, Colorado, USA; 915 MHz) vs. high frequency system (HF-MWA) (AMICA™, Aprilia, Italy; 2450 MHz).

METHOD AND MATERIALS

From September 2008 to July 2013 data for this retrospective study were collected in 54 patients (41 males and 13 females) with 76 ablation sessions. In 23 patients (37 ablations) LF-MWA was performed, in 31 patients (39 ablations) HF-MWA. MRI was performed 24 hours after each therapy and at 3, 6, 12, 18 and 24 months post ablation. The two groups were compared with Fisher’s exact test. Survival rates were calculated from first ablation using Kaplan-Meier test. Ablated region volume decrease was measured by the Kruskal-Wallis method. Inclusion criteria were up to 5 HCC nodules of <5cm in size.

RESULTS

Volume decrease after 6 months (70.52%), 12 months (73.67%) and 18 months (72.37%) was higher with LF-MWA vs. HF-MWA (6 months: 58.22%; 12 months: 66.97%; 18 months: 82.86%) but no statistically significant differences were documented at 3 and 24 months post ablation. Also no statistically significant differences were measured in stable disease. Recurrence rates were seen in HF-MWA vs. LF-MWA at 24 (p=0.018) months. With HF-MWA 4 lesions (p=0.102) were recurrent, with LF-MWA 8 lesions (p=0.026). The progression rate was significantly lower with HF-MWA (p=0.128) vs. LF-MWA (p=0.216). Median time to progression was 6.75 months with LF-MWA vs. 5.6 months with HF-MWA. Regarding survival, no statistically significant differences were documented at 1-, 2-, 3- and 4- year survival rates, 2-year survival rate was 96.77% (30 of 31) for HF-MWA vs 91.3% (21 of 23) for LF-MWA, and 4-year survival rate was 87.09% (27 of 31) for HF-MWA vs 73.91% (17 of 23) for LF-MWA.

CONCLUSION

Both MWA generator systems are effective treatment methods for hepatocellular liver metastases with differences seen in ablated, recurrence rates and progression time. No difference was seen in volume decrease, stable response and survival rates between two different MWA systems.

CLINICAL RELEVANCE/APPLICATION

HF-MWA is superior to LF-MWA in patients with HCC

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 evaluate radiation dose and image noise in abdominal spectral CT imaging with manual and automatic gemstone spectral imaging(GSI) protocol selection as compared with conventional 120kVp CT.
METHOD AND MATERIALS

This study received institutional review board approval, and all participants provided written informed consent. 71 patients underwent abdominal dynamic enhanced CT scans were divided into three groups based on the scanning phases. In group A, plain CT scan was performed with the mode of 120 kVp and automatic exposure control technique. According to the mA table of scout view, corresponding GSI scan parameters were manually selected for arterial phase (group B). With GSI-assist on and given noise index, GSI parameters were automatically selected for portal venous phase (group C). 65 keV monochromatic images with 5mm slice thickness were reconstructed for GSI enhanced series. Image noise of liver, muscle and fat; volume CT dose index (CTDvol), effective dose (ED) were recorded and compared by the analysis of variance and bonferroni test among the three groups.

RESULTS

The CTDIvol and ED in group B (12.4mGy±5.2 and 8.2mSv±1.2) were lowest among the three groups (P=0.041,0.037). No significant differences in CTDIvol and ED were showed between group A (14.5mGy±7.3 and 9.8mSv±1.4) and group C (15.7mGy±7.9 and 10.4mSv±1.7) (both P>0.05). The image noise of liver (10.1HU±1.0), muscle (11.1HU±1.6) and fat (8.8HU±0.9) in group A were higher than those in group B (7.9HU±0.9, 8.4HU±1.2 and 6.4HU±0.8) and group C (6.8HU±0.7, 7.6HU±1.3 and 7.0HU±0.9) (all P<0.05). Image noise of liver, muscle and fat between group B and group C showed no significant difference (P>0.05).

CONCLUSION

The radiation dose of conventional 120kVp scan and spectral CT scan with GSI assist mode was approximately equivalent, and both higher than that of manual GSI selection mode. Monochromatic images (65keV) from spectral CT with GSI assist mode or manual mode had lower image noise than conventional 120kVp images.

CLINICAL RELEVANCE/APPLICATION

Spectral CT with GSI assist mode is equivalent to conventional 120kVp mode in radiation dose and can reduce image noise. This mode is recommended in clinical as its easy operation.

The feasibility study of low tube voltage combined with adaptive iterative dose reduction algorithm in 320-detector row CT

METHOD AND MATERIALS

50 patients with lung cancer or breast cancer underwent 320-detector row CT, tracking no less than 3 scans for each patient. The scan was focused on the arterial phase only. The voltages for arterial phase were 80kV (group A), 120kV (group B), 100kV (group C) respectively, and other phases were adopted 120kV. Images were processed using both filtered back-projection (FBP) reconstruction algorithm (group B) and adaptive iterative dose reduction 3D (AIDR 3D) algorithm (group A, group C). The image quality was blindly evaluated using a 5-score classification system by two experienced radiologists. Noise of hepatic parenchyma, pancreas, stomach, and left erector muscle were measured. CNR of the three groups was calculated and compared. Independent samples t test or Mann-Whitney U test was used to compare the image quality of liver, pancreas, and stomach; then, X² test were used to compare the radiation dose.

RESULTS

Compared with portal venous phase, the arterial phase mean effective radiation dose was 49.1% reduction in group A and 25.2% reduction in group C. There was no statistical difference in revealing rate of image quality scores and objective noise among the three groups (p>0.05). The noise of each organ of group B was higher than that of group A and group C. The CNR of liver and stomach among the three groups has no statistical difference (CNRhepA=1.52±0.94, CNRhepB=0.85±0.47, CNRhepC=1.20±1.21) (p>0.05), (CNRstaA=1.20±1.54, CNRstaB=0.68±0.41, CNRstaC=1.18±0.95) (p>0.05). But there was a trend that CNRhepA is higher than CNRhepB (p=0.053), and that CNRhepA is higher than CNRstaB (p=0.052). The CNR of pancreas of group B is lower than that of group A and C (CNRpanA= 3.13±1.65, CNRpanB= 1.19±0.58, CNRpanC= 2.33±1.32) (p<0.05).

CONCLUSION

Lowering tube voltage combined with AIDR 3D can reduce the effective radiation dose but maintain a comparable image quality to that using conventional reconstruction algorithm.

CLINICAL RELEVANCE/APPLICATION

Optimal voltage imaging can reduce the effective radiation dose without sacrificing the image quality and be a good choice for patient-care.

The effect of R2* on the success rate of 4 spin-echo-based MR elastography sequences at 3T in patients with liver disease

METHOD AND MATERIALS

Participants

Long Cui, MD, PhD, Shenyang, China (Presenter) Nothing to Disclose
Ke Ren, MD, Shenyang, China (Abstract Co-Author) Nothing to Disclose
Ke Xu, MD, Shenyang, China (Abstract Co-Author) Nothing to Disclose
Songbai Li, Shenyang, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

To investigate the influence of 320-detector row CT using low tube voltage and iterative reconstruction algorithm on image quality and radiation dose.

RESULTS

Compared with portal venous phase, the arterial phase mean effective radiation dose was 49.1% reduction in group A and 25.2% reduction in group C. There was no statistical difference in revealing rate of image quality scores and objective noise among the three groups (p>0.05). The noise of each organ of group B was higher than that of group A and group C. The CNR of liver and stomach among the three groups has no statistical difference (CNRhepA=1.52±0.94, CNRhepB=0.85±0.47, CNRhepC=1.20±1.21) (p>0.05), (CNRstaA=1.20±1.54, CNRstaB=0.68±0.41, CNRstaC=1.18±0.95) (p>0.05). But there was a trend that CNRhepA is higher than CNRhepB (p=0.053), and that CNRhepA is higher than CNRstaB (p=0.052). The CNR of pancreas of group B is lower than that of group A and C (CNRpanA= 3.13±1.65, CNRpanB= 1.19±0.58, CNRpanC= 2.33±1.32) (p<0.05).

CONCLUSION

Lowering tube voltage combined with AIDR 3D can reduce the effective radiation dose but maintain a comparable image quality to that using conventional reconstruction algorithm.

CLINICAL RELEVANCE/APPLICATION

Optimal voltage imaging can reduce the effective radiation dose without sacrificing the image quality and be a good choice for patient-care.
Complex Morbidity - Perianal Fistulae And Involvement Of External Genitalia: MR Imaging Findings And Significance Of Fistulogram

Station #8

Participants

Sridhar Devu, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Umamahesh Matapathi, MD, MBBS, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Preetham Pantrangam, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Kranthi K. Marathu, MBBS, Hyderabad, India (Presenter) Nothing to Disclose
Rajani Sharath, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Rallabandi Kumar, MBBS, Hyderabad, India (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

The intention of the exhibit: 1. To understand the anal sphincter and pelvic anatomy. 2. To describe the perianal tract(s) morphology including, tract’s course, relation to external and internal anal sphincters, extension into adjacent organs and internal opening into anal canal. 3. To evaluate the significance of MR fistulogram in preoperative delineation of perianal tracks. 4. To characterise the anterior extension of inflammatory changes and tracks into genitalia. 5. To establish a classification of perianal fistula involving genitalia and other anterior structures.

TABLE OF CONTENTS/OUTLINE

Normal MR pelvic anatomy
Anal Sphincter Mechanism
MR Imaging and Significance of Fistulogram
Anterior Extension in Males:
Involvement of Urinary bladder, Prostate, Seminal Vesicles, Root of scrotum and Root of Penis
Anterior Extension in Females:
Involvement of Urinary bladder, Cervix, Vagina and Labia Majora
Representative cases
New Classification system
Summary

Current Concepts in Molecular Genetics and Management Guidelines for Pancreatic Cystic Neoplasms: An Essential Update for Radiologists

Station #9

Awards
Certificate of Merit

Participants
Matthew H. Kulzer, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Anil K. Dasyam, MD, Pittsburgh, PA (Presenter) Nothing to Disclose
Alessandro Furlan, MD, Pittsburgh, PA (Abstract Co-Author) Author, Reed Elsevier; Research Grant, General Electric Company
Radiologically inserted gastrostomy (RIG) is a widely used method for providing nutritional support in the medium and long term in patients who cannot tolerate sufficient oral intake. Radiologists should be familiar with the possible complications that may be encountered and their appearances on cross-sectional imaging and fluoroscopy. Understand the normal fluoroscopic and cross-sectional appearances post RIG insertion. Be aware of the incidence, types and presentation of post RIG complications. Know the imaging appearance of post RIG complications including; Peritonitis and peri-RIG leak Trans-colonic insertion of gastrostomy Intraperitoneal displacement of gastrostomy.

TABLE OF CONTENTS/OUTLINE

Introduction; Indications for RIG insertion Types and incidence of complications Basic overview of the insertion technique Imaging appearances of Peri-RIG leak Imaging appearances of a trans-colonic RIG Intraperitoneal displacement of a RIG Gastric Haemorrhage Conclusion

Participants

David J. Vining, MD, Houston, TX (Presenter) Royalties, Bracco Group; CEO, VisionSR; Stockholder, VisionSR

TEACHING POINTS

Practitioners of virtual colonoscopy (VC) anticipate that the United States Preventative Services Task Force (USPSTF) will update its recommendations for colorectal cancer screening in favor of VC in 2015, thus heralding an increase in the number of exams being performed in the US. Attention to detail is essential for achieving optimal VC results. In the spirit of Atul Gawande’s The Checklist Manifesto, the use of a checklist to follow required steps while performing VC is beneficial for nurses, technologists, and radiologists.

TABLE OF CONTENTS/OUTLINE

Check the prep. Snug the plug. Opacify the water. Pass the gas. Distend the colon. Vent the patient. Drop the balloon. Verify distention and coverage.
LEARNING OBJECTIVES

1) Identify the utility of PET CT in staging a wide variety of primary and recurrent GI, GU, and gynecological cancers. 2) Differentiate patterns of physiological FDG uptake from pathologic processes. 3) Explain the importance of CT correlation for selected cancer subgroups. 4) Describe the role of PET CT in assessing patient response to radiation therapy and chemotherapy, including early assessment and PET influenced treatment strategies.
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.

Mitrval Annular Dimensions and Geometry in Normals and Patients with Mitral Regurgitation:
Implications for CT-based Sizing in Transcatheter Mitral Valve Implantation

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.
RESULTS

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 images (3D planimetry; 2.0 mm slice thickness, 20 contiguous slices; image matrix, 256 × 209) were acquired with single breath-hold 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

SS303-03 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

Hae Jin Kim, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Sung Mok Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Moon Young Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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 (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 receiver operating characteristic (ROC) curve were calculated. Intra- and interobserver agreements were determined by using intraclass correlation coefficient (ICC).
CONCLUSION

The clinical relevance of this study is that, among patients with aortic stenosis, patients with BAV showed more eccentric WSS and larger aortic diameter as compared to those with TAV. These findings support the validity of 3D planimetry at accurate assessment of the severity of aortic valve stenosis.

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 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=0.04) 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±4.7 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 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). Intra- and interobserver agreements for 3D planimetry were excellent [ICC = 0.949 (CI, 0.981-0.979) and 0.846 (CI, 0.636-0.935), respectively; both, p = 0.000].

CLINICAL RELEVANCE/APPLICATION

Our findings support the validity of 3D planimetry at accurate assessment of the severity of aortic valve stenosis.

SS303-04 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: SS02AB

Participants
Hojin Ha, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Dong Hyun Yang, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Guk Bae, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jihoon Kweon, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young-Hak 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
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 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=0.04) 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±4.7 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.

SS303-05 Multidetector-row Computed Tomography in Patients with Suspected Prosthetic Valve Dysfunction: A Prospective Study

Tuesday, Dec. 1 3:40PM - 3:50PM Location: SS02AB

Participants
Dominika Sucha, MD, Utrecht, Netherlands (Presenter) Nothing to Disclose
Steven Chamuleau, MD, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Petr Symersky, MD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Renee B. Van Den Brink, MD, PhD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Wilco Tanis, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Eduard M. Laufer, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Bas De Mol, MD, PhD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Willem P. Mali, MD, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Jesse Habets, MD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Lex Van Herwerden, Utrecht, Netherlands (Abstract Co-Author) Research Consultant, St. Jude Medical, Inc
Ricardo P. Budde, MD, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose

WSS may be used to predict future risk of aortic dilatation in patients with aortic stenosis.
**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.

**PURPOSE**

The purpose of this study was to identify pre-interventional factors by means of CT-Angiography, which could predetermine 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 × [prosthesis D - D_mean Annulus]/prosthesis D) and eccentricity indices (D_meanAnnulus - D_areaAnnulus and D_maxAnnulus - 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.
PURPOSE
To evaluate whether there is variation in precontrast and postcontrast myocardial T1 time (prT1 and poT1, respectively) and extracellular volume fraction (ECVF) according to left ventricular (LV) segments and to search for any correlation between them and known cardiovascular risk factors.

METHOD AND MATERIALS
This study included 198 asymptomatic subjects (180 men and 18 women, age 54.4 ± 6.12 years) who underwent cardiac MR imaging. Precontrast T1 mapping and postcontrast T1 mapping 15 minutes after 0.2 mmol gadobutrol injection were performed using shortened modified look-locker inversion recovery [ShMOLLI] sequence at 1.5T (Magnetom Avanto, Siemens). Short-axial cine MR imaging was performed with SSFP technique. T1 values and ECVFs were calculated in 16 AHA myocardial segments. Those values were compared among LV segments and correlated with presence of hypertension (n = 52), diabetes mellitus (DM, n = 15), or both (n = 17). ECVF was also correlated with LV mass.

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
The septal 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.

SSJ04-03 3D-Dixon MRI Based Volumetry of Peri- and Epicardial Fat

Tuesday, Dec. 1 3:20PM - 3:30PM Location: SS04AB

Participants
Rami Homsi, Bonn, Germany (Presenter) Nothing to Disclose
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Hans H. Schild, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Daniel K. Thomas, MD, PhD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Alois Martin Sprinkart, MSc, Bonn, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
There is growing evidence that pericardial and epicardial fat volume (PFV, EFV) are associated with cardiovascular risk. The aim of this study was to develop a novel approach to accurately measure PFV and EFV using a 3D-Dixon based MRI approach.

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-volumes for PFV and EFV. Inter-reader agreement was good with a mean difference of 0.2±5.6ml and 4.5±4.2ml for PFV/EFV, (R>0.99, each). PFV and EFV differed significantly between overweighted and non-overweighted subjects (BMI >25kg/m2 and BMI <25kg/m2, n=17 each) with PFV 219.0±151.8ml vs. 96.9±44.7ml and EFV 102.3±66.3ml vs. 51.7±23.6ml (p<0.001, each). There was no significant difference in age between the two groups (41.4±14.3y vs. 42.9±16.0y, p=0.76).

CONCLUSION
The implemented Dixon method allows accurate measurement of PFV and EFV with all benefits of a 3D-approach similar to CT.

CLINICAL RELEVANCE/APPLICATION
The proposed 3D-Dixon based method allows accurate measurement of cardiac fat volumes, free of ionizing radiation and provides a...
SS304-04  Reproducibility of Cine Displacement Encoding with Stimulated Echoes (DENSE) in Human Subjects

Tuesday, Dec. 1 3:30PM - 3:40PM Location: S504AB

Participants
Kai Lin, MD, MSc, Chicago, IL (Presenter) Nothing to Disclose
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Gong Feng, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Bruce Spottiswoode, Chicago, IL (Abstract Co-Author) Employee, Siemens AG
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 test the hypothesis that two-dimensional (2D) displacement encoding via stimulated echoes (DENSE) is a reproducible technique for the depiction of segmental myocardial motion in human subjects.

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 difference 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.

SS304-05  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
Dimitris Mitsouras, PhD, Boston, MA (Presenter) Research Grant, Toshiba Corporation; Speakers Bureau, Toshiba Corporation
Rani S. Sewatkar, MBBS, Edison, NJ (Abstract Co-Author) Nothing to Disclose
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Marcus Y. Chen, MD, Bethesda, MD (Abstract Co-Author) Institutional research agreement, Toshiba Corporation
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Elizabeth George, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Michael Cheezum, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

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 rate (ml/min/m²) 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**

Yuki Tanabe, Toon, Japan (*Presenter*) Nothing to Disclose

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Akira Kurata, PhD, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose

**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**

**Chest (Lung Malignancy/COPD)**

**Tuesday, Dec. 1 3:00PM - 4:00PM Location:** S404CD

**CH CT OI**

AMA PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00

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**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**

**SSJ05-01**  
Quantitative CT Imaging Features Improve Prediction of EGFR Mutation Status in Lung Adenocarcinomas

**Tuesday, Dec. 1 3:00PM - 3:10PM Location:** S404CD

**Participants**

Ying Liu, Tianjin, China (Presenter) Nothing to Disclose  
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Zhao Xiang Ye, Tianjin, China (Abstract Co-Author) Nothing to Disclose  
Robert J. Gillies, PhD, Tampa, FL (Abstract Co-Author) Nothing to Disclose

**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.

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**SSJ05-02**  
18F-FDG Uptake as a Prognostic Factor for Tumor Recurrence in Patients with Pathologic Stage I Lung Adenocarcinomas

**Tuesday, Dec. 1 3:10PM - 3:20PM Location:** S404CD

**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's 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**

Caroline Caramella, MD, Villejuif, France (Presenter) Nothing to Disclose  
Maria Virginia Bluthgen, Villejuif, France (Abstract Co-Author) Nothing to Disclose  
Silvia Rossellini, Villejuif, France (Abstract Co-Author) Nothing to Disclose  
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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**

**Tuesday, Dec. 1 3:30PM - 3:40PM Location: S404CD**

**Participants**
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**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.
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 (Pearson'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)

Tuesday, Dec. 1 3:00PM - 4:00PM 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 Valturmo, Italy (Moderator) Nothing to Disclose

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

Purpose

Existing literature is mixed regarding risk of isolated below-the-knee deep vein thrombosis (BKDVT) relating to development of pulmonary embolus (PE). Patients with acuity of symptoms triggering an emergency department (ED) visit may be at higher risk. This study aims to quantify and characterize the risk of PE in ED patients found to have BKDVT.

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

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 pneumothoraces 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.

S3J06-03  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
Ismael T. Ali, MBChB, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Moomoa Mian, MD, FRCP, 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 scan, 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.

S3J06-04  Sickle Cell Patients Undergoing CT Pulmonary Angiography in the Emergency Department: An Analysis

Tuesday, Dec. 1 3:30PM - 3:40PM Location: N227

Participants

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Christina A. LeBedis, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Nagaraj-Setty Holakere, MD, Boston, MA (Abstract Co-Author) Owner, imaginglink, LLC

PURPOSE
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. Sickle 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.

SS306-05 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
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**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.

SS306-06 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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Hassan Al-Mohiy, Abha, Saudi Arabia (Abstract Co-Author) Nothing to Disclose
Bassam El-Achkar, MD, Beirut, Lebanon (Abstract Co-Author) Nothing to Disclose

**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.
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).
SSJ08

Gastrointestinal (CT Dose Reduction)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: E352

Participants
Vahid Yaghmai, MD, Chicago, IL (Moderator) Nothing to Disclose
Mannudeep K. Kalra, MD, Boston, MA (Moderator) Nothing to Disclose

Sub-Events

SSJ08-01  
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
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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±4.92) 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.

SSJ08-02  
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
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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), 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
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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 (CTDIvol 13.5 mGy), 150, 100, 50, and 25 eff mAs; 40-cm phantom:400 (CTDIvol 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

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
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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 image quality and tumor blood supply arteries under low concentration contrast condition.

METHOD AND MATERIALS

To assess image quality and tumor blood supply arteries under low concentration contrast condition.

RESULTS

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.
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 (CTDvol) 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=0.8; ICC value=0.75). The CT value and CNR of group A (458.85±69.03 HU and 20.20±3.30) were higher than those of group B (249.76±41.51HU and 9.31±1.89) (all P<0.001). The CTDvol 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.

SSJ08-05  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
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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 (κ-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...
SSJ08-06  Application of kV Assist Associated with Adaptive Statistical Iterative Reconstruction (ASiR) in Reducing Radiation Dose of Hepatic Enhanced CT Scan

Tuesday, Dec. 1 3:50PM - 4:00PM Location: E352

Participants
Qingguo Wang, Shanghai, China (Presenter) Nothing to Disclose

Purpose
To evaluate the impact of kV assist associated with ASiR on dose and image quality in hepatic enhanced CT scan.

Method and Materials
This study included 46 patients who underwent CT angiography for upper abdomen using a 64-row CT scanner (GE Discovery CT750 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 (CTDvol) of each patient were recorded. The dose length product (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 (0% ASiR) (73.82±10.83Hu) and group B (50% ASiR) (73.94±10.80Hu) (each p>0.05), respectively. The SD value of subcutaneous fat in group A (8.17±1.49HU) was lower than group B (50% ASiR) (9.57±1.59HU) (p<0.05). The CNR of liver (16.64±3.66) in group B (50% ASiR) was not significantly different with that in group A (18.99±3.75) (p>0.05). 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.
**SS090**

**Gastrointestinal (Liver Fat and Fibrosis)**

Tuesday, Dec. 1 3:00PM - 4:00PM Location: E350

**GI CT MR US**

**AMA PRA Category 1 Credit ™**: 1.00  
**ARRT Category A+ Credit**: 1.00

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**Participants**

Frank H. Miller, MD, Chicago, IL *(Moderator)* Nothing to Disclose  
Donald G. Mitchell, MD, Philadelphia, PA *(Moderator)* Consultant, CMC Contrast AB

**Sub-Events**

**SS090**

**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  
Témeï K. Yasar, New York, NY *(Abstract Co-Author)* Nothing to Disclose  
Cécilia 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, 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.

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**SS090**

**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  
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Kang Wang, PhD, San Diego, CA *(Abstract Co-Author)* Nothing to Disclose  
Paul Manning, MSc, La Jolla, CA *(Abstract Co-Author)* Nothing to Disclose  
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Kevin J. Glaser, Rochester, MN *(Abstract Co-Author)* Intellectual property, Magnetic Resonance Innovations, Inc; Stockholder, Resoundant, Inc

**Participants**

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Kevin J. Glaser, Rochester, MN *(Abstract Co-Author)* Intellectual property, Magnetic Resonance Innovations, Inc; Stockholder, Resoundant, Inc
A liver biopsy followed by histopathological assessment is a common approach for staging liver fibrosis. However, a biopsy can risk complications and is not always feasible. 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 effects 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.

**SSJ09-03 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
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Hiroyuki Morisaka, MD, Kofu, Japan (Abstract Co-Author) Nothing to Disclose
Katsuhito Sano, MD, PhD, Chuo, Japan (Abstract Co-Author) Nothing to Disclose
Tomkai Ichikawa, MD, PhD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose
Hirosi Onishi, MD, Yamanashi, Japan (Abstract Co-Author) Nothing to Disclose

**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 Boursier, Angers, France (Abstract Co-Author) Nothing to Disclose
- Jerome Lebigot, MD, Angers, France (Abstract Co-Author) Nothing to Disclose
- Frederic Oberti, MD, PhD, 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 for fibrosis were: FS: 0.89±0.018, ARFI: 0.76±0.027, SSI: 0.78±0.025. AUROC for significant fibrosis (Metavir F=>2) were: FS: 0.86±0.027, ARFI: 0.79±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 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
- Akihiro Nishie, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
- Yoshihisa Asayama, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
- Kousei Ishigami, MD, Fukuoka City, Japan (Abstract Co-Author) Nothing to Disclose
- Yasuhiro Ushijima, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
- Hiroshi Honda, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
- Yukihisa 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.

SS309-06  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
The Prognostic Value of Volumetric FDG PET/CT Parameters and Partial Volume Effect Correction in Patients with Locally Advanced Non-Small Cell Lung Cancer: A Secondary Analysis of ACRIN 6668/RTOG 0235 Trial

Tuesday, Dec. 1 3:00PM - 3:10PM Location: S505AB

Participants
Chadwick L. Wright, MD, PhD, Lewis Center, OH (Moderator) Nothing to Disclose
Andrew C. Homb, MD, Louisville, KY (Moderator) Nothing to Disclose

SUB-EVENTS

The Prognostic Value of Volumetric FDG PET/CT Parameters and Partial Volume Effect Correction in Patients with Locally Advanced Non-Small Cell Lung Cancer: A Secondary Analysis of ACRIN 6668/RTOG 0235 Trial

Tuesday, Dec. 1 3:00PM - 3:10PM Location: S505AB

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.

Impact of Point-spread Function Reconstruction on Quantitative FDG-PET/CT Imaging Parameters and Inter Reader Reproducibility in Solid Tumors

Tuesday, Dec. 1 3:10PM - 3:20PM Location: S505AB

Awards
Trainee Research Prize - Resident

Participants
Ali Salavati, MD, MPH, Philadelphia, PA (Presenter) Nothing to Disclose
Fenghai Duan, PhD, Providence, RI (Abstract Co-Author) Nothing to Disclose
Benjapa Khiewvan, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Bradley S. Snyder, MS, Providence, RI (Abstract Co-Author) Nothing to Disclose
Bo Wei, Providence, RI (Abstract Co-Author) Nothing to Disclose
Barry A. Siegel, MD, Saint Louis, MO (Abstract Co-Author) Consultant, Siemens AG; Advisor, General Electric Company Stockholder, Radiology Corporation of America
Mitchell Machtay, MD, Cleveland, OH (Abstract Co-Author) Consultant, Bristol-Myers Squibb Company; Consultant, Eli Lilly and Company; Consultant, AbbVie Inc
Abass Alavi, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS
Patients with inoperable stage II/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.
This study demonstrated early changes of VPs in FDG PET after 1 cycle of chemotherapy were more useful than changes of preSUVmax and treatment response.

**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 +1.14 (R1) and +1.1 (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.
was validated. 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.

**SS117-04  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
Azien Hawtani, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Ivayla I. Apostolova, MD, Magdeburg, Germany (Abstract Co-Author) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Victor F. Mautner, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Thorsten Derlin, MD, Hannover, Germany (Abstract Co-Author) Nothing to Disclose

**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.

**SS117-05  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
Wei Mu, Beijing, China (Abstract Co-Author) Nothing to Disclose
Zhe Chen, Beijing, China (Abstract Co-Author) Nothing to Disclose
Ying Liang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Ning Wu, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose
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 gray 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.

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
Rajan Jain, MD, Northville, MI (Moderator) Nothing to Disclose
Pina C. Sanelli, MD, Manhasset, NY (Moderator) Nothing to Disclose

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
Peter Sporns, MD, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Tarek Zoubi, Muenster, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Heermann, MD, Muenster, Germany (Abstract Co-Author) Nothing to Disclose
Sebastian Zimmer, MD, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Walter L. Heindel, MD, Muenster, Germany (Abstract Co-Author) Nothing to Disclose
Wolfram Schwindt, MD, Muenster, Germany (Abstract Co-Author) Nothing to Disclose
Thomas Niederstadt, MD, Munster, Germany (Abstract Co-Author) Nothing to Disclose
Uta Hanning, MD, Muenster, Germany (Presenter) Nothing to Disclose
PURPOSE

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.

SSJ18-03  Optimal Acquisition and Modeling Parameters for Accurate Assessment of Low Ktrans Blood Brain Barrier Permeability Using Dynamic Contrast-Enhanced MRI

Tuesday, Dec. 1 3:20PM - 3:30PM Location: N226

Participants

Samuel Barnes, PhD, Detroit, MI (Abstract Co-Author) Nothing to Disclose
Thomas S. Ng, MD, PhD, Boston, MA (Presenter) Nothing to Disclose
Axel Montagne, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
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.

SSJ18-04  Choosing the Right Arterial Input Function Selection Mode for T1-DCE MRI in the CNS
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 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.

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.
**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

**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 and radiation dose per run were recorded. Ion 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 placement (scale of 1 to 4; suitability cannot be determined to suitable for infra-renal filter). Paired t-test was used for analysis.
placement (mean 3.68 vs. 3.85; p=0.11) were similar between the groups.

**CONCLUSION**

Elimination of pre-contrast images by simultaneously triggering x-ray and contrast injection and using first post-contrast image as mask achieves significant radiation dose reduction with preserved SNR and diagnostic accuracy in selected DSA.

**CLINICAL RELEVANCE/APPLICATION**

It is common practice to obtain pre-contrast images and this adds significantly to overall radiation dose in DSA. In our study, the earliest post-contrast image contained very little contrast near the tip of the catheter and did not impact on the diagnostic usefulness when used as a mask to generate DSA run.

**SSJ21-03 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.

**SSJ21-04 The Effect of KV Assist on Radiation Dose Reduction and Image Quality for Abdominal CT in Different BMI Groups**

Tuesday, Dec. 1 3:30PM - 3:40PM Location: S403A

Participants
Ping Hou, MD, Zhengzhou, China (Presenter) Nothing to Disclose
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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 effect of KV Assist on radiation dose reduction and image quality for abdominal CT in different BMI groups

**METHOD AND MATERIALS**

100 patients underwent abdominal CT on a new generation spectral CT scanner (Discovery CT, GE healthcare). The patients were divided into 2 groups for prospective analysis. Group A(n=50) used KV assist protocol, which automatically selects an optimal kVp based on the scout view. While the conventional 120kVp scan using auto mA protocol was performed on Group B(n = 50). The main parameters of protocol were setup with noise index of 10, auto mA ranges at 100-450mA and rotation time at 0.8s. Group A and B were both further divided into two subgroups according to BMI (BMI <24 kg/m2 for group A1/B1 and BMI≥24 kg/m2 for group A2/B2). CT values and SD values, CNR of CA, PV, liver, pancreas and image quality score in abdomen were measured and calculated. CTDIvol and DLP of each patient was recorded and compared. Comparison between group A and B was implemented as a representative of those for the subgroups. The data were analyzed using Rand-sum test and t test.

**RESULTS**

Image noise of protocol A and B in dual phase was (10.70±2.65) vs. (8.83±2.38) HU and (11.27±3.82) vs. (8.82±2.25) HU respectively.
SUMMARY: Even today, many case reports have shown that even for patients with a BMI of less than 24 kg/m², the radiation dose reduction potential of an x-ray tube with additional tin (Sn) filtration in non-enhanced thoracic and abdominal CT can be significant. The entrance doses with cineangiography and fluoroscopy were measured in x-ray systems used for interventions today and in the past. The spatial resolution and low contrast detectability were quantified in many IR systems. To clarify the entrance doses of x-ray equipment currently used in cardiac intervention procedures, the radiation dose was measured with an ionization chamber in the centre and periphery of the phantoms. 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 liver equivalent tissue. Besides the reported CTDI, dose was measured with an ionization chamber in the centre and periphery of the phantoms. The contrast was virtually independent of kV and therefore assumed to be constant for 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
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. Dijkstra, 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 liver 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 clarify 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.

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**SSJ22**

**Physics (CT V-New Development 2)**

Tuesday, Dec. 1 3:00PM - 4:00PM Location: S403B

**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**

Participants
Rebecca Fahrig, PhD, Palo Alto, CA (Moderator) Employee, Siemens AG; Stockholder, TibaRay, Inc.;

Sub-Events

**SSJ22-01** 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

Tuesday, Dec. 1 3:00PM - 3:10PM Location: S403B

Participants
Andre Euler, MD, Basel, Switzerland (Presenter) Nothing to Disclose
Anna L. Falkowski, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Anushri Parakh, MBBS, MD, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Sebastian Manneck, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
David Dashti, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Bernhard Krauss, PhD, Forchheim, Germany (Abstract Co-Author) Employee, Siemens AG;
Zsolt Szucs-Farkas, MD, PhD, Berne, Switzerland (Abstract Co-Author) Nothing to Disclose
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 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/l/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.

**SSJ22-02** Whole-body Human Imaging with Photon-counting-based CT at Clinically Relevant Doses

Tuesday, Dec. 1 3:10PM - 3:20PM Location: S403B

Participants
Cynthia H. McCollough, PhD, Rochester, MN (Presenter) Research Grant, Siemens AG
Shuai Leng, PhD, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Ralf Gutjahr, Munich, Germany (Abstract Co-Author) Grant, Siemens AG
Zhicong Yu, 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
Steffen Kappler, Dipl Phys, Forchheim, Germany (Abstract Co-Author) Researcher, Siemens AG

**PURPOSE**

To develop a whole-body human imaging technique using photon-counting-based CT at clinically relevant doses with a high detector resolution and a high system efficiency.
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

Esmaeil 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
Jiang Hsieh, PhD, Waukesha, WI (Abstract Co-Author) Employee, General Electric Company
Kelley Branch, MD, Seattle, WA (Abstract Co-Author) Speakers Bureau, Pfizer Inc
Robb Genny, Seattle, WA (Abstract Co-Author) Nothing to Disclose
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
Heinz-Peter Schlemmer, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (Abstract Co-Author) Institutional research agreement, Siemens AG
Marc Kachelriess, PhD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To significantly reduce image noise or patient radiation dose in dynamic perfusion CT imaging.

METHOD AND MATERIALS
Due to the continuous x-ray exposure in CT perfusion, low values of tube current time product (e.g. 100 mAs) and tube voltage settings (e.g. 70 kV) are desired to reduce dose. Noise increases considerably, potentially affecting quantitative perfusion values. Recently a time-intensity profile similarity (TIPS) 3D filter has been proposed for denoising of 4D perfusion CT data, weighing each voxel according to the distance from the central voxel, and to their time attenuation curves (TACs) similarity. In a first step we created a digital brain perfusion phantom, to individually optimize and compare TIPS 3D, multi band frequency (MBF) and running average guided bilateral filters (RAGBF). After filter optimization, TIPS 3D showed better results compared to RAGBF and MBF in terms of spatial noise reduction, while noise in temporal domain was still significant for all filters. In a second step TIPS 3D was modified adding an adaptive temporal width and a spatial bilateral guide (aTIPS-BF 4D). Simulated as well as measured patient data from a third generation dual source CT system were processed to validate our approach. Color maps were generated using commercially available software and compared with adaptive Gaussian filter (aGF).

RESULTS
aTIPS-BF 4D led to significant improvements in terms of ground truth TACs fidelity (sum of squared differences reduced by a factor of 1.8), and spatial resolution (FWHM of line spread function reduced by a factor of 1.4) when compared to TIPS 3D, while CNR improvement factors were comparable (4.37 in aTIPS-BF 4D and 4.8 in TIPS 3D). aTIPS-BF 4D perfusion maps agreed with the ones obtained with aGF (average values $y=1.0482x+0.0954$, $R^2=0.9845$, standard deviations $y=1.0849x+0.1718$, $R^2=0.8743$) with the additional benefit of a higher spatial resolution. This led to a higher detection of small ischemic regions in one stroke case and small active spots in a rectum tumor case.

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
Marilyn J. Siegel, MD, Saint Louis, MO (Abstract Co-Author) Research Consultant, Siemens AG; Speakers Bureau, Siemens AG
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. Additionally, a more advanced task-based DI was calculated for a 10-mm diameter task with the purpose to simulate lung nodules. The 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.

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 the same time, the DI of tasks of 10mm diameter increased 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]%. A tissue-equivalent anthropomorphic five-year old phantom underwent a simulated nonenhanced CT examination of the chest using an anthropomorphic phantom.

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 the 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.
Participants
Janis P. O'Malley, MD, Birmingham, AL (Director) Nothing to Disclose
Samuel E. Almodovar-Reteguis, MD, Birmingham, AL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss imaging presentation and special considerations when interpreting FDG PET/CT studies for lymphoma, melanoma, and sarcoma. 2) Formulate a systematic approach to interpreting PET/CT studies for this patient population. 3) Discuss pertinent correlative findings on CT for each diagnosis on a case by case basis.

ABSTRACT
**Essentials of Cardiac Imaging**

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

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**Participants**

**Sub-Events**

**MSES34A  CMR Basics - Patterns of Enhancement**

Participants  
Nikhil Goyal, MD, Staten Island, NY (**Presenter**) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the basic components of a post contrast Cardiac MRI (CMRI) examination. 2) Understand the concept of myocardial nulling and its role in delayed enhancement CMRI. 3) Learn the patterns of delayed enhancement associated with ischemic and nonischemic cardiac disease.

**MSES34B  Congenital Anomalies of the Coronary Arteries with Pathologic Correlation**

Participants  
Seth J. Kligerman, MD, Denver, CO (**Presenter**) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Recognize various congenital anomalies of the coronary arteries on cross-sectional imaging. 2) Learn which anomalies are benign and which can lead to adverse cardiac events. 3) Understand how anomalies in the origin, course, and termination of the coronary arteries can lead to an abnormal perfusion of the myocardium.

**MSES34C  Cardiac CT and MRI: Seeing the Unseen**

Participants  
Musturay Karcaaltincaba, MD, Ankara, Turkey, (musturayk@gmail.com) (**Presenter**) Speaker, General Electric Company; Speaker, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) To describe the cardiac CT and MRI findings that can not be seen or characterized by echocardiography and catheter angiography. 2) To depict imaging features of mild atherosclerosis, napkin ring sign, bypass grafts, interatrial septal and myocardial pathologies. 3) To elucidate our understanding of cardiac pathologies (such as fibrosis, iron overload and amyloidosis) than can be diagnosed without biopsy.
Participants

Sub-Events

RC403A  Calcium Scoring

Participants
John J. Carr, MD, MS, Nashville, TN (Presenter) Nothing to Disclose

ABSTRACT
Coronary artery calcifications document the presence of advanced atheroma in the coronary arteries. Calcified plaque is the “sclerosis” of atherosclerosis and thus is an established imaging biomarker of coronary artery disease. In this presentation we will review the evidence of CAC supporting application of CT measured CAC as a risk marker of coronary artery disease and evidence-based application for clinical practice and prevention in 2015 and beyond.

RC403B  Coronary CT Angiography (CCTA)

Participants
John R. Lesser, MD, Minneapolis, MN, (jrlesser1@gmail.com) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review the data predicting cardiac events from information obtained on cardiac CT angiography. 2) Understand the predictive value of coronary CT angiography in the setting of acute chest pain in the emergency room. 3) Understand the predictive value of CT angiographic findings in the setting of chronic chest pain. 4) Review the additional predictive value of coronary CT angiography relative to calcium scoring in symptomatic vs asymptomatic populations.

ABSTRACT
Active Handout: John Raymond Lesser
Active Handout: John Raymond Lesser

RC403C  Myocardial Perfusion

Participants
Ricardo C. Cury, MD, Miami, FL (Presenter) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, Novartis AG; Research Consultant, Heartflow, Inc

LEARNING OBJECTIVES
1) To review the available literature supporting the growing evidence of myocardial perfusion to predict outcomes. 2) To discuss new imaging modalities, such as myocardial CT perfusion, and their current role. 3) To describe the current limitations and challenges of combined CTA/CTP evaluation and its future role.

ABSTRACT
Myocardial perfusion imaging (MPI) is an integral component for the diagnosis and management of patients with coronary artery disease. Single photon emission computed tomography (SPECT) is the most frequently requested and widely available non-invasive MPI modality. Importantly, it provides an accurate assessment of the presence or absence of a myocardial perfusion abnormality, yields incremental prognostic information, and contributes to therapeutic decision making. Coronary CT angiography (CTA) is a non-invasive procedure with high diagnostic performance for the detection and exclusion of obstructive coronary stenosis. While CTA offers high sensitivity and negative predictive value, its specificity and positive predictive value are less robust and indicate a systematic over-estimation of stenosis severity. Further, even for high-grade stenoses correctly identified by CTA, comparison with a fractional flow reserve or SPECT reference standard indicates that more than half do not cause ischemia. These findings have evoked concerns that CTA without adjunctive physiologic data may promote excess referral to invasive angiography and/or revascularization. Stress myocardial CT perfusion (CTP) has been shown to provide a combined assessment of both cardiac anatomy and physiology. Multiple single-center studies have established its feasibility using stress agents such as adenosine, dipyridamole and regadenoson, with similar diagnostic accuracy compared with other techniques, including SPECT, fractional flow reserve, cardiac magnetic resonance imaging, and invasive coronary angiography (ICA). Recent multi-center trials also demonstrated promising results of using combined CTA and Stress myocardial CT perfusion (CTP) for a comprehensive cardiac evaluation.
**Participants**

**Sub-Events**

**RC409A  Colorectal Cancer Screening and CT Colonography**

Participants

Kevin J. Chang, MD, Sharon, MA, (kchang@lifespan.org) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the epidemiology and pathophysiology of colorectal cancer and justifications for colorectal screening. 2) Identify the targets of colorectal screening and provide the rationale for selective polypectomy. 3) Compare and contrast CT Colonography with other screening options.

**ABSTRACT**

**RC409B  Optimizing CTC-based CRC Screening - Programmatic Approach and QA Metrics**

Participants

Elizabeth G. McFarland, MD, Saint Charles, MO (Presenter) Consultant, Toshiba Corporation

**LEARNING OBJECTIVES**

1) To review why CTC for screening is valuable for radiology practices. 2) To review the key elements of ACR Practice Parameters for patient preparation and CTC technique. 3) To review current insurance coverage issues and coding for CTC for screening and diagnostic uses. 4) To understand the ACR quality metrics for CT colonography currently in practice.

**RC409C  Technical Pitfalls at CTC and Problem Solving**

Participants

Jessica B. Robbins, MD, Madison, WI, (jrobbins@uwhealth.org) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify potential technical challenges encountered with CTC. 2) Describe techniques which may optimize colonic preparation. 3) Employ modifications to improve colonic distention in challenging situations.

**ABSTRACT**

**RC409D  Interpretative Pitfalls at CTC**

Participants

Judy Yee, MD, Clayton, CA, (judy.yee@ucsf.edu) (Presenter) Research Grant, EchoPixel, Inc

**LEARNING OBJECTIVES**

1) To understand the causes of errors of CT colonography interpretation on both 2D and 3D images. 2) To learn the morphologic appearance of pitfalls on CT colonography and their differential diagnosis. 3) To apply strategies to avoid common and uncommon interpretive errors. 4) To apply appropriate techniques to avoid polyp measurement errors on untagged and tagged cases.

**ABSTRACT**

This presentation will provide a discussion of the causes of errors of interpretation on CT colonography. The appearances of common and common pitfalls will be demonstrated. The differential diagnosis of morphologic types of lesions will be presented. Accurate lesion measurement is essential for CT colonography since this directly impacts management recommendations. Causes of inaccurate measurements will be reviewed along with strategies as to how to improve measurement accuracy.
RC412A  Cardiovascular 3D Printing

Participants
Frank J. Rybicki III, MD, PhD, Ottawa, ON (Presenter) Research Grant, Toshiba Corporation;

LEARNING OBJECTIVES
1) To understand the difference between 3D visualization and 3D printing as related to cardiovascular diagnoses. 2) To review the different 3D printing technologies that have impacted and will impact cardiovascular care. 3) To review the clinical impact of current 3D modelling in both cardiovascular diagnoses and intervention.

ABSTRACT
While advanced visualization in cardiovascular imaging is instrumental for diagnoses and communication with referring clinicians, there is an unmet need to render DICOM images as 3D printed models capable of providing both tactile feedback and tangible depth information of both anatomic and pathologic states. 3D printed models are being rapidly embraced in cardiovascular diagnoses. The purpose of this lecture is to review and summarize the numerous studies to date that support such benefits from cardiovascular 3D printing, as it is expected that the number of 3D printed models generated from DICOM images for planning intervention and fabricating implants will grow exponentially. 3D printing has closed the gap on the unmet need for true 3D visualization in cardiovascular surgical planning. Source image data is primarily contrast-enhanced MRI and CT. Various approaches have been used to develop a hollow STL model, including segmenting the blood pool and printing vessels with a high-resolution technology to achieve a smooth lumen. Growing data supports the use of models to capture complex anatomy including congenital heart disease requiring surgery. Applications have included acquired cardiac abnormalities such as ventricular aneurysms and cardiac tumors. Models have been useful to plan high-risk valve cases and for intra-operative navigation. Electrocardiographic (ECG) gated CT studies for Trans-catheter Aortic Valve Replacement (TAVR) planning enable 3D printed models of the aortic annulus and surrounding structures for potentially safer valve deployment. Incorporation of patient-specific elasticity of the normal versus calcified aorta will likely be an important area of future research. Models of the aorta and other smaller vessels, including the coronary arteries, enable studies of blood flow dynamics that otherwise would not be possible in vivo.

RC412B  Renal MRA and Functional MRI

Participants
Ulrike I. Attenberger, MD, Mannheim, Germany (Presenter) Research Consultant, Bayer AG

LEARNING OBJECTIVES
1) To describe the technical pre-requisites for successful contrast and non-contrast-enhanced renal MRA (i.e. signal-to-noise-ratio, scan time, spatial resolution, voxel size). 2) To review contrast-agent dose optimization strategies. 3) To understand the basics of functional renal MR imaging techniques and to illustrate their potential implications on patient care.

ABSTRACT
While advanced visualization in cardiovascular imaging is instrumental for diagnoses and communication with referring clinicians, there is an unmet need to render DICOM images as 3D printed models capable of providing both tactile feedback and tangible depth information of both anatomic and pathologic states. 3D printed models are being rapidly embraced in cardiovascular diagnoses. The purpose of this lecture is to review and summarize the numerous studies to date that support such benefits from cardiovascular 3D printing, as it is expected that the number of 3D printed models generated from DICOM images for planning intervention and fabricating implants will grow exponentially. 3D printing has closed the gap on the unmet need for true 3D visualization in cardiovascular surgical planning. Source image data is primarily contrast-enhanced MRI and CT. Various approaches have been used to develop a hollow STL model, including segmenting the blood pool and printing vessels with a high-resolution technology to achieve a smooth lumen. Growing data supports the use of models to capture complex anatomy including congenital heart disease requiring surgery. Applications have included acquired cardiac abnormalities such as ventricular aneurysms and cardiac tumors. Models have been useful to plan high-risk valve cases and for intra-operative navigation. Electrocardiographic (ECG) gated CT studies for Trans-catheter Aortic Valve Replacement (TAVR) planning enable 3D printed models of the aortic annulus and surrounding structures for potentially safer valve deployment. Incorporation of patient-specific elasticity of the normal versus calcified aorta will likely be an important area of future research. Models of the aorta and other smaller vessels, including the coronary arteries, enable studies of blood flow dynamics that otherwise would not be possible in vivo.

RC412C  Functional CTA in Athletes

Participants
Richard L. Hallett II, MD, Stanford, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify anatomic and functional lesions that predispose to vascular entrapment and fibrotic syndromes in athletes. 2) Describe methods to assess vascular entrapment and fibrotic syndromes in athletes using dynamic, functionally challenged CTA and MRA. 3) Describe the imaging findings for diagnosis and follow-up of affected athletes.

ABSTRACT
While exercise is a mainstay in preventing and treating atherosclerotic peripheral vascular disease, some vascular disorders manifest primarily in athletes. Both recreational and competitive athletes are at risk for development of non-atherosclerotic vascular diseases. These disease entities range from iliac endofibrosis in cyclists, popliteal entrapment syndrome in running sports, and thoracic inlet / outlet syndromes in "overhead" athletes. Recently, computed tomography angiography (CTA) and magnetic resonance angiography (MRA) have become valuable diagnostic options for many vascular diseases that can occur in the athlete. Optimum imaging in these disorders requires the ability to tailor the exam protocol to the specific disease entity and vascular territory in question. By combining rapid CT image acquisition with functional, physiologic provocative maneuvers, diagnostic information can be maximized. Newer blood-pool MR contrast agents also allow functional assessment without ionizing radiation exposure. This session will review the pathophysiology, risk factors, diagnosis, and classification of vascular diseases seen in the athlete. Logical protocol development utilizing (when necessary) provocative maneuvers will be reviewed. Interpretation strategies for interacting with these resulting large, dynamic datasets will also be reviewed.

Active Handout:Richard Lee Hallett
Participants
Michael D. Hope, MD, San Francisco, CA, (michael.hope@ucsf.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Explain why imaging approaches beyond assessment of vessel diameter are needed for improved risk stratification of aortic disease. 2) List potential aortic imaging targets for improved evaluation of disease progression. 3) Appraise the merits of advanced aortic imaging techniques including the use of MRI and PET for the evaluation of aortic hemodynamics and vessel wall inflammation.
Abdominal Dual Energy CT in Practice

Tuesday, Dec. 1 4:30PM - 6:00PM Location: E351

Participants
Desiree E. Morgan, MD, Birmingham, AL (Presenter) Research support, General Electric Company
Alec J. Megibow, MD, MPH, New York, NY (Presenter) Consultant, Bracco Group
Eric P. Tamm, MD, Houston, TX (Presenter) Nothing to Disclose
Daniel T. Boll, MD, Durham, NC (Presenter) Research Grant, Siemens AG; Research Grant, Koninklijke Philips NV; Research Grant, Bracco Group

LEARNING OBJECTIVES
1) Understand the principles of image acquisition and post processing of dual energy CT technologies currently commercially available in the US. 2) Assess the technological innovations made possible with dual energy CT and the potential advances to enhance clinical practice and problem-solving in abdominal imaging. 3) Contrast the workflow issues and limitations of the various dual energy approaches as applicable to imaging of patients with abdominal disease.

ABSTRACT
After a brief overview of basic physics principles that distinguish the currently available dual energy CT scanner technologies, a variety of topics regarding dual source dual energy CT, single source dual energy CT, and sandwich detector dual energy CT will be covered by three experts using the technology in clinical practice. This will include image acquisition and patient experience, development of specific abdominal imaging protocols, workflow considerations, such as automated generation of blended images, virtual monoenergetic energy images, iodine/water material density images or iodine maps at the scanner level versus radiologist image manipulation, and will focus on real experience approaches to image interpretation. Strengths and limitations of dual source, single source, and sandwich detector dual energy CT will be demonstrated and discussed.
Controversy Session: 'My Back Hurts': Fluoroscopy or CT-guided Intervention?

Wednesday, Dec. 2 7:15AM - 8:15AM Location: E451B

CT IR

AMA PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Walter S. Bartynski, MD, Charleston, SC (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify various etiologies of low back pain and neck pain that may be amenable to image-guided pain injections. 2) Develop a pain management plan utilizing image-guided injections. 3) Assess what imaging findings and clinical symptoms are appropriate for image-guided pain injections. 4) Discuss the advantages and disadvantages of CT versus fluoroscopically guided pain injections.

Sub-Events

SPSC40A For Fluoroscopic Injection Procedures

Participants
Lubdha M. Shah, MD, Salt Lake Cty, UT, (lubdha.shah@hsc.utah.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT

URL

SPSC40B CT Injection Procedures

Participants
Peter G. Kranz, MD, Durham, NC, (peter.kranz@duke.edu) (Presenter) Research Consultant, Cephalogics, LLC; Research Consultant, Biogen Idec Inc

LEARNING OBJECTIVES
View learning objectives under main course title.

URL
LEARNING OBJECTIVES

1) Understand the applications and limitations of HRCT in detecting and characterizing diffuse lung disease through the discussion of expert analysis of unknown cases. 2) Apply correct usage of the HRCT lexicon to specific findings, to better elucidate pathophysiology and to refine differential considerations, by observing experts in HRCT approach unknown cases. 3) Develop diagnosis and management algorithms by working through problematic cases with the expert discussants. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

ABSTRACT
Participants

ABSTRACT

Sub-Events

RC503A  Systematic Approach to CT Interpretation in Congenital Heart Disease

Participants
Suhny Abbara, MD, Dallas, TX (Presenter) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

LEARNING OBJECTIVES
1) To understand the systematic segmental approach to congenital heart disease. 2) To recognize the CT specific imaging findings that relate to each step in the segmental approach to congenital heart disease.

ABSTRACT

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/

Suhny Abbara, MD - 2014 Honored Educator

RC503B  Tailoring CT Scan Acquisitions to Specific Indications

Participants
Brian B. Ghoshhajra, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To understand the different indications for cardiac CT, including calcium scoring, coronary CT angiography, electrophysiology procedural planning, structural heart disease interventions (including TAVR), congenital heart disease, myocardial evaluation, and mass workup. 2) To review the differences between various available equipment, and how available equipment might affect a given protocol. 3) To review basic protocols for each of the above exam types, and review specific features of each exam type. 4) To review the advantages and disadvantages of individualized settings within each of the above protocols.

Active Handout: Brian Burns Ghoshhajra

RC503C  Imaging of Cardiac Shunts

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

LEARNING OBJECTIVES
1) Describe MR imaging methods for detection and quantification of intra and extracardiac shunts. 2) Describe CT imaging methods for detection and quantification of intra and extracardiac shunts. 3) Plan an optimized protocol for CT or MR imaging of shunts.

RC503D  Role of MRI in Adult CHD Management

Participants
Mini V. Pakkal, MBBS, FRCR, Toronto, ON, (mini.pakkal@uhn.ca) (Presenter) Nothing to Disclose

Active Handout: Mini Vithal Pakkal
Bladder, the Forgotten Organ: Role of CT, MRI, and PET in Diagnosis, Staging, and Surveillance of Cancer

Wednesday, Dec. 2 8:30AM - 10:00AM Location: N229

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

Participants
Stuart G. Silverman, MD, Brookline, MA, (sgsilverman@partners.org) (Coordinator) Author, Wolters Kluwer nv
Andrew B. Rosenkrantz, MD, New York, NY (Presenter) Nothing to Disclose
Homer A. Macapinlac, MD, Houston, TX (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Learn the latest developments on the role of CT, MRI, and PET/CT in the detection, diagnosis, staging, and surveillance of patients with bladder cancer. 2) Learn currently recommended CT, MRI, and PET/CT techniques and protocols and how to implement them in clinical practice. 3) Learn how to interpret CT, MRI, and PET/CT scans of the bladder with an emphasis on case review and diagnostic pitfalls.

ABSTRACT
The urinary bladder is the most common site of malignancy of the urinary tract and is imaged by radiologists on many abdominal imaging exams. However, historically the bladder has been a 'forgotten' organ and thought to be largely the purview of the urologist due to the central role that cystoscopy has played in both the diagnosis and local staging of bladder cancer. Recent advances in CT, MRI, and PET have emerged that now allow radiologists to play an important role in the detection, diagnosis, staging, and surveillance of patients with or suspected of having bladder cancer. This course will detail these advances and explain how, when, and why radiologists should be using these three modalities in clinical practice today. Using illustrative case examples, advances in knowledge such as how CT urography can be used to detect bladder cancer, how MR urography can be used to distinguish muscle-invasive from superficial tumors and evaluate the upper tracts, and how PET/CT (and the newly introduced PET/MRI) can be used to stage and follow patients. With additional advances in low dose CT, emerging MRI techniques, and novel PET agents, radiology will play an increasingly vital role in the care of patients with bladder cancer in the future.
**Radiation Dose Reduction in CT**

**Sub-Events**

**RC509-01**  
**Radiation Dose Reduction in CT**

**RC509-02**  
**Intra-Patient Comparison of Standard, BMI-based and Attenuation-based Tube Voltage Selection in Abdominal MDCT: Effect on Dose and Image Quality Parameters**

**Participants**

**Amy K. Hara, MD, Scottsdale, AZ**  
*Presenter*  
Royalties, General Electric Company;

**Faezeh Sodagari, MD, Chicago, IL**  
*Presenter*  
Grant, Siemens AG

**Adeel R. Seyal, MD, Chicago, IL**  
*Abstract Co-Author*  
Grant, Siemens AG

**Atilla Arslanoglu, MD, Chicago, IL**  
*Abstract Co-Author*  
Nothing to Disclose

**Fernanda D. Gonzalez Guindalini, MD, Chicago, IL**  
*Abstract Co-Author*  
Nothing to Disclose

**Vahid Yaghmai, MD, Chicago, IL**  
*Abstract Co-Author*  
Nothing to Disclose

**LEARNING OBJECTIVES**

1) Compare advantages and disadvantages of various techniques to reduce radiation dose for abdominal CT. 2) Describe how iterative reconstruction techniques work and how they can improve image quality of low dose exams. 3) Develop a strategy to implement low dose techniques in clinical practice.

**PURPOSE**


**METHOD AND MATERIALS**

This study was IRB approved and HIPAA compliant. Abdominal MDCT scans of fifty patients who had been imaged with both standard protocol (120 kV and filtered-back-projection reconstruction algorithm) and new protocol (automated kV selection and iterative reconstruction) were compared. Data was also analyzed based on BMI-based kV selection (100 kV if BMI <25 kg/m²). Radiation dose, image noise (subcutaneous fat), SNR (aorta and liver) and CNR (aorta and liver) were recorded. P<0.05 was considered significant.

**RESULTS**

Patient mean BMI was comparable between the two studies (24.6 kg/m² for first study and 24.7 kg/m² for second study; P=0.77). With automated tube voltage selection protocol, 43/50 (86%) were scanned with 100 kV, 5/50 (10%) with 120kV and 2/50 (4%) with 140kV. BMI for 100kV group ranged between 17.8 and 29.925 kg/m². Sixteen patients scanned with 100kV (28 vs 43). Compared with standard protocol, CTDIvol, DLP, and effective dose decreased 17.2%, 20% and 20.4%, respectively, in 43 patients that were automatically selected for 100kV scan. Image noise decreased by 21.7% (P<0.001) while CNR and SNR of liver and aorta increased >24% (P<0.001).

**CONCLUSION**

Attenuation-based automated tube voltage selection results in lower tube voltage in significantly higher number of patients, compared with standard and BMI-based selections. Image quality parameters improve with combination of lower tube voltage selection and iterative reconstruction.

**CLINICAL RELEVANCE/APPLICATION**

Attenuation-based automated tube voltage selection results in significantly higher number of patients imaged with lower dose...
Title: Oral Contrast Media Concentration Selection for Low kvp/keV CT Scanning

**Participants**

Manuel Patino, MD, Boston, MA (Presenter) Nothing to Disclose
Diana Murcia, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Andrea Prochowski Iamurri, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Yasir Andrabhi, 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

**METHOD AND MATERIALS**

Anthropomorphic CT colo phantom study: Four OCM solutions were used as follows: Water, Gastrografin® (Bracco dx, 9mg/ml), Iohexol (GE healthcare, 12mg/ml), and Barium Sulfate (Readi-CAT® 2.0%). Each solution was diluted with water to obtain 75, 50, and 25% of the standard dose of OCM for adults. The phantom was filled up serially with 400 ml of each OCM solution, from the lowest to the standard OCM concentration, and scanned on ssDECT scanner (Discovery-CT 750 HD, GE Healthcare) on SECT (80, 100 and 120 kvp, and 250mA) and DECT modes (140/80 kVp and 375 mA). VMC (40, 50, 60, and 70keV) images were generated yielding a total of 91 image datasets (39 on SECT, and 52 on DECT). Three ROIs were placed at 3 locations in colonic lumen to measure HU, SD and CNR. Clinical study: GI tract attenuation was measured in 50 consecutive patients with standard-dose, positive (barium and iodine) OCM in both SECT and DECT. Multiple ROIs were placed in different locations of the GI tract on 120-SECT and DECT-low keV images to measure HU. Statistical analysis was conducted with pair student t-test

**RESULTS**

Colonic attenuation in 120kVp-scans with standard OCM dose ranges between 261 and 303 HU. There was an inverse correlation between OCM HU and kvp/keV, irrespective of OCM concentration, increasing HU 2X on low-kvp and 5X on low-keV images (p<0.05). There was 5% drop in CNR with low-kvp but 15% increase with low-keV for all OCM’s. Clinical abdomen CT exams mirrored phantom results. Optimal OCM dilutions for 100/80kVp scans were: Gastrografin® 75/75%, Iohexol 75/75% and Barium 75/50%. OCM dilutions of 25-50% were optimal on 40-70keV scans

**CONCLUSION**

Low kvp/keV scans increase GI tract attenuation, enabling OCM dose concentration reduction for diagnostic exams

**LEARNING OBJECTIVES**

1) To understand the risks of intravenous administration of iodinated CT contrast media. 2) To be familiar with the latest information on the use of iodinated CT contrast media in the setting of renal impairment. 3) To be familiar with potential future developments in intravenous CT contrast agents.
Utilizing the novel algorithm broadened the sweet spot of diagnostically acceptable monoenergetic keV levels by 416%. With VMI+, the mean diagnostic range was 57-190 keV (SD 9.3 and 0.0, respectively), whereas using VMI, mean diagnostic range was 69-101 keV (SD 3.9 and 13.0, respectively). SNR and CNR were also significantly improved utilizing the VMI+ technique, by 107 and 76%, respectively. VMI images showed better CNR compared with t-test.

RESULTS

The body mass index between 2 groups showed no difference (p>0.05). For the 60keV spectral CT images, CT number and CNR were (359.00±453.21HU, 51.52±12.56) for abdominal aorta and (185.32±422.90HU, 20.63±46.19) for portal vein. These values were higher than the respective values of (306.03±46.36HU, 44.52±13.43) and (149.25±19.66HU, 15.11±3.65) for the 120kVp images. The SD values in erector spinae of the spectral CT images were 5.88±0.99HU in AP and 6.05±0.73HU in VP, statistically the same as those of the 120kVp images (5.90±1.43HU in AP and 5.85±0.73HU in VP) (P>0.05). The CTDI and effective dose were recorded. CT number and standard deviation (SD) of the abdominal aorta in arterial phase (AP), portal vein in venous phase (VP), liver parenchyma and erector spinae on the 120kVp images and 60keV spectral CT images were measured to calculate contrast-noise-ratio (CNR). Measurements were compared with t-test.

CONCLUSION

Compared with the conventional 120kVp CT, spectral CT can reduce the total contrast dosage by 30% and at the same time improves the vessel contrast enhancement and CNR without radiation dose increase.

CLINICAL RELEVANCE/APPLICATION

Spectral CT can reduce the total contrast dosage by 30% and improves vessel enhancement and CNR without radiation dose increase.
CONCLUSION
The "sweet spot" for virtual monoenergetic reconstructions was significantly increased when utilizing the VMI+ algorithm, with a diagnostic keV range increased by approximately 400%. SNR and CNR also demonstrate marked improvement by 107 and 76%, respectively, with VMI+ over VMI.

CLINICAL RELEVANCE/APPLICATION
The VMI+ reconstructions are markedly superior to the basic VMI algorithm, and are useful in assessing bowel wall enhancement.

RC509-07  Patient Size-independent Monoenergetic Imaging for Detection Hypervascular Liver Tumors: Impact of a Second-generation Monoenergetic Algorithm

Wednesday, Dec. 2 9:50AM - 10:00AM Location: E350

Participants
Daniele Marin, MD, Cary, NC (Presenter) Nothing to Disclose
Juan Carlos Ramirez-Giraldo, PhD, Malvern, PA (Abstract Co-Author) Employee, Siemens AG
Sonia Gupta, MD, Newark, DE (Abstract Co-Author) Nothing to Disclose
Sandra Stinnett, MS, MPH, Durham, NC (Abstract Co-Author) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Achille Mileto, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Wanyi Fu, BEng, Durham, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the impact of a novel monoenergetic reconstruction algorithm on the conspicuity of hypervascular liver tumors during dual-energy CT (DECT) of the liver.

METHOD AND MATERIALS
This retrospective, single-center HIPAA-compliant study was IRB-approved and informed patient consent was waived. Fifty-nine patients (35 men, 24 women) with 47 hypervascular liver tumors underwent DECT (80/Sn140 kVp) in the late hepatic arterial phase, with a dual-source CT system (Siemens Definition Flash). Datasets at energy levels ranging from 40 to 100 keV were reconstructed using first and second-generation monoenergetic algorithms (Syngo DE Monoenergetic and Monoenergetic Plus, respectively). Noise and tumor-to-liver contrast-to-noise ratio (CNR) were calculated and compared among different reconstructed datasets. The effect of patient’s effective diameter on lesion CNR was also assessed. P-values were obtained for paired difference using generalized estimating equations (GEE) to account for multiple lesions per patient.

RESULTS
Noise was significantly lower and tumor-to-liver CNR significantly higher between 40 and 60 keV energies using a second- compared to a first-generation monoenergetic algorithm (P <.001 for all comparisons). The highest tumor-to-liver CNR was achieved using the second-generation monoenergetic algorithm at 40 keV, with an approximately 25% improvement in CNR compared to a first-generation algorithm at the optimal energy of 70 keV (Mean [SD] = 4.99 [1.70] vs. 3.80 [2.40]; P <.001). Our data showed that patient body size did not significantly affect the selection of the optimal monoenergetic level using the second-generation monoenergetic algorithm. This is in contrast with the significant impact of body size in the selection of the optimal energy level with the first-generation algorithm.

CONCLUSION
The second-generation monoenergetic algorithm significantly improves the conspicuity of hypervascular liver tumors compared to a first-generation algorithm, while simultaneously decreasing the variability introduced by patient’s body weight in selecting the optimal monoenergetic level.

CLINICAL RELEVANCE/APPLICATION
A second-generation monoenergetic algorithm improves the conspicuity of hypervascular liver tumors and may streamline the workflow of DECT by decreasing the variability related to patient’s body size.

RC509-08  Dual Energy CT

Wednesday, Dec. 2 10:10AM - 10:30AM Location: E350

Participants
Alvin C. Silva, MD, Scottsdale, AZ (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss the basic principles and different approaches for Dual-Energy CT. 2) Review common Dual-Energy CT post-processing displays. 3) Describe strategies for implementing Dual-Energy CT in clinical practice.

ABSTRACT
RC509-09  Variability and Effect of Degree of Enhancement on CT Attenuation Measurements in Virtual Unenhanced Images Generated from Fast Kilovoltage Switching Dual-energy CT Using Iodine Material Suppression Algorithm

Wednesday, Dec. 2 10:30AM - 10:40AM Location: E350

Participants
Evan A. Raff, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Ravi K. Kaza, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
RESULTS

Overall, VUE and TUE measurements were not significantly different (p=0.29), and there was a very strong correlation between VUE and TUE CT numbers in both post-contrast phases (CM: r=0.91, NG: r=0.93, p<0.001). The mean difference between TUE and VUE images was 1 HU (95% CI: -7 to +9 HU) for CM phase imaging and 2 HU (95% CI: -6 to +10 HU) for NG phase imaging. Discrepancies ≥5 HU occurred 36 times (25%, 36/145) in the CM phase and 33 times (23%, 33/145) in the NG phase. Discrepancies ≥10 HU were rare in both phases (n=4 [CM], n=2 [NG]). Inter-phase VUE imaging differed by a mean of 0.7 HU (95% CI: -7 to +8 HU) between the CM and NG phases in the same subject, with 26 discrepancies ≥5 HU (18%, 26/145) and 3 discrepancies ≥10 HU (2%, 3/145). There was no significant correlation between the degree of enhancement and the magnitude of VUE-TUE discrepancies (r = 0.23).

CONCLUSION

CT numbers on VUE images generated from fast kilovoltage switching dual-energy CT scans have a very strong positive correlation to TUE CT numbers and are similar on a population level, but vary on a per-patient level.

CLINICAL RELEVANCE/APPLICATION

Discrepancies in TUE and VUE measurements of 5-9 HU are common and may affect enhancement calculations that rely on VUE data.

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Katherine E. Maturen, MD - 2014 Honored Educator


Wednesday, Dec. 2 10:40AM - 10:50AM Location: E350

Participants

Amir Borhani, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Alessandro Furlan, MD, Pittsburgh, PA (Abstract Co-Author) Author, Reed Elsevier; Research Grant, General Electric Company
Mark A. Sparrow, MD, Pittsburgh, PA (Presenter) Nothing to Disclose
Matthew H. Kulzer, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Mitchell E. Tublin, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Negar Iranpour, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE

GSI Assist (GE®) is an automated software which helps with selection of optimal dual-energy CT (DECT) scan parameters based on patient’s size and desired level of noise. This software uses scout-based attenuation characteristics to select an appropriate preset that will match (within 20%) the dose of a single-kvp CT scan (SECT). The purpose of this study is to evaluate the radiation dose when using GSI Assist for abdominal CT protocols and to compare the radiation dose of DECT with matched SECT.

METHOD AND MATERIALS

113 consecutive patients who underwent dual-energy CT of the abdomen, using a single source rapid kvp-switching DECT scanner (HD750 GE), were retrospectively reviewed. 43 patients (56 CT examinations) had matched SECT examinations (with comparable noise index, similar collimation, similar body part, and similar phase of contrast) within 2 years. The body part scanned, phase of study, absorbed dose (CTDIvol), dose-length product (DLP), effective dose (ED; using conversion factor of 0.015), body mass index (BMI), and weight were recorded for each scan. CTDIvol, DLP, and ED were compared between matched SECT and DECT examinations using paired t-test. Effect of weight, BMI, and phase of imaging on DECT radiation dose was also evaluated using linear regression analysis and Bland-Altman plot.

RESULTS

Mean CTDIvol and ED were 10.98 mGy (4.26-26.4; SD=5.95) and 7.68 mSv (2.1-21.2; SD=4.2) for DECT as compared to 11.6 mGy
(3.3-25.2; SD=7) and 7.9 mSv (1.7-20.6; SD=4.9) for matched SECT studies, respectively. These values were not statistically different (p=0.4 and 0.7, respectively). DECT radiation dose had significant correlation with patient's weight (R²=0.55; p<0.001) and BMI (R²=0.72; p<0.001), similar to SECT. Although DECT dose to patients with extreme weights (<65kg or >130kg) and extreme BMI (<18 or >30) was slightly higher, the correlation was not statistically significant (R² of 0.15 and 0.07, respectively).

CONCLUSION
There was no statistical difference between radiation dose of DECT and single-kvp CT when an automated software (GSI Assist) was used for optimal protocol selection. The average radiation dose from DECT was well below ACR reference level.

CLINICAL RELEVANCE/APPLICATION
Automated protocol selection software (GSI Assist) allows choosing the optimal abdominal CT technique on single-source dual-energy CT while maintaining the dose at the level of single-kvp CT dose.

RCS09-11 Advances in Oncologic Imaging
Wednesday, Dec. 2 10:50AM - 11:10AM Location: E350

Participants
Meghan G. Lubner, MD, Madison, WI (Presenter) Grant, General Electric Company; Grant, NeuWave Medical, Inc; Grant, Koninklijke Philips NV

LEARNING OBJECTIVES
1) Briefly define established size-related oncologic response criteria used in CT. 2) Discuss application of volumetric assessment of tumor burden at diagnosis and in assessing response to therapy. 3) Briefly describe selected examples of response assessment criteria looking at other tumor imaging characteristics such as tumor attenuation or enhancement in addition to size. 4) Examine CT tumor texture analysis as an additional tool to evaluate tumor heterogeneity at baseline and during therapy.

ABSTRACT

METHOD AND MATERIALS
A total of 24 cases were included. The most frequent mutations [single nucleotide polymorphisms (SNP)] found in a previous study with a cohort of 713 subjects of our institution, were analyzed. Five wild type (WT) tumors, 5 BRAF, 5 KRAS, 4 TP53 and 4 NRAS mutant (M) primary tumors were delineated and extracted from the pretreatment portal-venous phase 5mm slice thickness contrast enhanced CTs, creating a mask. For each phenotype we concatenated acquired texture energy measurements (TEV) for each slice of tumor to form a matrix (N by 9), where N is the number of slices. We computed more than 2000 pixels for each slice and, pixel spacing was normalized to 0.5 mm. Matrices were used for statistical analysis. Texture analysis was performed using software developed by the laboratory of medical imaging and computation from our institution which includes normalization, filtering, and calculation of texture energy in the primary tumors. Nine different texture energies were compared between genotypes using student T tests, Fisher's Exact Test was used to assess for statistical significance.

RESULTS
Significant differences were found on WT: M texture energy values (TEV)-3,4,5,8 and 9 at 59: 65, 41:47, 30: 37 and 31: 39 (p=0.005, 0.002 and <0.001 for the latter); on WT: KRAS on TEV-4,5,8 and 9 at 41: 46(p<0.001), 30: 39 (p<0.001), 63: 71 (p=0.003) and 31: 38 (p<0.001). WT: NRAS was significantly different for all TEV-1 through 9(p<0.001), at 724: 838 (16%), 268: 315(17%), 58: 77(33%), 40: 54(35%), 30:40 (31%), 303: 381(26%), 189: 236(25%), 63:78 (24%) and 31:44 (39%). NRAS was most significantly associated with TEVs greater than 16% of WT tumors (p<0.001).

CONCLUSION
Wild type tumors, KRAS and NRAS mutants were found to have distinct texture energy patterns compared with other tumors. WT showed significantly lower texture energy values than mutant tumors. NRAS was most significantly associated to high energy values relative to WT.

CLINICAL RELEVANCE/APPLICATION
Known associations of single nucleotide polymorphisms and clinical and imaging features play a pivotal role in treatment of colorectal cancer. Texture energy analysis is another tool for characterizing tumors using imaging data that can help us to guide genetic-driven biopsies and possibly treatments.

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Debra A. Gervais, MD - 2012 Honored Educator

**RCS09-13**  
**N-Staging in Primary Rectal Cancer: Can CT-Perfusion Differentiate between Malignant and Non-Malignant Pelvic Lymph Nodes? Preliminary Results from a Prospective, Blinded Feasibility Study Comparing CT-Perfusion Findings to Histopathology.**

**Participants**
Zahra Kassam, MD, London, ON (Presenter) Nothing to Disclose
Kyle Burgers, London, ON (Abstract Co-Author) Nothing to Disclose
Joanna Walsh, London, ON (Abstract Co-Author) Nothing to Disclose
Errol E. Stewart, PhD, London, ON (Abstract Co-Author) Nothing to Disclose
Pavlo Ohorodnyk, MD, London, ON (Abstract Co-Author) Nothing to Disclose
Barbara J. Fisher, MD, London, ON (Abstract Co-Author) Nothing to Disclose
Ting-Yim Lee, MSc, PhD, London, ON (Abstract Co-Author) Research Grant, General Electric Company Royalties, General Electric Company

**PURPOSE**

To determine whether CT-Perfusion has the potential to distinguish between malignant and non-malignant lymph nodes in patients with primary rectal cancer.

**METHOD AND MATERIALS**

18 patients with rectal cancer were evaluated preoperatively with CT-perfusion (CT-P). Dynamic CT-P of the pelvis was performed following IV contrast injection. All visible pelvic lymph nodes were categorized qualitatively by the radiologist as being positive or negative for malignancy. Wherever possible, the inguinal lymph nodes of each patient were used as internal negative controls. Analysis of the lymph nodes included: (1) Visual CT interpretation by the radiologist, (2) CT-Perfusion, and (3) Histopathology (standard of reference). The visual and CT-Perfusion analysis were done independently, by different reviewers. The lymph nodes were assessed for blood flow, blood volume, mean transit time and capillary permeability. Patients with T2 disease were treated surgically with total mesorectal excision (TME); while those with T3/4 or node-positive disease underwent neoadjuvant therapy, followed by repeat CT-P. The nodes within the TME specimen were organized into perirectal zones according to a pre-established regional lymph node map. Ultrastaging of the lymph nodes was performed at 2 mm sections. The pathologist was blinded to the imaging and perfusion results.

**RESULTS**

Visual interpretation yielded 100 abnormal and 68 normal nodes; sensitivity was 1.0 and specificity was 0.33. CT-P demonstrated a pattern of peripheral perfusion in malignant nodes, while reactive nodes demonstrated homogeneous perfusion. Overall blood flow in non-malignant nodes was significantly higher than in malignant nodes (p<0.000). Analysis revealed 31 abnormal and 104 normal nodes (some nodes could not be evaluated due to motion artifact). Sensitivity was 1.0 and specificity increased to 0.87. The lower size limit for technical lymph node evaluation by CT-P was 3.2 mm.

**CONCLUSION**

CT-Perfusion shows early promise in N-staging of primary rectal cancer, even in nodes <5 mm. Qualitative N-staging by conventional CT could potentially overstage disease.

**CLINICAL RELEVANCE/APPLICATION**

Accurate N-staging of small nodes by conventional imaging methods can be challenging. Early results suggest that N-staging by CT-Perfusion has the potential to positively impact patient management, in the settings of (1) Initial diagnosis, (2) Response to therapy, and (3) Assessment of recurrence.

**RCS09-14**  
**Dual Energy CT Utilization in Clinical Practice: Impact on Workflow and Radiation Doses**

**Participants**
Yasir Andrabi, MD, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose
Manuel Patino, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Rani S. Sewatkar, MBBS, Edison, NJ (Abstract Co-Author) Nothing to Disclose
Andrea Prochowski Ianuzzi, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Fanad Mehrkhani, 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 (Presenter) Research Grant, General Electric Company; Research Consultant, Allena Pharmaceuticals, Inc

**PURPOSE**

The growing demand for dual energy (DE) CT has introduced workflow challenges and radiation dose concerns. Therefore we studied the impact of increased DE CT utilization on the CT workflow and radiation doses of cancer FU exams performed in last 2 years.
METHOD AND MATERIALS

In this IRB approved retrospective analysis, 20,325 cancer FU CT exams (age=61.6 years, weight=76.8 kg) performed between Dec 2012 - Mar 2015 on 5 of our scanners (GE Healthcare=3, Siemens=2) were included. Two GE scanners (Discovery CT750 HD) have DE capability and iterative reconstruction algorithms (IRT; ASiR) and remaining 1 is a single energy (SE) scanner (Light Speed Pro) with FBP algorithm. Both Siemens scanners have IRTs (SAFIRE); DE is present on one scanner (Flash). Exams were stratified into 3 groups: Group1: DE exams (DE-GE, DE-Siemens), Group2: SE-FBP and Group3: SE-IRT (ASiR,SAFIRE). Radiation doses were retrieved and compared between different groups and National Averages.

RESULTS

The DE CT constituted 41% of all cancer FU exams (DE-GE=8089, DE-Siemens=208) compared to 59% SE exams (SE-FBP=2075; SE-ASiR=6647; SE-SAFIRE=3306). Three fold increases in DE CT utilization was noted (21% in 2012 and 67% in 2015) with an overall slight increase in the total number of CT exams performed on these scanners. The radiation doses for DE CT exams were substantially (47%) lower than National averages (DIR). Doses were comparable to SE-FBP exams (CTDI(mGy); Group1=10.6 (DE-GE=12.1, DE-Siemens=9.2); Group2=12.4;p>0.05) and nearly 13% higher than SE-IRT scans (Group3=9.3mGy(SE-ASiR=9.6,SE-SAFIRE=8.9); p<0.05). A16% reduction in DE-CT doses were noted in 2015 compared to 2012.

CONCLUSION

There is a threefold increase in the utilization of DE-CT exams for cancer FU exams from last 2 years. DE-CT radiation doses are substantially (47%) lower than national averages, comparable to our institutional SE-FBP cancer FU exams and 13% higher than our SE-IRT scans. There is also a 16% reduction in DE-CT doses from 2012.

CLINICAL RELEVANCE/APPLICATION

There is an increase in DE-CT utilization due to its growing clinical applications. These exams have different acquisition and postprocessing demands, thus, raising work flow and radiation dose concerns. Our study indicates that DE CT exams do not interfere with the work flow and the radiation doses are also in the acceptable range for diagnostic CT exams.

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

RC509-15 CT Workflow Issues

Wednesday, Dec. 2 11:40AM - 12:00PM Location: E350

Participants
Dushyant V. Sahani, MD, Boston, MA (Presenter) Research Grant, General Electric Company; Research Consultant, Allena Pharmaceuticals, Inc

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Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator
Participants
Hossein Jadvar, MD, PhD, Los Angeles, CA, (jadvar@med.usc.edu) (Moderator) Nothing to Disclose
David A. Mankoff, MD, PhD, Philadelphia, PA (Moderator) Speaker, Koninklijke Philips NV; Consultant, General Electric Company

LEARNING OBJECTIVES
1) Describe the kinetics of thymidine relevant to FLT PET imaging. 2) Discuss approaches to FLT image interpretation. 3) Describe studies that have tested FLT PET as a marker cancer response to treatment.

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David A. Mankoff, MD, PhD - 2013 Honored Educator

PURPOSE
CXCR4 is a chemokine receptor that is overexpressed in various human cancers and is involved in tumor metastasis. In this feasibility study we performed Positron Emission Tomography (PET) imaging of CXCR4 expression in patients suffering from various solid cancers.

METHOD AND MATERIALS
21 patients with histologically proven solid tumors underwent PET imaging using the novel CXCR4 nuclear probe [68Ga]Pentixafor. Maximum standardized uptake values (SUVmax) of the liver, spleen and bone marrow were measured for determination of physiological tracer distribution. For evaluation of in vivo CXCR4 expression on tumors, SUVmax and tumor-to-background ratios (T/B ratio) were determined in a total of 43 malignant lesions including 8 primary tumors, 3 local recurrent tumors and 32 metastases. When available, SUVmax of malignant lesions was compared to corresponding SUVmax measured in standard routine [18F]FDG PET.

RESULTS
Moderate tracer uptake was detectable in the liver, bone marrow and spleen with a mean SUVmax of 3.1, 3.7 and 5.6, respectively. By visual interpretation criteria, 9 of 11 primary and local recurrent tumors were detectable, exhibiting a mean SUVmax of 4.7 (range 2.1 to 10.9) and a mean T/B ratio of 2.9. 20 of 32 evaluated metastases were visually detectable (mean SUVmax of 4.5, range 3.2 to 13.8; mean T/B ratio of 2.8). Spearman’s correlation revealed a low correlation between SUVmax and number of lesions per patient (r=0.3). Compared to [18F]FDG PET obtained in 10 patients, tracer uptake in [68Ga]Pentixafor PET revealed a lower SUVmax in all measured lesions.

CONCLUSION
PET Imaging of CXCR4 in patients with solid cancers is feasible. Based on the experience gained within this small number of patients, SUVmax of malignant solid tumors seems to be lower in [68Ga]Pentixafor PET compared to [18F]FDG PET. Moreover, CXCR4 expression in solid malignancies seems to be highly heterogeneous depending on factors, that have to be elucidated in further studies.

CLINICAL RELEVANCE/APPLICATION
Once the areas of Pentixafor imaging are more clearly defined, PET imaging of CXCR4 might prove as a valuable modality, either as a
stand alone diagnostic tool, or in combination with [18F]FDG PET, i.e. when considering [68Ga]Pentixafor for monitoring CXCR4 directed pharmacological or endoradiotherapeutic treatment.

**RCS11-03** Dual-tracer (11C-acetate and 18F-FDG) PET/CT in Evaluating Gastrointestinal Stromal Tumors and Predicting the Mitotic Rate

**METHOD AND MATERIALS**

From 2013-14, 10 patients (M;7, F;3; mean age=63±17y) with primary GIST and 6 patients (M;5, F;1; mean age=66±13y) with metastatic GIST (primary excised previously) underwent preoperative ACT and FDG PET/CT. Postoperative pathology confirmed all primary/secondary GIST. The MiR was categorized as low (≤5/50) or high (>5/50 mitoses/50 high-power fields) according to the mitotic index recommended by NCCN guidelines. ROC curve analysis was performed to explore the relationship of lesion SUVmax to MiR for ACT and FDG, respectively.

**RESULTS**

10 lesions were found in 10 patients with primary GIST (stomach:5, small bowel:4, omentum:1): 3 with high and 7 with low MiR (size:14.2±11.2 vs 3.7±0.7cm). FDG PET/CT was positive in 7/10 (70%) but FN in 3/7 lesions with low MiR. ACT PET/CT was positive in 9/10 (90%) including all 3 FDG-negative lesions. 6 metastatic GIST patients presented with 11 lesions (liver:2, adrenal:1, retroperitoneal lymph node:1, peritoneum:7): 6 with high and 5 with low MiR. FDG PET/CT was positive in 8/11 (73%) but FN in 1/6 with high and 2/5 with low MiR. ACT PET/CT was positive in all metastatic lesions (11/11:100%). The incremental value of ACT over FDG is significant for primary and metastatic GIST with low MiR (both P<0.05). By ROC curve analysis, a FDG SUVmax cut-off value>=4.4 and 3.1 could differentiate lesions of high from low MiR for primary and metastatic GIST, respectively (AUC=0.905 vs 0.875, both P<0.05).

**CONCLUSION**

Metabolic avidity of GIST for FDG has a predictive value for cellular mitotic behavior, but with the disadvantage of FN for lesions having low MiR. ACT PET/CT has a distinct incremental value over FDG for detecting primary/metastatic GIST, but appears to be independent of mitotic behavior.

**CLINICAL RELEVANCE/APPLICATION**

ACT PET/CT has a high sensitivity for both primary and metastatic GIST, particularly for lesions with low mitotic rate and non-avid for FDG. FDG avidity, however, predicts mitotic behavior of GIST.

**RCS11-04** Monitoring Response to Antiangiogenic Therapy of Non-Small Cell Lung Cancer using 15O-water PET: The Relationship between Tumor Blood Flow and the Prognosis

**METHOD AND MATERIALS**

Bevacizumab (BEV) is a humanized monoclonal antibody that targets circulating vascular endothelial growth factor. The purposes of this study were to evaluate tumor blood flow in patients with non small cell lung cancer (NSCLC) before and after treatment of BEV using 15O-water PET and to examine the tumor blood flow change and time to tumour progression.

**RESULTS**

In 5 patients without BEV, median of tumor blood flow before and after treatment was 0.3506 and 0.3351, respectively. There was no significant difference (Wilcoxon test, p=0.81 ). Mean time to tumor progression after treatment was 80.4 days (range, 21 to 203). In 6 patients with BEV, median of tumor blood flow before and after treatment was 0.2785 and 0.1777, respectively. There was a significant difference (p=0.03). Mean time to tumor progression after treatment was 242.5 days (range, 86 to 413). The mean ratio (Fa/b) of tumor blood flow after BEV to that before BEV was 0.665 ml/cm³/min (range, 0.231 to 0.899). There was significant correlation between Fa/b and time to tumor progression (Correlation coefficient r=0.86, p=0.03): large decrease in blood
flow early after treatment of BEV was associated with short time to tumor progression.

CONCLUSION

Mean tumor blood flow decreased within 1-2 days after administration of BEV. Large decrease in blood flow early after treatment of BEV correlated with short time to tumor progression.

CLINICAL RELEVANCE/APPLICATION

The antiangiogenic therapy might not have a benefit for patients with large decrease in blood flow early after treatment of BEV.

**RC511-05 68Ga-PSMA-PET/CT in Patients with Renal Cell Cancer: Initial Results**

Participants
Lino Sawicki, MD, Dusseldorf, Germany (Presenter) Nothing to Disclose
Philipp Heusch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Christian Buchbender, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Markus Gr freezing, MD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Hubertus Hautzel, MD, Juelich, Germany (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

68Gallium (68Ga) labelled prostate specific membrane antigen (PSMA) positron emission tomography / computed tomography (PET/CT) has been shown to be a reliable imaging method for the detection of prostate cancer and its metastases. Immunohistochemic studies revealed that PSMA is also expressed in the neovasculature of other solid tumors, especially renal cell cancer (RCC), making these cancers a potential target for 68Ga-PSMA-PET imaging. The aim of this study was to explore the feasibility of 68Ga-PSMA-PET/CT for detection of RCC in patients.

METHOD AND MATERIALS

Three male patients (mean age 66 years; range 52 - 74) with primary or metastatic RCC (n=2 clear cell RCC; n=1 papillary RCC) prospectively underwent whole body 68Ga-PSMA-PET/CT (mean Mbq: 179,3; Scanner: Siemens Biograph mCT, Siemens Healthcare, Erlangen, Germany). Quantitative assessment of tracer uptake was performed 1 hour after injection (p.i.) by measuring maximum standard uptake values (SUVmax) using isocountour VOIs in histopathologically proven tumor lesions. Additionally, for each lesion tumor-to-background ratios were calculated.

RESULTS

All primary RCCs and known metastatic sites were detected by 68Ga-PSMA-PET/CT. Average SUVmax in clear cell and papillary RCC tumour lesions was 16.7 and 4.1, respectively. Mean tumor-to-background ratio was 18.6 for clear cell RCC lesions and was 4.1 for papillary RCC lesions.

CONCLUSION

Detection of primary tumors and metastases in RCC patients using 68Ga-PSMA-PET/CT is feasible. 68Ga-PSMA uptake is high in clear cell RCC but rather weak in papillary RCC. Thus the promising diagnostic potential of 68Ga-PSMA-PET/CT rather has to be investigated in clear cell RCC patients.

CLINICAL RELEVANCE/APPLICATION

Since RCCs have high metastatic potential exact staging is crucial. Imaging with CT, MRI but also 18F-FDG-PET/CT offers limited sensitivity. PET/CT using 68Ga-PSMA seems to be a promising alternative.

**RC511-06 Hypoxia Imaging: FMISO PET Imaging in Oncology**

Participants
Kenneth A. Krohn, PhD, Seattle, WA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the evolution of tumor hypoxia and its biological implications. 2) Identify the mechanistic changes in tumor biology that will result in tumor resistance and poor patient outcome. 3) Learn novel ways to image tumor hypoxia with focus on FMISO PET imaging. 4) Understand the potential approaches to overcoming the negative impact of hypoxia.

ABSTRACT

The physiological microenvironment for a tumor is largely dictated by abnormal vasculature and metabolism. Many solid tumors develop areas of hypoxia during their evolution caused by unregulated cellular growth, resulting in greater demand on oxygen for energy metabolism. Hypoxia induces a cascade of changes that reflects the homeostatic attempts (highly conserved evolutionally) to maintain adequate oxygenation that may result in tumor cells to adapt by developing more aggressive survival traits; mediated by Hypoxia Inducible Factor (HIF1a) part of the cellular oxygen sensing mechanism. Hypoxic tumors are not effectively eradicated with conventional doses of radiation and show resistance to several chemotherapy drugs. Hypoxia may also result in angiogenesis (itself a marker of tumor aggressiveness) mediated by Vascular endothelial growth factor (VEGF). While angiogenesis is a frequent consequence of hypoxia, some tumors develop extensive angiogenesis without the presence of hypoxia and vice versa. Advances in PET imaging instrumentation, coupled with the development of an increasing array of novel molecular probes, provide opportunities for imaging and selection of appropriate therapies to overcome the cure limiting effects of these two fundamental aspects of tumor microenvironment. The biology of tumor microenvironment related to hypoxia and its effect on patient outcome and developments in imaging technology for hypoxia imaging with a focus on F-18 FMISO would be reviewed. Challenges and novel treatments to overcome the cure limiting ability of hypoxia will be discussed.
Wednesday, Dec. 2 10:30AM - 11:00AM Location: S505AB

Participants
Hossein Jadvar, MD, PhD, Los Angeles, CA, (jadvar@med.usc.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review the major biological targets that may be useful for imaging in prostate cancer. 2) Understand the need for tailoring the imaging technique to the particular clinical phase of disease. 3) Analyze the current evidence with the potential utility of PET with various radiotracers in the imaging evaluation of prostate cancer.

ABSTRACT

Recent advances in the fundamental understanding of the complex biology of prostate cancer have provided increasing number of potential targets for imaging and treatment. In this presentation, I review the experience with a number of major PET radiotracers for potential use in the imaging evaluation of men with prostate cancer.

PURPOSE
To evaluate the additional value of 68Ga-DOTATATE-PET/CT compared to contrast-enhanced CT for primary tumor detection in cancer of unknown primary (CUP) of neuroendocrine origin.

METHOD AND MATERIALS
Patients (n=38, 27 male, 11 female, mean age 62 years) with histologically proven metastatic disease of neuroendocrine origin undergoing contrast-enhanced 68Ga-DOTATATE-PET/CT (Biograph 64, Siemens Healthcare, Erlangen, Germany) for primary tumor detection and staging were consecutively included in this retrospective study. Two blinded readers independently evaluated the separated contrast-enhanced CT and 68Ga-DOTATATE-PET data sets and noted from which of the two imaging modalities they suspected a primary tumor. In case of divergent blinded reading results, a consensus was reached. The final diagnosis, confirmed by either histopathology (n=24) or clinical follow-up (n=14), served as standard of reference.

RESULTS
Primary tumors were suspected in n=33 patients, localized in the small bowel (n=19), the pancreas (n=12), the lung (n=1), and the thyroid gland (n=1) (mean tumor-to-spleen ratio 1.10±0.69; PET/CT: true positive n=30, true negative n=3; CT: true positive n=20, true negative n=5). In n=4 patients, no primary tumor was identified (true negative n=3). N=10 primary tumors were correctly detected by PET but not contrast-enhanced CT, resulting in a diagnostic accuracy of 87 % for the fused 68Ga-DOTATATE-PET/CT, compared to 66 % for the contrast-enhanced CT alone. High interobserver agreement was noted regarding the localization of the primary tumor (Cohen's k 0.90, p<0.001).

CONCLUSION
68Ga-DOTATATE-PET/CT provides a significantly higher diagnostic accuracy for primary tumor detection in CUP of neuroendocrine origin as compared to contrast-enhanced CT alone.

CLINICAL RELEVANCE/APPLICATION
The present study provides evidence for the routine use of 68Ga-DOTATATE-PET/CT in neuroendocrine CUP, allowing for a comprehensive tumor staging at improved diagnostic accuracy as compared to standard whole-body imaging.

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S505AB

Participants
Philipp M. Kazmierczak, MD, Munich, Germany (Presenter) Nothing to Disclose
Axel Rominger, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Christine Spitzweg, Munich, Germany (Abstract Co-Author) Advisory Board, Novartis AG; Advisory Board, Pfizer Inc; Advisory Board, Ipsen SA; Speaker, Novartis AG; Speaker, Pfizer Inc; Speaker, Ipsen SA
Christoph Auernhammer, MD, PhD, Munich, Germany (Abstract Co-Author) Research Grant, Novartis AG; Speaker, Novartis AG; Research Grant, Ipsen SA; Advisory Board, Novartis AG
Maximilian F. Reiser, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Clemens C. Cyran, MD, Munich, Germany (Abstract Co-Author) Research Grant, Bayer AG Research Grant, Novartis AG Speakers Bureau, Bayer AG
Carsten Rist, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the additional value of 68Ga-DOTATATE-PET/CT compared to contrast-enhanced CT for primary tumor detection in cancer of unknown primary (CUP) of neuroendocrine origin.

METHOD AND MATERIALS
Patients (n=38, 27 male, 11 female, mean age 62 years) with histologically proven metastatic disease of neuroendocrine origin undergoing contrast-enhanced 68Ga-DOTATATE-PET/CT (Biograph 64, Siemens Healthcare, Erlangen, Germany) for primary tumor detection and staging were consecutively included in this retrospective study. Two blinded readers independently evaluated the separated contrast-enhanced CT and 68Ga-DOTATATE-PET data sets and noted from which of the two imaging modalities they suspected a primary tumor. In case of divergent blinded reading results, a consensus was reached. The final diagnosis, confirmed by either histopathology (n=24) or clinical follow-up (n=14), served as standard of reference.

RESULTS
Primary tumors were suspected in n=33 patients, localized in the small bowel (n=19), the pancreas (n=12), the lung (n=1), and the thyroid gland (n=1) (mean tumor-to-spleen ratio 1.10±0.69; PET/CT: true positive n=30, true negative n=3; CT: true positive n=20, true negative n=5). In n=4 patients, no primary tumor was identified (true negative n=3). N=10 primary tumors were correctly detected by PET but not contrast-enhanced CT, resulting in a diagnostic accuracy of 87 % for the fused 68Ga-DOTATATE-PET/CT, compared to 66 % for the contrast-enhanced CT alone. High interobserver agreement was noted regarding the localization of the primary tumor (Cohen's k 0.90, p<0.001).

CONCLUSION
68Ga-DOTATATE-PET/CT provides a significantly higher diagnostic accuracy for primary tumor detection in CUP of neuroendocrine origin as compared to contrast-enhanced CT alone.

CLINICAL RELEVANCE/APPLICATION
The present study provides evidence for the routine use of 68Ga-DOTATATE-PET/CT in neuroendocrine CUP, allowing for a comprehensive tumor staging at improved diagnostic accuracy as compared to standard whole-body imaging.

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S505AB

Participants
Jonas C. Apitzsch, MD, Marburg, Germany (Presenter) Nothing to Disclose
Dirk R. Albus, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Z. Erdem, Zonguldak, Turkey (Abstract Co-Author) Nothing to Disclose
Ökay Erdem, MD, Zonguldak, Turkey (Abstract Co-Author) Nothing to Disclose
Florian Behrendt, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Andreas H. Mahnken, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Alexander Heinzel, Aachen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

RC511-08 Primary Tumor Detection in CUP of Neuroendocrine Origin: Additional Value of 68Ga-DOTATATE-PET/CT Compared to Contrast-enhanced CT

RC511-09 Do we Need High-Dose Contrast-enhanced CT in the Detection of Extra-hepatic Metastases using Gallium-68-DOTATATE-PET/CT in Patients with Neuroendocrine Tumors (NET)?
Previous studies have shown that PET/CT with 68Ga-labeled somatostatin analogues is useful in the assessment of metastatic disease in patients with neuroendocrine tumors especially with regard to extra-hepatic lesions. It has to be noted that PET in combination with full-dose contrast-enhanced CT (ceCT) exposes the patients to a high dose of radiation whereas the non-contrast-enhanced low-dose CT (ldCT) might reduce the radiation and may in addition avoid side effects such as allergic reactions. Thus, we aimed to determine whether ceCT can be omitted from assessment for extra-hepatic metastases in patients with NET.

**METHOD AND MATERIALS**

We retrospectively compared the performance of PET/ldCT and PET/ceCT in 54 patients (26 male, 28 female) who underwent a Gallium-68-DOTATATE-PET/CT in our clinic. Selection criteria were as follows: available ldCT and ceCT; histologically confirmed NET; available follow-up of at least 6 months (median 12.6 months; range 6.1-23.2). PET/ldCT and PET/ceCT images were analyzed separately by four experienced physicians. The review process focused on metastases to lungs, bones and lymph nodes. Afterwards, the PET/ldCT and PET/ceCT results were compared to the reference standard consisting of clinical follow-up data to evaluate the diagnostic accuracy.

**RESULTS**

In PET/ceCT 139 true positive bone-lesions were detected compared to 140 in PET/ldCT, 106 true positive lymph node metastases (PET/ceCT) vs. 90 (PET/ldCT) and 26 true positive lung lesions (PET/ceCT) whereas PET/ldCT found ?? true positive lung lesions. On a per patient basis ld and ce PET-CT achieved similar sensitivity (both 100%) however, specificity was lower for PET/ldCT (89% vs. 77%). For lymph nodes PET/ceCT showed superior sensitivity and specificity (sensitivity 92% vs. 80% and specificity 83% vs. 65%). For the detection of pulmonary lesions the sensitivity of PET/ldCT was also clearly inferior (23 vs 100%) while specificity was similar (94% vs. 93%).

**CONCLUSION**

These results represent first evidence that ceCT should not be omitted for extra-hepatic staging using Gallium-68-DOTATATE-PET/CT in patients with neuroendocrine tumors. However, the results need to be confirmed in a prospective trial.

**CLINICAL RELEVANCE/APPLICATION**

PET/ldCT is sufficient in the detection of extrahepatic metastatic disease in NET. There is no further need for high-dose CeCT.

**RC511-10 PSA and PSA Kinetics in Predicting 18F-NaF PET Positivity for First Bone Metastases in Patients with Biochemical Recurrence after Radical Prostatectomy**

**Wednesday, Dec. 2 11:20AM - 11:30AM Location: S505AB**

**Participants**

James Yoon, BA, Los Angeles, CA (Presenter) Nothing to Disclose  
Leslie Ballas, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose  
Bhushan Desai, MBBS, MS, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose  
Lingyun Ji, MS, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose  
Susan Groshen, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose  
Hossein Jadvar, MD, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate PSA and PSA kinetics in addition to other pathologic factors to determine their predictive value for 18F-NaF PET positivity for first bone metastases in patients with biochemical recurrence after radical prostatectomy.

**METHOD AND MATERIALS**

All 18F-NaF PET scans that were performed at USC between 2010 and 2014 were queried to find patients who demonstrate biochemical recurrence after radical prostatectomy. Patients with known metastatic disease at the time of 18F-NaF PET were excluded. Records were reviewed to obtain data on PSA at the time of 18F-NaF PET, PSA kinetics, and pathologic features of the prostatectomy specimen, which were then used for receiver operating characteristic (ROC) analysis to determine predictability for 18F-NaF PET positivity.

**RESULTS**

36 patients met our inclusion criteria. Of these, 8 (22.2%) had positive 18F-NaF PET scans. Mean values for PSA, PSA doubling time, and PSA velocity were 2.02 ng/mL (range 0.06-11.7 ng/mL), 13.2 months, and 1.28 ng/mL/yr for 18F-NaF PET negative patients and 4.11 ng/mL (range 0.04-14.38 ng/mL), 8.9 months, and 9.06 ng/mL/yr for 18F-NaF PET positive patients (p=0.07, 0.47, and 0.02 respectively). ROC analysis for 18F-NaF positivity gave AUC values of 0.634 for PSA, 0.598 for PSA doubling time, and 0.568 for PSA velocity. ROC analysis with combined models gave AUC values of 0.718 for PSA and PSA doubling time, and 0.718 for PSA, PSA doubling time, and PSA velocity. There was no significant association found between 18F-NaF PET positivity and Gleason score, TN staging, and status of surgical margins.

**CONCLUSION**

18F-NaF PET detected first time osseous metastases in 22.2% of patients with PSA relapse. PSA velocity was the best single variable for predicting 18F-NaF PET positivity. Combining PSA with PSA doubling time or PSA with PSA doubling time and PSA velocity resulted in higher predictability than any variable independently.

**CLINICAL RELEVANCE/APPLICATION**

18F-NaF PET can detect early prostate cancer bone metastases in the post-prostatectomy setting.

**RC511-11 Bone PET Imaging: NaF PET in Oncology**

**Wednesday, Dec. 2 11:30AM - 12:00PM Location: S505AB**

**Participants**

Baris Turkbey, MD, Bethesda, MD (Presenter) Nothing to Disclose
LEARNING OBJECTIVES

1) To identify the advantages of F-18 NaF PET/CT in oncology 2) To understand the importance of a standardized imaging protocol and reporting for F18-NaF PET/CT 3) To become comfortable in differentiating benign lesions from malignant ones on F18-NaF PET/CT

ABSTRACT

F-18 NaF PET/CT has been shown to have higher sensitivity than planar 99m-Tc MDP bone scanning in several studies. The concomitant acquisition of anatomic images permits immediate correlation of any abnormal findings. Additionally, F-18 NaF PET/CT bone imaging can be quantitated, allowing bone disease to be ‘measureable’, increasing its utility therapy monitoring. When a consistent F-18 NaF uptake period is used, the SUV values are highly reproducible, and due to the high extraction fraction, high quality images can be obtained with a radiation dose exposure similar to that of Tc-99m MDP (including the low dose CT scan). This presentation will discuss the benefits and challenges of F-18 NaF PET/CT in oncology.

ABSTRACT

F-18 NaF PET/CT has been shown to have higher sensitivity and specificity than planar 99m-Tc MDP bone scanning in several small studies. The concomitant acquisition of anatomic images permits immediate correlation of any abnormal findings. Additionally, F-18 NaF PET/CT bone imaging can be quantitated, allowing bone disease to be “measureable”, increasing its utility therapy monitoring. When a consistent F-18 NaF uptake period is used, the SUV values are highly reproducible, and due to the high extraction fraction, high quality images can be obtained with a radiation dose exposure similar to that of Tc-99m MDP (including the low dose CT scan). This presentation will discuss the benefits and challenges of F-18 NaF PET/CT in oncology.
LEARNING OBJECTIVES

1) Understand the basic concepts behind iterative reconstruction algorithms. 2) Understand the differences between these methods and conventional reconstruction. 3) Appreciate the potential advantages and disadvantages of iterative methods.

ABSTRACT

For many decades, essentially all CT images have been reconstructed using an "analytic" algorithm, such as filtered backprojection. These methods are computationally efficient, allowing fast image reconstruction, and if the raw data are of high quality the images can be exact. As the dose is reduced or if there are deterministic errors in the data, analytic reconstruction may produce lower image quality than may be possible. Iterative reconstruction methods can build in knowledge of measurement noise and other errors and yield higher image quality. They can produce lower noise images in low dose settings and in some cases higher spatial resolution. Iterative methods are generally nonlinear, meaning that the image quality depends on the object being scanned. They also produce images whose properties are "non-stationary", meaning that the image quality can vary significantly across the image. Understanding these allows the user to best evaluate their performance and appropriately use them in clinical settings.

METHOD AND MATERIALS

Patients with FSGs underwent 2 CTA exams, one using a CT system with IR and improved spatial resolution (System A: Somatom Force, Siemens), and the other without IR (System B: Somatom Definition Flash or Sensation 64, Siemens). A kV selection/chart and identical slice thickness were used for both exams. Anonymized images from each system were reviewed by a 2 radiologists in side-by-side comparison, with readers specifying preference and rationale. In a separate session, readers evaluated each artery with a stent for stenosis (0=none to 3=>80%) and intraluminal artifacts (0=none to 4=non-diagnostic). Occlusion, in-stent neointimal hyperplasia, and kinks were also noted (present vs. not). Confidence for each parameter was recorded (0=uncertain to 9=completely confident). Slice-specific CTDIvol at the proximal portion of each artery was recorded from the DICOM header.

RESULTS

21 pts with FSGs having 73 vessels with stents (14 Celiac, 18 SMA, 41 renal) underwent CTA on both CT systems. System A used lower tube potentials across the study cohort. The slice-specific CTDIvol of System A was 10% lower than System B, mean intraluminal artifacts scores were lower for System A (1.8 vs. 2.1, p<0.01) and confidence for in-stent stenosis was higher (7.2 vs. 6.5, p<0.002). Otherwise, there was no
difference in artifact score, stenosis, occlusion, kink or artifact (p>0.34), except that System B had a higher confidence for neointimal hyperplasia (7.6 vs. 6.8, p=0.02).

CONCLUSION
Improved spatial resolution and IR were visually preferred in unblinded comparisons, and resulted in higher confidence for in-stent visualization at lower relative doses.

CLINICAL RELEVANCE/APPLICATION
Improved spatial resolution and IR can improve confidence and reduce stent-related artifacts at lower dose levels, which facilitates surveillance in patients with fenestrated endografts.

RC512-03  Assessment of Adamkiewicz Artery Using Low Dose Multi-detector Computed Tomography with Novel Iterative Model-based Reconstruction Technique
Wednesday, Dec. 2 9:05AM - 9:15AM Location: E352

Participants
Tae Hyun Nam, Seongnam-Si, Korea, Republic Of (Presenter) Nothing to Disclose
Eun Ju Chun, MD, PhD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyo Jin Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Bon Seoung Gu, Seongnam, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Soon Ahn Kwon, Seongnam-si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Gwan Hong Min, Seongnam-si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the visualization of the Adamkiewicz artery (AKA) on multi-detector computed tomography (MDCT) with novel iterative model-based reconstruction (IMR) in comparison to the iterative reconstruction (iDOSE) and filtered back projection (FBP) when the low dose CT protocol was applied.

METHOD AND MATERIALS
Forty patients (male 65.0%, mean age 65±16 years) with aortic aneurysm or dissection who underwent 256-slice MDCT with low dose CT protocol (100 kVp and 20 mA) were enrolled. Acquired raw data were reconstructed by using FBP, median level of iDOSE (iDOSE4) and IMR, and analyzed blindly by two observers. In the quantitative analysis, the signal-to-noise ratio (SNR) of the aorta and contrast-to-noise ratio (CNR) of the anterior spinal artery relative to the spinal cord were measured on multi-planar reformatted images. In qualitative analysis, the visualization of the AKA and its continuity with the intercostal or the lumbar artery were evaluated by using a four-point scale (1, poor to 4, excellent). The visualization scale of 3 or 4 was considered assessable. The one-way analysis of variance was used to evaluate the image quality of three reconstruction algorithm.

RESULTS
The interobserver agreement was good for SNR (k=0.94) and fair for CNR (k=0.73). In qualitative analysis, both SNR and CNR of IMR (SNR, 29.4±7.3; CNR, 4.8±1.7) were significantly higher than iDOSE (SNR, 20.3±6.2; CNR, 3.7±1.4) and FBP (SNR, 14.3±3.1, CNR, 3.2±1.2) (P<.05 for all comparisons). The visualization of AKA was also significantly better in IMR (3.7±0.9) from than iDOSE (3.0±0.9) and FBP (2.5±0.7) (p-value <.05). The prevalence of the assessable AKA was highest in IMR (87.5%) followed by iDOSE (70.0%) and FBP (42.5%) (p<0.05).

CONCLUSION
IMR algorithm led to improving the visualization of the AKA compared to the use of iDOSE and FBP when the low dose CT protocol was applied.

CLINICAL RELEVANCE/APPLICATION
Presurgical localization of the AKA is very important for protecting the spinal cord injury. As compared to iDOSE and FBP, novel IMR algorithm is helpful for evaluation of the AKA.

RC512-04  CT-angiography (CTA) with Low kV and Low Contrast Medium Volume Using a 256 Multi Detector CT Scanner (MDCT) in the Evaluation of Abdominal Aorta Disease: Diagnostic Efficacy and Radiation Dose Reduct
Wednesday, Dec. 2 9:15AM - 9:25AM Location: E352

Participants
Camillo R. Talei Franzesi, Milan, Italy (Presenter) Nothing to Disclose
Davide Ippolito, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose
Davide Fior, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose
Pietro A. Bonaffini, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose
Maria V. Schiavone, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose
Sandro Sironi, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
To reduce the radiation dose exposure and the contrast medium volume by using low-kV setting CT-angiography (CTA) protocol, in the evaluation of abdominal aorta disease.

METHOD AND MATERIALS
From January 2013 to December 2014, 60 patients (23 women and 37 men; mean age 64.2 years; range, 34-83 years) with abdominal aorta disease were prospectively enrolled in our study. All patients underwent 256 MDCT scan examination of abdominal aorta (Brilliance-ICT, Philips, NL). Thirty-four patients were evaluated using low-dose radiation protocol (100 kV; automated tube current modulation) and low-contrast volume (30 mL; 4 mL/s; 350 mgI/mL). Twenty-six patients, as control group, underwent standard CTA protocol (120 kV; automated tube current modulation), with 80 mL of contrast medium volume. Intravessels density
measurements (HU) were performed manually drawing a region of interest (ROI) in the lumen of abdominal aorta, renal arteries and common iliac arteries. The radiation dose exposure (dose-length product, DLP; CT dose index, CTDIvol) and the signal-to-noise-ratio (SNR) were calculated. The obtained data were then compared between the two groups and statistically analysed.

RESULTS

All exams reached high diagnostic quality, permitting to correctly visualize and evaluate the lumen and wall of the main aortic branches. In the study group higher density measurements were observed as compared to control group, in abdominal aorta (mean attenuation value 332 HU vs 318 HU), renal arteries (341 HU vs 305 HU) and common iliac arteries (324 HU vs 311 HU). No significant noise increase was observed in the study group (mean signal to noise ratio, SNR 14.3) in comparison to control group (SNR 18.2). A significant (p<0.05) reduction in radiation dose exposure was achieved using low-kV protocol (DLP 335 mGy*cm, CTDIvol 5.8 mGy), as compared to control group (DLP 973 mGy*cm; CTDIvol 19.4 mGy), with an overall radiation dose reduction of 65%.

CONCLUSION

Low kV protocol with low contrast medium volume allows reducing the radiation dose exposure, preserving the renal function, in the evaluation of patients with abdominal vascular disease.

CLINICAL RELEVANCE/APPLICATION

Low-kV protocol with low contrast media volume reduces the radiation exposure, preserving renal function and providing an effective tool for the evaluation of patients with abdominal vascular disease.

RCS12-05 Impact of Noise-Optimized Virtual Monochromatic Imaging at Third-Generation Dual-Source Dual-Energy CT Angiography of the Lower Extremity Run-off

Wednesday, Dec. 2 9:25AM - 9:35AM Location: E352

Participants

Julian L. Wichmann, MD, Charleston, SC (Presenter) Nothing to Disclose
Matthew R. Gildott, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, 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; ;
Ricardo Yamada, 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
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 assess the impact of a noise-optimized image-based virtual monochromatic imaging algorithm (VMI+) on objective and subjective image quality at third-generation dual-source dual-energy CT angiography (CTA) of the lower extremity run-off.

METHOD AND MATERIALS

We retrospectively evaluated dual-energy CTA studies of the lower extremity run-off in 48 patients (32 male, 16 female; mean age 63.3 ± 13.8 years) performed on a third-generation dual-source CT system. Images were reconstructed with standard linear blending (F_0.5) representing 120-kVp polychromatic acquisition, VMI+ and traditional monochromatic (VMI) algorithms at 40-120 keV energy levels in 10-keV increments. Vascular attenuation and image noise in 18 run-off artery segments were measured; signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated. Two observers used five-point scales to subjectively evaluate vascular attenuation and image noise.

RESULTS

Objective image quality metrics peaked in the 40 and 50 keV VMI+ series (SNR: 20.2 ± 10.7 and 19.0 ± 9.5, respectively; CNR: 18.5 ± 10.3 and 16.8 ± 9.1, respectively) and were significantly (all P <0.0001) higher compared to the corresponding 40 and 50 keV VMI series (SNR: 8.7 ± 4.1 and 10.8 ± 5.0; CNR: 8.0 ± 4.0 and 9.6 ± 4.9) and the standard linearly-blended F_0.5 datasets (SNR: 10.7 ± 4.4; CNR: 8.3 ± 4.1). Subjective assessment of attenuation was highest for the 40 and 50 keV VMI and VMI+ image series (range, 4.84-4.91), both superior to F_0.5 (4.67; P <0.0001). Corresponding subjective noise assessment was superior for 50 keV VMI+ (4.71; all P <0.0001) compared to corresponding VMI (2.60) and F_0.5 (4.11).

CONCLUSION

Image reconstruction with VMI+ at low keV levels (40-50 keV) improves objective and subjective image quality compared to traditional VMI and standard linear blending reconstructions at dual-energy CTA of the lower extremity run-off.

CLINICAL RELEVANCE/APPLICATION

Improved image quality using VMI+ may improve evaluation and diagnosis in lower extremity run-off dual-energy CTA cases with suboptimal vascular opacification and potentially facilitate reduction of iodine load.

RCS12-06 Salvage of Suboptimal CT Angiographic Studies Using Virtual Monoenergetic Images from Novel Spectral Detector CT Scanner

Wednesday, Dec. 2 9:35AM - 9:45AM Location: E352

Participants

Hamid Chalian, MD, Cleveland, OH (Presenter) Nothing to Disclose
Bahar Mansoori, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
To evaluate the ability of spectral detector CT (SDCT), a novel dual-layer technology to salvage suboptimal CT angiographic studies utilizing retrospectively generated virtual monoenergetic images.

**METHOD AND MATERIALS**

This study included 17 patients who had CTA on SDCT prototype (Philips Healthcare, Cleveland, OH, USA) and had a suboptimal study, defined as aortic attenuation < 200 HU. Monochromatic image sets were generated at 40, 50, 60, 70, 80 keV. Attenuation, noise, SNR and CNR were measured at ascending aorta (AA), descending aorta (DA), aortic root (AR), LAD, and left ventricle (LV).

Subjective evaluation of vascular enhancement, image noise and overall image quality were graded on a 5-point scale (1- Non diagnostic, 5- excellent) by cardiac imager. From the monoenergetic reconstructions, an ideal set was chosen, defined as the highest energy that provided a mean attenuation value of > 200 HU, while maintaining good image quality. At this ideal energy level, attenuation, noise, SNR and subjective image quality were compared to standard 120 kVp polychromatic study. Paired t-test was used for analysis of quantitative variables. Qualitative analysis was done using Chi-square test.

**RESULTS**

Mean attenuation in the conventional images was 175.9+/−55.9 HU, 188.9+/−70.4 HU, 178.2+/−67.1 HU, 164.6+/−60.1 HU, and 153.3+/−86.1 HU in the AA, DA, AR, LV, and LAD, respectively. With monochromatic images, there was improved attenuation at 40, 50, 60, 70, 80 keV levels (p value < 0.001 for all) in all patients. 50 keV image provided the best subjective image quality (4.1 vs. 1.5 on conventional images, p=0.017). Attenuation (175.9+/−55.9 vs. 334.7+/−126.8 HU, p<0.001), SNR (10.5+/−9.0 vs. 18.2+/−14.2, p<0.001) and CNR (16.0+/−13.9 vs. 25.4+/−20.2, p=0.001) of AA was significantly higher at 50 keV as compared to the conventional polychromatic images. Similar trends were seen in other structures. Attenuation, CNR, and SNR increased for 46.5%, 37.5%, and 41.5% at 50 keV compared to conventional 120 keV.

**CONCLUSION**

All suboptimal CTAs were salvaged using low monoenergetic reconstruction. At the optimal monoenergetic level, the attenuation, SNR, CNR and image quality were significantly higher than that of conventional polychromatic image.

**CLINICAL RELEVANCE/APPLICATION**

Suboptimal angiographic studies can be salvaged using SDCT, thus obviating the need for additional contrast and radiation.

**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

**RC512-07 Dual-energy and Low kVp CTA**

*Wednesday, Dec. 2 9:45AM - 10:10AM Location: E352*

**Participants**

Thomas Henzler, MD, Mannheim, Germany, (thomas.henzler@medma.uni-heidelberg.de) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) The lecture will review the technical background behind dual-energy CT and primarily acquired low kVp single energy CT angiography. 2) Advantages and disadvantages between dual energy CT angiography and low kVp CT angiography are discussed. 3) Practical advices for different CTA protocols are given. 4) The clinical impact of the techniques regarding radiation dose reduction as well as contrast medium reduction will be discussed.

**RC512-08 Implications for Contrast Medium Delivery**

*Wednesday, Dec. 2 10:20AM - 10:45AM Location: E352*

**Participants**

Dominik Fleischmann, MD, Palo Alto, CA (Presenter) Research support, Siemens AG;

**LEARNING OBJECTIVES**

1) Physics of kVp dependent attenuation of x-rays (see previous lecture). 2) Physiologic principles (rules) of early atrial enhancement following intravenous contrast medium injection. 3) Potential limitations and disadvantages of low-contrast protocols in clinical practice.

**ABSTRACT**

Advances x-ray tubes technology allow the routine use of lower kVp settings for CT data acquisition. Lower kVp increases the x-ray attenuation of iodine relative to soft tissues, with the potential to either increase vascular opacification for the same contrast medium volume, or decrease the total contrast medium volume while maintaining image contrast. Judicious selection and modification of contrast medium injection parameters requires not only a basic understanding of the physics of kVp-dependent x-ray attenuation of x-rays (see previous presentation in this course), but also a fundamental understanding or early arterial contrast dynamics, and the potential limitations of reducing contrast medium volume for a given cardiovascular CT exam.

**CONTRAST PHYSIOLOGY**

Early x-ray attenuation of iodine relative to soft tissues, with the potential to either increase vascular opacification for the same contrast medium volume, or decrease the total contrast medium volume while maintaining image contrast. Judicious selection and modification of contrast medium injection parameters requires not only a basic understanding of the physics of kVp-dependent x-ray attenuation of x-rays (see previous presentation in this course), but also a fundamental understanding or early arterial contrast dynamics, and the potential limitations of reducing contrast medium volume for a given cardiovascular CT exam.
This IRB approved clinical trial was designed in three phases. A total of 105 patients with AAA, scheduled for a follow-up CTA were included in the study. The primary purpose of the study was to assess the performance of abdominal angiography with ssDECT using standard- (33 to 35g), low- (21 to 24g) and ultra-low- (16g) contrast media protocols.

METHOD AND MATERIALS

In this prospective, IRB approved study, 190 patients (69.6±11.3 years) undergoing thoracoabdominal CTA with ATVS were included. Intravenous contrast media (CM) volume was adapted based on iodine attenuation curves derived from a phantom study and depending on automatically selected tube voltages (range: 80-110kVp at 10kVp intervals). CM volume and injection rate decreased at a maintained bolus length from 110kVp (68 ml@3.6 ml/s) to 80kVp (33 ml@1.8 ml/s). Subjective image quality was assessed by three blinded, independent readers. Objective image quality (aortic attenuation and contrast-to-noise ratio [CNR]) was determined. Volume CT-dose-index (CTDIvol) and size-specific dose estimates (SSDE) were recorded. Cohen's kappa was calculated to evaluate inter-reader agreements. Linear regression was used to assess relationships between selected tube voltage and aortic attenuation/CNR.

RESULTS

62 Patients were imaged at 80kVp, 84 at 90kVp, 33 at 100kVp and 11 at 110kVp. Agreements between the three readers were good for subjective image quality (κ = 0.691). Diagnostic image quality was achieved in 96.9% of scans. Scans at 80kVp showed mean aortic attenuation of 330±54HU, at 90kVp 325±54HU, at 100kVp 336±74HU and at 110kVp 387±62HU. CNR values were as follows: 80kVp 15±4, 90kVp 15±4, 100kVp 14±4 and 110kVp 15±4. Linear regression analysis showed no significant correlation between selected tube voltage and mean aortic attenuation (p= 0.108) and between selected tube voltage and CNR (p=0.795). Mean CTDI was 3.50±0.83mGy and mean SSDE was 4.08±0.72mGy.

CONCLUSION

Individualized adaptation of the CM volume and injection rate to automatically selected tube voltages using ATVS allows for a reduction of CM in CTA of the aorta, while maintaining a constant and diagnostic image quality.

CLINICAL RELEVANCE/APPLICATION

Contrast media can be reduced in an individualized fashion according to the automatically selected tube voltage for CTA of the aorta.
enrolled. Each subject had a standard-iodine dose CTA. The follow-up CTA was performed on a ssDECT scanner (Discovery CT750 HD; GE Healthcare), with DECT mode and Iodixanol (GE Healthcare) as follows: Phase 1) 35 patients were scanned with standard-iodine dose (33 to 35g). Phase 2) 64 patients were scanned with 30%-reduced iodine dose (21-24g). Phase 3: 10 patients were scanned with 55%-reduced iodine dose (16g). Virtual monochromatic images (VMC) (40, 50, 60 and 70keV) were generated from arterial-phase DECT images. Two experienced-radiologists evaluated the VMC images for image quality, diagnostic keV-range, optimal keV for vascular assessment, and vascular evaluation. Aortic attenuation was measured and contrast-to-noise-ratio (CNR) was calculated from SECT and VMC images. CTDi without and DLP were measured and recorded. Statistical analysis was conducted with pair student t-test.

RESULTS
Standard, low and ultra-low-dose DE-CTA exams were rated as high diagnostic quality by the readers (IQ=4.5, 4.2 and 4, respectively). VMC (40 to 70 keV) images were rated diagnostic, and 40 to 50keV were rated optimal for vascular evaluation for all 3 groups. Compared to SE-CTA images, intravascular attenuation and CNR on 40-50keV DECT images were higher at standard (3X/35%), low (2X/30%) and ultra-low (2X/20%) iodine dose (p<0.001). Both readers detected 18/18 endoleaks on the DECT scans. Radiation dose was 20-30% lower on DE-CTA, compared to SE-CTA (p<0.05).

CONCLUSION
DECT increases intravascular attenuation and CNR enabling substantial iodine dose reduction, compared to SECT. Ultra-low iodine dose DE-CTA is feasible without reduction in diagnostic quality.

CLINICAL RELEVANCE/APPLICATION
DECT allows substantial reduction of iodine dose for CT angiography while rendering high quality images, providing an opportunity to decrease contrast media related renal risks, especially in older patients. These results can be applied to other vascular regions.
Our study demonstrates the clinical feasibility of deformable, motion-coherent modeling based on ECG-gated MDCT angiography.

CONCLUSION

pressure gradients within the aorta. Axial deformation was dependent on the magnitude of passing blood volume. Inverse correlation a significant trend towards an increase in axial deformation was observed with progressive increase in heart rate (R2= 0.79), as well as longitudinal (R2= 0.95) and axial strain (R2= 0.31) was noted.

RESULTS

One hundred fifty-four patients were categorized as having severe aortic stenosis with a mean flow rate of 4.7 ± 0.6 mL/s; 96 patients were categorized with mild to moderate aortic stenosis with a mean flow rate of 3.5 ± 0.6 mL/s. Inverse correlation of VPCT with serological parameters in treated periaortitis patients suggests a potentially increased role for VPCT displaying serologically ‘occult’ disease activity. For the first time the use of a new imaging technique for diagnosis and assessment of disease activity in patients with treated and untreated aortitis and periaortitis is reported. The weak correlation with serological markers in treated periaortitis suggests a potentially increased role for VPCT displaying serologically ‘occult’ disease activity.

CLINICAL RELEVANCE/APPLICATION

For the first time the use of a new imaging technique for diagnosis and assessment of disease activity in patients with treated and untreated periaortitis was performed using the PhyZiodynamic framework. The complex aortic motion was dissected into three types of aortic wall translocation, namely longitudinal strain, axial strain, and axial deformation by utilizing exported four-dimensional coordinates for seven anatomic locations, using the Matlab environment.

METHOD AND MATERIALS

For this IRB-approved, HIPAA-compliant prospective study we employed thoracic ECG-gated dual-source MDCT angiography (CTA) datasets from 250 consecutive patients (150 men,100 women;mean age, 79.0 ± 9.1 years), who prospectively underwent CTA and echocardiography on the same day. Deformable, motion coherent modeling of aortic wall stress was performed using the PhyZiodynamic framework. The complex aortic motion was dissected into three types of aortic wall translocation, namely longitudinal strain, axial strain, and axial deformation by utilizing exported four-dimensional coordinates for seven anatomic locations, using the Matlab environment.

RESULTS

One hundred fifty-four patients were categorized with mild to moderate aortic stenosis with a mean flow rate of 4.7 ± 0.6 mL/s; 96 patients were categorized with mild to moderate aortic stenosis with a mean flow rate of 3.5 ± 0.6 mL/s. Inverse correlation between heart rate and longitudinal strain (R2= 0.79), as well as longitudinal (R2= 0.95) and axial strain (R2= 0.31) was noted. In contrast, a significant trend towards an increase in axial deformation was observed with progressive increase in heart rate (P<.001). These findings indicated that shorter R-R interval may limit aortic motion in the longitudinal and axial planes due to inherent aortic wall rigidity. Increased aortic blood flow in the ascending aorta led to significantly greater longitudinal strain throughout the cardiac contraction cycle (P<.001), whereas increasing aortic valve areas led to significantly increased magnitudes in axial deformation (P<.001). Longitudinal strain propagating through the aortic wall was predominantly dependent upon the pressure gradients within the aorta. Axial deformation was dependent on the magnitude of passing blood volume.

CONCLUSION

Our study demonstrates the clinical feasibility of deformable, motion-coherent modeling based on ECG-gated MDCT angiography.

PURPOSE

To evaluate the role of CT perfusion-based assessment of inflammatory activity in patients with treated and untreated aortitis and chronic periaortitis (A/CP) and to compare results with those of clinical and serological markers.

METHOD AND MATERIALS

35 patients (20 female, 15 male) with aortitis/chronic periaortitis (A/CP) and clinical symptoms were examined by whole-body contrast-enhanced computed tomography (CECT) and subsequently by segmental volume perfusion-CT (VPCT) for assessment of the degree of vascularization of A/CP as surrogate marker for inflammatory activity. Blood flow (BF), blood volume (BV), volume transfer constant (k-trans), time to peak (TTP) and mean transit time (MTT) were determined and the thickness of the increased connective tissue formation was measured. Imaging data was subsequently correlated with clinical symptoms as well as with acute phase inflammatory parameters (C-reactive protein/CRP, erythrocyte sedimentation rate/ESR and leukocyte number).

RESULTS

21/35 patients were untreated, 14/35 had previous of ongoing immunosuppression. The interobserver agreement was good (0.78) for all VPCT parameters. Average values of perfusion parameters were higher in untreated patients, but remained also abnormally elevated in treated patients. Good agreement was found between perfusion data and CRP as well as ESR in aortitis (treated and untreated; p < 0.05) and in untreated patients with periaortitis (p<0.05).

CONCLUSION

Perfusion-CT parameters in untreated aortitis and periaortitis show good correlation with serological markers with respect to disease activity assessment. In treated periaortitis, however, correlations with serological markers were week or inexistent suggesting an increased role for (perfusion-based) imaging.
acquisition for regional mapping aortic wall stress.

**CLINICAL RELEVANCE/APPLICATION**
Regional mapping of aortic wall stress may provide more objective information on quiescent landing zones suitable for deploying aortic prosthetic grafts, as well as providing insights on atherosclerotic changes of aortic wall.

**RC512-14  Post Processing, Workflow and Interpretation**

Wednesday, Dec. 2 11:35AM - 12:00PM Location: E352

Participants
Karin E. Dill, MD, Evanston, IL (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**
1) Understand the newest post processing techniques currently available for CT angiography. 2) Describe patient-centric imaging and workflow tools which optimize patient care.

**ABSTRACT**
Rapid evolution of imaging post-processing tools allows for continued advancement in the ability to manipulate data for image interpretation. The newest CTA post processing software will be demonstrated, leading to improved diagnostic capability. Efficient workflow algorithms will be reviewed which center around the patient, bringing multidisciplinary teams together in the workup, diagnosis and treatment of those seeking care. An emphasis will be placed on imaging guidelines which will ultimately be linked to decision support for reimbursement.
LEARNING OBJECTIVES

1) To comprehend the basic physical principles of dual-energy CT (DECT).
2) To review the current clinical potential applications of DECT in thoracic imaging.

ABSTRACT

There are different methods by which dual-energy CT images can be generated. The advantages of DECT technique are twofold: 1) Low kilovoltage imaging with increased iodine conspicuity (based on increased photoelectric interactions) is especially useful for evaluation of vascular structures. 2) Material specific post-processing allows material differentiation (based on the differential CT attenuation of selected substances at two different energies), which can be tailored for each particular clinical indication, for example to evaluate for contrast enhancement in pulmonary nodules. The current potential clinical applications of DECT in thoracic imaging include evaluation of pulmonary arteries, aorta, pulmonary nodules, pleural masses and airways disease.

LEARNING OBJECTIVES

1) To describe the basic principles of DECT imaging.
2) To explain how post-processing is practised.
3) To discuss radiation exposure issues.
4) To critically appraise the strengths and weaknesses of the technique in oncologic imaging.
5) To comment on the contribution of DECT imaging in oncologic patients management.

ABSTRACT

Dual Energy CT (DECT) is an innovative imaging technique, whose basic principle is the application of two distinct energy settings making able to distinguish materials with different molecular composition on the basis of their attenuation profiles and thus operating a transition from density based image to spectral imaging. DECT applications are based on two distinct capabilities: 1) material differentiation, which means achieving material-specific imaging with separation of distinct materials, for example iodine, calcium, and uric acid, within an image obtained during a single examination and 2) material identification and quantification, which means accurate assessment of the presence and amount of iodine within a target lesion. In particular, with DECT acquisition multiple data-sets such as elemental decomposition analysis, iodinated density map, monochromatic images or virtual unenhanced images can be obtained simultaneously making the Radiologist able to address different diagnostic problems and improving lesion detection and characterization. These technical characteristics make DECT an innovative imaging modality particularly useful in oncologic imaging, having clear advantages in tumor detection, lesion characterization, evaluation of response to therapy, and detection of oncologic-related disease. In conclusion, DECT represents an innovative imaging technique, which can significantly impact on the management of oncologic patients.

LEARNING OBJECTIVES

1) Review the technique and principles of DECT and spectral imaging as it pertains to the musculoskeletal applications.
2) Demonstrate the musculoskeletal applications of DECT/spectral imaging in musculoskeletal imaging with an emphasis on the ability to diagnose and monitor progression of gout. 3) Display additional abilities and demonstrate imaging examples of DECT/spectral imaging for identification of bone marrow edema, soft tissue (tendon and ligamentous) injuries, reduction of metal artifacts and novel applications in the assessment of soft tissues. 4) Review the advantages and limitations of DECT compared to other imaging modalities for musculoskeletal imaging.

ABSTRACT

Dual energy CT and Spectral imaging are useful tools for musculoskeletal imaging. We will focus on the utility of this in the setting of musculoskeletal imaging of gout by demonstrating its ability to aid in diagnosis in challenging cases, delineate anatomy of crystal deposition disease, and monitor disease progression and treatment of the monosodium urate crystals. The audience will learn the utility of DECT/Spectral imaging for additional musculoskeletal applications such as characterization of acute bone marrow edema, identification of tendon and ligamentous injuries and reduction of metal artifacts using monoenergetic imaging.
Dialogue with The Joint Commission: New Diagnostic Imaging Standards for CT and MR

Wednesday, Dec. 2 8:30AM - 10:00AM Location: S404AB

CT MR HP

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

Participants
Ehsan Samei, PhD, Durham, NC (Director) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (Moderator) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (Presenter) Nothing to Disclose
Alec J. Megibow, MD, MPH, New York, NY (Presenter) Consultant, Bracco Group
Richard C. Semelka, MD, Chapel Hill, NC, (richsem@med.unc.edu) (Presenter) Research support, Siemens AG.; Consultant, Guerbet SA.
Fergus V. Coakley, MD, Lake Oswego, OR (Presenter) Nothing to Disclose
Andrea D. Browne, PhD, Oakbrook Terrace, IL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe areas addressed by the new and revised imaging standards. 2) Understand why The Joint Commission made changes to and/or revised the diagnostic imaging standards. 3) Describe how compliance with the new and revised imaging standards will be evaluated during the on-site survey. 4) Describe ways to demonstrate compliance with the new and revised imaging standards to promote patient safety and patient care.

ABSTRACT
This presentation will provide an overview of the new and revised diagnostic imaging standards. These new standards impact both Ambulatory Care and Hospital diagnostic imaging customers of the Joint Commission. Topics to be covered include: Background on the new and revised diagnostic imaging standards; an overview of the new and revised diagnostic imaging standards; a description of how compliance with the new and revised diagnostic imaging standards will be evaluated during the on-site survey. It will also provide practical insights and suggestions regarding implementation of the new and revised diagnostic imaging standards to promote patient safety and improve patient care in Joint Commission accredited organizations.
**Cardiac (Contrast Media)**

**Wednesday, Dec. 2 10:30AM - 12:00PM Location: S502AB**

**SSK03-01 Long-term Adverse Effects of Low-osmolar Compared with Iso-osmolar Contrast Media after Coronary Angiography: A Propensity Score Analysis**

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

**SSK03-02 Evaluation of Individually Body Weight Adapted Contrast Media Injection in Coronary CT-angiography**

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 and cardiovascular events beyond 90 days) 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.

**SSK03-02 Evaluation of Individually Body Weight Adapted Contrast Media Injection in Coronary CT-angiography**

Participants
Casper Mihl, MD, Maastricht, Netherlands (Presenter) Nothing to Disclose
Madeleine Kok, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Sibel Altintas, Maastricht, Netherlands (Abstract Co-Author) Nothing to Disclose
Bastiaan Ketelselaer, 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-
94kg; 95-109kg) and scan duration ('high-pitch: 1s; 'dual-step prospective triggering': 7s), as determined by contrast injection software (CertegraTM P3T, Bayer). Group 2 (n=124) received a standard fixed CM bolus; Iopromide 300mgI/ml; volume: 75ml; flow rate: 7.2ml/s. Contrast enhancement was measured in all proximal and distal coronary segments. Statistical analysis was performed using SPSS (IBM, version 20.0).

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±6m (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.

**SSK03-04** Impact of Contrast Media Iodine Dose on Radiation Induced DNA Damage after Cardiac CTA

Wednesday, Dec. 2 10:50AM - 11:00AM Location: S502AB

Participants
Toon Van Cauteren, MSc, Brussels, Belgium (Presenter) Nothing to Disclose
Nico Buls, DSc, PhD, Jette, Belgium (Abstract Co-Author) Nothing to Disclose
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 1.1ml/kg, 0.93ml/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 extraction 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.

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 compliant 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. Indications 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.

PURPOSE
Lower volume of lower concentration isotonic contrast medium for 320-row detector coronary CT angiography
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 50ml 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, BMIs 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).
PURPOSE

To compare the diagnostic accuracy of dynamic first pass CT perfusion (CTP) imaging and the transluminal attenuation gradient derived from coronary CT angiography in the assessment of coronary artery stenosis.

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.

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 1.3x1.3mm. 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 lPA) were automatically segmented after placement of seed points. Volumes for mPA, rPA and lPA 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 10484/3807 (p<0.001) and lPA 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 lPA AUC 0.889 (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 Gieske, DSC, Bonn, Germany (Abstract Co-Author) Employee, Koninklijke Philips NV
Hans H. Schidl, 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. RV and LV 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.
RESULTS

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.

METHOD AND MATERIALS

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).

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: 131ml±43; AP: 190ml±45; p<0.0001), slight decrease of LV-EF (baseline: 63%±10; AP: 58%±8; p=0.0112) and a consecutive increase of LV-ESV (baseline: 49ml±20; AP: 80ml±18; p<0.0001). FS as a parameter of regional function also decreased significantly during apnea (baseline: 35%±5; AP: 25%±5; p<0.0001). Flow measurement revealed an increase of blood-flow to the brain (left ACC; baseline: 5.0ml±2.0; AP: 12.4ml±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.

Is it Possible to Investigate Archeological Hearts Using CT and MRI? About Five Archeological Hearts

Participants

Fatima-Zohra Mokrane, MD, Toulouse, France (Presenter) Nothing to Disclose
Rozenn Collette, Cesson-Sevigne, France (Abstract Co-Author) Nothing to Disclose
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Anou Sewou, PhD, Toulouse, France (Abstract Co-Author) Nothing to Disclose
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Norbert Telmon, Toulouse, France (Abstract Co-Author) Nothing to Disclose
Fabrice H. Dedouit, MD, PhD, Toulouse, France (Abstract Co-Author) Consultant, Medtronic, Inc

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
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.

Atherosclerotic Plaque Burden Assessment: Coronary CT Angiography versus Invasive Coronary Angiography

Wednesday, Dec. 2 11:40AM - 11:50AM Location: S504AB

Participants
Pal Maurovich-Horvat, MD, PhD, Budapest, Hungary (Presenter) Nothing to Disclose
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Istvan Edes, Budapest, Hungary (Abstract Co-Author) Nothing to Disclose
Zsolt Bagyura, Budapest, Hungary (Abstract Co-Author) Nothing to Disclose
Bela Merkely, MD, PhD, Budapest, Hungary (Abstract Co-Author) Speakers Bureau, Medtronic Inc

PURPOSE

Strong relationship exists between atherosclerotic disease burden and risk for adverse events as assessed by coronary computed tomography angiography (CTA) and conventional invasive coronary angiography (ICA). Despite widespread use of CTA and ICA for coronary plaque burden assessment, few studies have compared coronary CTA and ICA regarding semi-quantitative plaque burden measurements.

METHOD AND MATERIALS

We enrolled 71 consecutive patients (mean age 60.8±11.7 yrs, 36.6% women) who underwent both 256-slice coronary CTA and conventional ICA within no more than 120 days. A total of 1016 coronary segments were evaluated for the presence of plaque and stenosis severity. On average, 32 [IQR:15-62.5] days passed between the two examinations. A total of 16 segments were excluded due to presence of a stent. We calculated the segment stenosis score (SSS), which describes the amount and severity of the stenosis (0-normal, 1-minimal, 2-mild 3-moderate 4-severe 5-occluded). The presence of plaques has been described by the segment involvement score (SIS) (0-intact, 1-plaque). The SSS index (SSSi)=SSS/all assessed segments and SIS index (SISi)=SIS/all assessed segments were also calculated. CTA and ICA scores were compared using Wilcoxon rank sum test (SPSS 22).

RESULTS

CT detected coronary artery plaques in 48.7% of all assessed segments (487/1000), whereas ICA showed coronary plaques in only 23.5% (235/1000) of 1000 segments (p<0.001). Importantly, CTA detected atherosclerotic plaque in 34.8 % (266/765) of coronary segments where the ICA was negative. Conversely, ICA detected plaques only in 2.7% (14/513) segments where CTA was negative. We found significant differences between the two methods for segment involvement and luminal stenosis indices, CTA versus ICA; SISi: 0.49±0.22 vs. 0.24±0.14 (p<0.001); SSSI: 1.17±0.64 vs. 0.67±0.50 (p <0.001).

CONCLUSION

Coronary CTA detected approximately twice as many coronary segments with atherosclerotic plaques as ICA. Our findings are in line with previous histological studies, according to which a significant number of plaques do not cause luminal stenosis. Using coronary CTA for atherosclerotic plaque burden assessment may allow for better risk stratification and improved patient outcomes.

CLINICAL RELEVANCE/APPLICATION

Coronary CTA for atherosclerotic plaque burden assessment may allow for improved risk stratification as compared to invasive coronary angiography.

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
SSK05

**Chest (Emphysema)**

Wednesday, Dec. 2 10:30AM - 12:00PM Location: S404CD

**SSK05-01 A New Subtype of COPD in Cigarette Smokers**

**Participants**

Brett M. Elicker, MD, San Francisco, CA (Moderator) Nothing to Disclose
Sanligo E. Rossi, MD, Capital Federal, Argentina (Moderator) Advisory Board, Koninklijke Philips NV Speaker, Pfizer Inc Royalties, Springer Science+Business Media Deutschland GmbH

**Method and Materials**

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.

**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.

**SSK05-02 Optimal Threshold for Quantification of Air-trapping Using Non-Rigid Image Registration of Inspiration/Expiration CT Scans in COPD**

**Participants**

Sang Min Lee, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Joon Beom Seo, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sang Min Lee, 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
Sang Young Oh, MD, 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 retrospectively investigate the optimal threshold for quantification of air-trapping using non-rigid registration of inspiration and expiration CT scans in COPD.
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 -856 HU 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 80 HU. As for RV/TLC, as threshold increased, the correlation coefficient decreased. The highest correlation coefficient was 0.664, using the threshold of 30 HU. 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 60 HU 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, Bracco Group
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 (DLCO/SB) 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 response 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 cross-sectional 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
RESULTS

In the 142 current smokers, in the 93 former smokers and in the 42 quitters PD15 g/l at T1 and 30 at T3, p<.0001. No functional tests and diffusion capacity demonstrated significant evolution in the 2 years of follow-up except FEV1/FVC (p=0.031). In the 950=13 at T1 and 13.5 at T3 (p<.0001); %RA-960 = 9.8 at T1 and 10.2 at T3, (p<.0001); %RA-910=29.2 at T1 and 29.5 at T3 (p<.0003). On the contrary, PD15 g/l decreased (33.4 at T1 and 30 at T3, p<.0001). No functional tests and diffusion capacity demonstrated significant evolution in the 2 years of follow-up except FEV1/FVC (p=0.031).

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.

SSK05-05 Different Progression of CT Defined Emphysema Depending of Trends in Smoking Habit in the ITALUNG Screening Trial

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S404CD

Participants

Chiara Romei, Pisa, Italy (Presenter) Nothing to Disclose
Barbara Conti, Pisa, Italy (Abstract Co-Author) Nothing to Disclose
Laura Caffiero, T3, Italy (Abstract Co-Author) Nothing to Disclose
Francesca Carozzi, Firenze, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Palla, Pisa, Italy (Abstract Co-Author) Nothing to Disclose
Fabio Falaschi, MD, Pisa, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate with low dose computed tomography (LDCT) densitometric analysis, changes in pulmonary emphysema over 2 years, in subjects with different trends in smoking habit enrolled in the ITALUNG trial of lung cancer screening.
decreased respectively from 38.2±20 at T1 to 39.2±17.4 at T3 (p<0.00504), 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<0.0001). 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.

SSK05-07 The Airway Remodelling and Emphysema Alteration as Determined by Quantitative CT Measurement: Correlations with the Frequency of COPD Exacerbation

Participants
Yu Guan, MD, Shanghai, China (Presenter) 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
We aimed to evaluate the change of airway remodelling and emphysema in COPD exacerbations as determined by quantitative CT measurement. We also 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.
analysis was performed to examine 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 bronchi 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 index in COPD exacerbations. The small airway alteration was associated with COPD exacerbations frequency.

CLINICAL RELEVANCE/APPLICATION

Quantitative CT can identify the change of small airway and emphysema of COPD exacerbations 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
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David A. Lynch, MBBSch, 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 Perc 15 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 RA 950 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.

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
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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 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

ISP: Gastrointestinal (Colon Cancer Screening and Staging)

Wednesday, Dec. 2 10:30AM - 12:00PM Location: E351

GI CT MR DI

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

FDA Discussions may include off-label uses.

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

SSK06-01 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 (Presenter) Consultant, Viatronix, Inc; Co-founder, VirtuoCTC, LLC; Medical Advisory Board, Digital ArtForms, Inc; Stockholder, Cellectar Biosciences, Inc

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 58-60 years, living in the Piedmont Region, Italy and in Verona, Italy. Individuals with a history of CRC/adenomas, inflammatory bowel disease, recent colonoscopy, or 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: 1.37-3.18; 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). Polyp 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**
Yoon Joo Shin, MD, Seongnam, Korea, Republic Of (Presenter) Nothing to Disclose
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
Ji Hoon Park, MD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Research Grant, Bracco Group
Kyoung Ho Lee, MD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ji Ye Sim, MD, MS, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**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**
Bryan D. Pooler, MD, Madison, WI (Presenter) Nothing to Disclose
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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

**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 57.24±7.7 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.

**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

**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 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**

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.
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

Participants
Mitsuru Sato, Maebashi, Japan (Presenter) Nothing to Disclose
Toshihiro Ogura, PhD, Maebashi, Japan (Abstract Co-Author) Nothing to Disclose
Mika Okajima, Gunma, Japan (Abstract Co-Author) Nothing to Disclose
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Mikio Hasegawa, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Kunio Doi, PhD, Chicago, IL (Abstract Co-Author) Shareholder, Hologic, Inc; License agreement, Hologic, Inc; License agreement, Deus Technologies, LLC; License agreement, Riverain Technologies, LLC; License agreement, Mitsubishi Corporation; License agreement, MEDIAN Technologies; License agreement, General Electric Company; License agreement, Toshiba Corporation; Research support, Deus Technologies, LLC; Research support, E. I. du Pont de Nemours & Company; Research support, Elcint Medical Imaging Ltd; Research support, FUJIFILM Holdings Corporation; Research support, General Electric Company; Research support, Hitachi, Ltd; Research support, Eastman Kodak Company; Research support, Konica Minolta Group; Research support, Mitaya Manufacturing Co, Ltd; Research support, Mitsubishi Corporation; Research support, Koninklijke Philips NV; Research support, Hologic, Inc; Research support, Riverain Technologies, LLC; Research support, Seiko Corporation; Research support, Siemens AG; Research support, 3M Company; Research support, Toshiba Corporation
Shoko Tsutsuji, Maebashi, Japan (Abstract Co-Author) Nothing to Disclose
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Atsuko Torimoto, Otaru, Japan (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS
Participants were recruited from a multi-center CTC trial for patients with average or high risk of colorectal cancer. We used an eye gaze point sensing system (JVCKenwood Co., Yokohama, Japan) which consisted of an eye tracking sensor 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 (32.6 sec) by expert observers was significantly shorter (p<.001) than that (46.2 sec) 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
An eye gaze tracking analysis using infrared cameras can be set-up easily. Gaze points on CTC images by experts and non-clinical observers was 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.
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.
**SSK07**

**ISP: Gastrointestinal (Pancreas Benign Diseases)**

**GI** **CT** **MR** **US**

**AMA PRA Category 1 Credits ™: 1.50**

**ARRT Category A+ Credits: 1.50**

**Participants**
- Elizabeth M. Hecht, MD, New York, NY (Moderator) Nothing to Disclose
- Koenraad J. Mortele, MD, Boston, MA (Moderator) Nothing to Disclose
- Atif Zaheer, MD, Baltimore, MD (Moderator) Nothing to Disclose

**Sub-Events**

**SSK07-01 Gastrointestinal Keynote Speaker: Update on Imaging Benign Pancreatic Diseases**

*Wednesday, Dec. 2 10:30AM - 10:40AM Location: E353B*

**Participants**
- Koenraad J. Mortele, MD, Boston, MA (Presenter) Nothing to Disclose

**SSK07-02 Using T1 Mapping for the Diagnosis of Mild Chronic Pancreatitis**

*Wednesday, Dec. 2 10:40AM - 10:50AM Location: E353B*

**Participants**
- Temel Tirkes, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
- Jordan K. Swensson, MD, Indianapolis, IN (Presenter) Nothing to Disclose
- Chen Lin, PhD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
- Qun Zhong, MD, PhD, Fuzhou, China (Abstract Co-Author) Nothing to Disclose
- Qushi Wang, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
- Evan Fogel, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
- Fatih Akisik, MD, Indianapolis, IN (Abstract Co-Author) Nothing to Disclose
- Kumaresan Sandrasegaran, MD, Carmel, IN (Abstract Co-Author) Nothing to Disclose

**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.

**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/

- Temel Tirkes, MD - 2013 Honored Educator
- Temel Tirkes, MD - 2014 Honored Educator
- Kumaresan Sandrasegaran, MD - 2013 Honored Educator
- Kumaresan Sandrasegaran, MD - 2014 Honored Educator
- Fatih Akisik, MD - 2014 Honored Educator

**SSK07-03 Quantitative MRI Evaluation of the Pancreatic Parenchyma in Diabetes Mellitus**
Participants
Fabio A. Uyeno, MD, Sao Carlos, Brazil (Presenter) Nothing to Disclose
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Valdair F. Muglia, MD, PhD, Ribeirao Preto, Brazil (Abstract Co-Author) Nothing to Disclose

PURPOSE
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 including 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.

SSK07-04 Co-existing Liver and Pancreas Steatosis Related to Chronic Non-alcoholic Liver Diseases (NALD) but not to Viral Infection

Participants
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PURPOSE
Liver steatosis is related to metabolic syndrome but is also present in other diffuse liver diseases. Pancreas steatosis may be also present in association with steatohepatitis and metabolic syndrome. However, little is known about pancreas fat deposition in other diffuse liver diseases such as viral hepatitis. Our purpose was to assess the Proton Density Fat Fraction (PDF) of the liver and pancreas, with a multiecho GRE MR sequence, in patients with diffuse liver diseases, and to evaluate the relationship between fat infiltration of both organs and the influence of the underlying liver disease.

METHOD AND MATERIALS
The study population included consecutive patients with diffuse liver disorders and clinically indicated liver biopsy, who underwent a 3T MR examination using a single breath-hold multiecho chemical shift GRE sequence with 12 echoes. PDF quantification was performed with magnitude and phase reconstruction, T1 and T2* biases corrected, selecting a ROI in the biopsied liver segment and also in 3 pancreatic regions (head, body, tail). Differences of liver and pancreas PDF between histologic grades were assessed with Spearman correlation analysis. Furthermore, the study population was categorized by clinical diagnosis (chronic viral hepatitis vs. chronic NALD).

CONCLUSION
We found a significant correlation between liver and pancreas PDF quantification, in patients with NALD but not in patients with viral hepatitis.

CLINICAL RELEVANCE/APPLICATION
Fat deposition in liver and pancreas appears to be related in patients with chronic non-alcoholic disease but not in chronic viral hepatitis.

SSK07-05 Intravoxel Incoherent Motion Diffusion-weighted MR Imaging in Characterizing Tumorous and Inflammatory Pancreatic Diseases
**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 $D_{fast}$ values (20.0 ± 12.6 x 10^{-3}mm^2/sec) than normal pancreas (48.2 ± 23.9 x 10^{-3}mm^2/sec) (P<0.05). For AIP, $f$ value (0.14 ± 0.06) was significantly lower than that of normal pancreas (P<0.05). $D_{fast}$ values of acute pancreatitis (25.4 ± 14.6 x 10^{-3}mm^2/sec), NET (26.5 ± 19.9 x 10^{-3}mm^2/sec), and SPT (17.8 ± 9.5 x 10^{-3}mm^2/sec) were lower than that of normal pancreas. Although the %Del of AIP (1.06 ± 0.19 x 10^{-3}mm^2/sec) were lower than normal pancreas (1.14 ± 0.15 x 10^{-3}mm^2/sec) and the other pancreatic diseases, the difference was not statistically significant.

**CONCLUSION**

Perfusion related parameters ($f$ and $D_{fast}$) are more helpful in characterizing pancreatic diseases than %Del. 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

**METHOD AND MATERIALS**

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.

**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

Wednesday, Dec. 2 11:30AM - 11:40AM Location: E353B

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 RFA. Thus, MR imaging may not be necessary.

SSK07-08 Methodology for True Dynamic Contrast-Enhanced MRI of Pancreatic Lesions

Wednesday, Dec. 2 11:40AM - 11:50AM Location: E353B

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 inter-scan 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 DVFs. 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

He An, Shenyang, China (Presenter) Nothing to Disclose
Yu Shi, PhD, Shenyang, China (Abstract Co-Author) Nothing to Disclose
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 0.01kPa (95% agreement limits: -0.54-0.55kPa). 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 0.05kPa (95% agreement limits: -0.51-0.62kPa). The averaging stiffness value was 1.46±0.21kPa for chronic pancreatitis and 3.28±1.09kPa for PDAC, in contrast with 1.11±0.08kPa 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.
Participants
Stephen J. Glick, PhD, Silver Spring, MD (Moderator) Nothing to Disclose
Bruce R. Whiting, PhD, Pittsburgh, PA (Moderator) Nothing to Disclose

Sub-Events

SSK15-01 Accurate Perfusion Maps from C-arm Cone Beam CT Perfusion Acquisition: A Canine Study

Participants
Kai Niu, MS, Madison, WI (Presenter) Nothing to Disclose
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Ke Li, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
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Kevin Royalty, PhD,MBA, Hoffman Estates, IL (Abstract Co-Author) Employee, Siemens AG
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Guang-Hong Chen, PhD, Madison, WI (Abstract Co-Author) Research funded, General Electric Company; Research funded, Siemens AG

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.

SSK15-02 Time-resolved Contrast-enhanced Cone Beam CT Imaging of Livers in Rabbits

Participants
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Chao-Jen Lai, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Tianpeng Wang, Houston, TX (Abstract Co-Author) Nothing to Disclose
Chris C. Shaw, PhD, Houston, TX (Presenter) Nothing to Disclose

PURPOSE
Currently available cone beam CT (CBCT) imaging methods do not allow temporal information with a single scan. We investigated the use of a time-resolved CBCT method to generate multiple phase imaging with a single post-injection scan and measured the contrast time-density curves in rabbit livers. Such information may help guide and transcatheter arterial interventional procedures.
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 interventional 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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Vivek Singh, PhD, Detroit, MI (Abstract Co-Author) Nothing to Disclose

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. Deq and 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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Jeffrey H. Sievers, 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
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 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.

CLINICAL RELEVANCE/APPLICATION
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.

SSK15-05 Respiratory and Cardiac Motion-Compensated 5D Cone-Beam CT (CBCT) of the Thorax Region

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S403B

Participants
Sebastian Sauppe, Heidelberg, Germany (Presenter) Nothing to Disclose
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PURPOSE
To provide motion artifact-free 5D CBCT images from a conventional flat detector-based CBCT scan.

METHOD AND MATERIALS
Image quality of retrospectively respiratory- and cardiac-gated volumes from flat detector cone-beam CT scans is deteriorated by severe sparse projection artifacts. These artifacts further complicate motion estimation, as it is required for motion compensated (MoCo) image reconstruction. For high quality 5D CBCT images at the same x-ray dose and the same number of projections as today’s 3D CBCT we developed a double motion compensation approach based on the motion vector fields (MVFs) of respiratory as well as cardiac motion. In a first step our previously published artifact-specific cyclic motion-compensation (acMoCo) approach is applied to compensate for the respiratory patient motion, thus leading to high fidelity 4D CBCT images. With this information a cyclic phase-gated deformable heart registration algorithm is applied to the respiratory motion-compensated 4D CBCT data, thus resulting in cardiac MVFs and thereby in respiratory and cardiac motion-compensated 5D CBCT images. Our new 5D MoCo approach is validated using simulated rawdata obtained by deforming a clinical patient dataset by realistic deformation fields, and by processing patient data acquired with the TrueBeam 4D CBCT system (Varian Medical Systems), as it is used in radiation therapy.

RESULTS
The typical streak artifacts in gated, but non motion-compensated 4D CBCT reconstruction become even more severe when cardiac gating is additionally applied: In scenarios with a 10% respiratory and a 10% cardiac window only 1% of the initial data are available for reconstruction. Our double MoCo approach turned out to be very efficient and removed nearly all streak artifacts due to making use of 100% of the projection data for each reconstructed frame. The simulations show that the 5D MVFs represent the ground truth very well. The 5D MoCo patient data show fine details and no motion blurring, even in regions close to the heart where motion is fastest.

CONCLUSION
Our preliminary results indicate that the proposed double motion-compensated 5D CBCT results in high quality 5D images with full dose usage. This is guaranteed because now all data contribute to each time frame.

CLINICAL RELEVANCE/APPLICATION
High quality 5D images are a prerequisite for precise adaptive radiation treatment. Our approach may also be useful for interventional imaging with C-arm systems.

SSK15-06 Polyenergetic Known Component Reconstruction (KCR) for Flat-panel CBCT with Unknown Material Compositions and Unknown X-ray Spectra

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S403B

Participants
detecting large vessel occlusions (AUC=0.987 and 1).

agreed that image quality for large cerebral arteries was very good and ROC curves demonstrated excellent diagnostic value for

Post processing greatly reduced the noise contained in each volume and a half-second temporal resolution was achieved. Observers

RESULTS

agreement and diagnostic value of this novel image presentation.

image quality and diagnosed each case. Cronbach’s alpha coefficients and ROC analysis were used to evaluate the inter-observer
time-resolved noise and TEmporal REsolution and SAmpling Recovery (TERESAR) to enhance temporal resolution and improve the temporal

each multi-sweep CBCTP dataset, a 3D isotropic filtered back projection (FBP) image volume of each rotation was reconstructed

Under IRB approval, 21 C-arm cone beam CT dynamic perfusion scans of 17 patients with acute ischemic strokes were acquired. For

directly in the interventional suite potentially enable faster patient triaging and improved patient outcomes. In this work, we

target high-fidelity models where they are needed most. Specifically, we adopt a polyenergetic component model while maintaining a simple monoenergetic model for the patient anatomy. We modify KCR to jointly estimate a STF with the reconstruction and component registration using alternating optimizations. We evaluate this new calibration-free KCR in cone-beam CT (CBCT) scans of objects containing metal pedicle screws with unknown material composition. The proposed methodology is compared with filtered-backprojection (FBP) and KCR using calibration scans.

RESULTS

STFs estimated using pre-calibration and the modified KCR were very similar and provided a good fit to air-scan data. In CBCT

during 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
cumber some KCR method with pre-calibration. 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
critical.

SSK1S-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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License agreement, Siemens AG
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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 evaluate the inter-observer 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.

SSK15-08 Should Dental CBCT Devices be Equipped with Cu-filters? A Monte Carlo Organ Dose Comparison Study

Participants
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PURPOSE
To investigate the influence of different x-ray tube filter combinations on organ doses in a dental CBCT exam.

METHOD AND MATERIALS
Promax 3D Max x-ray tube (Planmeca, Finland) is equipped with 0.5mmCu and 2.5mmAl. Its equivalent source model (energy spectrum and filter description) was specified via half value layer (HVL) and air kerma measurements across the detector and by applying the Matlab Spektr tool (Mathworks,Inc). The tube housing (TH) equivalent Al filtration was also determined. Equivalent sources for different filter combinations were designed, employed to the x-ray tube and simulated: from (0 mmCu, 2.5mmAl) to (0.5mmCu, 2.5mmAl) in 0.1mmCu steps and from (0mmCu,2.5mmAl) to (0mmCu,10mmAl) in 2.5mmAl steps. Each spectrum was ray-traced through a 10 cm thick water phantom to determine the attenuation each spectrum undergoes. A spectrum specific scaling factor was calculated as the quotient of the total number of photons in the spectrum to the total number of photons of the lowest HVL spectrum (0 mmCu, 2.5mmAl) which yields the same amount of energy to the detector. Each source model was then used in an EGSnrc based Monte Carlo framework to simulate the jaw protocol (FOV: 130x90 mm2, 96kV, 85.2mAs) for the Zubal head voxel model. Organ doses were calculated for each different filtration such that the detector always receives the same amount of energy.

RESULTS
Increasing the HVL from 6.09mmAl (0mmCu,2.5mmAl,TH) to 9.05mmAl (0.5mmCu, 2.5mmAl,TH) results in dose decrease of 21.3% in skin, 9.4% decrease in cranial bone, 16.3% decrease in muscle, 6.5% decrease in ET and 16.6% decrease in blood doses. On the other hand, there is a 9.7% increase in the dose to brain, 4.5% increase in spinal bone marrow dose, 5.6% increase in eye lens dose and a 3.6 % dose increase to the thyroid. In absolute values these doses remain very low.

CONCLUSION
The beam hardening impact of Cu filtration results in reducing the dose to the skin. On the other hand, the higher mean photon energy results in higher doses outside the primary beam due to more scatter radiation. For the jaw protocol, this is the case for the thyroid and the eye lenses.

CLINICAL RELEVANCE/APPLICATION
To determine whether or not the implementation of Cu filtration has a benefit on organ dose reduction.

SSK15-09 Ultra-High Resolution Quantitative Cone Beam CT of the Extremities with a CMOS X-ray Detector

Participants
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PURPOSE
Early detection of pathological alterations in trabecular bone could accelerate 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 scinitillator) 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.
A Computer Program to Assess Organ Doses for Pediatric and Adult Patients Undergoing CT Scans

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.

Can Gaming Consoles Be Used to Improve X-Ray Imaging? A Feasibility Study

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...
were automatically displayed with a precision of 1 mm at the central ray, defined body part, or at a user-specified point. The system identified the relationship of the patient’s ordered anatomy with respect to the location of automatic exposure chambers (AECs) and image receptor. The software was designed to highlight the body part in red when it was not overlapping the AECs, yellow when partially on a specified AEC, and green when completely covering that AEC. Motion was tracked graphically over time and 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

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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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, thus (AEC) and image receptor. The software was designed to highlight the body part in red when it was not overlapping the AECs, yellow when partially on a specified AEC, and green when completely covering that AEC. Motion was tracked graphically over time and 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).

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.

SSK16-04 Improving Staff Radiation Protection during Computed Tomography Using a Simple Traffic Light System

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S404AB

Participants
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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.

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).

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).

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.

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
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To develop and validate a methodology for precise and accurate comparison of three distinct radiation dose levels from a single MDCT acquisition

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 milliamperage 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).

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.

A reliable strategy to simultaneously obtain three dose levels from a single, dose-neutral, MDCT acquisition can overcome the
RIS-integrated Dose Monitoring System: First Optimization Results for a Breast Screening Program on a Large Dataset of FFDM and DBT Exams

Participants
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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 integrated dose 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.

Effects on Radiation Exposure and Image Quality of Abdominal CT with Attenuation-based Automatic Kilovoltage Selection

Participants
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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. CT Dose and DLP were recorded and the effective dose (ED) was calculated. The objective image quality was assessed in both arterial phase and portal venous phase. Signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR) 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
KV Assist protocol in group A resulted in a kV-decline from 120 to 100 kV in 20 patients (66.67%) and to 80 kV in 10 patients (33.33%). Overall CT Dose (mGy), DLP (mGy-cm) and ED (mGy) of group A were significantly lower than in group B (21.85±7.19 vs. 36.91±4.83 mGy, 1099.48±379.72 vs. 1854.38±455.28 mGy-cm, 16.49±5.70 vs. 27.82±4.83 mSv; p<0.001), with a dose reduction of 40.80% (15.06/36.91), 40.71% (754.90/1854.38) and 40.73% (11.33/27.82), 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±2.11 vs. 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
Does Body Mass Index (BMI) Outperform Body Weight as a Surrogate Parameter for Size Specific Dose Estimates (SSDE) in Adult Patients?

Participants
Johannes Boos, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Rotem S. Lanzman, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
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Christoph K. Thomas, MD, Dusseldorf, 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.

Body Mass Index Based GSI Assist in Abdominal CT: Investigation of Radiation Dose and Image Noise

Participants
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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(CTDvol) 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.
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 24kg/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.
GI371-SD-WEA1  
**Natural Progression of Liver Imaging Reporting and Data System Category 4 (LI-RADS 4) Nodules in the Cirrhotic Liver: Risk Factors Predicting Upgrade to Definite Hepatocellular Carcinoma**

**PURPOSE**
To identify demographic and imaging features that predict upgrade of LI-RADS category 4 (LR4) nodules to LI-RADS category 5 (LR5), and to assess their effects on progression rate and time to progression.

**METHOD AND MATERIALS**
For this HIPAA-compliant retrospective dual-center study, dynamic contrast-enhanced MRIs performed at two institutions between January 2010 and December 2013 were reviewed. Patients were included who had cirrhosis and at least one LR4 liver nodule, including 139 patients with 181 LR4 nodules. LI-RADS major and ancillary imaging features on the index MR examination were recorded for each LR4 nodule. Stepwise multivariate Cox proportional hazards model analysis for the clustered data was fitted to identify predictive risk factors for upgrade to LR5, including patient demographic and LI-RADS imaging features. Overall cumulative rate of upgrade was calculated by using the Kaplan-Meier method. The cumulative risks of upgrade were also compared in the presence and absence of significant predictive risk factors using the log-rank test.

**RESULTS**
31% (56/181) of the LR4 nodules upgraded to LR5. The independent significant predictive risk factors for upgrade were T2 hyperintensity (P<0.001; hazard ratio=1.83; 95%CI: 1.29-2.59), growth from prior to index MRI (P<0.005; hazard ratio=4.32; 95% CI, 1.57-11.26), and hepatitis C infection (P=0.05; hazard ratio=1.52; 95% CI, 1.03-2.27). The overall 3- and 6-month cumulative risk rate of upgrade was 10.2% and 32.7%. The 3- and 6-month cumulative risk rates were significantly higher in the presence of T2 hyperintensity (P=0.03; 11.1% and 48.1% vs 9.6% and 25.4%), although the presence of hepatitis C (P=0.71) or growth between prior and index examinations (P=0.98) did not show significant differences.

**CONCLUSION**
For LR4 nodules, T2 hyperintensity, growth, and hepatitis C infection are associated with significantly higher risk of upgrade to LR5. Although T2 hyperintensity was the greatest risk factor of upgrade, actual risk level was only mildly elevated and the risk of upgrade associated with LR4 nodules is similar across nodule subtypes.

**CLINICAL RELEVANCE/APPLICATION**
For LI-RADS category 4 nodules, T2 hyperintensity, growth, and hepatitis C infection are associated with greater risk of upgrade to LR5, but actual risk levels are only mildly elevated in the presence of these risk factors.
VPCT was performed in 52 (44 male, 8 female; mean age: 60 years) patients with advanced liver cirrhosis and clinical signs of portal hypertension. Images were post-processed using a software package based on a separate calculation of the dual blood supply based on a maximum-slope approach. We calculated additionally the HPI using volume-of-interest (VOI) analysis of three large areas of the left, right and caudate lobes. Following CT-examinational protocol: 80kV, 100/120mAs, 64x0.6mm collimation, 26 consecutive volume measurements, IV injection of 50 mL of iodinated contrast at a flow rate of 5 mL/s, was used. A transsplanchnic approach was used for pressure measurements in the hepatic and the portal vein calculating subsequently the pressure gradient between the two.

RESULTS
The mean hepatic vein pressure was 12mmHg; the mean portal vein pressure was 31mmHg whereas the gradient between the two was 19mmHg. Mean diameter of the portal vein was 14.9mm. The mean ALP, PVP and HPI were 17.1, 33.7 and 41.8 mL/min per 100 mL, respectively. We found no correlation between the portal-venous pressure and the porto-systemic pressure gradient and the magnitude of ALP, PVP and HPI, although the latter yielded all abnormal values.

CONCLUSION
Perfusion parameters measured by VPCT in the cirrhotic liver in patients with portal hypertension are generally abnormal. However, the magnitude of ALP, PVP and HPI does not significantly correlate with that of the porto-systemic pressure gradient and therefore it should not be reciprocally used as surrogate parameters. The degree of collateralization might be a possible confounder in this setting.

CLINICAL RELEVANCE/APPLICATION
VPCT measures separately the contributions of hepatic arterial and portal venous blood supply, but in portal hypertension arterial buffer response is complex and cannot be simply assessed by VPCT.

G1373-SD-WEA3 Value of MRI for Diagnosis and Local Staging of Recurrent Rectal Cancer: Correlation with Surgery and Histopathology of Resected Specimen

Participants
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PURPOSE
To assess the value of MRI for predicting surgical outcome of local recurrent rectal cancer (LRRC). In addition, patterns for diagnosis of LRRC on MRI using T2- weighted sequences (T2W) and contrast enhanced series (CEMRI) were evaluated.

METHOD AND MATERIALS
Surgically resected LRRC with curative intent were included. MRI was performed on 1.5 T using a pelvic coil (8- or 16-channel). MRI protocol included T2W FSE in axial, sagittal, and coronal planes and contrast- enhanced series in arterial, venous, parenchymal and late dominant phases after i.v. Gadolinium. MR image analysis was done through visual interpretation by an experienced observer (reader 1) and compared with post processing image evaluation by an inexperienced observer (reader 2). MRI findings of LRRC were correlated with surgery and histopathology (PA) of the resected specimen. Bland and Altman plots were used to determine the limits of agreement for measurements between two readers and between T2W and CEMRI with PA. To determine actual tumor size, only R0 resected lesions were included for comparison between MRI and PA. Categorical variables were compared using Chi-square test. A Two-sided significance level of 0.05 was used.

RESULTS
A total of 51 lesions (47 patient) were included. MRI was performed after completion of neo- adjuvant (chemo) radiotherapy within a mean time interval of 3 weeks (range 3-5 weeks) and prior to surgery (mean 6 weeks, range 4-7 weeks).Thirty (59%) tumors were radically resected (R0), 21 (41%) tumors were incompletely resected (R1). Lesions fixed to the pelvic side walls or presacral fascia (n=28) had 36% R0; non-fixed lesions (n=23) had 87% R0 (P=0.001).Tumor measurements on CEMRI had better agreement with PA than T2W.Imaging characteristics of LRRC on CEMRI include: arterial enhancement (100 %), persistent enhancement (100 %), dominant peripheral rim enhancement (59%), heterogeneous mosaic enhancement (21%).

CONCLUSION
LRRC fixed to the pelvic side walls or presacral fascia yield incomplete resection margins in 64%, whereas non- fixed tumors were completely resected in 87%. CEMRI has typical imaging characteristics for LRRC and is more consistent for tumor dimension than T2W.

CLINICAL RELEVANCE/APPLICATION
CEMRI is highly accurate for delineation of LRRC and should be included in the MRI protocol. Surgery alone is inadequate for fixed LRRC and should be followed by addional treatment methods (eg radiation therapy on resected surfaces)

G1374-SD-WEA4 Patient Size-independent Monoenergetic Imaging for Detection Hypervascular Liver Tumors: Impact of a Second-generation Monoenergetic Algorithm

Participants
Daniele Marin, MD, Cary, NC (Presenter) Nothing to Disclose
Juan Carlos Ramirez-Giraldo, PhD, Malvern, PA (Abstract Co-Author) Employee, Siemens AG
Sonia Gupta, MD, Newark, DE (Abstract Co-Author) Nothing to Disclose
To investigate the impact of a novel monoenergetic reconstruction algorithm on the conspicuity of hypervascular liver tumors during dual-energy CT (DECT) of the liver.

METHOD AND MATERIALS
This retrospective, single-center HIPAA-compliant study was IRB-approved and informed patient consent was waived. Fifty-nine patients (35 men, 24 women) with 47 hypervascular liver tumors underwent DECT (80/Sn140 kVp) in the late hepatic arterial phase, with a dual-source CT system (Siemens Definition Flash). Datasets at energy levels ranging from 40 to 100 keV were reconstructed using first and second-generation monoenergetic algorithms (Syngo DE Monoenergetic and Monoenergetic Plus, respectively). Noise and tumor-to-liver contrast-to-noise ratio (CNR) were calculated and compared among different reconstructed datasets. The effect of patient’s effective diameter on lesion CNR was also assessed. P-values were obtained for paired difference using generalized estimating equations (GEE) to account for multiple lesions per patient.

RESULTS
Noise was significantly lower and tumor-to-liver CNR significantly higher between 40 and 60 keV energies using a second-generation compared to a first-generation monoenergetic algorithm (P < .001 for all comparisons). The highest tumor-to-liver CNR was achieved using the second-generation monoenergetic algorithm at 40 keV, with an approximately 25% improvement in CNR compared to a first-generation algorithm at the optimal energy of 70 keV (Mean [SD] = 4.99 [1.70] vs. 3.80 [2.40]; P < .001). Our data showed that patient body size did not significantly affect the selection of the optimal monoenergetic level using the second-generation monoenergetic algorithm. This is in contrast with the significant impact of body size in the selection of the optimal energy level with the first-generation algorithm.

CONCLUSION
The second-generation monoenergetic algorithm significantly improves the conspicuity of hypervascular liver tumors compared to a first-generation algorithm, while simultaneously decreasing the variability introduced by patient’s body weight in selecting the optimal monoenergetic level.

CLINICAL RELEVANCE/APPLICATION
A second-generation monoenergetic algorithm improves the conspicuity of hypervascular liver tumors and may streamline the workflow of DECT by decreasing the variability related to patient’s body size.

GI375-SD-WEAS
Denovo Development of Intra-lesional Pseudo-aneurysms in Focal Hepatic Lesions: Do They Impart Underlying Malignancy in the Lesion?

Participants
Muhammad Idris, MBBS, KARACHI, Pakistan (Presenter) Nothing to Disclose
Zafar Saijd, MBBS, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose
Zihan Haider, MBBS, FRCR, Karachi, Pakistan (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the presence of denovo intra-lesional pseudo-aneurysms (DILPA) within focal hepatic lesions prior to any intervention or therapy and its association with the underlying nature of the lesion.

METHOD AND MATERIALS
Retrospective cross-sectional review of 823 patients with 1108 focal hepatic lesions at a tertiary care university hospital to identify the presence of DILPA prior to any therapy, intervention or trauma, and its relation to underlying nature of the lesion. From November 2006 till December 2014 data obtained was obtained from radiology information system (RIS) and medical record room. Patients’ baseline data along with imaging findings, histopathology results and any prior treatment and history were recorded. Those patients were excluded who had any history of prior intervention, therapy or trauma. MDCT scans of selected patients were reviewed for presence of any DILPA and their final diagnosis was recorded. Data analysis was done on SPSS version 19. Pearson chi square test was applied to analyze the association of DILPA to a particular focal lesion. P value of < 0.05 was considered significant.

RESULTS
DILPA without any prior intervention were found in 3.5% (39/1108) of total patients with focal hepatic lesions. Out of these 90% (35/39) were HCC, 5% (2/39) were liver abscesses, 2.5% (1/39) angiosarcoma and 2.5% (1/39) were metastasis. The association of DILPA with malignant lesions showed a significant p value of 0.011. While its association with benign lesions was statistically insignificant (p value 0.651. Focal hepatic lesions not showing DILPA include HCC 46% (498/1069), hemangioma 27% (284/1069), metastasis 21% (223/1069), others 6% (64/1069) inclusive of abscesses, FNH, adenoma, intrahepatic cholangiocarcinoma, angiomylipomas, and lipomas.

CONCLUSION
Denovo development of intra-lesional pseudo-aneurysms in focal hepatic lesions are not uncommon and may point towards the underlying diagnosis of malignancy particularly HCC. Further prospective randomized studies are required to confirm this association.

CLINICAL RELEVANCE/APPLICATION
Denovo development of intra-lesional pseudo-aneurysms in focal hepatic lesions though rare but not uncommon. These cases provide a unique insight into usefulness of recognizing DILPA on imaging studies. Their presence in focal hepatic lesion may point
CT Signs Can Predict Treatment Response and Long-Term Survival: A Study in Locally Advanced Esophageal Cancer with Preoperative Chemotherapy

Participants
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Ying-Shi Sun, MD, PhD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
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.

The Diagnostic Performance of Transabdominal Ultrasonography for Incidental Pancreatic Cysts: Focus on the Effect of Prior Images, Size, and Location

Participants
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Joo Hyun Jeon, 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 before CT, MR, 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 2 cm. 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.
variants (accessory ducts, abnormal insertion of segmental ducts, low insertion of right anterior or cystic ducts, complex anomalies, etc.)

MR technique description:
MR cholangiopancreatography: Thick-slab and high resolution 3D T2-weighted images.

MR technique description:
Hepatobiliary phase: T1-weighted fat saturated VIBE images, associated or not with controlled aliasing in parallel imaging results in higher acceleration (CAIPIRINAH) technique. Illustration, with correlation with intraoperative cholangiograms:

CLINICAL RELEVANCE/APPLICATION

Transabdominal US is useful image modality for incidental pancreatic cysts; especially follow up after CT, MRI, and EUS.

GII48-ED-WEA8 Getting to the Bottom of Post Colorectal Endoscopic Mucosal Resection (EMR) Imaging -What to Expect and Potential Pitfalls

Station #8

Participants
Joseph H. Mullineux, MBChB, FRCP, Leicester, United Kingdom (Presenter) Nothing to Disclose
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Peter Wurm, Leicester, United Kingdom (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1) Colonic EMR is a safe effective treatment for non-invasive polyps. CT is the modality of choice for imaging complications.2) The general radiologist must be aware of the 'expected' findings post colon EMR, which include circumferential transmural oedema of the colon, mesenteric fat stranding, intramural gas and occasionally local locules of extraluminal gas.3) The key feature that may require surgical intervention is extra-luminal gas distant from the affected colon and potentially signs of ischaemia.4) On staging CT for polyps found to contain adenocarcinoma, caution should be applied if reporting locoregional spread, as extramural changes and lymphadenopathy often resolve.

TABLE OF CONTENTS/OUTLINE

AIM: To share our high volume centre experience of 'expected' post EMR appearances to avoid the pitfall of over interpretation and distinguish from acute perforation.1) A brief description of colonic EMR and its increasing role in the management of colonic polyps and the role of imaging post EMR.2) Pictorial review of common 'expected' imaging findings post colon EMR with an emphasis on CT.3) Pictorial review of abnormal post EMR findings, which require urgent intervention.4) Discussion of pitfalls in interpretation of CT findings particularly over interpretation of findings in the acute and cancer staging settings.

GII11-ED-WEA9 From Novice to Expert: A Systematic Approach to Dynamic Pelvic Floor MRI

Station #9

Participants
Tina Islam, MD, Cambridge, MA (Presenter) Nothing to Disclose
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Emily von Bargen, DO, Cambridge, MA (Abstract Co-Author) Nothing to Disclose
J. Pierre Sasson, MD, Cambridge, MA (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1. The reader will learn a systematic approach to interpreting dynamic pelvic floor MRI.2. The reader will understand normal and abnormal findings in dynamic pelvic floor MRI.

TABLE OF CONTENTS/OUTLINE

1. Clinical Indications2. MR Imaging Technique3. Relevant Pelvic Anatomy4. Overview of a systematic approach to interpreting dynamic pelvic floor MRI with illustrative normal and abnormal clinical cases5. A structured dictation template is provided on how to report findings


Station #10

Participants
Luis S. Guimaraes, MD, Toronto, ON (Presenter) Nothing to Disclose
Gary Levy, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Ian McGillivray, Toronto, ON (Abstract Co-Author) Nothing to Disclose
David Grant, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Kartik S. Jhaveri, MD, Toronto, ON (Abstract Co-Author) Speaker, Bayer AG

TEACHING POINTS

To demonstrate the importance of preoperative evaluation of biliary anatomy, especially in potential live liver transplant donors. To describe state-of-the-art Magnetic Resonance (MR) pulse sequences directed to biliary visualization: T2-weighted and hepatobiliary phase after administration of Gd-EOB-DTPA. To extensively illustrate common and uncommon biliary anatomic variants.

TABLE OF CONTENTS/OUTLINE

Introduction: Significance of preoperative identification of biliary anatomy. Description of common and uncommon anatomic variants. MR technique description: MR cholangiopancreatography: Thick-slab and high resolution 3D T2-weighted images. Hepatobiliary phase: T1-weighted fat saturated VIBE images, associated or not with controlled aliasing in parallel imaging results in higher acceleration (CAIPIRINAH) technique. Illustration, with correlation with intraoperative cholangiograms: Conventional anatomy. Most common variants (trifurcation/short right hepatic duct, right posterior duct joining left hepatic duct, etc.). Rare variants (accessory ducts, abnormal insertion of segmental ducts, low insertion of right anterior or cystic ducts, complex anomalies,
Suboptimal MR cases and discussion of causes/solutions. Examples of advantages of Gd-EOB-DTPA enhanced images over T2w images and vice versa.

**Post-operative Bowel: Part I, Foregut (Esophagus to Duodenum) - A Guide for the Radiologist**

Hardcopy Backboard

**Participants**
Nishant Patel, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Ashish P. Wasnik, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
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Amy Morris, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
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Katherine E. Maturen, MD, Ann Arbor, MI (*Abstract Co-Author*) Consultant, GlaxoSmithKline plc; Medical Advisory Board, GlaxoSmithKline plc

**TEACHING POINTS**

To demonstrate normal postsurgical radiological anatomy from esophagus to duodenum with illustrations. To demonstrate normal postoperative anatomy and complications on fluoroscopy, CT and MRI To provide a guide for radiologists to interpret these studies.

**TABLE OF CONTENTS/OUTLINE**

Discussion of the performance, indication, expected postoperative anatomy of the following:
- Esophagus: Esophagectomy with gastric pull-through Fundoplication
- Stomach and Duodenum: Gastrectomy with esophago-jejunal anastomosis Roux-en-Y gastric bypass Sleeve gastrectomy Partial gastric resection Whipple procedure Billroth I and II Peustow procedure Choledochojejunostomy
- in liver transplant

Demonstration of complications related to these procedures including:
- Anastomotic leak
- Stricture - edema vs true narrowing
- Wound dehiscence

Mimics of common complications

**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
Cardiac Wednesday Poster Discussions

Wednesday, Dec. 2 12:45PM - 1:15PM Location: CA Community, Learning Center

Assessment of Diffuse Ventricular Fibrosis in Atrial Fibrillation Using Extracellular Volume Fraction Mapping: Initial Study

Station #1

Participants
Lisa Diethelm, MD, New Orleans, LA (Moderator) Nothing to Disclose

Sub-Events

**CA245-SD-WEB1**

**Assessment of Diffuse Ventricular Fibrosis in Atrial Fibrillation Using Extracellular Volume Fraction Mapping: Initial Study**

Participants
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**PURPOSE**

In atrial fibrillation (AF), diffuse myocardial fibrosis may be induced by arrhythmia or reflect pre-existing cardiomyopathy. The presence of concurrent AF and diffuse myocardial fibrosis has been associated with an increased risk of heart failure progression. The extracellular volume fraction (ECV) mapping may provide new insights to the understanding of AF. Unlike focal fibrosis, diffuse myocardial fibrosis is not visualized on delayed enhancement magnetic resonance imaging (MRI), but can be quantified with extracellular volume fraction (ECV) mapping. Therefore, the purpose of this study was to evaluate diffuse myocardial fibrosis of the left ventricle (LV) in patients with AF.

**METHOD AND MATERIALS**

Ten subjects underwent MRI using a clinical 3 T scanner (Magnetom Verio, Siemens Healthcare): 8 persistent AF patients and 2 controls. Left-atrial volume was evaluated from MR cine imaging. A validated Look-Locker T1 Mapping Siemens prototype sequence was used to generate T1 maps as an index of diffuse myocardial fibrosis. The imaging parameters were: TE/TR = 1/295.33ms, FOV = 360mm, Slice Thickness = 8mm, image matrix = 192. 3 short axes of pre and post T1 maps were acquired as shown in Figure 1. Global ECV values were calculated from T1 maps acquired pre- and post-contrast calibrated by blood hematocrit. The ECV value was calculated as:

**RESULTS**

AF patients had larger left atrial volume (115.8±36.5 ml) than controls (75.85.1 ml) and published normal values [3]. Mean ECV of AF patients was 32.7±4.5% in the basal segments, 30.0±4.8% in the mid-cavity segments, 33.3±5.3% in the apical segments, which were higher than the controls (basal: 26.1±0.0 %, mid-cavity: 26.0±1.5 %, apical: 27.9±1.8 %).

**CONCLUSION**

ECV of AF patients were higher than healthy controls in the left ventricle from basal to apical levels. ECV is higher in patients with heart failure [4]. AF patients demonstrated diffuse fibrosis suggesting that AF itself may play an independent role in adverse prognosis. The mean left atrial volume of AF patients was larger than in controls, which is in line with other studies. ECV mapping could help to identify the diffuse LV fibrosis in patients with AF. The quantification could be a better solution for clinicians in diagnosing diffuse LV fibrosis. Our findings need to be validated by enrolling more subjects.

**CLINICAL RELEVANCE/APPLICATION**

Unlike focal fibrosis, diffuse myocardial fibrosis is not visualized on delayed enhancement magnetic resonance imaging (MRI), but can be quantified with extracellular volume fraction (ECV) mapping. In atrial fibrillation (AF), it may be induced by arrhythmia or reflect pre-existing cardiomyopathy.
obstructive cardiomyopathy (HOCM). Cine steady-state free precession (SSFP) imaging quantifies the myocardial wall thickness and mass, and visualizes jet flow crossing the left ventricular outflow tract (LVOT). Late gadolinium enhancement (LGE) MRI identifies myocardial infarction (MI) after PTSDMA. The aim of this study was to evaluate whether we could detect PTSMA-induced MI and microvascular obstruction (MO) and LVOT jet flow with a single contrast-enhanced SSFP (ceSSFP) imaging in patients with HOCM.

METHODS AND MATERIALS
The 16 MRI examinations of 12 HOCM patients after PTSMA were assessed. Precontrast SSFP, ceSSFP and LGE MRI were performed with a 1.5-T imager. The ceSSFP was performed immediately after gadolinium injection. The signal ratios between PTSMA-induced MI and MO and the remote myocardium were compared between ceSSFP and LGE imaging. The LVOT flow was observed using ceSSFP in the three-chamber view.

RESULTS
LGE and ceSSFP visualized PTSMA-induced MI in all 16 studies, while precontrast SSFP did only in the 6 studies (37.5%) of the 6 patients. Both LGE and ceSSFP showed PTSMA-induced MO in the 7 patients who underwent MRI within 7 weeks after PTSMA. However, precontrast SSFP did only in one patient. The location of MO identified by ceSSFP or LGE was related to the decrease in the LVOT pressure gradient (i.e. left-sided MO, good efficiency; right sided MO, limited efficiency). The signal ratio of MI/remote myocardium was significantly higher in LGE imaging than in ceSSFP imaging (P=0.011). The signal ratio of MI/MO was significantly higher in LGE imaging than in ceSSFP imaging (P=0.042). The ceSSFP visualized the abnormal jet flow crossing the LVOT, which was consistent with an LVOT pressure gradient higher than 30 mmHg at echocardiography, in 3 of the 4 studies.

CONCLUSION
The ceSSFP is feasible for detecting PTSMA-induced MI and MO and the LVOT jet flow in a single scan.

CLINICAL RELEVANCE/APPLICATION
Contrast enhanced SSFP is feasible for detecting PTSMA-induced myocardial damages and the left ventricular outflow tract jet flow in patients with HOCM.

CA247-SD- WEB3 Impact of an Automated Planning Software in Daily CMR Protocols

Station #3

Participants
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PURPOSE
Cardiac Magnetic Resonance (CMR) has rapidly developed and is now a very used technique in our clinical practice. Furthermore, in CMR studies, scan times continue to be extended. Recently, it has been developed the program “Day Optimizing Throughput” (Cardiac DOT Engine) that perform an automatic planning of the various cardiac planes and allows us to obtain superimposable slices. The aim of our study was to demonstrate whether this software is able to decrease scan time.

METHOD AND MATERIALS
From October 2012 to September 2014, 300 studies were consecutively analyzed. CMR studies were performed on a 1.5T system (MAGNETOM Aera XQ). We retrospectively selected cardiomyopathies and Stress perfusion MRI protocols because they are the most frequently used in our hospital. Cardiomyopathies protocol included (HASTE, four, three, two and short axis chambers cine, perfusion and delayed enhancement sequences) and stress perfusion protocol included (HASTE, four, three, two and short axis chambers cine, perfusion, delayed enhancement and resting perfusion sequences). The total examination time comprises the time from the beginning until the end of each scan. The average scan time in minutes for each group was analyzed and compared with a standard software (SS) using a T-Test for independent samples with SPSS Statistics software 20.0.

RESULTS
SS was performed in 89 patients and DOT in 211. We observed a difference in the time spent on exploration between the use of software DOT and the use of a standard software SS in both protocols (cardiomyopathies and stress-perfusion). The average time for the cardiomyopathies group were (n=130): DOT (t =37.99 +/- 11.52 minutes) to SS (t =64.89 +/- 16.9 minutes) (P=.001). The average time for the stress perfusion group were (n=170): DOT (t =42.91 +/- 13.95 minutes) to SS (t =62.25 +/- 12.85 minutes) (P=.001).

CONCLUSION
Using an automatic planning software on cardiomyopathies and stress perfusion MRI protocols always decrease the scan time.

CLINICAL RELEVANCE/APPLICATION
Systematical and reproducible studies with examination time reduction are always obtained with Cardiac Dot Engine.

CA249-SD- WEB5 Feasibility, Image Quality and Radiation Dose of Coronary CT Angiography (CCTA) in Patients with Atrial Fibrillation using a New Generation 256 Multi-Detector CT (MDCT)

Station #5

Participants
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PURPOSE
To evaluate feasibility, image quality and radiation dose of CCTA in patients with atrial fibrillation (AF) using a new generation 256-MDCT.

**METHOD AND MATERIALS**

Thirty consecutive patients (mean HR 103.8±52.2 bpm) with AF underwent CCTA on a 256-MDCT (Revolution CT, General Electric). Prevalence and impact on diagnosis of motion and step artifacts were independently evaluated by two experienced readers using a 3-point scale (0: no artifact; 1: artifacts without interference on diagnosis; 2: artifacts interfere with diagnosis) and percentage of assessable coronary segments was calculated. Contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR) were measured for quantitative assessment. Radiation dose was evaluated by calculating the mean effective dose (ED).

**RESULTS**

On a per-patient analysis, all the coronary segments were assessable in 28 (93%) patients. Only 3 coronary segments were not assessable in 2 patients due to motion artefacts resulted in a coronary segments assessability of 99.3% (453/456 segments) in the overall population. No step artifact was observed whereas motion artefacts (3-point scale score of 0.53±0.6) were infrequent and do not interfere with diagnosis. The mean CNR and mean SNR were respectively 13.3±4.6 and 13.0±3.3. ED remains low with an average of 3.3±2.5 mSv.

**CONCLUSION**

CCTA is feasible in AF patients using a new generation 256-MDCT providing good image quality and low radiation dose in this challenging population.

**CLINICAL RELEVANCE/APPLICATION**

Improvement of CCTA in atrial fibrillation patients

**CA251-SD-WEB7**

**High-pitch Single Heart Beat Coronary CT Angiography, The Effect of Heart Rate on Image Quality ? a 2nd and 3rd Generation Dual Source CT Study**

**Station #7**

Participants
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**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 458mm/sec to 737mm/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.

**CA148-ED-WEB8**

**Cardiac MR in Left Ventricular Hypertrophy: State of the Art**

**Station #8**

Participants
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Benjamin Dubourg, MBBS, MD, Rouen, France (Abstract Co-Author) Nothing to Disclose
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TEACHING POINTS
1. To define and quantify left ventricular hypertrophy (LVH) by cardiac MR (CMR).
2. To describe the diagnostic approach when exploring a patient with LVH.
3. To discuss and illustrate the usefulness of CMR in identifying the cause of LVH and the associated prognosis.
4. To know the basics of T1 mapping and extracellular volume fraction of the myocardium and their interest when exploring a patient with LVH.

TABLE OF CONTENTS/OUTLINE
In this exhibit will be described: 1. Definition and main causes of LVH; 2. Applicable methods to explore LVH; 3. Pictorial review of LVH with CMR; 4. Differential diagnosis and pitfalls.
Gi379-SD-WEB2

Diagnostic Performance and Imaging Features of Gadoxetic Acid-enhanced MR for Hypervascular Hepatocellular Carcinoma and Concordance Rate of Liver Imaging Reporting and Data System

Participants
Nirvikar Dahiya, MD, Phoenix, AZ (Moderator) Nothing to Disclose

Sub-Events

Purpose
To assess diagnostic performance and imaging features of gadoxetic acid-enhanced MR for hypervascular hepatocellular carcinoma (HCC) detected by C-arm CT and concordance rate of Liver Imaging Reporting and Data System (LI-RADS).

Method and Materials
One hundred and sixty seven patients (M:F = 131:36, 63.8 years) with HCC (n = 379; 257 ≥ 1 cm, 122 ≤ 1 cm) underwent gadoxetic acid-enhanced MR imaging. HCC was confirmed by showing typical enhancement patterns on MR (n = 347; 253 ≥ 1 cm, 94 ≤ 1 cm), by showing hypervascularity on C-arm CT and continuous compact lipiodol uptake after TACE (n = 6; all 6 ≤ 1 cm), or by showing growth at follow-up C-arm CT with typical enhancement patterns on CT or MRI (n = 26; 4 > 1 cm, 22 ≤ 1 cm). Two radiologists graded likelihood of HCC with a five-point confidence scale and assessed MR imaging features. All HCCs were evaluated the concordance rate of LI-RADS. Jackknife alternative free-response receiver operating characteristic (JAFROC) method was used.

Results
Mean JAFROC figure of merit for large (>1-cm) HCC was 0.948, while that for small HCC was 0.787 with fair agreement (κ = 0.409). Mean sensitivity and positive predictive value (PPV) were 91% (466 of 514) and 90% (466 of 517) for large HCC versus 63.0% (153 of 244) and 79% (153 of 194) for small HCC, respectively. Seventeen of 122 small HCCs (13.9%) were not seen on MR images, even after careful investigation. Among 379 HCC, 99 (26%) met LR 5, 259 (66%) met LR 4, and 4 (1%) met LR 3. Mean sensitivity of two radiologists according to LI-RADS were 92% (91 of 99) for LR 5, 85% (220 of 259) for LR 4, and 12.5% (0 of 4 by reader 1, 1 of 4 by reader 2) for LR 3. Although, all four major features were more prevalent in large HCCs (p < 0.01), common features for small HCC included arterial enhancement (81.9%), hepatobiliary phase hypointensity (80.3%), and delayed washout (72.9%).

Conclusion
Diagnostic performance of gadoxetic acid-enhanced MR imaging for small hypervascular HCC detection is still low, with mean sensitivity of 63.0% (153 of 244) and mean PPV of 79% (153 of 194), compared with large HCC. The concordance rate of LI-RADS was 26% in LR 5 and 66% in LR 4.

Clinical Relevance/Application
Although, diagnostic performance of MRI for small HCC is still low, arterial enhancement (81.9%), hepatobiliary phase hypointensity (80.3%), and delayed washout (72.9%) were common in small hypervascular HCC.

Gi380-SD-WEB3

Intra-patient Comparison of Standard and Ultra-low-dose Examinations of an Iterative Model-based CT Reconstruction Algorithm

Participants
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Peter B. Noel, PhD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

Purpose
To evaluate the quality, at different radiation dose levels, of three reconstruction algorithms including the latest generation of model-based iterative reconstruction (IR) for diagnostics of patients with proven liver metastases in tumor follow-up examinations.

Method and Materials
Approval of this prospective single-center study was obtained by the IRB and the German Federal Office for Radiation Protection. A total of 40 thorax-abdomen-pelvis CT examinations acquired from 20 patients in a tumor follow-up were included into the evaluations. All patients were imaged on a 256-slice CT scanner using the departmental standard-dose and, immediately afterwards, a specific low-dose tumor-staging CT protocol. Reconstructed slices were generated by using three different reconstruction algorithms: a classical filtered backprojection (FBP), a first generation IR algorithm (iDose4, Philips Healthcare, Cleveland, OH, United States) and a next generation model-based IR algorithm (IMR, Philips Healthcare, Cleveland, OH, United States).

RESULTS

The overall detection of liver lesions tended to be higher with the IMR algorithm than with FBP or iDose4. The IMR data set at standard dose yielded the highest overall detectability, while the low-dose FBP data set showed the lowest detectability. For the low-dose protocols a significantly improved detectability of the liver lesion can be reported compared to FBP or iDose4 (P = .01). The radiation dose decreased by an approx. factor of five between the standard-dose (average effective dose: 12.2 ± 1.4 mSv) and the low-dose protocol (average effective dose: 2.7 ± 0.3 mSv). For the scan range of the liver the effective dose could be reduced to sub mSv.

CONCLUSION

The latest generation of IR algorithms significantly improved the diagnostic image quality and provided virtually noise-free images for ultra-low dose CT imaging of the liver.

CLINICAL RELEVANCE/APPLICATION

Advanced IR algorithms are leading CT towards sub mSv whole body imaging thereby limiting radiation exposure to a minimum.

Participants

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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.

Participants
Purpose

To evaluate the success of interventional treatments of liver tumors using a new color coded perfusion quantification software with CEUS.

Method and Materials

In 80 malignant liver lesions (49 Patients, 47 HCC, 32 metastases, 1 CCC, age 21 - 84 years, mean 60.3 years) CEUS was performed using a multifrequency probe (1-5 MHz, LOGIQ E9, GE, USA) within 24 hours following interventional treatment ( 16 TACE, 30 IRE, 32 Microwave ablation, 2 RFA). For each patient 1-2.4 mL of SonoVue® (BRACCO, Italy) was used. The digitally stored cine loops of the tumor microvascularization (up to 120 sec.) were evaluated retrospectively using a perfusion software (VueBox, BRACCO, Italy) regarding time to peak (TTP), mean transit time (mTT), peak enhancement (pE) and Wash-in Area Under the Curve (WIAUC). Each parameter was analyzed in the center and border area of the lesion. In 72 lesions, each parameter was additionally evaluated in the tumor periphery. Statistical evaluation was performed using the Wilcoxon-test.

Results

The pre-interventional tumor size ranged from 11 mm to 55 mm, mean 26 mm in diameter. The post-interventional defect size ranged from 11 mm to 73 mm, mean 38 mm. In all patients, a post-interventional reduction of the tumor microvascularization was observed. Regarding the WIAUC (p<0.01) and pE (p<0.01) the differences between center of the lesion vs. border area and border area vs. periphery were found to be statistically significant. Evaluation of mTT showed no significant difference between center, border area or periphery whereas for TTP the differences between center and border area were also found to be statistically significant (p< 0.05).

Conclusion

CEUS with perfusion imaging offers new possibilities for the measurement of results following interventional treatment of liver lesions.

Clinical Relevance/Application

Evaluation of the post-interventional success of ablation or embolization treatments of liver tumors using a new color coded perfusion quantification software with CEUS.

GI383-SD-WEB6 Intraductal Papillary Mucinous Neoplasms (IPMN) of the Pancreas: Diagnostic Accuracy of Low-dose Abdominal MDCT Scan

Station #6

Participants

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Sandro Sironi, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose

Purpose

To evaluate the diagnostic accuracy of low-dose MDCT combined with iterative reconstruction algorithm (iDose4) in the assessment of intraductal papillary mucinous neoplasms (IPMN) of the pancreas, to determining the correct surgical approach.

Method and Materials

We retrospectively evaluated nineteen patients (13 men; mean age 70.7±13.1 years) with pancreatic IPMN and who underwent from January 2013 to March 2015 an abdominal MDCT examination on a 256-slice scanner (iCT; Philips), with low-dose scanning protocol (120 kV, mAs determined by x-, y- and z-axis dose modulation) and iDose4 reconstruction modulation. Standard Magnetic Resonance (MR) imaging examination was used as reference standard for diagnosis of IPMN. For every IPMN the following data and protocol (120 kV, mAs determined by x-, y- and z-axis dose modulation) and iDose4 reconstruction modulation. Standard Magnetic Resonance (MR) imaging examination was used as reference standard for diagnosis of IPMN. For every IPMN the following data and morphologic features were reported: location within the gland (head, uncinate process, neck, body, tail), number (multifocality), maximum diameter(measured either on axial images or multiplanar reconstructions), communication with the main pancreatic duct (MPD), maximum MPD diameter, presence of septa, wall thickening, mural enhancing nodules and close adjacency to the portal vein, according to surgical guidelines of International Association of Pancreatologists.

Results

Multiplanar CT reconstructions were performed and the imaging data were reviewed as axial and as MPR images: coronal, sagittal and curved in order to evaluate the surgical criteria of malignancies and therefore the surgical approach. A total of 44 IPMN (26 in the tail, 8 in the body, 6 in the head, 2 in the neck) in 19 patients were evaluated (single in 8 cases, multiple in 11). The main lesion diameter was 14.4±6.8 mm; 22/44 (50%) demonstrated a distinct communication with MPD and MPD mean diameter was 2.7±0.7 mm. 5/44 (11%) lesions demonstrated inner septa and 10/44 (23%) wall thickening and 2/44 (4%) mural enhancing nodules. 8/44 (18%) of IPMN demonstrated close proximity to the portal vein.

Conclusion

Low-dose abdominal MDCT scans with iDose4 reconstruction algorithm are able to properly depict morphologic features of pancreatic IPMNs that may allow their proper characterization according to surgical guidelines.

Clinical Relevance/Application

MDCT scans combined with iDose4 might represents a useful imaging technique, rapid and widely available, for the proper surgical assessment of pancreatic IPMN.
**TEACHING POINTS**

The root of small-bowel mesentery is an important peritoneal reflection. Usually it is involved by the spread of disease from surrounding structures, some disease processes can occur primarily within it. The purpose of this exhibit is:- To familiarize the viewer with the anatomy of the root of the small-bowel mesentery and various primary lesions arising within the root with emphasis on CT imaging findings.- To help the viewer learn an imaging pattern-based approach to develop a reasonable differential diagnosis of abnormalities arising in the root of mesentery, suggest additional work-up, if needed and in many cases help making the specific diagnosis.

**TABLE OF CONTENTS/OUTLINE**

The contents will be organized as follows with short discussions, illustrated examples and few cases as quiz towards the end of presentation:

1. Small-bowel mesenteric root anatomy
2. Lesions:
   - Vascular lesions such as Superior mesenteric artery and venous thrombosis, Superior mesenteric artery dissection/pseudo-aneurysm
   - Inflammatory and infectious entities such as Mesenteric panniculitis, Retractile mesenteritis, Abscess, Adenitis
   - Benign masses such as Cyst, Lipoma, Desmoid tumor, pseudotumor
   - Malignant masses such as Carcinoid, Lymphoma, Gastrointestinal stromal tumor, Mesothelioma
   - Miscellaneous such as Rosai-Dorfman disease
3. Short quiz cases.

**TEACHING POINTS**

High Resolution (HR) MRI is now widely used for treatment decisions and surgical planning in primary rectal cancer Inter observer variability in assessment of key parameters is a significant challenge in the successful implementation of this technique We review inter-observer variability and solutions to improve consistency in the interpretation of HR MR scans for primary rectal cancer

**TABLE OF CONTENTS/OUTLINE**

Review key imaging parameters in the preoperative staging of rectal cancer
Review the incidence of interobserver variability in the assessment of T stage, N stage, depth of invasion and vascular invasion
Review techniques and steps to improve consistency in assessment of key parameters

**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/

Raghunandan Vikram, MBBS, FRCR - 2012 Honored Educator
TABLE OF CONTENTS/OUTLINE

- Background
- Surgical Options and Anatomy
- Radiologist’s Role
- CT Volumetry
- Discuss and illustrate different methods
- Define non-standardized and standardized liver volumetry measurements
- Describe target volumes and kinetic growth rate pertaining to future liver remnant
- Cases to illustrate decision making process

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/

David J. DiSantis, MD - 2014 Honored Educator

Post-operative Bowel: Part II - Mid and Hind Gut (Jejunum to Anus) - A Guide for the Radiologist

Hardcopy Backboard

Participants
- Ashish P. Wasnik, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
- Nishant Patel, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
- Ravi K. Kaza, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
- Katherine E. Maturen, MD, Ann Arbor, MI (Abstract Co-Author) Consultant, GlaxoSmithKline plc; Medical Advisory Board, GlaxoSmithKline plc
- Mahmoud M. Al-Hawary, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

- Post-operative bowel is frequently imaged to evaluate for complications, and knowledge of expected normal postoperative anatomy remains crucial in identifying complications.
- Review common operative procedures related to small and large bowel with graphic illustrations and imaging examples.
- The learner should be able to identify the surgical procedure and post-op anatomy of small and large bowel, along with commonly seen complications.

TABLE OF CONTENTS/OUTLINE

- Description of various operative procedures and their indication involving the small and large bowel with illustrations, and representative examples on fluoroscopy and CT.
- Following procedures that will be discussed include:
  - Small Bowel: Small bowel resection with primary or secondary anastomosis, procedure from urinary diversion (ileal conduit, Indiana pouch, Mitrofanoff appendicovesicostomy, neobladder)
  - Colon: Hemicolectomy/ileo colic anastomosis, abdominoperineal resection (Miles procedure), low anterior resection, colectomy with ileal J-pouch-anal anastomosis, segmental colectomy with diverting/ end loop colostomy, Hartman's pouch.
- Complications related to these procedures will be presented with examples (anastomotic leak, fistula, stricture, bowel obstruction, inflammation, wound dehiscence and mimics like outpouching/capacious segment from side-side anastomosis).

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
**LEARNING OBJECTIVES**

1) To explain the significance of injury mechanism and its role in the formation of consequent abdominal lesions and their complications.
2) To outline the role of proper imaging technique and diagnostic algorithm in the sufficiently fast diagnosis of abdominal injuries.
3) To learn more about the typical and unusual findings of various abdominal traumatic conditions.

**ABSTRACT**

Abdominal injuries require a timely and reliable diagnosis in order to prevent the potentially lethal outcome. The armory of clinical tools (physical examination, lab tests) does not fulfill these criteria, since they are either not fast, or not reliable. Imaging diagnostic modalities help the clinician to acquire the necessary amount of information to initiate focused and effective treatment. However, the selection of the appropriate imaging algorithm, modality and technique, as well as the precise detection and interpretation of essential imaging findings are frequently challenging, especially because the circumstances, under which these examinations are performed (open wounds, bandages, non-removable life-supporting equipment, lack of patient cooperation, etc.), are frequently less than optimal. Knowledge of critical imaging signs, symptoms and the role they play in the evaluation of the patient’s condition, but also fast decision-making and ability to closely cooperate with the clinicians are skills of key importance for radiologist members of the trauma team.

**LEARNING OBJECTIVES**

1) Attendees will be able to better analyze CT scans for non-traumatic causes of abdominal pain.
2) Attendees will learn the CT signs and causes of bowel ischemia.
3) Attendees will learn the CT findings of common causes of an "acute" abdomen.
4) Attendees will learn the imaging findings of acute, nontraumatic urinary tract and GI tract emergencies.

**ABSTRACT**

This segment of the course will go over the optimal imaging approach for patients presenting with acute abdominal pain. CT findings will be emphasized. Key imaging findings of nontraumatic causes of acute abdominal pain including gastrointestinal tract and urinary tract pathology will be explained. A systematic approach for the imaging evaluation of patients with abdominal emergencies will be illustrated and explained including proper scan protocols and analysis of imaging findings. Imaging diagnosis of urinary tract obstruction, infection, bowel obstruction, and ischemia will be emphasized.

**LEARNING OBJECTIVES**

1) Attendees will be able to better analyze CT scans for traumatic and non-traumatic causes of abdominal pain.
2) Attendees will learn the CT signs and causes of bowel ischemia and injuries.
3) Attendees will learn the CT findings of common causes of a traumatic and non-traumatic 'acute' abdomen.
4) Attendees will learn the imaging findings of acute, traumatic and nontraumatic urinary tract and GI tract emergencies.

**ABSTRACT**

Using cases and an audience response system, this segment of the course will go over the optimal imaging approach for patients presenting with acute abdominal pain and abdominal conditions. CT findings will be emphasized. Key imaging findings of traumatic and nontraumatic causes of acute abdominal pain including gastrointestinal tract and urinary tract pathology will be explained. A systematic approach for the imaging evaluation of patients with abdominal emergencies will be illustrated and explained including proper scan protocols and analysis of imaging findings. Imaging diagnosis of blunt and penetrating abdominal injuries, urinary tract obstruction, infection, bowel obstruction, and ischemia will be emphasized.
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 systematically 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

Wednesday, Dec. 2 3:10PM - 3:20PM Location: SS02AB

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 Petrini, 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<.001). RVSvi was significantly correlated with PRF (r=0.605; P<.001) and PRV (r=0.701; P<.001). ΔRVEDVi was significantly correlated with PRF (r=0.427; P=.004) and PRV (r=0.489; P=.001).

**CONCLUSION**

PRV is stronger correlated with RVEDVi, RVSvi and ΔRVEDVi than PRF.

**CLINICAL RELEVANCE/APPLICATION**

Pulmonary reverse volume is a stronger indicator of RV dysfunction than regurgitant 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 1.42 x 1.42 x 2 mm³, 4D PC MRI had a velocity encoding between 3 and 4 m/s, a spatial resolution of 1.41 x 1.41 x 2.3 mm³, and a temporal resolution of 40 ms.

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 22 mmHg 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. Table 1 is a comparison of the segmental artifact 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 statistical 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.

SSM04-04 High-pitch Single Heart Beat Coronary CT Angiography, The Effect of Heart Rate on Image Quality? A 2nd and 3rd Generation Dual Source CT Study

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S504AB

Participants
Adriaan Coenen, MD, Rotterdam, Netherlands (Presenter) Nothing to Disclose
Philip V. Linsen, BSc, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Raluca G. Saru, MD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Marcel L. Dijkstra, RT, Rotterdam, Netherlands (Abstract Co-Author) Consultant, Siemens AG
Mohamed Ouhib, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
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

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. This study investigates the effect of heart rate on image quality while 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 458mm/sec to 737mm/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 higher 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.

SSM04-06 Radiation Dose Levels of Retrospectively ECG-Gated Coronary CT Angiography Using 70 kVp Tube Voltage in Patients with High or Irregular Heart Rates

Wednesday, Dec. 2 3:50PM - 4:00PM Location: S504AB

Participants
Mathias Meyer, Mannheim, Germany (Presenter) Speaker, Siemens AG; Speaker, Bracco Group
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.
**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;  

**Method and Materials**

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.

**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 in 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.

**RESULTS**

Interobserver agreement for scoring perfusion defects on each segment was good ($k = 0.79$, 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 ($r = 0.50$, $P < 0.01$), systolic PAP ($r = 0.55$, $P < 0.001$), diastolic PAP ($r = 0.42$, $P < 0.01$), PVR ($r = 0.57$, $P < 0.001$), RVP ($r = 0.50$, $P < 0.01$) and BNP ($r = 0.42$, $P < 0.01$), a tendency of negative correlation with 6MWD ($r = -0.35$, $P = 0.08$). No significant correlation was found with CO ($r = -0.22$, $P = 0.18$) or CI ($r = -0.26$, $P = 0.11$).

**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.

**SSMOS-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
Alexi Otrakji, MD, Boston, MA (Presenter) Nothing to Disclose
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
Mannudeep K. Kalra, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Subha 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±15years, M:F 25:32, mean weight 77±19kg) who had pulmonary embolism on chest DECT. 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
Alexi Otrakji, MD, Boston, MA (Presenter) Nothing to Disclose
Shaunagh McDermott, FFR(RCSI), Boston, MA (Abstract Co-Author) Nothing to Disclose
Efen 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 prolonged 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.

SSM05-05  Observer Performance at Varying Dose Levels and Reconstruction Methods for Detection of Indeterminate Pulmonary Nodules

Wednesday, Dec. 2 3:40PM - 3:50PM Location: S404CD

Participants
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PURPOSE
Observer Performance at Varying Dose Levels and Reconstruction Methods for Detection of Indeterminate Pulmonary Nodules
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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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±7.9 HU vs 48.5±13.7 HU; 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.
**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.
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

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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

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Xiulian Lu, Shanghai, China (Abstract Co-Author) Nothing to Disclose
PURPOSE
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
Participants
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PURPOSE
To compare the effectiveness of digital tomosynthesis (DT) with dual-energy subtraction radiography (DES) and chest radiography (CXR) for detecting simulated pulmonary nodules (SPNs) according to the nodule size and location.

METHOD AND MATERIALS
Four different sizes (5, 8, 10 and 12 mm 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 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. Except the smallest nodules (5 mm), the TPF for DT was about 1.5 times higher than CXR and DES (0.99 vs 0.677 and 0.670) in danger zone but there was a little difference in non-danger zone (0.988, 0.889, and 0.905 for DT, CXR and DES). 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
Participants
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Aamibika Talwar, MA, MBCHIR, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
Shameema Stalin, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
PURPOSE

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.
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 hemorrhages 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

Participants
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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 valve, 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 of 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 markers 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?

Participants
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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," "antiplatelet" and "blood thinner." Studies were further screened on the basis of a repeat 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 Warfarin anticoagulation with average INR of 2.5 at the time of admission and were subsequently treated to reverse their anticoagulation 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.
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

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) 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

GI  CT  IR  MR  OI  US

AMA 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; Amo 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’ habitus 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: centrolhepatic, 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; 49: 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

Abstract Co-Author
Nothing to Disclose

Presenter
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Presenter
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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

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

PURPOSE
To compare local recurrence rate of radiofrequency ablation (RFA) and surgical metastasectomy for colorectal cancer liver metastases from a surgical and radiological database of consecutive patients and to define the best candidates for each treatment.

METHOD AND MATERIALS
We analyzed, lesion by lesion, 121 metastases treated by metastasectomy (in 43 patients, median follow up 798 days) and 110 metastases treated by RFA (in 60 patients, median follow up 590 days). We compared rate of local recurrence (LR) and hepatic recurrence (HR) between the two groups. Predictive factors for recurrence (patients and primary tumor characteristics and metastasis data - size, depth in the liver (distance between metastasis and hepatic capsule), distance to vascular structures (all veins located within 10 mm to the metastasis were registered), pathological margins in case of surgery (R0/R1 status)), were analyzed by Chi square and logistic regression in univariable and multivariable analysis.

RESULTS
We found no difference between the two groups for patients and primary tumor characteristics. Survival curves were similar between the two groups. Mean metastasis size was larger in metastasectomy group than RFA group (18mm, range 2-90mm, standard error=0.11 and 15mm, range 3-55mm, standard error=0.06; p=0.03). Rate of LR and HR between the two groups were nearly statistically different in favor of RFA: LR was 19% for metastasectomy group and 10% for RFA group (p=0.06, delay: 245 and 289 days, p=0.56), HR were 78.5% for metastasectomy and 66% for RFA (p=0.054, delay: 226 and 235 days, p=0.81). R1 status and metastasis deepness were predictive factors for recurrence in the metastasectomy group (p=0.03 and p=0.02, respectively). Metastases deepness and proximity to vascular structure increased risk for R1 (p=0.04 and p<0.001, respectively). We found no predictive factor for recurrence in RFA group.

CONCLUSION
Pending proper selection (small lesions visible under imaging guidance), RFA tends to have a lower recurrence rate than metastasectomy. Lesions localized in depth in the liver parenchyma, close to large veins are at risk of local recurrence after metastasectomy.

CLINICAL RELEVANCE/APPLICATION
Metastasectomy and radiofrequency ablation are currently used for treatment of colorectal cancer liver metastasis aiming for total tumor ablation and sparing liver parenchyma. There is no study comparing results and risk of local recurrence between metastasectomy and RFA.

Participants
Diana Murcia, MD, Boston, MA (Presenter) Nothing to Disclose
Andrea Prochowski Janurri, 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
scans and subtraction images which increase the cumulative radiation dose and are affected by artifacts.

**Honored Educators**

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

**SSM08-06**  
**CT and MR Imaging Features to Predict Residual or Recurrent Hepatocellular Carcinoma after Trans-arterial 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  
Michael A. Ohliger, MD, 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;  
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 therapy.

**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 100% 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.
**SSM09**

**Gastrointestinal (Esophagus Imaging)**

*Wednesday, Dec. 2 3:00PM - 4:00PM Location: E353B*

<table>
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<tr>
<th>GI</th>
<th>CT</th>
<th>MI</th>
<th>MR</th>
<th>NM</th>
<th>OI</th>
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**SSM09-01 Changes in Esophageal Dimensions during Continuous Swallowing in Healthy Adults as Detected by Magnetic Resonance Imaging**

*Wednesday, Dec. 2 3:00PM - 3:10PM Location: E353B*

**Participants**

David J. Lomas, MD, Cambridge, United Kingdom (*Moderator*) Nothing to Disclose  
Lisa M. Ho, MD, Durham, NC (*Moderator*) Nothing to Disclose

**Sub-Events**

**SSM09-01** Changes in Esophageal Dimensions during Continuous Swallowing in Healthy Adults as Detected by Magnetic Resonance Imaging

**Participants**

Sabarish Narayanasamy, MBBS,MD, Aligarh, India (*Presenter*) Nothing to Disclose  
Mehtab Ahmad, MBBS, Aligarh, India (*Abstract Co-Author*) Nothing to Disclose  
Mudit Arora, DMRD, Aligarh Ho, India (*Abstract Co-Author*) Nothing to Disclose  
Faisal Janal, MBBS, Aligarh, India (*Abstract Co-Author*) Nothing to Disclose  
Breethaa J. Selvamani, Aligarh, India (*Abstract Co-Author*) Nothing to Disclose  
Anusha Sundararajan, Loma Linda, CA (*Abstract Co-Author*) Nothing to Disclose

**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.

**SSM09-02 Differentiate Esophageal Cancer Stages with Spectral CT Imaging**

*Wednesday, Dec. 2 3:10PM - 3:20PM Location: E353B*

**Participants**

Yang Chuangbo, MMed, Xianyang City, China (*Presenter*) Nothing to Disclose  
Yongjun Jia, MMed, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose  
Xirong Zhang, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose  
Chenglong Ren, Shaxi, China (*Abstract Co-Author*) Nothing to Disclose  
Haifeng Duan, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose  
Taiping He, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose  
Xiaoxia Chen, MMed, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To explore the value of spectral CT imaging to differentiate esophageal cancer stages.

**METHOD AND MATERIALS**

67 patients with esophageal cancer diagnosed by esophagoscopy underwent plain and double-phase enhanced CT scan with spectral CT mode. Patients were divided into well-to-moderately differentiated and poorly differentiated squamous carcinoma groups. The iodine-based material decomposition (MD) images were generated and analyzed with GSI Viewer software to measure the iodine concentration (IC) in tumors. Normalized iodine concentration (NIC) was obtained by dividing tumor IC to that of aorta. Data from the two cancer groups were analyzed statistically by independent-samples t test and were correlated with pathological...
RESULTS
There were 32 well-to-moderately differentiated (Picture 1) and 35 poorly differentiated (Picture 2) 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 is 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.

PURPOSE
This pilot study was intended to prospectively compare the diagnostic performance of Diffusion-Weighted Magnetic Resonance Imaging (DW-MRI), Multidetector Computed Tomography (MDCT) and Endoscopic Ultrasonography (EUS) in the preoperative loco-regional staging of esophageal cancer.

METHOD AND MATERIALS
This study was institutional review board-approved. Eighteen patients with biopsy proved esophageal or gastro-esophageal (Siewert I) tumor (9 directly treated with surgery and 9 addressed to chemo/radiotherapy before) underwent 1.5 T DW-MRI, 64-channels MDCT and EUS before and after neoadjuvant treatment. All images were analyzed and staged blindly by dedicated operators according to the 7th TNM edition and two radiologists calculated independently the Apparent Diffusion Coefficient (ADC) from the initial scan. The results were then compared with histopathological findings. Statistical analysis included Spearman and intraclass correlation coefficients, Mann-Whitney U test and receiver operator characteristic curve analysis. After the population had been divided according to local invasion (T1-2 vs T3-4) and nodal involvement (N0 vs N+), sensitivity, specificity, accuracy, positive and negative predictive value were calculated and compared for each technique. Quantitative measurements from DWI were also analyzed.

RESULTS
For T staging, EUS showed the best sensitivity (100%) while MR showed the highest specificity (92%) and accuracy (83%). For N staging, MR and EUS showed the highest sensitivity (100%) but none of the three techniques showed adequate results for specificity. Overall, MR showed the highest accuracy (66%) for N stage. Mean pathological ADC was different between surgery-only and chemo/radiotherapy groups (1.90 vs 1.30 x 10-3 mm2/s, respectively; p= 0.005), with an optimal cut off for local invasion of 1.33 x 10-3 mm2/s (p=0.05).

CONCLUSION
DW-MRI could improve the current preoperative staging workup for esophageal cancer, showing characteristic advantages for both staging and initial treatment decision-making.

CLINICAL RELEVANCE/APPLICATION
DW-MRI can be useful in the preoperative workup for esophageal cancer and could help to select appropriate treatments after initial staging.

PURPOSE
To evaluate diagnostic feasability of MP-MRI for the preoperative staging of EC and to assess its efficacy in discrimination between findings.
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%~85.7%) 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.

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.

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).

CT signs can predict therapeutic efficacy and survival outcomes and provide an opportunity to offer additional treatment options before surgery.

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.
**SSM10**

**ISP: Gastrointestinal (Pancreas Cystic Lesions)**

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E353C

GI  CT  MR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

**Participants**
Douglas S. Katz, MD, Mineola, NY (Moderator) Nothing to Disclose
Desiree E. Morgan, MD, Birmingham, AL (Moderator) Research support, General Electric Company

**Sub-Events**

**SSM10-01**  
**Gastrointestinal Keynote Speaker: Update on the Management of Small Pancreatic Cysts**

Wednesday, Dec. 2 3:00PM - 3:10PM Location: E353C

Participants
Douglas S. Katz, MD, Mineola, NY (Presenter) Nothing to Disclose

**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/

Douglas S. Katz, MD - 2013 Honored Educator
Douglas S. Katz, MD - 2015 Honored Educator

**SSM10-03**  
**Diffusion-Weighted MR Imaging in Distinguishing between Mucin-producing and Serous Pancreatic Cysts**

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E353C

Participants
Chiara Pozzessere, MD, Siena, Italy (Presenter) Nothing to Disclose
Sandra L. Castanos Gutierrez, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Celia P. Corona-Villalobos, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Chunnniao Xu, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Ihab R. Kamel, MD, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

**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 x10⁻³ mm²/sec, 3.27 x10⁻³ mm²/sec and 3.35 x10⁻³ mm²/sec for the three readers, respectively. The mean ADC value of the serous cysts was 2.86 x10⁻³ mm²/sec, 2.85 x10⁻³ mm²/sec and 2.85 x10⁻³ mm²/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 3x10⁻³ mm²/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
Among 95 patients with 150 cysts, 12 patients with 16 cysts underwent operations. Out of 134 cysts in 83 non-surgical patients, preliminary radiologic diagnosis with the pathologic results.

METHODS AND MATERIALS

To describe the natural history of small, incidental pancreatic cysts after long-term follow-up, with an emphasis on identifying cyst visualization at ultrasound was identified. 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 ≥5 mm and <1 cm; and 16% (16/101) of cysts <5 mm. Measured max diameter at US differed from max 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 of the pancreas on the same date as the MRI examination. US was performed in blinded fashion to same date MR results. Detection rate of US was correlated with patient factors including weight, AP abdominal diameter, thickness of subcutaneous abdominal fat, location of cyst within pancreas, and size of cyst, using chi-squared and Wilcoxon rank sum tests. Size measurements of pancreatic cysts at US were compared with MR measurements. MR measurements were taken as gold standard for cyst size.

METHODS AND MATERIALS

In an IRB-approved, HIPAA-compliant study, patients with known PCL scheduled for MRI follow up underwent prospective transabdominal ultrasound of the pancreas on the same date as the MRI examination. PCL were measured in transverse (TR), anteroposterior (AP), and craniocaudal (CC) dimensions and the longest dimension obtainable in any plane. US was performed in blinded fashion to same date MR results. Detection rate of US was correlated with patient factors including weight, AP abdominal diameter, thickness of subcutaneous abdominal fat, location of cyst within pancreas, and size of cyst, using chi-squared and Wilcoxon rank sum tests. Size measurements of pancreatic cysts at US were compared with MR measurements. MR measurements were taken as gold standard for cyst size.

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 ≥5 mm and <1 cm; and 16% (16/101) of cysts <5 mm. Measured max diameter at US differed from max 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.

Fate of Small Pancreatic Cysts (<3cm) after Long-term Follow-up: Analysis of Significant Radiologic Characteristics and Proposal of Follow-up Strategy

METHODS AND MATERIALS

We retrospectively selected 95 patients with 150 cysts from our hospital database. Selection criteria included patients with pancreatic cysts <3 cm 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 95 patients with 150 cysts, 12 patients with 16 cysts underwent operations. Of 134 cysts in 83 non-surgical patients, preliminary radiologic diagnosis with the pathologic results.

METHODS AND MATERIALS

To assess the utility of transabdominal ultrasound in follow up evaluation of known pancreatic cystic lesions (PCL) using same-day MRI examinations as gold standard.

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 ≥5 mm and <1 cm; and 16% (16/101) of cysts <5 mm. Measured max diameter at US differed from max 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.

Fate of Small Pancreatic Cysts (<3cm) after Long-term Follow-up: Analysis of Significant Radiologic Characteristics and Proposal of Follow-up Strategy

METHODS AND MATERIALS

We retrospectively selected 95 patients with 150 cysts from our hospital database. Selection criteria included patients with pancreatic cysts <3 cm 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 95 patients with 150 cysts, 12 patients with 16 cysts underwent operations. Of 134 cysts in 83 non-surgical patients, 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 85 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±5.5mm, 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.

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
Jin 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 before CT, MR, 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, 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

**ISP: Genitourinary (Intravenous Contrast Issues and CT Dose Reduction)**

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E352

**SSM11-01** Genitourinary Keynote Speaker: Safety and Efficacy of Corticosteroid Prophylaxis

Wednesday, Dec. 2 3:00PM - 3:10PM Location: E352

**Participants**
Matthew S. Davenport, MD, Cincinnati, OH (Moderator) Book contract, Wolters Kluwer nv; Book contract, Reed Elsevier; Dean A. Nakamoto, MD, Beachwood, OH (Moderator) Research Grant, Galli Medical Ltd; Research agreement, Toshiba Corporation

**SSM11-02** The Effect of IV Contrast on Renal Function in Patients on Metformin

Wednesday, Dec. 2 3:10PM - 3:20PM Location: E352

**Participants**
Cody W. McHargue, BA, San Francisco, CA (Presenter) Nothing to Disclose
Arti D. Shah, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Judy Yee, MD, Clayton, CA (Abstract Co-Author) Research Grant, EchoPixel, Inc
Priyanka Jha, MBBS, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Isabel Allen, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Donald Chau, BA, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Robert Rushakoff, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Due to concerns of acute kidney injury and the theoretical risk of lactic acidosis with metformin, the Food and Drug Administration mandates that metformin be held for two days after intravenous (IV) contrast until renal function is checked and in an acceptable range. However, there is minimal evidence to support this practice. Further investigation is warranted.

**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 general model estimating equations method was used to determine whether IV contrast and pre-contrast creatinine (Cr) or pre-contrast 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±.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 improved 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.

**SSM11-03** The Presence of a Solitary Kidney is not an Independent Risk Factor for Acute Kidney Injury Following Contrast-enhanced CT

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E352

**Participants**
Jennifer S. McDonald, PhD, Rochester, MN (Abstract Co-Author) Research Grant, General Electric Company
Richard W. Katzberg, MD, Sacramento, CA (Abstract Co-Author) Research Grant, Siemens AG Research Grant, Bayer AG
Robert J. McDonald, MD, PhD, Rochester, MN (Presenter) Nothing to Disclose
Eric E. Williamson, MD, Rochester, MN (Abstract Co-Author) Research Grant, General Electric Company
David F. Kallmes, MD, Rochester, MN (Abstract Co-Author) Research support, Terumo Corporation Research support, Medtronic, Inc
**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.

**SSM11-04**  New Insights in the MRI Excretory Phase: The Use of Gd-EOB-DTPA for the Evaluation of the Excretory System

**Participants**

Caterina Colanonti, 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 3605±1025.3 for Gd-EOB-DTPA, respectively. The mean signal intensity ratio was 2.2±1.59 for Gadobutrol, 2.7±0.88 for Gadobenate dimeglumine, and 3.8±1.46 for Gd-EOB-DTPA. Significant differences were found between 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 of Gd-EOB-DTPA (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.

**SSM11-05**  Feasibility and Image Quality of Reduced Dose CT Intravenous Pyelogram Using Model-Based Iterative Reconstruction in Patients with Hematuria

**Participants**

Caterina Colanonti, MD, Milan, Italy (Presenter) Nothing to Disclose
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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**

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.
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 (CTDIvol = 7.7 +/- 2.8 mGy) compared to SD CT IVP (CTDIvol = 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 CTDIvol = 23.91 +/- 5.3 mGy). Overall image quality impression of the collecting system, artifacts, and image sharpness were not significantly different (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.

Reduced Radiation Dose with Iterative Reconstruction in 100 kVp CT Urography: With different Iodine Dosage

Participants
Huili Wang, MD, Beijing, China (Presenter) Nothing to Disclose
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Purpose
To evaluate the image quality and radiation dose in CT urography at 100kVp with iterative reconstruction, combining a different iodine dosage.

Method and Materials
This study was approved by the institutional review board. From March to June 2012, 45 consecutive patients who underwent CTU for hematuria were divided into 3 groups: group A, 100kVp and 0.9mL/kg contrast material (CM) (9 men, 6 female; mean age 49.4 years; mean BMI 22.6kg/m²); group B, 100kVp and 1.1mL/kg CM (8 men, 7 female; mean age 50.1years; mean BMI 22.6kg/m²); group C, 120kVp and 1.1mL/kg CM (13men, 2 female; mean age 58.5 years, mean BMI 23.5kg/m²). Automatic tube current was used in all groups. The 100kVp images (group A and B) were reconstructed with 80% adaptive statistical iterative reconstruction (ASIR), while filter back projection (FBP) for 120kVp images (group C). Urinary tract was divided into 11 segments, and mean CT values and contrast-to-noise ratio (CNR) of each segment in the excretory phase were measured respectively in 3 groups. The radiation dose in excretory phase was compared (volume computed tomography dose index, CTDIvol; size-specific dose estimate, SSD and estimated effective dose, ED).

Results
There were no significant differences among group A, B and C for age, BMI and transverse circumstance (all P>0.05). All examinations were considered to be of acceptable image quality and inter-observer agreement was good (K=0.717, P<0.001). There were no significant differences in mean attenuations of all urinary segments among 3 groups (P>0.05). Image noise was much less 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). 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), but there were no notable differences in CNRs between group A and B (P>0.05). Mean CTDIvol, SSD and ED in excretory phase in
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.
**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

**Sub-Events**

**SSM16-01** Anthropometric-based Radiopharmaceutical Dosing to Reduce Radiation in SPECT MPI: Initial Experience

**Participants**
Jie Zhang, PhD, Lexington, KY (Presenter) Nothing to Disclose
Vince Sorrell, MD, Lexington, KY (Abstract Co-Author) Nothing to Disclose
Paul Anaya, Lexington, KY (Abstract Co-Author) Nothing to Disclose
M. Elizabeth Oates, MD, Lexington, KY (Abstract Co-Author) 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.
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 \pm 0.86 \text{ ml/g/min}} vs. 2.13 \pm 0.84 \text{ ml/g/min}; p=0.045, \text{Mann-Whitney Test}) and decreased MFR \((2.40 \pm 0.81 \text{ vs. 2.75 } \pm 1.05; p=0.002)\). Resting MBF was not significantly different \((0.82 \text{ ml/g/min vs. 0.79 ml/g/min}; p=0.305)\). 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 \((r=-0.364, p=0.044)\) 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 vasodilation 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.

**SSM16-03 The Influence of Myocardial Scar as Assessed by Myocardial Perfusion SPECT on the Development of Electrical Reverse Remodeling after Cardiac Resynchronization Therapy**

**Wednesday, Dec. 2 3:20PM - 3:30PM Location: S505AB**

Participants
Guang-Uei Hung, MD, Lugang, Taiwan (Presenter) Nothing to Disclose
Ji Chen, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Cardiac resynchronization therapy (CRT) can provide cardiac reverse remodeling (RR), which may include electrical (ERR: QRS duration shortened \(\geq 10\) ms) and/or mechanical (MRR: ESV reduced \(\geq 15\%\)) reverse remodeling. However, the pathophysiological mechanism is not clear. Myocardial perfusion SPECT (MPS) provided a comprehensive evaluation of LV perfusion, function and mechanical activation. The purpose of this was to explore the mechanism of RR with MPS.

**METHOD AND MATERIALS**

Forty-one patients \((26 \text{ men, mean age 66} \pm 10 \text{ yrs})\) with heart failure received CRT for at least 12 months underwent resting MPS under transient CRT-off. The patients were divided into three groups according to their RR levels: group I: MRR+ERR, group II: MRR only and group III: non-responder. Emory cardiac toolbox was used for analysis of MPS to assess myocardial scar, LV volume, EF, dyssynchrony, activation sequence and contraction delay.

**RESULTS**

Between the three groups of patients, there were significant differences for scar burden \((15.9 \pm 9.5\%, 26.8 \pm 16.1\% \text{ and } 45.6 \pm 15.1\% \text{, for group I, II and III, respectively, } p < 0.001)\), EDV \((136.6 \pm 64.9\text{ ml}, 221.6 \pm 123.9\text{ ml} \text{ and } 351.8 \pm 216.3\text{ ml}; p = 0.002)\), ESV \((82.6 \pm 59.8\text{ ml}, 172.3 \pm 117.2\text{ ml} \text{ and } 293.3 \pm 209.6\text{ ml}; p = 0.001)\), systolic phase SD \((23.4 \pm 10.3^\circ, 36.0 \pm 16.2^\circ \text{ and } 57.0 \pm 22.2^\circ, p < 0.001)\) and diastolic phase SD \((32.1 \pm 12.4^\circ, 48.4 \pm 18.3^\circ \text{ and } 64.7 \pm 22.5^\circ, p < 0.001)\). As shown on the polar map of phase analysis (see attached figures), myocardial scar interfered with the normal propagation of mechanical activation and resulted in heterogeneous activation sequences. Compared to group II, group I had significantly less initiation points \((1.9 \pm 1.0 \text{ vs. } 2.6 \pm 0.7, p< 0.05)\) and smaller maximal contraction delay \((46.9 \pm 12.9^\circ\text{vs. } 58.8 \pm 18.5^\circ, p <0.05)\).

**CONCLUSION**

The perfusion, function and mechanical activation parameters as assessed by MPS were significantly associated with different levels of RR. The volume of myocardial scar may play a critical role in the development of electrical RR.

**CLINICAL RELEVANCE/APPLICATION**

The comprehensive evaluation of myocardial substrates by myocardial perfusion SPECT disclosed the pathophysiological mechanisms of different reverse remodeling patterns post CRT.

**SSM16-04 Development of a Novel Software for Calculating Myocardial Flow Reserve from Dynamic Kinetic Analysis Using a Cadmium-zinc-telluride (CZT) SPECT**

**Wednesday, Dec. 2 3:30PM - 3:40PM Location: S505AB**

Participants
Masao Miyagawa, MD, PhD, Toon, Japan (Presenter) Nothing to Disclose
Yoshiko Nishiyama, MD, Toon, Japan (Abstract Co-Author) Nothing to Disclose
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Akira Kurata, PhD, Toon, Japan (Abstract Co-Author) Nothing to Disclose
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**PURPOSE**

CZT camera enables fast acquisition of serial dynamic images during the first pass of flow agents. The aims are to develop a novel
software for calculating myocardial flow reserve (MFR) and validate the utility for screening patients (pts) with multi-vessel coronary artery disease (CAD).

**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 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, Ion Beam Applications, SA

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. The normal range for Mi/Vi = 1.0-1.5. We compared ejection fraction (EF), myocardial blood flow (MBF), and coronary vascular resistance (CVR) against Mi/Vi. LV MBF and CVR were computed from the first pass transit of injected Rb-82 using a 2-compartment model, and volumes and EF values were computed from subsequent myocardial gated equilibrium data.

**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±71 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**
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Yuka Yamamoto, MD, PhD, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose
Yukito Maeda, Kita-Gun, Japan (Abstract Co-Author) Nothing to Disclose
Takahisa Noma, Kita-Gun, Japan (Abstract Co-Author) Nothing to Disclose
Yoshihiro Nishiyama, MD, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose

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.
Vascular/Interventional (Advances in Transarterial Chemoembolization)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E351

SSM23-01 Transpulmonary Chemoembolization (TPCE) in Pulmonary Malignant Tumors: Evaluation of Treatment Response Using Parenchymal Blood Volume (PBV)

Participants
Sarah B. White, MD, MS, Milwaukee, WI (Moderator) Nothing to Disclose
Hyun S. Kim, MD, Atlanta, GA (Moderator) 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). 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 Melphalan for Hepatic Metastases from Uveal Melanoma: Multiinstitutional Evaluation

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

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
Between 2012 and 2014 fourteen patients with hepatic metastases of uveal melanoma received one to three sessions of Chemosaturation-PHP. Eleven patients were evaluated by means of RECIST criteria. Survival time analysis was performed. Adverse events and complications were registered.

RESULTS

Chemosaturation is well tolerated by the majority of all fourteen patients. After therapy seven patients developed leukopenia, six patients had thrombopenia 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 spurtng 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. Scherenthaler, 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

PURPOSE

To determine the treatment response of advanced hepatocellular carcinoma (HCC) treated with transarterial chemoembolization (TACE) in a single medical institution between 2012 and 2014. Adverse events and complications were registered.

METHOD AND MATERIALS

This is a retrospective 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. Imaging acquisition and injection protocols remained the same before and after TACE. 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.
The efficacy and safety of transarterial chemoembolization (TACE) for Barcelona Clinic Liver Cancer (BCLC) class C remains controversial. We conducted a large retrospective study to summarize our available data about the treatment of TACE in advanced HCC patients over the last 15 years.

**METHOD AND MATERIALS**

Between November 1998 and December 2013, all advanced stage (BCLC C) HCC patients with Child-Pugh (A/B) and Eastern Cooperative Oncology Group score of 0-2 were consecutively enrolled. Cox proportional hazards model was used to examine risk factor association with survival. Risk scores for individual patients were calculated by combining the 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.

**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 1.44-2.46), AFP≥400ng/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 (R) for individual patients were calculated by combining these five prognostic values with the corresponding regression coefficients. The c-statistic associate with the model in the prediction of 1 year, 2 year and 3 year survival was 0.74 (95%CI 0.69-0.78), 0.73 (95%CI 0.68-0.78) and 0.72 (95%CI 0.66-0.79), respectively. To achieve both the best sensitivity and specificity, we selected 5.5 as the cut-off value for R score. The Kaplan-Meier analysis showed that the median survival in the patients <5.5 was significantly longer than those >5.5 (21.6 vs. 6.9months, P<0.001).

**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**

**Participants**

Rory O’Donohoe, MBChB, Dublin, Ireland (Presenter) Nothing to Disclose
Alexis M. Cahalane, MBChB, Dublin 4, Ireland (Abstract Co-Author) Nothing to Disclose
Aoife Hayes, Dublin, Ireland (Abstract Co-Author) Nothing to Disclose
Olivia Connolly, Dublin, Ireland (Abstract Co-Author) Nothing to Disclose
Jeffrey W. McCann, MBChB, Dublin, Ireland (Abstract Co-Author) Nothing to Disclose
Edmund Ronan Ryan, MBChB, Dublin, Ireland (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

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.

**METHOD AND MATERIALS**

Flat-detector CT perfusion imaging using syngo DynaPBV Body (Siemens Heathcare AG, Forchheim, Germany) is performed using rotational angiography before and after injection of a fixed small volume of dilute iodinated contrast via a microcatheter positioned either within the proper hepatic artery or more distally. Beginning in June 2014, nine chemoembolization procedures have been performed on seven patients using syngo DynaPBV for whom follow-up imaging is now available. We reviewed the post-chemoembolization DynaPBV images from these nine procedures and performed a direct comparison with the subsequent multi-phase CT or MRI. We assessed for abnormally increased perfusion immediately following treatment and correlated this with the presence or absence of residual viable tumor on follow-up imaging.

**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.

**CLINICAL RELEVANCE/APPLICATION**

Flat-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.
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.
Controversy Session: US, CT, or MR Imaging in Possible Appendicitis in Children: Three Pegs and Often Only One Hole

Wednesday, Dec. 2 4:30PM - 6:00PM Location: E451A

Participants
Nancy R. Fefferman, MD, New York, NY, (nancy.fefferman@nyumc.org) (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the advantages, disadvantages and limitations of US as an effective imaging modality in the diagnosis of appendicitis in children. 2) Review the current literature addressing the diagnostic performance of US for pediatric appendicitis. 3) Discuss the role of US in the imaging evaluation of suspected appendicitis in children.

ABSTRACT

Participants
Michael J. Callahan, MD, Boston, MA, (michael.callahan@childrens.harvard.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Highlight the advantages, disadvantages and versatility of computed tomography for the diagnosis of suspected acute appendicitis in children. 2) Describe published sensitivity and specificity values for computed tomography in the setting of suspected acute appendicitis in the pediatric population. 3) Explain the challenges and potential barriers for standardization of pediatric appendicitis clinical practice guidelines at academic and non-academic centers.

Participants
R. Paul Guillerman, MD, Houston, TX, (rpguille@texaschildrens.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Develop an MRI protocol for suspected pediatric appendicitis. 2) Estimate the diagnostic efficacy of MRI for suspected pediatric appendicitis. 3) Appraise how radiation-induced cancer risks and diagnostic performance characteristics influence the optimal selection of US, CT and MRI for suspected pediatric appendicitis.
Controversy Session: CT Perfusion (CTP) and Stroke: RIP?

Wednesday, Dec 2 4:30PM - 6:00PM Location: S406B

NR CT ER

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

Participants
Gordon K. Sze, MD, New Haven, CT (Moderator) Investigator, Remedy Pharmaceuticals, Inc

ABSTRACT
Recent trials have shown that intervention produces favorable outcomes when acute ischemic stroke patients are selected using CTP. Does that mean that CTP is adequate to decide whether an INDIVIDUAL patient should undergo treatment? The answer is "no". CTP is simply too imprecise to reliably measure the infarct core - the critical parameter for excluding from therapy patients who are at great risk of hemorrhagic complications, and are unlikely to benefit. Moreover, there is a more precise alternative, diffusion MRI. CTP measures hemodynamics, not tissue status. Hence, although a marker for irreversible injury absent timely reperfusion, CTP - which reflects a snapshot-in-time - is not a marker for treatment futility. Not surprisingly, validation studies in animal models are sparse and have not been reproduced. All published clinical data are consistent: CTP core estimates have high error. Although CTP may be adequate for selection of patients with small cores, where large measurement errors are of little consequence, the cost is exclusion of many with a high likelihood of treatment benefit. CTP core-lesions segmented using automated software offer the illusion of quantitative accuracy that simply does not exist. CTP and DWI are different. The inherently poor signal-to-noise ratio (SNR) of post-processed CTP images is another fundamental weakness of the technique. Low SNR measurements may be useful if repeated and a mean calculated; this cannot be done for individual patients. That a strong linear correlation exists between CTP and DWI derived ischemic lesion volumes is not surprising, since both result from the same arterial occlusion. High correlation in a population, however, does not confer high measurement accuracy in an individual. As Bland and Altman pointed out almost 30 years ago, regression analyses are inappropriate to judge the validity of a quantitative clinical test. More appropriate are difference tests that establish the 95% confidence limits. As shown by Schaefer et al, a CBF core measurement of 70 ml could actually range from 11- to 124 ml within the 95% confidence limits; other papers in the CTP literature reveal similar variability. Although this large variability does not preclude using CTP to enroll patients into clinical trials, it does make such selection inherently less efficient compared to using "reference standard" DWI. Indeed, power calculations show that, for a simulated treatment study designed to detect a 20 ml improvement in final infarct volume, using CTP instead of DWI would require at least twice as many patients to reach significance. Given CTP's relative inaccuracy in delineating "core", what is the reason for the good outcome rate using a CTP-based selection strategy? The answer lies in its patient selection criteria. The successful trials used a highly conservative selection strategy, "cherry picking" the very best patients with very small cores who were likely to do well even with alteplase alone. Targeting small cores minimizes the effects of large measurement errors, at the cost of excluding many who might benefit. All agree that clinical trials have demonstrated that thrombolysis and thrombectomy are effective treatments for stroke caused by large vessel occlusion. All agree that identifying a target occlusion is important, and that measurement of the infarct-core is critical. The question centers on whether core measurement by CTP is sufficiently precise to be used for treatment selection in INDIVIDUAL patients? A wealth of theoretical, experimental, and clinical evidence suggests the answer is "no". Many argue that "CTP may be short of perfect, yet close enough." Would an internist accept a blood glucose or INR measurement with >50% error as "close enough?" No, she would not. Why, then, should stroke physicians accept a core measurement error of >50% as "close enough?" Clearly, they should not - especially when a more accurate alternative is readily available. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet. 1986 Feb 8;1(8476):307-10. Schaefer PW, Souza L, Kamalian S, Hirsch JA, Yoo AJ, Kamalian S, Gonzalez RG, Lev MH. Limited reliability of computed tomographic perfusion acute infarct volume measurements compared with diffusion-weighted imaging in anterior circulation stroke. Stroke. 2015 Feb;46(2):419-24.

Participants
Max Wintermark, MD, Lausanne, Switzerland, (max.wintermark@gmail.com) (Presenter) Advisory Board, General Electric Company;

Learning Objectives
1) To review the indications of perfusion CT imaging in patients suspected of acute ischemic stroke.

ABSTRACT
Perfusion-CT is an imaging method used to assess the ischemic core and penumbra in acute stroke patients. A prospective multicenter study reported that an absolute cerebral blood volume (CBV) threshold reflected the ischemic core and that a relative mean transit time (MTT) threshold most accurately reflected the penumbra. However, in more recent and larger studies, relative cerebral blood flow (rCBF) was found to be more predictive of the ischemic core (nonviable tissue) than absolute CBV. There is a need for...
standardization of the PCT methods used to define the ischemic core and the penumbra. Determination of tissue viability based on imaging has the potential to individualize thrombolytic therapy and extend the therapeutic time window for some acute stroke patients. Although perfusion imaging has been incorporated into acute stroke imaging algorithms at some institutions, its clinical utility has not been proven. It is important to note that perfusion imaging has many applications beyond characterization of the penumbra and triage of patients to acute revascularization therapy. The negative results of the MR RESCUE trial do not negate these potential benefits. These applications include, but are not limited to: (1) improving the sensitivity and accuracy of stroke diagnosis (in some cases, a lesion on PCT leads to more careful scrutiny and identification of a vascular occlusion that was not evident prospectively, particularly in the M2 and more distal MCA branches), (2) excluding stroke mimics, (3) better assessment of the ischemic core and collateral flow, and (4) prediction of hemorrhagic transformation and malignant edema.
Controversy Session: Ultrasound versus CT for Suspected Renal Colic: Which Modality Rocks in the ER?

Wednesday, Dec. 2 4:30PM - 6:00PM Location: S404CD

Participants
Judy Yee, MD, San Francisco, CA (Moderator) Research Grant, EchoPixel, Inc
Mitchell E. Tublin, MD, Pittsburgh, PA (Presenter) Nothing to Disclose
Aaron D. Sodickson, MD, PhD, Wayland, MA, (asodickson@bwh.harvard.edu) (Presenter) Research Grant, Siemens AG; Consultant, Bracco Group
D. Mark Courtney, MD, MSc, Chicago, IL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the advantages of ultrasound and present a cost effective, rational algorithm for its use in the evaluation of ER patients with potential renal colic. 2) Understand the benefits of CT over ultrasound in ER imaging of suspected renal colic. 3) Understand the perspective and preferences of the ER physician for the workup of renal colic and the effect on clinical workflow.

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Aaron D. Sodickson, MD, PhD - 2014 Honored Educator
Participants
Hersh Chandarana, MD, New York, NY (Moderator) Equipment support, Siemens AG; Software support, Siemens AG; Consultant, Bayer, AG;

LEARNING OBJECTIVES
1) This course will cover the basics and application of Dual Energy CT in GU Radiology.

ABSTRACT

Sub-Events

SPHS50A Principles of DECT

Participants
Daniel T. Boll, MD, Durham, NC (Presenter) Research Grant, Siemens AG; Research Grant, Koninklijke Philips NV; Research Grant, Bracco Group

LEARNING OBJECTIVES
1) Discuss DECT advantages for renal mass evaluation. 2) Describe useful DECT applications for renal mass characterization. 3) Summarize recent literature and future opportunities of DECT of renal masses.

ABSTRACT
Application of DECT to renal mass evaluation and improved characterization.

URL

SPHS50B DECT of GU Masses-2015 Update

Participants
Terri J. Vrtiska, MD, Rochester, MN (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss DECT advantages for renal mass evaluation. 2) Describe useful DECT applications for renal mass characterization. 3) Summarize recent literature and future opportunities of DECT of renal masses.

ABSTRACT
Application of DECT to renal mass evaluation and improved characterization.

URL

SPHS50C Establishing DECT in Your Practice: Nuts and Bolts

Participants
Avinash R. Kambadakone, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the basic principles, technique and clinical applications of DECT. 2) Identify and appraise the different technologies, workflow implications and challenges of DECT in day-to-day practice. 3) Apply and incorporate the most appropriate DECT protocols into routine practice.

ABSTRACT

URL
Contemporary Imaging of Lung Cancer

Thursday, Dec. 3 8:30AM - 10:00AM Location: N227

CH  CT  MI  MR  OI

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

Participants
Jeremy J. Erasmus, MD, Houston, TX (Moderator) Nothing to Disclose

Sub-Events

RC601A  Non-small Cell Lung Cancer Staging: Concepts and Controversies

Participants
Ioannis Vlahos, MRCP, FRCR, London, United Kingdom (Presenter) Research Consultant, Siemens AG Research Consultant, General Electric Company

LEARNING OBJECTIVES
1) Summarize the origins, basis and rationale of the current TNM classification of lung cancer. 2) Discuss the strengths and limitations of the current system and how to practically address these 3) Highlight areas where current radiology, oncological, surgical and pathological best practice and evolving knowledge in these area are progressing beyond the current staging system.

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Ioannis Vlahos, MRCP, FRCR - 2015 Honored Educator

RC601B  Contemporary Concepts in Small Cell Lung Cancer

Participants
Fergus V. Gleeson, MBBS, Oxford, United Kingdom (Presenter) Consultant, Alliance Medical Limited; Consultant, Blue Earth Diagnostics Limited; Consultant, Polarean, Inc;

LEARNING OBJECTIVES
1) To learn the clinical manifestations, staging and prognostic factors of small cell lung cancer. 2) To become familiar with the role of PET-CT in the investigation and management of small cell lung cancer. 3) To review unusual presentations of small cell lung cancer and their investigation and treatment.

ABSTRACT
Small cell lung cancer, SCLC, accounts for approximately 15% of all lung cancers, with its overall incidence decreasing, although it is increasing in women, with the male to female incidence ratio now 1:1. Small cell lung cancer has a more rapid doubling time than non-small cell lung cancer, with most patients presenting with hematogenous metastases, and only approximately one-third presenting with limited-stage disease confined to the chest. Small cell lung cancer uncommonly presents with a solitary pulmonary nodule, and the disease does not appear to have benefited from Lung Cancer Screening. There are multiple neurologic and endocrine paraneoplastic syndromes associated with small cell lung cancer, with marked improvement on treatment of the underlying tumour. Historically SCLC was staged according to the Veteran’s Administration Lung Group’s 2 stage classification of 1) extensive-stage disease or 2) limited-stage disease, and this classification used to guide therapy. More recently it has been recommended that SCLC is staged according to the International Association of the Study of Lung Cancer (IASLC) and the AJCC Cancer Staging Manual 7th edition, using the same staging system for NSCLC and SCLC. Whilst contrast enhanced CT scan of the chest and abdomen remain routine as the initial method for staging SCLC, FDG PET-CT now plays a more important role in staging and management. SCLC is a highly metabolic disease, and PET-CT both upstages and downstages disease, potentially altering management.

RC601C  PET Imaging of Lung Cancer: Beyond Standard Metabolic Assessment

Participants
Eric M. Rohren, MD, PhD, Houston, TX (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review advanced image processing and metabolic parameters in FDG-PET/CT. 2) Discuss non-FDG radiotracers and their potential applications in non-small cell lung cancer. 3) Illustrate the application and clinical use of advanced metabolic imaging biomarkers derived from FDG-PET/CT using case examples.

ABSTRACT
Assessment of non-small cell lung cancer with PET is typically performed using F-18 fluorodeoxyglucose (FDG). The uptake and retention of FDG by the tumor is taken to be a measure of metabolism, which in turn can provide useful information on staging, grading, and prognosis. Advances in the field of PET/CT imaging may provide additional information for the evaluation and care of patients with lung cancer. Advanced semi-quantitative analyses including total lesion glycolysis (TLG) and metabolic tumor volume
(MTV) have been employed to capture additional information from FDG-PET/CT studies, which in some cases is additive to standard metabolic parameters such as SUVmax. New tracers are under development, with some nearing approval in the U.S. and elsewhere. These include tracers targeting proliferation, receptor expression, and protein catabolism, investigating molecular events and processes beyond glucose metabolism.

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Eric M. Rohren, MD, PhD - 2015 Honored Educator

RC601D  MRI: Advances in Nodule Characterization and Lung Cancer Staging

Participants
Kyung S. Lee, MD, PhD, Seoul, Korea, Republic Of, (kyungs.lee@samsung.com) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To review most popular MRI techniques that are used in thoracic MR imaging. 2) To demonstrate how effective MR imaging is in nodule characterization and lung cancer staging, particularly focused on diffusion-weighted imaging (DWI) and diffusion-weighted whole-body imaging with background body signal suppression (DWIBS).

ABSTRACT
Diffusion-weighted MR imaging helps characterize lung nodule, and enables staging and prognosis prediction in lung cancer. Diffusion-weighted whole-body imaging with background body signal suppression (DWIBS) is known to be specific in nodal staging and effective in whole body MR imaging. Both whole body MRI and PET-CT may be used in extra-thoracic lung cancer staging, but each modality has its own and different merits in lung cancer staging. Whole body MRI-PET may be the future oncologic imaging modality.

URL

RC601E  CT Perfusion Imaging in Lung Cancer

Participants
Friedrich D. Knollmann, MD, PhD, Sacramento, CA, (fkollmann@ucdavis.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To identify suitable indications for the use of CT perfusion imaging in lung cancer. 2) To apply CT perfusion imaging to lung tumors. 3) To recognize important features of a valid CT perfusion imaging protocol. 4) To interpret the results of a CT perfusion study in lung tumors.

ABSTRACT
CT perfusion (CTP) imaging has become a tenable proposition with the advent of multislice CT. Preliminary data have indicated a potential role in the assessment of treatment response in lung cancer, but the method is not widely used. In this course, the rationale for using CT perfusion imaging as a quantitative imaging biomarker in lung cancer is discussed. A review of CT protocols includes factors that have impeded a wider adoption of the method in the clinical sphere, such as the reproducibility of measurements, and validation efforts. Solutions to these problems, such as improved anatomic coverage with wider detectors and table motion, reduced radiation exposure with iterative reconstruction, advanced postprocessing with dual blood supply algorithms, motion registration and correction, and volumetric perfusion analysis are addressed. With these methods, tumor classification, assessment of tumor response, and prognostic testing are promising applications of CTP imaging.

RC601F  Thoracic Oncologic Imaging: Treatment Effects and Complications

Participants
Brett W. Carter, MD, Houston, TX (Presenter) Author, Reed Elsevier; Consultant, St. Jude Medical, Inc;  

LEARNING OBJECTIVES
1) Understand the role of imaging in the evaluation of patients who have been treated for thoracic malignancies. 2) Recognize the manifestations of radiation therapy in the chest and be able to differentiate expected changes from residual or recurrent disease. 3) Identify intrathoracic complications from radiation therapy, chemotherapy, and surgery.

ABSTRACT
Imaging plays an important role in the evaluation of patients who have been treated with radiation therapy, chemotherapy, and/or surgery for intrathoracic malignancies such as lung cancer, esophageal cancer, malignant pleural mesothelioma, and thymoma. Following thoracic radiation therapy, radiation pneumonitis (1-6 months following therapy) and radiation fibrosis (6-12 months following therapy) are typically identified in the lungs. However, complications such as esophagitis, esophageal ulceration, and radiation-induced cardiovascular disease may develop. Patients treated with chemotherapy may develop pulmonary and cardiovascular complications such as drug toxicity, organizing pneumonia, thromboembolic disease, vasculitis, and cardiomyopathy. Knowledge of the spectrum of expected treatment-related changes, potential treatment complications and the appearance of tumor recurrence is critical in order to properly monitor patients, identify iatrogenic complications, and avoid misinterpretation.

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educational content in their field of study. Learn how you can become an honored educator by visiting the website at:
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Brett W. Carter, MD - 2015 Honored Educator
Participants

LEARNING OBJECTIVES

ABSTRACT

Sub-Events

RC603A Imaging and Interpreting Re-vascularized Coronary Arteries (I: Bypass Grafts)

Participants
Smita Patel, MBBS, Ann Arbor, MI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To review the basic approach of evaluating coronary artery bypass grafts on CT. 2) To review normal surgical anatomy and pathology of coronary artery bypass graft conduits on CT.

ABSTRACT

RC603B Imaging and Interpreting Re-vascularized Coronary Arteries (II: Stents)

Participants
Marc Dewey, MD, Berlin, Germany (Presenter) Research Grant, General Electric Company; Research Grant, Bracco Group; Research Grant, Guerbet SA; Research Grant, Toshiba Corporation; Research Grant, European Commission; Research Grant, German Research Foundation; Speakers Bureau, Toshiba Corporation; Speakers Bureau, Guerbet SA; Speakers Bureau, Bayer AG; Consultant, Guerbet SA; Author, Springer Science+Business Media Deutschland GmbH; Editor, Springer Science+Business Media Deutschland GmbH; Institutional research agreement, Siemens AG; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Toshiba Corporation; ; ;

LEARNING OBJECTIVES

1) Review the issues involved in detecting coronary in-stent restenosis by CT angiography. 2) Get an overview of the diagnostic accuracy of CT angiography for coronary stents. 3) Understand the potential advantages of iterative reconstruction and perfusion assessment by CT for stents.

URL

www.herz-kurs.de

RC603C Deciphering Coronary Anomalies and Fistulas

Participants
Jonathan D. Dodd, MD, Dublin 4, Ireland (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the basic classification of coronary anomalies and fistulas. 2) Understand the most clinically important anomalies and fistulas.
**RC608-01** Current Issues in Trauma CT Protocols

**Thursday, Dec. 3 8:30AM - 8:55AM Location: S405AB**

**Participants**
Scott D. Steenburg, MD, Zionsville, IN, (ssteenbu@iuhealth.org) (Moderator) Nothing to Disclose
Savvas Nicolaou, MD, Vancouver, BC (Moderator) Institutional research agreement, Siemens AG
Martin L. Gunn, MBChB, Seattle, WA, (marting@uw.edu) (Moderator) Research support, Koninklijke Philips NV; Spouse, Consultant, Wolters Kluwer NV; Medical Advisor, TransformativeMed, Inc;

**LEARNING OBJECTIVES**
1) Summarize challenges that are encountered when performing trauma CT in the ED. 2) Identify tradeoffs that are encountered when deciding ‘who’ to scan and ‘how’ to scan. 3) Understand CT techniques that can be used to optimize radiation dose, contrast use, workflow, and injury detection.

**ABSTRACT**

**PURPOSE**
To investigate the prognostic biomarker of CT images in patients with blunt trauma.

**METHOD AND MATERIALS**

From April 2014 to March 2015, 1077 patients (pts) were admitted to ER (emergency room) unit of our hospital. Among them, total 89 traumatized patients (male 58 pts, female 31 pts, average age 57.6 year-old) who underwent biphasic contrast enhanced CT were enrolled in this study. The causes of trauma were motor vehicle accident (MVA) in 52 pts, fallen accident in 26 pts, stab wound in 3 pts, and others in 8 pts. Radiological and surgical interventional treatments were performed in 10 pts and in 42 pts, respectively. Patient’s status, laboratory data, blunt trauma associated score and CT signs as prognostic biomarker were statistically correlated with the mortality.

**RESULTS**

Among the patient’s status, laboratory data, blunt trauma associated score and CT signs as prognostic biomarker, there was a statistically significant correlation between the mortality and low maximal blood pressure (p=0.0041), tachycardia (p=0.0236), low sPO2 (p<0.0001), low scores of GCS (Glasgow Coma Scale) (p=0.0014), high scores of injury severity score (ISS) (p <0.0001), low serum hemoglobin level (p=0.0254), base excess (p=0.0002), and chest blunt trauma (p=0.0155). Meanwhile, among the CT signs as prognostic biomarker, there was a statistically significant correlation between the mortality and the intense adrenal enhancement (IAE) at early phase (p<0.0001), the flattening of the inferior vena cava (FIVC) (p=0.0016) and the shock bowel (p=0.0098).

**CONCLUSION**
It is important to recognize not only the patient’s derived information but also the IAE, FIVC and shock bowel as predictive biomarker on biphasic CT images in patients with blunt trauma because the early intervention is required.

**CLINICAL RELEVANCE/APPLICATION**
Biphasic CT images could provide the information of critically ill patients with blunt trauma and lead us to share decision-making in the treatment.
Participants
Ken F. Linnau, MD, MS, Seattle, WA (Presenter) Speaker, Siemens AG; Royalties, Cambridge University Press;
Bharti Khurana, MD, Boston, 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
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Jorge A. Soto, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
David Dreizin, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Matthew T. Heller, MD, Pittsburgh, PA (Abstract Co-Author) Consultant, Reed Elsevier; Author, Reedl Elsevier
Keith D. Herr, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Scott D. Steenburg, MD, Zionsville, IN (Abstract Co-Author) Nothing to Disclose
Tarek N. Hanna, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
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Savvas Nicolaou, MD, Vancouver, BC (Abstract Co-Author) Institutional research agreement, Siemens AG
Christina A. LeBedis, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ludo F. Beenen, MD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess triage pathways and imaging findings in blunt pelvic trauma patients who underwent catheter angiography and establish practice pattern variation and effectiveness of CECT.

METHOD AND MATERIALS
This retrospective multicenter cohort study from 12 level-1-trauma centers in the United States, Canada and Europe included victims of blunt trauma with pelvic fracture and subsequent conventional catheter angiography for treatment of arterial bleeding. Patient data including demographics, clinical and imaging variables prior to angiography was abstracted at each center and sent to a central data repository. Triage algorithms and imaging protocols of each participating center were obtained through a web-based survey. Descriptive, univariate and multivariate analysis was performed. Mixed-effects multivariate logistic regression analysis which accounted for site heterogeneity was performed.

RESULTS
813 patients (37% women, median age 50 yrs, 24% > 65 yrs, 25% transfers) from 2009 to 2013 were included. The median Injury Severity Score (ISS) was 34 with most injuries due to motor vehicles. Overall, 61 (7.5 %) patients died within 24 hrs of admission. Imaging work-up varied with 3 of 12 centers always performing CECT prior to conventional angiography. Pelvic radiographs were obtained in 88% patients and 62% had FAST during initial resuscitation. CECT was obtained in 77% of patients before angiography. ISS was significantly higher in those who had no CECT (39 vs 33). Door-to-angio time was 3.8 hrs. Overall, 69% of patients had catheter angiographic findings of any arterial injury, 55% had active contrast extravasation. The positive angio rate was 67% if CECT was obtained and 76% if no CECT was done before angiography (p = 0.024). Site-adjusted multivariate logistic regression accounting for laparotomy, pelvic binder, pelvic packing, any transfusions, HR >120, hematocrit revealed an odds ratio for positive angiography of 0.83 (CI: 0.53-1.31, p= 0.42) if CECT was obtained.

CONCLUSION
Although CECT is widely utilized, the rate of arterial vascular injury on conventional catheter angiography is not substantially different in blunt pelvic trauma patients who do not get CECT before intervention.

CLINICAL RELEVANCE/APPLICATION
Although catheter angiography is recommended in hemodynamically unstable patients with pelvic fractures, it remains unclear if contrast-enhanced computed tomography (CECT) aids in triage of such patients to angiography.

Honored Educators

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Bharti Khurana, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator

RC608-04 CT of Neck Injuries

Thursday, Dec. 3 9:15AM - 9:40AM Location: S405A

Participants
Clint W. Sliker, MD, Ellicott City, MD (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Recognize the imaging appearances of injuries to a number of important neck structures other than the spine and cerebrovasculature, including the larynx, pharynx, trachea, esophagus, and external carotid artery branches. 2) Understand the limitations and pitfalls of CT when used to diagnose injuries to these structures.

ABSTRACT

Active Handout:Clint W. Sliker

Immediate Total-body CT Scanning versus Conventional Imaging and Selective CT Scanning in Severe Trauma Patients: A Randomised Controlled Trial (REACT-2 Trial)

Thursday, Dec. 3 9:40AM - 9:50AM Location: S405AB

Participants
Joanne C. Sierink, MD, PhD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Kaj Treskes, MD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Ludo F. Beenen, MD, Amsterdam, Netherlands (Presenter) Nothing to Disclose
Joachim Hohmann, MD, DIPLPHYS, Basel, Switzerland (Abstract Co-Author) Nothing to Disclose
Michael J. Edwards, MD, PhD, Nijmegen, Netherlands (Abstract Co-Author) Nothing to Disclose
Benn J. Beuker, MD, PhD, Groningen, Netherlands (Abstract Co-Author) Nothing to Disclose
Dennis den Hartog, MD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Marcel Dijkgraaf, PhD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Jan S. Luitse, MD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Markus W. Hollmann, MD, PhD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Goslings, MD, PhD, Amsterdam, Netherlands (Abstract Co-Author) Nothing to Disclose

PURPOSE
Recent literature suggests a survival benefit for trauma patients when they are evaluated with total-body Computed Tomography (TBCT) scanning during the initial trauma evaluation. Since level-1 evidence is lacking this study aimed to assess the value of immediate total-body CT scanning in severely injured trauma patients.

METHOD AND MATERIALS
In this multicentre clinical trial, we randomly assigned 541 trauma patients to immediate TBCT scanning and 542 patients to the standard workup with conventional imaging supplemented with selective CT scanning. Trauma patients having compromised vital parameters, clinical suspicion of life-threatening injuries or severe injury mechanisms were eligible. The primary endpoint was inhospital mortality. Secondary endpoints were clinically relevant time intervals, radiation exposure, missed injuries and direct medical costs.

RESULTS
The in-hospital mortality rate was not statistically different between groups (TBCT 15.9% vs. standard 15.7%, P=0.923). Subgroup analyses in polytrauma patients also did not reveal a significant difference between groups (TBCT 22.4% vs. standard 24.8%, P=0.457). Imaging time in the trauma room was decreased in the TBCT group (30 min vs. 37 min, P<0.001). More patients in the standard workup group received a lower effective radiation dose during the total hospital stay (21.0mSv [IQR=20.9-25.2] versus 20.6mSv [IQR=11.8-27.6], P<0.001). The number of missed injuries found during the tertiary survey were not different between groups (45 [8.8%] vs. 53 [10.1%], P=0.448). The medical costs were €24,967 (95% CI: €21,880-€28,752) for the TBCT group and €26,995 (95% CI: €23,326-€30,908) for the standard workup group (P=0.439).

CONCLUSION
Total-body CT scanning was safe, shortened the imaging time and did not increase the medical costs, but it did not improve survival, and most patients in the standard workup group received a lower radiation dose.

CLINICAL RELEVANCE/APPLICATION
Total-body Computed Tomography can be used for evaluation in trauma as it is safe and fast. Further research should focus on improvement of selection of trauma patients for evaluation by TBCT scanning.

Utility of MDCT Findings in Predicting Patient Management Outcomes in Renal Trauma

Thursday, Dec. 3 9:50AM - 10:00AM Location: S405AB

Participants
Arthur Baghdanian, MD, Boston, MA (Presenter) Nothing to Disclose
Armonde Baghdanian, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Anthony S. Armetta, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Christina A. LeBedis, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Jose A. Soto, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Stephan W. Anderson, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the utility of MDCT findings in predicting clinical outcomes in renal trauma.

METHOD AND MATERIALS
This retrospective study was IRB approved and HIPAA compliant; informed consent was waived. Adult patients suffering from blunt or penetrating renal trauma from 01/01/2006 to 12/31/2013 were included. During this interval, 162 patients met this inclusion criteria (males, n=121; females, n=41; mean age = 33 years-old, range 15-88 years; blunt trauma, n=114; penetrating trauma, n=48). Renal injury was graded based on the AAST kidney injury scale. Additional variables that were blind read from abdominopelvic CT studies as well as recorded from the EMR included: active extravasation, collecting system injury, embolization, collecting system stenting and surgical management. Fisher’s exact test was used to evaluate the association between: active extravasation and operative or endovascular therapy; AAST score and operative or endovascular therapy; and AAST score and collecting system stenting.

RESULTS
AAST kidney injury score: grade 1 (n=26), grade 2 (n=33), grade 3 (n=61), grade 4 (n=37), and grade 5 (n=5). Active extravasation (n=25) and collecting system injury (n=20). 13/162 (8%) patients received further management related to renal trauma. 2 patients (1%) required renal artery embolization. 11 patients underwent surgery: nephrectomy (n=2; 1%), renorrhaphy (n=3; 2%), and collecting system stent (n=6; 3.7%). 7/25 patients (13/25 grade 3/4; 12/25 grade 1/2/3) with active extravasation received surgical management or embolization. There was a statistically significant correlation between active extravasation and...
CONCLUSION

Active extravasation is a significant predictor of surgical or endovascular management of renal trauma. The AAST grade does not correlate with the need for surgical or endovascular management, however, it does correlate with collecting system injury and intervention.

CLINICAL RELEVANCE/APPLICATION

An imaging based renal trauma scoring system that incorporates active extravasation may be necessary to more accurately predict patient outcomes.

HONORED EDUCATORS

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Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator

LEARNING OBJECTIVES

1) Review key imaging findings which need to be identified on the trauma chest radiograph. 2) Discuss indications for thoracic CT imaging in trauma patients. 3) Introduce an organized approach to the chest CT in thoracic trauma. 4) Identify and understand important findings which are commonly seen on chest CT examinations in trauma.

ABSTRACT

In Major Trauma (ISS - Injury Severity Score \(\geq 15\)), imaging approach of A.T.L.S. take into account supine- CXR for pneumothorax detection, during Primary Survey that have shown low accuracy in the assessment of pneumothorax while it’s clearly demonstrated the superiority of lung ultrasound for this diagnosis. The aim of our study was to evaluate the clinical impact for pneumothorax diagnosis of new Imaging approach in a Trauma dedicated logistical context (Shock Room, CT Room, Operating Room strictly closed; Emergency Radiologist 24h/7days): only extended (to thorax)-focused assessment with sonography in trauma (e-FAST), during Primary Survey, and Whole-Body Multidetector Computed Tomography (MDCT) as secondary, during two years of experience in our Level I Trauma Center.

METHOD AND MATERIALS

This was a retrospective case-series study involving 660 consecutive adult patients admitted to the our Emergency Department (422men and 238women) (average age: 41y- age range: 18-81y) between January 2013-December 2014 for a Major Trauma. We evaluated the accuracy of lung ultrasonography in the detection of pneumothorax (compared with the results of Multidetector Computed Tomography (MDCT) and of invasive interventions (thoracostomy tube placement), and timing of this imaging approach.

RESULTS

Among the 1320 lung fields included in the study, we observed 264 pneumothoraces with thoracic MDCT scans. The e-FAST detected 242 pneumothoraces and didn't recognize 22 pneumothoraces. About 2 years, total diagnostic performance of LUS was: sensitivity 92%, specificity 100%, PPV 100%, NPV 98%, Accuracy 98% At Major Trauma's arrival, median time to achieve pneumothorax diagnosis with Extended was 3 min. (1-5'). These results demonstrate that (e-FAST+ WB-MDCT) has good results, reduces time (e-FAST within 5'; WB-MDCT within 40') and effectively omits many diagnostic steps between clinical suspicion and definitive proof of injuries that require immediate therapeutic attention. Beyond pneumothorax diagnosis, further studies will occur to analyze clinical impact for every single other traumatic lesions.
CONCLUSION
This new Imaging approach, Lung Ultrasound-FAST during primary survey, and WB-MDCT as secondary, demonstrate high accuracy to achieve avoidable pneumothorax’s death; CT scanner should be placed very close to, or in the trauma room; Emergency Radiologist available 24h/7d.

CLINICAL RELEVANCE/APPLICATION
A new powerful Ultrasound field: pneumothorax diagnosis.

PURPOSE
Retrospectively review the accuracy of MDCT for the detection of acute blunt traumatic injury of the diaphragm. Identify the most relevant imaging signs of diaphragmatic injury.

METHOD AND MATERIALS
A waiver for informed consent was granted by the institutional review board. We retrospectively reviewed the records of all patients admitted to our Level I trauma center with intraoperative findings of diaphragmatic injury between 2005 and 2015. Our study was limited to the patients with blunt trauma and a total of 57 patients met this criteria. A group of 10 patients were excluded from the analysis, since diagnosis was made with the initial AP chest radiograph or with the scout view and therefore underwent corrective surgery before being scanned. An additional patient was excluded given that imaging studies were not available.

RESULTS
The diagnosis of diaphragmatic injury was confirmed by using the intraoperative findings as the reference standard. Review of the official radiologic interpretation at the time of admission, yielded a sensitivity of 71%(p<0.005). A secondary assessment of the available images was also conducted, including a systematic evaluation for the presence of alternative signs of diaphragmatic injury that have been previously described by others. This approach resulted in an increased sensitivity of 93%(p<0.005). Multivariate analysis including laterality of the injury was also included to complement the statistical analysis.

CONCLUSION
To our knowledge this is the largest series of blunt diaphragmatic injury in the English literature. Left sided injuries are more evident and usually present as herniation while diaphragmatic thickening/hematoma was highly specific of right sided injuries. MDCT is an useful tool in the detection of blunt diaphragmatic injuries; the use of a systematic approach may increase its accuracy.

CLINICAL RELEVANCE/APPLICATION
The widespread use of MDCT in the evaluation of patients with major trauma has improved the detection and characterization of injuries to most organs and structures. In spite of the technologic advances, the detection of diaphragmatic injury remains a diagnostic challenge in the setting of acute trauma. Ischemia to the bowel and other structures has being described as early as 24 hours after the initial injury, hence in the era of nonoperative management of abdominal trauma, timely diagnosis and operative repair of diaphragmatic injury is crucial to avoid complications.

Honored Educators
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Carlos S. Restrepo, MD - 2012 Honored Educator
Carlos S. Restrepo, MD - 2014 Honored Educator
Purpose

CT grading of traumatic solid organ injuries is well established. A grading scale based on CT findings for blunt bowel or mesenteric injuries does not exist [2,3]. With the advent of high speed, multi-detector CT we hypothesize that blunt bowel and mesenteric injuries requiring operative intervention can be graded by CT imaging.

Method and Materials

IRB approved, retrospective review of our level-1 ACS verified trauma center database of patients with blunt trauma that had both a multi-detector CT scan and laparotomy from 1/2010 to 9/2011 were included. A single trauma surgeon reviewed operative reports and determined the primary outcome of bowel/mesenteric injury requiring surgical intervention (IRSI). The first 20 patients with IRSI were randomly matched to 20 patients during the same study period without IRSI. 3 emergency radiology attendings were blinded and reviewed all 40 subjects'. They scored based on the scoring system developed internally. After initial individual reading session, a consensus reading session was performed on discrepant scoring. Receiver operating characteristic (ROC) curves and sensitivity/specificity analyses were performed on the scores relative to IRSI.

Results

The 2 groups were matched by age, sex, injury severity score (ISS), and timing of presentation to scan and eventual operation (standardized differences < .10). No individual radiologist's scores reached both sensitivity and specificity ≥ 75% relative to IRSI. AUROCs showed "good" (> .6) to "very good" (> .8) discrimination of IRSI. The consensus score AUROC of .799 is good, with .800 considered very good discrimination of the need for surgical intervention (Figure 1). The consensus score of all three radiologists of 

Conclusion

The proposed grading system demonstrates proof of concept in becoming a diagnostic tool in the management of blunt bowel and mesenteric IRSI injuries. The scale provides significant information regarding the extent of injury, need for surgery with diagnostic significance in the very first iteration of this application. Further studies are needed to validate the grading scale.

Clinical Relevance/Application

CT grading scale for bowel and mesenteric injury is possible and may improve communication between radiologist and surgeon.

RC608-13 Inter-reader Agreement in the Detection and Classification of Pancreatic Trauma Injury on CT Using AAST Pancreatic Injury Scoring System

Thursday, Dec. 3 11:35AM - 11:45AM Location: S405AB

Participants

Marta E. Heilbrun, MD, Salt Lake City, UT (Presenter) Nothing to Disclose
Nickolas Byrne, MD, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose
Daniel N. Sommers, MD, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose
Nicole S. Winkler, MD, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose
Raminder Ninula, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose

Purpose

Pancreatic injuries occur in 1-5% of blunt and penetrating trauma. Mortality may be as high as 20%, often relates to the presence of other injuries, and increases with delayed diagnosis. The sensitivity of CT ranges from 65-91%. Up to 40% of patients may show no abnormality of the pancreas on initial CT and extent of injury may be difficult to characterize. Assessment of pancreatic duct integrity is critical since disruption causes most complications. The 5-point American Association for the Surgery of Trauma (AAST) pancreas injury scale is an accepted scoring system. Intervention may be necessary if AAST ≥ 3. The goal of this study is to determine if there is reader agreement on the presence of pancreatic injury and the extent of injury based on AAST scores on initial trauma CT.

Method and Materials

102 CTs from an multi-institutional AAST de-identified trauma database were reviewed by 3 fellowship trained abdominal radiologists after an initial training. Training was completed after agreement > 0.6 (25 studies). Blinded to clinical information and each other, the readers assigned a binary score (Y/N) to the presence of pancreatic injury, pancreatic duct injury, a 4 point Likert item scale for confidence in injury scores and AAST score. Interrater reliability is assessed with the intraclass correlation coefficient.

Results

The binary assessment of any pancreatic injury ranged from 80-93% for the 3 readers, with interrater agreement of 0.37(95%CI,0.25-0.50) and confidence of assessment 0.53(95%CI,0.40-0.64). The binary assessment of any ductal injury ranged from 31-39% with interrater agreement of 0.65(95%CI,0.52-0.75) and confidence of 0.70(95%CI,0.60-0.78). Mean AAST score ranged from 1.8-2.4. Interrater agreement for AAST score is 0.69(95%CI,0.58-0.77). The greatest disagreement related to the absence of any pancreatic injury, with 2 readers giving 21 studies no injury, but 1 reader giving 7 studies no injury.

Conclusion

Even with training, there was relatively poor agreement when there is no or minimal pancreas injury. There is better agreement when there is more extensive injury, especially suspected duct injury. Readers demonstrate good agreement when using the AAST injury score.

Clinical Relevance/Application

Clinically actionable pancreatic trauma (ductal injury) is reliably recognizable on CT. The use of surgical scoring systems, such as the AAST pancreatic injury score, improves reader agreement.
Participants

LEARNING OBJECTIVES

1) Understand the technical advancements associated with new scintillation cameras and SPECT-CT and PET-CT cameras. 2) Appreciate the benefits of CT attenuation correction. 3) Appreciate the adjunctive benefits of anatomic definition provided with CT and physiologic/function information provided by SPECT and PET. 4) Improve interpretive skills related to SPECT and PET-CT.

ABSTRACT

Camera and software technology recently has rapidly advanced, providing improved SPECT image resolution and increased counting statistics. These advancements in turn have provided the possibility of reduced-time and reduced radiopharmaceutical dose image acquisitions. Moreover, increased flexibility in imaging protocols has been realized. Future development of these methods hold promise in increasing diagnostic accuracy and expanding diagnostic applications. The addition of CT to SPECT and PET has afforded the ability to perform attenuation correction, thereby minimizing attenuation artifacts and increasing diagnostic specificity. With CT acquisitions of sufficient resolution, complementary anatomic diagnostic information is provided. In addition, more precise anatomic localization of SPECT and PET abnormalities significantly increases clinical applicability.

Sub-Events

Participants

E. Gordon Depuey, MD, New York, NY (Presenter) Steering Committee, Adenosine Therapeutics, LLC;

LEARNING OBJECTIVES

1) Understand software methods to cope with lower SPECT counting statistics in order to reduce scan acquisition time and/or radiopharmaceutical injected activity and their clinical impact. 2) Understand instrumentation advances that allow new cameras to perform SPECT with markedly reduced acquisition times and/or less radiopharmaceutical activity and their clinical impact. 3) Implement protocols that facilitate patient-centered imaging and that reduce patient radiation exposure.

ABSTRACT

New software methods and new innovative hardware now allow for significantly shortened SPECT acquisition times without a decrease in image quality. Advancements include iterative reconstruction, resolution recovery, and noise reduction software, and focused collimation and solid state detectors incorporated into new camera designs. Attenuation correction increases diagnostic specificity and facilitates stress-only protocols. Software advancements such as high resolution imaging, scatter correction, and respiratory gating increase diagnostic sensitivity. There has been an intersocietal effort to promote patient-centered imaging with a focus on appropriateness guidelines, cost-containment, radiation dose reduction, and the selection of the most appropriate imaging test and protocol to suit particular patient needs. The technical advancements described above facilitate implementation of patient-centered imaging. Even with such technical advancements, however, attention to technical detail is essential to assure optimal image quality. Camera and radiopharmaceutical quality control deserve the highest priority. A systematic review of myocardial perfusion SPECT images is essential to recognize artifacts and optimize diagnostic accuracy. Case examples will be presented to reinforce this approach.

Participants

Sharmila Dorbala, MBBS, Boston, MA (Presenter) Research Grant, Astellas Group; Stockholder, General Electric Company; ; ;

LEARNING OBJECTIVES

1) Review the advantages and disadvantages of myocardial perfusion PET compared to SPECT for evaluation of coronary artery disease. 2) Learn the added value of absolute quantitative parameters derived from PET for assessment of cardiovascular disease. 3) Update of current and future clinical applications of cardiac PET imaging in cardiovascular medicine.

ABSTRACT

Novel advances in PET detectors, radiotracer availability, clinical software, as well as hybrid PET/CT and PET/MR scanners have revolutionized the clinical and investigative applications of cardiac PET. Cardiac PET myocardial perfusion imaging, in the 1970's, was a predominantly investigative tool, with home-grown software, available at select major academic centers with access to a cyclotron. Over the last decade, with easy access to PET scanners, and to positron emitting perfusion tracers, the use of cardiac PET has exploded -well beyond major academic centers to several hospitals and to large office-based practices. Commercially available software has made quantitative myocardial blood flow assessment, a main-stream clinical application. Hybrid PET/CT scanner applications- calcium score and CT based coronary angiography-have further advanced the applications of cardiac PET. PET/MR is an emerging technology with promising cardiovascular applications. Each of these exciting developments has transformed cardiac PET from a predominantly investigative tool of the 1970's to the advanced clinical tool of the 2015. The primary goal of this session is to discuss the present-day clinical and emerging applications of cardiac PET/CT and PET/MR using a practical case-based approach.
Peripheral Artery Disease (PAD)

Thursday, Dec. 3 8:30AM - 10:00AM Location: N229

VA CT MR

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

FDA

Discussions may include off-label uses.

Participants
Stephen T. Kee, MD, Stanford, CA (Moderator) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the basic pathology of peripheral artery disease. 2) Describe the risk factors associated with the development of peripheral artery disease. 3) Outline the benefits of providing a comprehensive clinical service in the management of PVD. 4) Discuss how to build a PVD practice. 5) Describe the basic techniques employed in the treatment of PVD.

ABSTRACT

Peripheral arterial disease (PAD) is a common cause of morbidity and mortality in developed countries. Traditionally, imaging for risk stratification and therapeutic planning involved catheter angiography. In recent years, cross-sectional imaging by CTA and MRA has proven a robust technique for non-invasive PAD assessment. Given ubiquity of CT scanning technology, CTA is widely available. High resolution datasets can be acquired rapidly, which facilitates assessment of clinically labile or trauma patients. To be optimally effective, CTA techniques require particular attention to contrast medium and scan protocol. With appropriate protocol design, data acquisition requires limited operator dependence. The acquired 3D dataset is rich with information, but requires careful scrutiny by the interpreting physician. Volumetric review of these datasets produces the most accurate results. Extensive small vessel calcification remains a potential barrier to full assessment of pedal vessels by CTA. Recent published data validates the clinical effectiveness of CTA for diagnosis of PAD and for the direction of treatment planning. Ongoing research aims to exploit the newest generation of CT scanners to acquire additional information, including dual energy data, time-resolved information, and radiation dose savings.

URL

Active Handout:Richard Lee Hallett

Participants
Harald Kramer, MD, Munich, Germany (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the appropriate technique for peripheral MRA depending on the available hardware and the clinical question and condition of the patient. 2) Differentiate between different contrast agents and their specific characteristics. 3) Chose between different contrast agent application schemes depending on the technique used and the clinical question. 4) Compare the pros and cons of contrast-enhanced and non contrast-enhanced techniques for peripheral MRA.

ABSTRACT

The prevalence of symptomatic peripheral artery disease (PAD) ranges around 3% in patients aged 40 and 6% at an age of 60 years. Additionally, the prevalence of asymptomatic PAD lies between 3% and 10% in the general population increasing to 15% to 20% in persons older than 70 years of age. However, these data still might underestimate the total prevalence of PAD since
screening studies showed that between 10% and 50% of all patients with intermittent claudication (IC) never consult a doctor about their symptoms. These data prove the need for an accurate and reliable method for assessment of the peripheral vasculature. Digital subtraction angiography (DSA) still serves as the reference standard for all vascular imaging techniques. However, because of the absence of ionizing radiation, the use of non-nephrotoxic contrast agents or even non contrast-enhanced sequences and the large toolbox of available techniques for high-resolution static and dynamic imaging Magnetic Resonance Angiography (MRA) constitute an excellent non-invasive alternative. Different acquisition schemes and contrast agent application protocols as well as different types of data sampling for static, dynamic, contrast- and non contrast-enhanced imaging enable to tailor each exam to a specific question and patient respectively.

Participants
Stephen T. Kee, MD, Stanford, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
Radiomics Mini-Course: Oncologic Applications

Thursday, Dec. 3 8:30AM - 10:00AM Location: S103AB

Participants
Sandy Napel, PhD, Stanford, CA (Director) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc

Sub-Events
RC625A  Breast Cancer with PET-CT

Participants
Richard L. Wahl, MD, Saint Louis, MO (Presenter) Research Consultant, Nihon Medi-Physics Co, Ltd;

Learning Objectives
1) Describe the FDG pet uptake characteristics before therapy of 'triple - negative' breast cancers vs other subtypes.

Abstract
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/

Richard L. Wahl, MD - 2013 Honored Educator

RC625B  Radiogenomics of Lung Cancer

Participants
Michael D. Kuo, MD, Los Angeles, CA (Presenter) Nothing to Disclose

Learning Objectives
1) To discuss the principles behind lung cancer radiogenomics. 2) Highlight clinical applications of lung cancer radiogenomics.

Abstract

RC625C  Brain Cancer: Radiomics, Radiogenomics, and Big Data

Participants
Rivka R. Colen, MD, Houston, TX, (rcolen@mdanderson.org) (Presenter) Nothing to Disclose

Learning Objectives
1) Define the field of radiomics and imaging genomics. 2) Apply radiomics and imaging genomics in brain tumors. 3) Describe the use of MRI as a biomarker for genomic signatures and profiles. 4) Define role of MRI in personalized medicine for target discovery of therapeutic targets. 5) Explain the use of MRI in drug development and clinical trials. 6) Assess the research available in imaging genomics and radiomics. 7) Define and describe the integration of radiomics and imaging genomics into big data platforms.

Abstract
This objective of this course is to introduce the recently emerged field of radiomics and imaging genomics (radiogenomics) in brain tumors, specifically glioblastoma (GBM). Emphasis will be on radiomics with regards to the high-dimensional, high-throughput feature extraction of imaging features from medical images, specifically MRI; the second emphasis will be on the use of imaging in relation to underlying tumor genomics, how to use MRI as a biomarker, surrogate and correlate of tumor genomics as well as the use of MRI as a genomic target discovery tool and its application in therapeutic discovery and drug development. The role of radiomics and imaging genomics in the era of big data and how we can leverage the imaging-omic data will also be discussed.
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 SSQ02-04

1H-MRS may be useful for noninvasively evaluating HF patients post-acute hospitalization.

mass and, to a lesser degree, cardiac output. We believe that metabolic imaging for measurement of myocardial UFA content by

higher level of UFA in the low LVEF group than in the normal LVEF group. Myocardial UFA was strongly correlated with LVEDV, LV

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 marginally correlated with LV end-diastolic mass index (BMI, 20-25 kg/m2) who were randomly assigned into 2 groups. The scan protocol for group 1 was 100kVp, 600mAs with 70ml contrast medium at an injection rate of 4.5 to 5.5ml/s, and images were reconstructed with a hybrid iterative reconstruction technique (Dose4, Philips Healthcare), while the protocol for group 2 was 80kVp, 600mAs with 35ml contrast medium at an injection rate of 3.5 to 4.5ml/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 gI/s to 1.0±0.5 gI/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 combining 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.

SSQ02-03 Myocardial Triglyceride and Left Ventricular Systolic Function: A Cross-Sectional CMR Study in Post-Acute Hospitalization Heart Failure Patients

Thursday, Dec. 3 10:50AM - 11:00AM Location: S502AB

Participants Pen-An Liao, MD, Taipei City, Taiwan (Presenter) Nothing to Disclose

Gigin Lin, MD, Guishan, Taiwan (Abstract Co-Author) Nothing to Disclose

Shang-Yueh Tsai, Taipei, Taiwan (Abstract Co-Author) Nothing to Disclose

Chao-Hung Wang, Keelung City, Taiwan (Abstract Co-Author) Nothing to Disclose

Yu-Hsiang Juan, MD, Taoyuan, Taiwan (Abstract Co-Author) Nothing to Disclose

Yu-Ching Lin, MD, Tao Yuan, Taiwan (Abstract Co-Author) Nothing to Disclose

Min-Ting Wu, MD, Kaohsiung, Taiwan (Abstract Co-Author) Nothing to Disclose

Lan-Yan Yang, Guishan, Taiwan (Abstract Co-Author) Nothing to Disclose

Min-Hui Liu, Keelung City, Taiwan (Abstract Co-Author) Nothing to Disclose

Tsun-Ching Chang, Keelung City, Taiwan (Abstract Co-Author) Nothing to Disclose

Yu-Chun Lin, MSC, Taoyuan, Taiwan (Abstract Co-Author) Nothing to Disclose

Yu-Chieh Huang, Keelung City, Taiwan (Abstract Co-Author) Nothing to Disclose

Pei-Ching Juan, Taoyuan City, Taiwan (Abstract Co-Author) Nothing to Disclose

Koon-Kwan Ng, Guishan, Taiwan (Abstract Co-Author) Nothing to Disclose

Shu-Hang Ng, MD, Taoyuan, Taiwan (Abstract Co-Author) Nothing to Disclose

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 as well as the left ventricular (LV) function and LV mass was 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 was 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.

SSQ02-04 13N-ammonia PET/MR Myocardial Stress Perfusion Imaging Early Experience

Thursday, Dec. 3 11:00AM - 11:10AM Location: S502AB

Participants Amir K. Durrani, MD, St Louis, MO (Presenter) Nothing to Disclose
This study demonstrated the feasibility of DUS for gating human CMR at 3T. With the benefit of not being influenced by 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**

15 patients with reversible myocardial perfusion defect on GSPECT-MPI for whom standard of care coronary angiography was planned were recruited. Patients received 400mcg Regadenoson, followed 30 seconds later by simultaneous 13N-Ammonia-PET (10.2 +/- 0.46 mCi) and gadolinium-based (0.075 mmol/kg) contrast MR perfusion imaging. The procedure was repeated at rest. PET attenuation correction µ-map was a dual echo VIBE Dixon sequence. PET images were reconstructed with 3D-OSEM (Ordered Subset Estimation Maximization) with 3 iterations, 21 subsets and post-Gaussian filter of 4 mm. The presence and absence of ischemia and infarction were assessed by two independent readers. Areas of decreased perfusion on MRI were correlated to PET myocardial blood flows (MBF) as measured by 2-compartment modeling analysis.

**RESULTS**

PET/MR demonstrated excellent concordance with coronary angiographic findings. In this small data set, when compared to GSPECT-MPI, combined PET/MR demonstrated superior diagnostic accuracy (69% vs 54%). The inter-reader concordance was 77%. Using PET/MR as a diagnostic tool for CAD, in this small cohort, there is a 100% sensitivity, 100% negative predictive value, and a 64% positive predictive value.

**CONCLUSION**

Early experience with 13N-PET/MR perfusion imaging showed excellent diagnostic accuracy, sensitivity and specificity for CAD detection.

**CLINICAL RELEVANCE/APPLICATION**

Perfusion PET/MR offers a comprehensive myocardial ischemic evaluation. Potential benefits including shorter exam time than SPECT, lower radiation dose, absolute myocardial blood flow quantification, and internal validation between PET and MR findings.

**DOPPLER-Ultrasonic in Comparison to Electrocardiogram and Pulse Oximetry for Gating Cardiac MRI at 3T**

**PURPOSE**

Doppler ultrasound (DUS) is not affected by magnetic interference but may be influenced by 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 strongly 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 the electromagnetic field of the MRI, 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.
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
Klein, PhD, Ottawa, ON (Abstract Co-Author) Consultant, Jubilant DraxImage Inc; Shareholder, Jubilant DraxImage Inc
Brittany Reiche, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Benjamin Chow, MD, Ottawa, ON (Abstract Co-Author) Research Grant, General Electric Company Support, TeraRecon, Inc
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, 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.

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.

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) on 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

Cardiac (General Topics II)

SSQ03-02 The Impact of Iterative Reconstruction on Detectability and Quantification of Calcifications in CT Coronary Calcium Scoring: Individual Lesion-by-lesion Comparison

Thursday, Dec. 3 10:40AM - 10:50AM Location: S504CD

PURPOSE

The amount of coronary artery calcium (CAC) as quantified in cardiac CT is a strong and independent predictor of cardiovascular events. Cardiac CT can be reconstructed using iterative reconstruction (IR), which reduces objective image noise compared with filtered back projection (FBP). We have investigated the impact of IR on the detectability and quantification of CAC lesions.

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.
Resonance Post-contrast T1 Mapping

Myocardial Involvement in Anderson Fabry Disease Can Be Assessed and Quantified Using Magnetic

Cecile Tremblay, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose

PURPOSE

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.

METHOD AND MATERIALS

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.

RESULTS

Fifty-three patients (mean age 53.6 yo) were included. In comparison to FBP, IR reduced image noise ad 53%, increased SNR ad 11% 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±17.6 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.

CONCLUSION

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.

CLINICAL RELEVANCE/APPLICATION

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.

SSQ03-04 Myocardial Involvement in Anderson Fabry Disease Can Be Assessed and Quantified Using Magnetic Resonance Post-contrast T1 Mapping

Thursday, Dec. 3 11:00AM - 11:10AM Location: S504CD

Participants

Julian Donhauser, MD, Wurzburg, Germany (Presenter) Nothing to Disclose
Gordian G. Schmid, Wuerzburg, Germany (Abstract Co-Author) Nothing to Disclose
Andreas M. Weng, Wurzburg, Germany (Abstract Co-Author) Nothing to Disclose
Herbert Koestler, PhD, Wuerzburg, Germany (Abstract Co-Author) Research support, Siemens AG
Dietbert Hahn, MD, Kuernach, Germany (Abstract Co-Author) Nothing to Disclose
Thorsten A. Bley, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Christian O. Ritter, MD, Wuerzburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

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.

METHOD AND MATERIALS

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.

RESULTS

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.

CONCLUSION

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.

CLINICAL RELEVANCE/APPLICATION

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.
**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**

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**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 purpose is to assess the effect of ADMIRE on image quality in CCTA.

**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% (SSFP), 74% (66/89), 69% (71/103) and 84% (63/76), 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**
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**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: SS04CD

Participants
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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.
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.

**CONCLUSION**

0.2, respectively).

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).

**RESULTS**

The prevalence of CAD was 56%. Of 308 patients, 162 patients were scanned at 1.5-T and 146 patients at 3-T. Significant coronary stenoses and old myocardial infarction (MI) were found in 101 (62%) and 66 (41%) patients at 1.5-T and 70 (48%) and 27 (18%) patients at 3-T. Diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value for detection of significant coronary stenoses were 77%, 71%, 81%, 70%, and 82% at 1.5-T and 83%, 64%, 91%, 75%, and 86% at 3.0T. The diagnostic performance of 3-T perfusion imaging was not significantly greater than that of 1.5-T (area under receiver-operator characteristic [ROC] curve: 0.81 vs 0.76; p=0.159). The combined perfusion and delayed contrast enhancement CMR imaging did not provide incremental diagnostic value over perfusion CMR imaging only at both 1.5-T and 3-T in the diagnosis of CAD. In patients without old MI (n=215), diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value for detection of significant coronary stenoses were 60%, 57%, 84%, 44%, and 90% at 1.5-T and 85%, 60%, 92%, 69%, and 89% at 3-T. The diagnostic performance of 3-T perfusion imaging was significantly greater than that of 1.5-T (area under ROC curve: 0.79 vs 0.87; p=0.026).

**CONCLUSION**

3-T CMR perfusion imaging is superior to 1.5-T in detection of significant CAD in patients without old MI.

**CLINICAL RELEVANCE/APPLICATION**

3-T CMR perfusion is feasible to detect inducible myocardial ischemia consistent with significant CAD in clinical setting.

**SSQ03-09 Comparison of the Plaque Attenuation Values on Non-enhanced- and Enhanced 320-row Coronary CT Angiographs Using a Subtraction Technique: In vivo Evaluation of the Effect of Intracoronary Attenuation on Coronary Plaque Measurements**

**METHOD AND MATERIALS**

This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. We performed subtraction CCTA on a 320-detector row CT scanner in 113 patients. Our inclusion criterion was 50-70% stenosis by non-calcified plaques in the proximal coronary artery. Patients with total occlusion and multi-vessel disease were excluded. Consequently, 30 patients (30 plaques) were included in this study. Two CT datasets, one with- and the other 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.

**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 in subtraction CCTA may be helpful for the characterization of the plaques.

**CLINICAL RELEVANCE/APPLICATION**

Intravascular attenuation modified the attenuation of coronary atherosclerotic plaques in our in vivo validation study.
Pulmonary Thin-Section MR Imaging with Ultra-Short TE vs. Low- and Standard-Dose Thin-Section CTs: Capability for Lung Nodule Detection and Nodule Type Evaluation

Participants
Christian J. Herold, MD, Vienna, Austria (Moderator) Nothing to Disclose

Sub-Events
SSQ04-01 Pulmonary Thin-Section MR Imaging with Ultra-Short TE vs. Low- and Standard-Dose Thin-Section CTs: Capability for Lung Nodule Detection and Nodule Type Evaluation

Participants
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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.

SSQ04-02 Persistent Pulmonary Subsolid Nodules with Solid Parts of 5mm or Smaller: Their Natural Courses and Predictors for Interval Growth on Follow-ups

Participants
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Jim Mo Goo, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Research Grant, Guerbet SA;
PURPOSE
To investigate the natural courses of persistent pulmonary subsolid nodules (SSNs) with solid parts ≤5mm and the clinicoradiological 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

Thursday, Dec. 3 10:50AM - 11:00AM Location: E351

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. Another seven radiologists independently recorded GGN presence and their locations by continuously-distributed rating. 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. 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.
SSQ04-04  
Breath-Hold Lung MR Imaging for Nodule Detection: Combination of 3D mDixon and Black-blood Fat-saturated HASTE Sequences

Thursday, Dec. 3 11:00AM - 11:10AM Location: E351

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PURPOSE
To compare the diagnostic performance of breath-hold lung MR imaging with combined use of 3D mDixon and black-blood fat-saturated HASTE sequences 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 and 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 66.6% (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 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.

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.

SSQ04-05  
Value of [18F]Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography in Patients with Persistent Pulmonary Part-Solid Nodules Detected at CT

Thursday, Dec. 3 11:10AM - 11:20AM Location: E351

Participants
Jihang Kim, MD, Seongnam, Korea, Republic Of (Presenter) Nothing to Disclose
Kyung Won Lee, MD, PhD, Seongnam, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Although current National Comprehensive Cancer Network guidelines suggest [18F]fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) for the pretreatment evaluation of early stage non-small cell lung cancer, the role of FDG-PET/CT in patients with persistent pulmonary part-solid nodules is yet to be determined. The purpose of our study was to evaluate the incremental value of FDG-PET/CT in the pretreatment evaluation of non-small cell lung cancer detected as part-solid nodules at chest CT.

METHOD AND MATERIALS
From March 2011 through March 2015, 164 consecutive patients who underwent whole-body FDG-PET/CT for the pretreatment evaluation of non-small cell carcinoma detected as pulmonary part-solid nodules at chest CT were included. We analyzed the chest CT and FDG-PET/CT reports prospectively made by board-certified radiologists and nuclear medicine physicians as a part of our standard practice. The CT, FDG-PET/CT and histopathologic characteristics of the nodules were demonstrated and the incremental value of FDG-PET/CT over chest CT in the nodal or extrathoracic staging was evaluated.

RESULTS
For the pretreatment evaluation, FDG-PET/CT was performed in 164 patients with 181 part-solid pulmonary nodules (diameter; 23.4±8.2 mm, mean solid proportion; 67.8%). Among them, 156 patients had 172 nodules underwent subsequent surgical resection. All of the nodules were histopathologically confirmed as adenocarcinoma (n = 1, 91, 51 and 29 for Tis, T1a, T1b, and T2a, respectively). In the retrospective analysis of prospective CT and FDG-PET/CT interpretations, only 4 and 3 patients were suspected to have lymph node metastases, respectively. In histopathologic confirmation, 5 of 156 patients had lymph node metastases and the maximum standardised uptake value of them varied from 1.2 to 6.1. The per-patient sensitivities of CT and FDG-PET/CT in detection of lymph node metastasis were 40% and 20%, respectively, and FDG-PET/CT showed no incremental value in nodal staging. While eight incidental extrathoracic malignancies were suspected at FDG-PET/CT, further diagnostic work-up revealed them as benign.

CONCLUSION
FDG-PET/CT showed no incremental value in the pretreatment evaluation of non-small cell lung cancer detected as part-solid
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.
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.

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 (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 (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 using t-test. Dimension and mean CT density (MCTD) of 71 larger GGNs with the diameter of 5mm or more and SSDE based assessed by 3-grade scales (1: obscure to 3: definitely visible) using SDS as standard of reference and compared between ULDS and LDS (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. SSDE had mild negative correlation with RVC#(ULDS/SDS) and between LDS and SDS (RVC#(LDS/SDS): 100(LDS-SDS)/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.

CLINICAL RELEVANCE/APPLICATION
ULDS is optimal for larger GGN detection, whereas, higher dose scanning such as LDS could be desirable as quantification tool in follow-up examination of detected GGNs.

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 assessed by 3-grade scales (1: obscure to 3: definitely visible) using SDS as standard of reference and compared between ULDS and LDS (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. 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.

METHOD AND MATERIALS
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CLINICAL RELEVANCE/APPLICATION
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METHOD AND MATERIALS
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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.

CLINICAL RELEVANCE/APPLICATION
ULDS is optimal for larger GGN detection, whereas, higher dose scanning such as LDS could be desirable as quantification tool in follow-up examination of detected GGNs.
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 (Diffuse Lung Disease/Funional Imaging)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S404CD

SSQ05-01  Distribution and Associated High-Resolution CT findings Predict Survival in Chronic Hypersensitivity Pneumonitis

Thursday, Dec. 3 10:30AM - 10:40AM Location: S404CD

Participants
Yoshiharu Ohno, MD, PhD, Kobe, Japan (Moderator) Research Grant, Toshiba Corporation; Research Grant, Koninklijke Philips NV; Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Terumo Corporation; Research Grant, Fuji Yakuhin Co, Ltd; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Guerbet SA; Hiroto Hatabu, MD, PhD, Boston, MA (Moderator) Research Grant, Toshiba Corporation Research Grant, AZE, Ltd Research Grant, Canon Inc

Sub-Events
SSQ05-01 Distribution and Associated High-Resolution CT findings Predict Survival in Chronic Hypersensitivity Pneumonitis

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.

CLINICAL RELEVANCE/APPLICATION
Chest CT may be a valuable biomarker in HP, aside from diagnosis and follow-up.

Honored Educators

Jonathan H. Chung, MD - 2013 Honored Educator

SSQ05-02 Prevalence of Pulmonary Fibrosis in Asymptomatic 1st Degree Relatives of Patients with Familial Pulmonary Fibrosis (FPF)

Thursday, Dec. 3 10:40AM - 10:50AM Location: S404CD

Participants
Jonathan H. Chung, MD, Denver, CO (Presenter) Research Grant, Siemens AG; Royalties, Reed Elsevier
Anna Peljto, Aurora, CO (Abstract Co-Author) Nothing to Disclose
Tasha Fingerlin, Denver, CO (Abstract Co-Author) Nothing to Disclose
Marvin I. Schwarz, MD, Denver, CO (Abstract Co-Author) Nothing to Disclose
SSQ05-03 Prediction of Survival with Baseline Extent and 1-year Change of Regional Disease Patterns at Thin Section CT in Idiopathic Pulmonary Fibrosis

Thursday, Dec. 3 10:50AM - 11:00AM 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
Namkug Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Stockholder, Coreline Soft, Inc
Jin Woo Song, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To know if the baseline extent and 1-year change of regional disease patterns at thin-section CT (TSCT), which is measured with texture-based automated quantification system, can predict survival of idiopathic pulmonary fibrosis (IPF).

METHOD AND MATERIALS
Total 194 IPF patients (M:F = 153:41; 63.3 ± 7.8yrs) with TSCT scans at the time of diagnosis and 1 year after were included. Mean follow-up period of survival was 36.0 ± 18.9 months. Using in-house, texture-based automated system, the area percent of abnormal lung (AbN) and fibrosis (FIB) were calculated. The survival analyses were performed by constructing Kaplan-Meier disease-free survival curves. The association of baseline extent and 1-year change of TSCT measures with survival was assessed with Cox proportional hazards regression. Both univariable and multivariable analyses were performed by constructing Kaplan-Meier disease-free survival curves. The association of baseline extent and 1-year change of regional disease patterns (all p<0.001). Univariable analysis revealed that baseline FVC%pred, DLCO%pred, and SpO2% were predictive of survival. After adjustment, the baseline extent of RO and 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**
Hanan Sherif, MD, Doha, Qatar (Abstract Co-Author) Nothing to Disclose
Ahmed-Emad Mahfouz, MD, Doha, Qatar (Abstract Co-Author) Nothing to Disclose
Maysa A. Mohamed, MBBS, Doha, Qatar (Abstract Co-Author) Nothing to Disclose
Ahmed Sayedin, MBBCh, Doha, Qatar (Presenter) Nothing to Disclose

**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**
Wei Zha, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Stan Kruger, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Robert V. Cadman, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
David Mummy, MS, MBA, Madison, WI (Presenter) Nothing to Disclose
Nizar Jarjour, Madison, WI (Abstract Co-Author) Nothing to Disclose
Ronald L. Sorkness, Madison, WI (Abstract Co-Author) Nothing to Disclose
Scott K. Nagle, MD, PhD, Madison, WI (Abstract Co-Author) Research Grant, General Electric Company Research Consultant, Vertex Pharmaceuticals Incorporated
Sean B. Fain, 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
METHOD AND MATERIALS

Perfusion parameters and apparent diffusion coefficient (ADC) with microvessel density in lung cancer patients who underwent surgical resection. The purpose of this study was to correlate MR perfusion parameters and ADC with microvessel density in lung cancer patients who underwent surgical resection.

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)

Participants

Tahreema N. Matin, MBBS, Oxford, United Kingdom (Presenter) Nothing to Disclose
Mitchell Chen, DPhil,MBBS, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
Xiaojun Xu, MSc, DPhil, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
Najib Rahman, MSc, DPhil, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
Annabel Nickol, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
Fergus V. Gleeson, MBBS, Oxford, United Kingdom (Abstract Co-Author) Consultant, Alliance Medical Limited; Consultant, Blue Earth Diagnostics Limited; Consultant, Polarean, Inc;

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).

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 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 Xe-MRI 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

Participants

Chin A Yi, MD, PhD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Jae-Hun Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyoke-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
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

Thursday, Dec. 3 11:40AM - 11:50AM Location: S404CD

Participants
Simon Veldhoen, MD, Wurzburg, Germany (Presenter) Nothing to Disclose
Daniel Stab, St Lucia, Australia (Abstract Co-Author) Nothing to Disclose
Andreas M. Weng, Wurzburg, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Kunz, Wurzburg, Germany (Abstract Co-Author) Nothing to Disclose
Andre Fischer, DIPLPHYS, PhD, Wurzburg, Germany (Abstract Co-Author) Nothing to Disclose
Clemens Wirth, MD, Wuerzburg, Germany (Abstract Co-Author) Nothing to Disclose
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

Thursday, Dec. 3 11:50AM - 12:00PM Location: S404CD

Participants
Miho Hori, MSc, Toronto, ON (Presenter) Research Grant, Toshiba Corporation
TomoHitoshi 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
Narinder S. Paul, MD, Richmond Hill, ON (Abstract Co-Author) Research Grant, Toshiba Corporation; Research Grant, Carestream Health, Inc

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.
SSQ06
Gastrointestinal (Quantitative Imaging)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E350

GI  BQ  CT  MI  MR

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

FDA  Discussions may include off-label uses.

Participants
Claude B. Sirlin, MD, San Diego, CA (Moderator) Research Grant, General Electric Company; Speakers Bureau, Bayer AG; Consultant, Bayer AG;
Alexander R. Guiñáreas, MD, PhD, Portland, OR (Moderator) Speakers Bureau, Siemens AG; Expert Witness, Rice, Dolan, Kershaw
Andrew D. Smith, MD, PhD, Jackson, MS (Moderator) 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;

Sub-Events

SSQ06-01  3D Vibe-Dixon MR Sequence in Hepatic Fat Quantification: Inter-reader Reproducibility and Correlation to MRS Results in a Liver Donor Cohort

Thursday, Dec. 3 10:30AM - 10:40AM Location: E350

Participants
Chiara Pozzessere, MD, Siena, Italy (Presenter) Nothing to Disclose
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Ihab R. Kamel, MD, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

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

SSQ06-02  Inter-site Reproducibility of 2D MR Elastography Analysis for Hepatic Stiffness in a Cohort of Obese
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 -0.23 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)

To 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 biopsy.
RESULTS
Median FF differed (p<0.0001) between all histological steatosis grades at 1.0%(0.7-1.4), 6.1%(3.9-8.8), 17.4%(11.3-21.1) and 26.3%(25.0-30.1). Median CAP only differed between grades S0 and S2 (p=0.025) and S1 and S2 (p=0.006) at 260 dB/m (221-320), 281 dB/m (249-331), 330 dB/m (305-378) and 348 dB/m (321-353). FF (rs 0.90;95%-CI:0.81-0.95) correlated better (P=0.0002) with steatosis grades than CAP (rs 0.53;95%-CI:0.25-0.73). The area under the ROC curve (AUROC) to identify ≥S1 was higher (P=0.04) for ¹H-MRS at 0.98 (95%-CI:0.93-1.0) than for CAP at 0.76 (95%-CI:0.56-0.95). Optimal cut-off values of 4.1% and 261 dB/m resulted in sensitivity/ specificity/positive/negative predictive values of 89%/100%/100%/56% for ¹H-MRS and 89%/60%/94%/43% for CAP.

CONCLUSION
¹H-MRS derived FF differed between all four steatosis grades on biopsy, while CAP did not. Better correlation with histological features and superior AUROC to identify steatosis stage ≥S1 reaffirm ¹H-MRS as preferred method for noninvasive liver fat content assessment.

CLINICAL RELEVANCE/APPLICATION
¹H-MRS derived liver fat fractions show better diagnostic accuracy than CAP values for accurate noninvasive liver fat content assessment.

SSQ06-04 Assessment of Liver and Pancreas Iron Overload with a 3T MRI Multiecho GRE Sequence in Diffuse Liver Disorders: Rorrelation with Serum Ferritin and Liver Biopsy

Thursday, Dec. 3 11:00AM - 11:10AM Location: E350

Participants
Manuela Franca, MD, Porto, Portugal (Presenter) Nothing to Disclose
Angel Alberich-Bayarri, MD, Valencia, Spain (Abstract Co-Author) Nothing to Disclose
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Jose Ramon Vizcaino Vazquez, Porto, Portugal (Abstract Co-Author) Nothing to Disclose

PURPOSE
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 diseases, 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.

SSQ06-05 Liver Volume-assisted Estimation of Liver Function Based on Gd-EOB-DTPA- enhanced MR-Relaxometry

Thursday, Dec. 3 11:10AM - 11:20AM Location: E350

Participants
Michael Haimerl, Regensburg, Germany (Presenter) Nothing to Disclose
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Marcel D. Nickel, Erlangen, Germany (Abstract Co-Author) Employee, Siemens AG
Christian R. Stroszczyński, MD, Regensburg, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Wiegmann, Regensburg, Germany (Abstract Co-Author) Nothing to Disclose

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

Participants
Maxime Ronot, MD, Clichy, France (Abstract Co-Author) Nothing to Disclose
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Sylvain Terraz, MD, Geneve, Switzerland (Abstract Co-Author) Nothing to Disclose
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.

SSQ06-07  MRI Based Quantification of Hepatic Uptake and Excretion of Gadoxetic Acid: Preliminary Results

Participants
Daniel Truhn, MD, Cologne, Germany (Presenter) Nothing to Disclose
Alexander Ciritsis, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Nienke L. Hansen, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Alexandra Barabasch, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Burkhard Maedler, Bonn, Germany (Abstract Co-Author) Researcher, Koninklijke Philips NV
Christiane K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Nils A. Kraemer, Aachen, Germany (Abstract Co-Author) Nothing to Disclose

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.

SSQ06-08 The Attenuation Distribution Across the Long Axis (ADLA): Evaluation of Predictive Performance in a Large Clinical Trial

Awards

Trainee Research Prize - Medical Student

Participants

Nikita Lakomkin, Nashville, TN (Presenter) Nothing to Disclose
Allison Hainline, Nashville, TN (Abstract Co-Author) Nothing to Disclose
Hakmook Kang, Nashville, TN (Abstract Co-Author) Nothing to Disclose
M. S. Hutson, Nashville, TN (Abstract Co-Author) Nothing to Disclose
Carlos L. Arteaga, Nashville, TN (Abstract Co-Author) Nothing to Disclose
Richard G. Abramson, MD, Nashville, TN (Abstract Co-Author) Consultant, ICON plc;

Purpose

Novel methods of image feature analysis may be a useful adjunct to standard methods of cancer treatment response assessment. The attenuation distribution across the long axis (ADLA) is a simple, easily extractable measure of lesion heterogeneity; in a recent preliminary study, ADLA measurements predicted overall survival (OS) better than RECIST 1.1. The purpose of this study was to evaluate the ability of the ADLA method to predict OS in a larger clinical trial.

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 a treatment response by ADLA measurements to predict OS. The ADLA method was then compared to RECIST 1.1 using a bootstrapping technique that generated 95% confidence intervals on the Brier scores for both approaches.

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.
Awards

RSNA Country Presents Travel Award

Participants
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Annika Keulers, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Sebastian Keil, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose

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).
**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 monoexponential 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**

**METHOD AND MATERIALS**

This study was approved by our ethics committee. We retrospectively analyzed 47 colon cancer patients who underwent
preoperative dual-phase contrast enhanced spectral CT scans. Patients were divided into the well-differentiated group (A) and the poorly and undifferentiated group (B) based on the pathological findings for analysis. Iodine concentration (IC) for tumors was measured in arterial phase (AP) and venous phase (VP) on the iodine-based material decomposition images and 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: \( \frac{(CT(40keV)-CT(90keV))}{50} \). Values of the 2 groups were compared and ROC study was performed to assess the differential diagnosis performance.

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±49.03 HU vs. 63.97±15.86 HU; 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
Quantitative parameters obtained in spectral CT in the arterial phase improve accuracy for differentiating well-differentiated and un-differentiated colon cancers.

CLIENCIAL 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

Thursday, Dec. 3 11:00AM - 11:10AM Location: E353C

Participants
Suxing Yang, Beijing, China (Presenter) Nothing to Disclose
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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.

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.
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, 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
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Jae Woo Yeon, Sungnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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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 make 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

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Jae Woo Yeon, Sungnam-Si, 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, 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
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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 make 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.
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

Myung Sub Kim, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
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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) Appendixal 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
**Participants**
Raghunandan Vikram, MBBS, FRCR, Houston, TX (Moderator) Nothing to Disclose
Daniele Marin, MD, Cary, NC (Moderator) Nothing to Disclose

**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 preoperative 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
Neema Jamshidi, MD, PhD, Los Angeles, CA (Presenter) Nothing to Disclose
Eric Jonasch, MD, Houston, TX (Abstract Co-Author) Consultant, Pfizer Inc Consultant, Novartis AG Consultant, GlaxoSmithKline plc Consultant, AstraZeneca PLC Research funded, Pfizer Inc Research funded, GlaxoSmithKline plc Research funded, Bristol-Myers Squibb Company Research funded, Novartis AG Research funded, Exelixis, Inc Research funded, Onyx Pharmaceuticals, Inc
Matthew A. Zapol, MA, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ronald L. Korn, MD, PhD, Scottsdale, AZ (Abstract Co-Author) Chief Medical Officer, Imaging Endpoints; Founder, Imaging Endpoints; Shareholder, Imaging Endpoints
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Sudeep Banerjee, BA, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
James Brooks, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Borje Ljungberg, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Michael D. Kuo, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose

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
For our quantitative NIMA faithfully represents the tissue-based molecular assay it models. The RRS scaled with the SPC gene signature (R²=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 (R²=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

METHOD AND MATERIALS

With IRB approval for this HIPAA-compliant retrospective study, our pathology and imaging databases were queried to obtain a cohort of RCC, oncocytoma, and lipid-poor angiomyolipoma (AML) with preoperative multiphasic multidetector CT imaged with a four-phase renal mass protocol (unenhanced, corticomedullary (C), nephrographic (N), and excretory (E)). A whole lesion 3D contour was obtained in all phases with proprietary software. The CAD algorithm determined a 0.5cm diameter region of peak enhancement ≤300HU within the 3D lesion contour. All contours were confirmed by a radiologist. T-tests were used to compare peak multiphasic enhancement. P values <0.05 were considered significant.

RESULTS

206 patients (65% men, 35% women) with 223 unique renal masses (105 (47%) ccRCC, 41(18%) oncocytoma (O), 18 (8%) chromophobe RCC (chRCC), 45 (20%) papillary RCC (pRCC), 14 (6%) lipid-poor AML) were analyzed. In the C phase, CAD absolute peak attenuation of the ccRCC (174 HU) was greater than that of O (167 HU, p=0.333), chRCC (136 HU, p=0.007), pRCC (85 HU, p<0.0001), and lipid-poor AML (104 HU, p=0.004). In the N phase, CAD absolute peak attenuation of the ccRCC (144 HU) was greater than that of O (132 HU, p=0.015), chRCC (106 HU, p<0.0001), pRCC (103 HU, p<0.0001), and lipid-poor AML (115 HU, p<0.0001). In the E phase, CAD absolute peak attenuation of the ccRCC (118 HU) was greater than that of O (104 HU, p=0.001), chRCC (86 HU, p<0.0001), pRCC (86 HU, p<0.0001), and lipid-poor AML (98 HU, p=0.001).

CONCLUSION

CAD derived absolute attenuation discriminates ccRCC from indolent RCC subtypes and benign RCC mimics at four-phase MDCT.

CLINICAL RELEVANCE/APPLICATION

CAD enhancement is a robust method to discriminate clear cell RCC from RCC subtypes and benign mimics, enabling clinicians to stratify patients to active surveillance, preoperative biopsy or surgical therapy.

SSQ09-06 Prognostic Value of Newly Proposed Response Criteria in Assessing Tumor Response in Advanced Renal Cell Carcinoma

Participants

Hyunseon C. Kang, MD, PhD, Houston, TX (Presenter) Nothing to Disclose
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Haesun Choi, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE

Several new solid tumor response criteria have been proposed to overcome the limitations of traditional size based criteria. This study examines the prognostic value of these criteria, and the additive value of clinical risk factors, in patients with advanced renal cell carcinoma (RCC) treated with pazopanib.
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

**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 (9 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 sensitivity, specificity and accuracy for preliminary diagnosis versus final diagnosis using DWI were 82, 69, and 77, 82, 73, 78 respectively. The area under the receiver operator curve for the diagnosis with DWI was 0.8512. The addition of DWI result 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

**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.
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
Adeel R. Seyal, MD, Chicago, IL (Presenter) Grant, Siemens AG
Atilla Arslanoglu, MD, Chicago, IL (Abstract Co-Author) Grant, Siemens AG
Faezeh Sodagari, MD, Chicago, IL (Abstract Co-Author) Grant, Siemens AG
Yuri Velichko, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Paul Nikolaidis, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Vahid Yaghmai, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

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.
Vahid Yaghmai, MD - 2012 Honored Educator
Vahid Yaghmai, MD - 2015 Honored Educator
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 (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

SSQ11-02  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, Everest 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
**Institution Certification System for Low-Dose Lung Cancer CT Screening in Japan: Development of a New Web-based Image Evaluation Function**

Participants
Oleg S. Pianykh, Newton Highlands, MA (Presenter) Nothing to Disclose

**Background**

The fundamental standards of digital medical data exchange, such as DICOM and HL7, date back to the late 1980s. And although these standards went through countless enhancements, one particular aspect - security - remained virtually untouched. The main purpose of our work was to perform the first comprehensive study of clinical security worldwide.

**Evaluation**

We used DICOM and HL7 association establishment protocols to develop a fast, parallel-processing security-probing application. Testing each IP address for its openness to transmit medical data (with no actual data transferred), the application scanned the entire worldwide space of IP addresses in 3 weeks. Geolocation services were used to map each unsecure IP we identified. As a result, we compiled a comprehensive map of open clinical servers worldwide, with different levels of security threats.

**Discussion**

Our scan discovered 2774 DICOM servers worldwide, out of which 719 were open for medical data communications. HL7 results were similar. Each protocol was used to categorize our findings by different levels of security threats, and geolocation data - by countries and regions. As a result, we compiled clinical security ratings per country, per capita, and per IT infrastructure. We also built the first map of DICOM/HL7 adoption worldwide.

**Conclusion**

Medical data archives, left wide-open to security threats, is by far the most common security problem, which needs to be addressed with a robust, standardized, and fully implemented solution. Our results demonstrate the full scope of this problem, and the areas where it needs to be solved first.

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**SSQ11-04**

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**

**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, pediatrics 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 Xray technology basis. Consciousness will be done with explanations of dose effect on kids (stochastics and determinists effects).

**Conclusion**
Dose monitoring electronic solution allow us reeucing 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**

**Participants**
Yasuyuki Ueda, Fukuoka, Japan (Presenter) Nothing to Disclose  
Junji Morishita, PhD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose  
Shohei Kudomi, Ube, Japan (Abstract Co-Author) Nothing to Disclose  
Katsumiko 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**

**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.

**CLINICAL RELEVANCE/APPLICATION**

The developed dose tracking and reporting system could greatly facilitate the tasks of CT dose monitoring and management.

**SSQ11-08  
Implementation of a Virtual 'Learning from Discrepancy' Meeting: A Method to Improve Radiologist Attendance and Facilitate Shared Learning from Radiological Error**

**PURPOSE**

To assess the effect on radiologist participation in learning from discrepancy meetings (LDMs) in a large radiology department spread across three hospital sites by establishing virtual LDMs using OsiriX (Pixmeo).

**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**

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.
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**

**SSQ12-01 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 MRL. 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.

**SSQ12-02 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 Annapragnada, PhD, Houston, TX (Abstract Co-Author) Stockholder, Marval Pharma Ltd Stockholder, Alzea 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...
Conventional MRI contrast agents employ paramagnetic metal ions to generate contrast in 1H MRI scans. While this approach is highly sensitive, specificity and unambiguous quantification of signal is challenging and metal ion toxicity is a concern so other alternatives are sought. 19F presents a great potential for reasons including: spectroscopic properties of 19F are similar to 1H therefore existing 1H MRI hardware can be used for 19F MRI with minimal modifications; no endogenous 19F in soft tissue so the potential to generate a directly quantifiable signal with high contrast-to-noise ratio. However, almost all 19F-based agents utilize perfluorocarbons (PFCs), with several drawbacks: highly hydrophobic (limiting formulation to water emulsions) and magnetically diverse 19Fs (result in diffuse 19F MR images). We report novel hydrophilic fluorinated molecules with magnetically equivalent 19Fs, amenable to aqueous formulations for 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.

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 milimolar 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.

SSQ12-03 [¹¹C]Me@HAPTHI - A Novel PET-ligand for the Norepinephrine Transporter - Part 1: Target Affinity and Radiosynthesis

Thursday, Dec. 3 10:50AM - 11:00AM Location: S504AB

Participants
Christina Rami-Mark, MSc, Vienna, Austria (Presenter) Nothing to Disclose
Neydher Berroteran-Infante, MSc, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
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Marcus Hacker, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Markus Mitterhauser, Vienna, Austria (Abstract Co-Author) Speaker, General Electric Company
Wolfgang Wadsak, Vienna, Austria (Abstract Co-Author) Speaker, General Electric Company; Consultant, THP Medical; Research Grant, ABX GmbH; Research Grant, Rotem GmbH

PURPOSE

The norepinephrine transporter (NET) has been demonstrated to be relevant to a multitude of neuro-psychiatric and cardiovascular pathologies. Due to the wide range of possible applications for PET imaging of the NET together with the limitations of currently available radioligands, novel NET-PET tracers are seriously needed.

METHOD AND MATERIALS

Precursor, HAPTHI ((S)-1-(4-amino-3-hydroxybutyl)-3-phenyl-1,3-dihydrobenzo[c][1,2,5]thiadiazole 2,2-dioxide), and reference compound, Me@HAPTHI ((S)-1-(3-hydroxy-4-(methylamino)butyl)-3-phenyl-1,3-dihydrobenzo[c][1,2,5]thiadiazole 2,2-dioxide), were custom-synthesized by ABX. For optimization of radiosynthesis conditions, small-scale reactions (< 2GBq) were performed. The influence of various reaction conditions, i.e. reaction temperature, solvent and base, precursor concentration and radiomethylation agent, was investigated. The automation of the N-¹¹C-methylation reaction was done on a TRACERlab FX C Pro synthesizer (GE Healthcare). The affinity of new radiolabeled ligand was determined in a NET-expressing membrane binding protocol.

RESULTS

In the radiochemical evaluation, best results were obtained with sodium hydroxide catalysis in 2-butanone (MEK) as solvent for 2min at 75°C using 2mg/mL precursor HAPTHI. Thereby, 54.0 ± 8.3% radiochemical incorporation yield was achieved. These optimum reaction parameters were subsequently used in the fully automated radiosynthesizer. So far, 7 large-scale radiosyntheses were performed, yielding 2.2 ± 0.6GBq (18.9 ± 13.3%, corrected for decay) of sterile, formulated [¹¹C]Me@HAPTHI within 36min. A mean specific activity of 46.8±28.5 GBq/µmol was found in the large-scale syntheses. Full radiopharmaceutical quality control took 5min and showed that radiochemical purity always exceeded 98%. Affinity of reference compounds, Me@HAPTHI, using human NET membranes evinced a Kd of 0.21 ± 0.07nM (n=9). For determination of selectivity, additionally the affinity towards human DAT and SERT membranes were measured and revealed >10µM for DAT and 409 ± 43nM for SERT, respectively, (n=5). Hence, selectivity of Me@HAPTHI towards NET was determined as DAT/NET>1947.6 and SERT/NET=9757.

CONCLUSION

This study confirms an outstanding affinity and selectivity of the title compound towards human NET as well as its feasible radiochemical preparation for further preclinical evaluations ans future in-vivo applications.

CLINICAL RELEVANCE/APPLICATION

N/A

SSQ12-04 [¹¹C]Me@HAPTHI - A Novel PET-ligand for the Norepinephrine Transporter - Part 2: Preclinical Evaluation

Abstract Co-Author
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Evaluation

While this approach is...
Participants
Christina Rami-Mark, MSC, Vienna, Austria (Presenter) Nothing to Disclose
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PURPOSE
The norepinephrine transporter (NET) has been demonstrated to be pivotal in many neuro-psychiatric and cardiovascular pathologies. $[{}^{11}C]Me@HAPTHI$, a novel potential NET-PET tracer, was shown to have a high target affinity and selectivity. Hence, further in vitro evaluation regarding blood-brain-barrier (BBB) penetration, stability and binding properties in autoradiography on different tissues is required.

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. EJNMMI, 2014) to achieve $P_m$ (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 human brain tissue (cortex, thalamus, hippocampus, cerebellum, and hypothalamus) as well as rat heart. Non-specific binding was determined with excess Nisoxetine ($10\mu M$). For competition, non-radioactive FMeneR-D2 and Me@HAPTHI were added. After 1h at room temperature, incubation was stopped and slices were processed on phosphor imaging films. Post-autoradiographic processing of the slices was done by Nissl staining in order to facilitate morphological mapping. Immunohistochemical (IHC) staining experiments were performed on rat and human tissue cryo-slices, vicinal to the slices used for autoradiography.

RESULTS
Excellent affinity ($K_d$ of 0.21±0.07nM) and selectivity ($DAT/NET>1940$; $SERT/NET=9700$) were already shown for $[{}^{11}C]Me@HAPTHI$. Now, both logD (2.27±0.01) and $P_m$ (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. $ff$ was found to be 8.24±0.3%. In the autoradiographic experiments, highest uptake of $[{}^{11}C]Me@HAPTHI$ was observed in NET-rich regions identified with IHC and a concentration dependent binding displacement was seen for both competitors. (see figure)

CONCLUSION
Side from its high affinity and selectivity, we now demonstrated $[{}^{11}C]Me@HAPTHI$'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

SSQ12-05 Multimodal Imaging of Insulin-dependent Triglyceride-rich lipoprotein Uptake into Brown Adipose Tissue at 7T MRI and Intravitral Microscopy

Participants
Caroline Jung, Hamburg, Germany (Presenter) Nothing to Disclose
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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
Jorg Heeren, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Nils Mangels, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
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 (SPIONS) for MRI or quantum dots (QD) for intravitral microscopy (IVM) embedded into triglyceride-rich lipoproteins (TRL).

METHOD AND MATERIALS
BAT activity of C57BL/6J wild-type was stimulated by treatment with the $\beta_3$ 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-SPIONS using a T2*w Multiecho-GRE sequence (TR/TE first 400/2ms, ETL 12, ES 1ms, FA 25°). $\Delta R_2^*$ 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-SPIONS was detectable for control mice, a significant signal drop and increase of $\Delta R_2^*$ (82.9±1; p<0.001) was estimated for CL treated, BAT activated mice. Inhibition of insulin signalling resulted in a significant lower uptake of TRL-SPIONS into BAT ($\Delta R_2^* = 21.15±1$; 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
$\beta_3$-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 visualised 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**

Thursday, Dec. 3 11:20AM - 11:30AM Location: S504AB

Participants
Caroline Jung, Hamburg, Germany (*Presenter*) Nothing to Disclose
Johannes M. Salamon, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Martin Hofmann, Dipl Phys, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
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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**

Thursday, Dec. 3 11:30AM - 11:40AM Location: S504AB

**Awards**

Molecular Imaging Travel Award

Participants
Xin-Gui Peng, MD,PhD, Nanjing, China (*Presenter*) Nothing to Disclose
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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±49.53mg/cm³, and -655.1 ± -69.141mg/cm³, respectively; P=0.001). The based iron (water) material concentration of BAT was significantly higher compared to WAT (-4.92±1.80mg/cm³ and -13.80 ± 0.36mg/cm³, respectively; P<0.001). Water (iron) 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). The effective atomic number of BAT was significant 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
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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
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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.
Calcium Pyrophosphate Deposition Disease Detected with MRI Is Associated with Accelerated Cartilage Degeneration—Data from the Osteoarthritis Initiative

**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.

Study of 640-slice Dynamic Volume CT Perfusion and Pathological Changes on Acute Gouty Arthritis of Knee-joint in Rabbit Model

**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 at those six intervals (one-way ANOVA and LSD 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

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
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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: 38.8±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 enthesopathy-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 Kleng, 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 sacroiliitis (modified NY criteria). Other SIJ 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-ilii=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
Tatsuya Atsumi, MD, PhD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Michihito Kono, Obihiro, Japan (Abstract Co-Author) Nothing to Disclose
Minghui Tang, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
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.

SSQ13-07 Detection of Synovitis in Rheumatoid Arthritis and Differentiation to Healthy Volunteers by Means of a 2D Optical Imaging System in Comparison to MRI

Thursday, Dec. 3 11:30AM - 11:40AM Location: E451A

Participants
Jan Neumann, MD, Munich, Germany (Presenter) Nothing to Disclose
Klaus Thuermel, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Ernst Meier, MD, PhD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

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, FOI 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 FOI 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 FOI system appears to be of limited value for the clinical routine.

SSQ13-08 MRI-detected Markers of Inflammation Especially in Overweight Persons Increase Risk of Incident Osteoarthritis: The POMA Study

Thursday, Dec. 3 11:40AM - 11:50AM Location: E451A

Participants
Frank W. Roemer, MD, Boston, MA (Presenter) Chief Medical Officer, Boston Imaging Core Lab LLC Research Director, Boston Imaging Core Lab LLC Shareholder, Boston Imaging Core Lab LLC
Ali Guermazi, MD, PhD, Boston, MA (Abstract Co-Author) President, Boston Imaging Core Lab, LLC; Research Consultant, Merck KgaA; Research Consultant, Sanofi-Aventis Group; Research Consultant, TissueGene, Inc; Research Consultant, OrthoTrophic; Research Consultant, AstraZeneca PLC
CONCLUSION

reliability, with ICC = 0.65 (95% CI 0.53-0.74).

peak OCJ SI ratio between group 1 (0.81 ±0.23) and group 2 (0.80 ±0.13). The technique demonstrated substantial interobserver ratio between group 1 (mean ±SD = 0.85 ±0.10) and group 2 (0.77 ±0.12).

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 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

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

For those who would develop OA, an increased risk of effusion was observed for the combined overweight/obese group at P-2 but not for synovitis. In regard to interaction of BMI with synovitis, the presence of synovitis increases risk of ROA in overweight women while obese women had an increased risk for ROA without synovitis.

CLINICAL RELEVANCE/APPLICATION

Presence of inflammation seems to play a role especially in overweight women whereas obese women have an increased risk for ROA even in the absence of imaging markers of inflammation confirming that both mechanical load and inflammation play a role in OA incidence at least for 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. Bivariate 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.

CONCLUSION

For those who would develop OA, an increased risk of effusion was observed for the combined overweight/obese group at P-2 but not for synovitis. In regard to interaction of BMI with synovitis, the presence of synovitis increases risk of ROA in overweight women while obese women had an increased risk for ROA without synovitis.

CLINICAL RELEVANCE/APPLICATION

Presence of inflammation seems to play a role especially in overweight women whereas obese women have an increased risk for ROA even in the absence of imaging markers of inflammation confirming that both mechanical load and inflammation play a role in OA incidence at least for women.

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

SSQ13-09  Ultrasound Evaluation of Osteochondral Junction Alterations in Early Osteoarthritis

Thursday, Dec. 3 11:50AM - 12:00PM Location: E451A

Participants

James MacKay, MBBCIR, MRCP, Norwich, United Kingdom (Presenter) Nothing to Disclose
Samantha B. Low, MBChB, Norwich, United Kingdom (Abstract Co-Author) Nothing to Disclose
Andoni P. Toms, FRCR, PhD, Norwich, United Kingdom (Abstract Co-Author) Nothing to Disclose

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 medial (MT) and lateral tibial (LT) plateau 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

Presence of inflammation seems to play a role especially in overweight women whereas obese women have an increased risk for ROA even in the absence of imaging markers of inflammation confirming that both mechanical load and inflammation play a role in OA incidence at least for women.
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.
**SSQ14-01  Improved Detection of Melanoma Metastases Using Iodine Maps from Dual Energy CT**

**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.

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**SSQ14-02  Diagnostic Performance of Diffusion-weighted 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 Somaiah, 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%, 47.7% 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 range = 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
To evaluate the ultrasonographic appearance of subcutaneous soft-tissue tumors and pseudo-tumors with a focus on epidermal cysts.

**METHOD AND MATERIALS**

112 small subcutaneous nodules (mean maximum size: 9.7mm) with US imaging and pathologic correlation were included in this retrospective study. The histopathology revealed 7 ganglion cysts, 24 epidermal cysts, 10 pilomatricomas, 47 benign tumors (including 25 lipomas), 9 malignant tumors and 15 various lesions. One MSK radiologist with 20 years of experience analysed several US imaging features of the lesions: morphology, margins, size, echogenicity, Doppler signal, peripheral halo, focal intra-dermal penetration, relative skin thinning opposite to the mass, posterior acoustic enhancement, lateral shadows. ROC analysis was performed to evaluate the performance of individual parameters and that of a multi-parametric model using logistic regression in the specific identification of epidermal cysts.

**RESULTS**

Best imaging parameters were posterior acoustic enhancement (AUC = 0.87, Se = 100%, Sp = 65%), lateral shadows (AUC = 0.83, Se = 75%, Sp = 91%), Doppler signal=0 (AUC = 0.75, Se = 86%, Sp = 63%), well-defined margins (AUC = 0.74, Se = 96%, Sp = 27%), relative skin thinning (AUC = 0.71, Se = 100%, Sp = 35%) and focal intra-dermal penetration (AUC = 0.65, Se = 42%, Sp = 89%), showing a performance ranging from moderate to good. A multi-parametric model based on 4 parameters (posterior acoustic enhancement, well-circumscribed margins, lateral shadows and Doppler) allowed diagnosis of epidermal cysts with a very good performance (AUC = 0.96, Se = 91%, Sp = 94%).

**CONCLUSION**

A computer-aided decision based on a multi-parametric model of US imaging features of subcutaneous lesions allows diagnosis of epidermal cysts. Further tests on a larger cohort of patients are needed to confirm the performance of the present model.

**CLINICAL RELEVANCE/APPLICATION**

Ultrasound is a reliable imaging technique for the diagnosis of epidermal cysts.
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 intermuscular 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

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
To retrospectively determine the added value of diffusion-weighted imaging (DWI) to standard magnetic resonance imaging (MRI) to detect recurrent soft tissue sarcoma after surgical resection at 3.0 T.

**METHOD AND MATERIALS**

The institutional review board approved this retrospective study and informed consent was waived. From June 2009 through April 2014, 30 patients without residual tumor referred for postoperative surveillance of soft tissue sarcoma underwent 3T MRI including DWI. Two independent musculoskeletal radiologists first scored standard MRI. Then, they assessed a combination of standard MRI 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.

**RESULTS**

There were 13 histologically proved recurrent soft tissue sarcoma in nine patients. In qualitative analysis of DWI, all recurrent soft tissue sarcoma revealed hyperintensity relative to skeletal muscle. In quantitative analysis of recurrent soft tissue sarcoma, median ADCs of two readers were 1025 (774-1092) μm²/sec and 996 (801-1126) μm²/sec, respectively, showing excellent interobserver agreement (ICC = 0.900). Sensitivity, specificity and accuracy of each reader were 69%, 81%, and 77%; 92%, 57%, and 71% on standard MRI alone, whereas 100%, 95%, and 97%; 92%, 95%, and 94% on standard MRI combined DWI, respectively. AUCs of a combination of standard MRI and DWI were higher than those of standard MRI alone: 0.824 vs 0.969 (P = .029), and 0.866 vs 0.958 (P = .127) for each reader, respectively.

**CONCLUSION**

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.
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.
SSQ15 Nuclear Medicine (Emerging Methods and Techniques)

Thursday, Dec. 3 10:30AM - 12:00PM Location: S505AB

Participants
Charles M. Intenzo, MD, Philadelphia, PA (Moderator) Nothing to Disclose
Don C. Yoo, MD, Providence, RI (Moderator) Nothing to Disclose

Sub-Events

SSQ15-01 Nuclear Medicine Keynote Speaker: Advances in Clinical Optical Imaging

Thursday, Dec. 3 10:30AM - 10:50AM Location: S505AB

Participants
Jan Grimm, MD, PhD, New York, NY (Presenter) Nothing to Disclose

SSQ15-03 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

Thursday, Dec. 3 10:50AM - 11:00AM Location: S505AB

Participants
Lino Sawicki, MD, Dusseldorf, Germany (Presenter) Nothing to Disclose
Benedikt M. Schaarschmidt, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Heusch, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Christian Buchbender, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Frank Floeth, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose

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.

SSQ15-04 Volumetric, Metabolic and CSF Biomarkers Profile in Different Subtypes of MCI

Thursday, Dec. 3 11:00AM - 11:10AM Location: S505AB

Participants
Artur Coutinho, MD, Sao Paulo, Brazil (Presenter) Nothing to Disclose
Fabio H. Porto, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Silvana Prando, DPLPHYS, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
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Patricia H. Vale, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Mild cognitive impairment (MCI) is a transitional stage between normal aging and dementia, particularly Alzheimer’s disease (AD). There are few reports investigating multiple biomarkers of non-amnestic MCI (naMCI) as a single group, in comparison to amnestic subtypes (aMCI) and a normal elderly control group (CG). Our study investigated: a) regional brain glucose metabolism (rBGM) with [18F]FDG-PET and volume-based morphometry with magnetic resonance imaging (MRI) of a naMCI group in comparison to CG and aMCI, and b) the profile of amyloid-β peptide, tau and p-tau proteins in the cerebrospinal fluid (CSF) of naMCI and aMCI groups.

METHOD AND MATERIALS
114 subjects composed three groups: naMCI (N = 38), aMCI (N = 46) and CG (N = 30). All subjects underwent brain MRI and [18F]FDG-PET. Imaging data was analysed with the software SPM8. A subsample (naMCI = 33, aMCI = 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 aMCI groups. Both MCI groups had lower rBGM in relation to CG in the precuneus. Additional right prefrontal lobe hypometabolism was seen in naMCI. aMCI group had bilateral mesial and polar temporal lobe volume reduction in comparison to naMCI and CG. 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 aMCI have different biomarker profiles. There are few reports investigating multiple biomarkers of naMCI as a single group in comparison to aMCI and cognitively normal elderly subjects (CG). Our study characterizes naMCI as a heterogeneous group, less related to classical AD and different from aMCI. This group should be better prospectively investigated in order to search for specific biomarkers indicating risk of developing different kinds of neurodegenerative disorders.

SSQ15-05 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

Thursday, Dec. 3 11:10AM - 11:20AM Location: S505AB

Participants
Shigeki 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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Hiroshi Takashima, Kagoshima, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
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). The study was done to evaluate 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
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 PE-2I PET/CT and iodine-123-labeled metaiodobenzylguanidine (123I-MIBG) myocardic scintigraphy. Three dimensional VOI (volume of interest) was automatically drawn around striatum respectively on C-11 PE-2I PET/CT images. Both sided 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 sides 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 of all lymph nodes in patients with malignant melanoma. Our goal was to determine the minimum scan completion time that Tc99m (Tc99m SC).

A total of 34 consecutive patients underwent SLN mapping with Tc99m tilmanocept.

METHOD AND MATERIALS
Between 1st of July 2008 and 6th of November 2014 in total 1982 patients underwent a SN breast procedure, using intratumoral tracer administration. SPECT/CT scans for non-visualization on planar lymphoscintigraphy were acquired for 298 (15%) breast cancer patients. Ninety-one (30.5%) patients had previous surgery or radiation therapy at the same breast prior to the SN procedure and 40 (13.4%) were scheduled for neo-adjuvant chemotherapy. If SN non-visualization persisted on SPECT/CT images, a second radiotracer injection with repeated scintigraphy was performed when logistics allowed this. Univariate analysis was performed to examine if specific subgroups, such as age, BMI, T-stage or previous treatment, have influence on visualization rates of SPECT/CT.

RESULTS
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).

CONCLUSION
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.

CLINICAL RELEVANCE/APPLICATION
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.

SSQ15-07 Does Tc-99m Tilmanocept Offer Shorter Patient Through-Put Time Than Tc99m Sulfur Colloid for Sentinel Lymph Node Mapping in Malignant Melanoma?

Participants
Charles M. Intenzo, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Sung M. Kim, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Adam Berger, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE
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.

METHOD AND MATERIALS
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.

RESULTS
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.

CONCLUSION
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.

CLINICAL RELEVANCE/APPLICATION
Tc99m tilmanocept is more time-efficient than Tc99m SC for SLN mapping in malignant melanoma thereby facilitating patient
correlation concerning SUV (max and mean) measurements between PET/CT, non-TOF and TOF reconstructions. The general image
All malignant lesions and the majority of physiologic tissue (except the subcutaneous fat, spleen and blood pool) showed a good
detectability were assessed as well. Count rates between both systems were also compared.

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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Patrick Veit-Haibach, MD, Zurich, Switzerland (Abstract Co-Author) Research Grant, Bayer AG; Resaarch 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.
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.
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 70% 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**

**Thursday, Dec. 3 10:50AM - 11:00AM Location: N228**

**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**

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**

**Thursday, Dec. 3 11:00AM - 11:10AM Location: N228**

**Participants**
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 produces 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.
Magnetic resonance spectroscopic imaging (MRSI) of the brain allows to map several metabolites and provide complementary metabolic 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 3 T and 7 T. SNR was 2.8 times higher at 7 T compared to 3 T. CRLBs were below 10% for all metabolites measured at 7 T 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 7 T 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 7 T but not at 3 T. 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

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MRSI of the brain allows to map several metabolites and provide complementary metabolic 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.

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Satisfactory data quality was achieved from all subjects measured at 3 T and 7 T. SNR was 2.8 times higher at 7 T compared to 3 T. CRLBs were below 10% for all metabolites measured at 7 T 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 7 T 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 7 T but not at 3 T. 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

Satisfactory data quality was achieved from all subjects measured at 3 T and 7 T. SNR was 2.8 times higher at 7 T compared to 3 T. CRLBs were below 10% for all metabolites measured at 7 T 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.

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MRSI of the brain allows to map several metabolites and provide complementary metabolic 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 3 T and 7 T. SNR was 2.8 times higher at 7 T compared to 3 T. CRLBs were below 10% for all metabolites measured at 7 T 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.
We describe an ex vivo whole brain MRI protocol that recapitulates standard clinical protocols well to guide clinical or research radiology-pathology studies in a variety of patient populations.

**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.
Atypical Head CT Artifact-Potential for Misdiagnosis

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 it 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.

Estimation of Bias Corrections in Observer Model Performance Metrics for Accurate Comparisons of CT Image Quality

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...
A previously validated channelized Hotelling observer (CHo) model was employed to evaluate the detectability of a 3 mm diameter circular object. The object was submerged in a 35x 25 cm2 iodine-doped water filled phantom, yielding -15 HU object contrast. The phantom was scanned with 3 different dose levels (quantified by CTDIvol): 3.6, 7.2, and 21.8 mGy. For each dose level, the phantom was scanned 100 times with and without the object present. A bias-corrected CHo detectability index (bc-DI) was derived from DIs calculated with varied numbers of training images (N). Specifically, bc-DI values were determined from intercept values of linear fits of DI versus 1/N for all dose levels. Additionally, bc-DI values were derived from limited datasets: 70, 80, and 90 total images and compared with bc-DI values obtained from the full 100 image datasets.

RESULTS

Estimates of bc-DI values revealed variable bias in DI as a function of dose. DI values calculated for images acquired with higher dose levels yielded greater absolute bias as compared to the DI values calculated from image acquired with lower dose levels. For all dose levels, estimates of bc-DI values derived from reduced datasets were consistent; percent deviations from the value derived from N=100 were ≤ 7%.

CONCLUSION

The use of a finite number of training images leads to bias in the CHo's performance that varies with dose and number of training images. Through the methodology employed here, it is possible to estimate reliable bc-DI values with reduced number of training images.

CLINICAL RELEVANCE/APPLICATION

Observer models are being widely investigated to evaluate and compare CT image quality. Variability in model performance bias should be well-understood for accurate image quality comparisons.

SSQ19-03 A Task-Based kV-mAs Optimization Framework for Both Linear and Nonlinear CT Systems

Thursday, Dec. 3 10:50AM - 11:00AM Location: S403B

Participants
Daniel Gomez-Cardona, Madison, WI (Presenter) Nothing to Disclose
Ke Li, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Meghan G. Lubner, MD, Madison, WI (Abstract Co-Author) Grant, General Electric Company; Grant, NeuWave Medical, Inc; Grant, Koninklijke Philips NV
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
Guang-Hong Chen, PhD, Madison, WI (Abstract Co-Author) Research funded, General Electric Company; Research funded, Siemens AG

PURPOSE

Zero-frequency metrics such as the contrast-to-noise ratio (CNR) are commonly used for the optimal selection of tube voltage (kV) and tube current-rotation time product (mAs) in CT. However, these metrics are invalid for nonlinear CT systems such as those using model based iterative reconstruction (MBIR) algorithms. This study reports a new task-based framework to optimize the selection of kV and mAs for both linear and nonlinear CT systems.

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 mAs 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 map. Thus, for a prescribed detectability level (d'), 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 study.

RESULTS

For a prescribed detectability level of d'=16, the kV-mAs combinations (followed by CTDIvol dose levels (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.

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/

Meghan G. Lubner, MD - 2014 Honored Educator
Meghan G. Lubner, MD - 2015 Honored Educator
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 lesion 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 5=completely 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
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Shannon P. Sheedy, MD, Rochester, MN (Abstract Co-Author) Nothing to Disclose

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 ipsilateral lung 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
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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, Nextest, 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
Jiayang 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

TeraRecon iNtuition version 4.4.11.164.7713). The accuracy of the volume measurement was quantified as the percent difference between the estimated volume and the nominal volume provided by the phantom manufacturer.

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.
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-CTmus)/SD. The volumetric CT dose index (CTDiver) 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 included in this study. Compared with the conventional 120 kV protocol, kV Assist allowed for an overall average decrease of 45 % in CTDiver (8.73±4.28 mGy vs 15.77±4.10 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**

**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**

**METHOD AND MATERIALS**

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.
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 $E_{eff}$ (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.
Participants
Robert C. Chatelain, RT, Ottawa, ON (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To identify normal anatomy and its variants demonstrated by CT of the urinary system. 2) To explain the value of having specific dedicated protocols for the renal and urographic imaging. 3) To differentiate renal and urographic pathologies by origin (congenital, neoplastic, vascular etc.)

ABSTRACT
The urinary system is subject to a wide variety of pathological processes and anatomical variants. Fortunately, it lends itself well to being imaged by a range of modalities. This presentation will focus on the imaging of the urinary system using Computed Tomography (CT). Due to high spatial resolution, CT is an excellent tool to evaluate stones, masses, traumatic injuries and infections. Non contrast CT is the procedure of choice to evaluate kidney stones. CT is also used to differentiate malignant from nonmalignant renal masses, to evaluate the local spread of a renal malignancy and CT angiography (CTA) is an excellent tool to define the anatomy of the renal arteries and veins.
Revisiting Contrast Induced Nephropathy in Azotemic Patients with Aortic Stenosis being Considered for TAVI

Station #1

Participants
Balazs Ruzsics, MD, PhD, Charleston, SC (Moderator) Nothing to Disclose

Sub-Events

CA252-SD-THA1

Morphological and Functional Evaluation of Quadricuspid Aortic Valves using Cardiac CT

Station #2

Participants
Sung Min Ko, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ji Hun Kang, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

PURPOSE

Patients with severe aortic stenosis being considered for transcatheter aortic valve implantation (TAVI) often have multiple co-morbidities, frequently including renal dysfunction. Contrast-enhanced computed tomographic angiography (CTA) of the aortic root and aorto-iliac vessels is the accepted assessment prior to TAVI to determine device sizing and treatment plan. Our aim was to evaluate the incidence and outcomes of contrast nephropathy in azotemic patients undergoing CTA assessment for TAVI with a reduced contrast dose protocol.

METHOD AND MATERIALS

An IRB and HIPAA compliant retrospective review was performed to evaluate renal function immediately prior to and following CTA with Iopamidol contrast for pre-TAVI assessment from 2013 through to 2015. Thirty patients with chronic renal insufficiency in addition to aortic stenosis (AS) were identified. Renal failure was defined as an estimated GFR (mL/min/1.73 sq m) of < 45. Contrast load was optimized based on the patient’s body habitus and renal function; all subjects were hydrated with 250 mL of NS prior to contrast administration. The GFR and Creatinine (Cr, mg/dL) post-procedure was compared to baseline for evaluation of evidence of contrast induced nephropathy. The GFR and Cr were also evaluated up to 6 months post CTA for evidence of renal function recovery or delayed nephropathy.

RESULTS

The mean baseline GFR was 39±7 (Cr 1.6±0.3). Patients received an average dose of 67±24 mL Iopamidol 370. In 3/30 patients the GFR decreased from baseline by > 10. Of these, none required dialysis, and all three showed return of renal function to baseline subsequently. The GFR increased from baseline by > 10 in 8/30 patients. The average deviation from baseline in this population was 7.4±7.7; this was not a significant deviation (p = 0.34).

CONCLUSION

A regimen of prehydration with normal saline and optimizing the contrast load per patient is a safe strategy to implement for pre-TAVI assessment. Only ten percent of patients developed significant renal impairment post CTA which subsequently reversed. No subjects required hemodialysis or demonstrated permanent reductions in renal function.

CLINICAL RELEVANCE/APPLICATION

Patients with severe AS and concurrent significant renal dysfunction require contrast enhanced CTAs putting these patients at increased risk for acute renal decompensation. It is important to be aware if contrast administration leads to irreversible decline in renal function.

CA253-SD-THA2

Morphological and Functional Evaluation of Quadricuspid Aortic Valves using Cardiac CT

Station #2

Participants
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PURPOSE

Most previous studies on quadricuspid aortic valves (QAV) were isolated case reports or review articles focusing on surgical results or echocardiographic findings. This study was aimed to identify the usefulness of cardiac computed tomography (CCT) to assess the morphology and function of QAV.

METHOD AND MATERIALS

We retrospectively enrolled 11 patients with QAV. All patients underwent CCT and transthoracic echocardiography (TTE), and seven patients underwent cardiovascular magnetic resonance (CMR). Valvular morphology assessed by CCT was compared with that of TTE and intraoperative findings. The regurgitant orifice area (ROA) measured by CCT was compared with severity of aortic
regurgitation (AR) by TTE and the regurgitant fraction by CMR. Ascending aortic diameters were measured by CCT.

RESULTS

Nine patients had pure AR, and one had concomitant aortic stenosis and regurgitation. Two patients had a subaortic fibrotic membrane and one showed a subaortic stenosis. The dimensions of the ascending aorta increased >4.0 cm in diameter in four patients. All CCT scans accurately detected QAVs, but one QAV was misdiagnosed on TTE. In accordance with the Hurwitz and Robert’s classification, consensus was reached on the QAV classification between the CCT and TTE findings in seven of ten patients. The patients were classified as type A (n = 1), type B (n = 3), type C (n = 1), type D (n=4), and type F (n = 2) on CCT. A very high correlation existed between ROA by CCT and regurgitant fraction by CMR (r = 0.99) and good correlation existed between ROA by CCT and regurgitant severity by TTE (r = 0.62).

CONCLUSION

CCT allowed for a morphological and functional assessment of QAV.

CLINICAL RELEVANCE/APPLICATION

Cardiac computed tomography is a useful imaging modality for comprehensively assessing QAV, including detection, classification, QAV-related cardiovascular abnormalities, AR severity, and dimensions of the ascending aorta.

CA254-SD-THA3 Resorption of Microembolized Ischemic Myocardium Assessed and Characterized on MRI and Microscopy

Station #3

Participants

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PURPOSE

To quantitatively assess and characterize the coronary microemboli effects on previously ischemic myocardium and infarct resorption rate using MRI and microscopy.

METHOD AND MATERIALS

The left anterior descending coronary artery (LAD) was occluded, under fluoroscopy, for 45 min (group I, n=8) and combined with microemboli (group II, n=8). A 1.5T MR scanner was used at 3 days and 5 weeks to acquire delayed contrast enhanced MRI (DE-MRI). Inversion recovery gradient-echo sequence was used to delineate damaged myocardium. Imaging parameters: TR/TE/flip angle=5ms/2ms/15°; FOV=26×26cm; slice thickness=6mm without gap; read and phase matrix size=256×162, NEX=2 and TI=220-240ms. DE-MRI images were acquired after delivery of 0.15mmol/kg Gd-DTPA (10 min). After the second imaging session, the hearts were excised, sliced, fixed and stained with Masson trichrome for microscopic quantification using planimetry. Cardiac injury biomarkers (creatine kinase MB and troponin I) collected in the first 3 days and tissue samples at 5 weeks were used to confirm/deny MI.

RESULTS

On DE-MRI, group I showed small subendocardial infarct with the extent of 3.3±2.2g, while group II showed significantly larger infarct of 9.8±0.6g (P<0.01) at 3 days. At 5 weeks, group I showed substantial shrinkage (60%, 1.3±0.9g) compared with group II (22%, 7.7±0.5, P<0.01), suggesting that the healing process in microembolized ischemic myocardium is slow (Fig). On microscopy, the infarct sizes were significantly greater in I (2.8±0.4) and II (13.4±2.4) compared to DE-MRI. There was no significant difference in plasma cardiac injury biomarkers (creatine kinase MB and troponin I) collected in the first 3 days and tissue samples at 5 weeks were used to confirm/deny MI.

CONCLUSION

DE-MRI has the potential to detect additional loss of cellular integrity in the territory exposed to microembolization as well as the difference in infarct resorption. However, this technique has limited spatial resolution for measuring true microinfarct when compared to microscopy.

CLINICAL RELEVANCE/APPLICATION

Infarct resorption is delayed by dislodged microemboli and MRI may be useful in testing the efficacy of newer distal protective devices in eliminating microemboli during coronary revascularization.

CA255-SD-THA4 Beam Hardening Correction for Myocardial Perfusion Imaging using Computed Tomography

Station #4

Participants

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PURPOSE

Beam hardening artifacts (BHA) is preventing accurate blood flow measurement in myocardial perfusion imaging computed
We are using a beam hardening correction (BHC) algorithm with an advanced cost function in order to reduce the BHA in MPI-CT.

**METHOD AND MATERIALS**

In order to evaluate the BHA, we measure the difference between the average HU values in the affected ROI to the average HU of unaffected ROIs. We are using a polynomial technique with an advanced cost function to allow a semi-automatic correction of BHA in MPI-CT scans, reconstructed by a conventional CT scanner. Our method is designed to work with reconstructed images and does not require RAW projection data. This makes our technique robust regardless to the type of scanner used. In order to validate our BHC, we use a prototype spectral detector CT (SDCT) scanner (Philips Healthcare) to generate mono-energetic (monoE) images. BHA in those images are greatly reduced or eliminated. We use those monoE images as the ground truth for comparison. In order to preserve the blood flow accuracy, we apply the same correction to the whole MPI-CT time series.

**RESULTS**

BHA in the conventional image was 28.7 ± 3.6 HU. That means that BH ROI was “darker” in 28.7 HU in comparison to the average of other ROIs in the myocardium. After BHC the BHA went down to 2.2 ± 3.5 HU. The rest of the image had differences of ±4.23 HU compared to the 70keV image. We observe even better results in unenhanced image (image with no iodine) subjected to the same correction.

**CONCLUSION**

Using the polynomial BHC technique with our cost function greatly reduces BHA in MPI-CT. This will allow a more accurate calculation of myocardial blood flow.

**CLINICAL RELEVANCE/APPLICATION**

Reducing BHA in MPI-CT scans will allow a non-invasive blood flow measurements in the myocardium with a conventional CT scanner. This will greatly improve and reduce risk of heart disease detection.

**CA256-SD-THA5**  
**A Method for Characterizing Pulmonary Hemodynamics in Pulmonary Hypertension using CT Test Bolus Imaging**

Station #5

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**PURPOSE**

Currently, invasive cardiac catheterization is the only method to accurately assess the severity of pulmonary hypertension by providing hemodynamic measures such as pulmonary vascular resistance (PVR) and mean pulmonary artery pressure (mPAP). Recent work has demonstrated strong correlation between bolus kinetics measured in the main pulmonary artery on MR angiography and these physiologic parameters. (1,2) We propose a method for characterizing PVR and mPAP using test bolus imaging performed for routine CT pulmonary angiography (CTPA). Swift, Andrew J et al. Pulmonary circulation (2014). Skrok, Jan et al. Radiology (2012).

**METHOD AND MATERIALS**

25 patients with known pulmonary hypertension who had a CTPA study within one month of right heart catheterization were included in this IRB-approved retrospective cohort. Several parameters were measured from the CTPA including size of the central pulmonary arteries, PA/Aorta ratio, and arterial-branchial (A/B) ratio. In addition, the full-width at half-maximum (FWHM) was calculated from the attenuation-time curve as follows. Density (HU) over time was measured in the main pulmonary artery and pulmonary arteries, PA/Aorta ratio, and arterial-bronchial (A/B) ratio. In addition, the full-width at half-maximum (FWHM) was included in this IRB-approved retrospective cohort.

**RESULTS**

Of the 25 patients, 18 had adequate gamma variate fits (R2>0.9). Inadequate data (N=7) was a result of inadequate scan duration, motion, or extensive streak artifact. There is a strong direct linear correlation (N=18) between FWHM and PVR (R2=0.80) and exponential correlation with mPAP (R2=0.68).

**CONCLUSION**

CT test bolus imaging is simple, practical, and most importantly noninvasive. Patient-specific bolus kinetics can be accurately extracted from these scans to noninvasively predict PVR and to a certain extent mPAP.

**CLINICAL RELEVANCE/APPLICATION**

Invasive testing (catheter angiography) is currently the gold standard to assess severity and prognosis in patients with pulmonary hypertension. With our proposed method, physiologic parameters can be accurately measured non-invasively with a simple, readily available CTPA test bolus. This has the potential to assess and trend treatment response.

**CA150-ED-THA6**  
**Cardiac MRI in Acute Chest Pain with Coronary Arteries Anatomically Normal. Signs, Pitfalls, Differential Diagnosis and Schematic Diagnostic Approach**

Station #6

**Participants**

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TEACHING POINTS

MRI is an accurate method to make differential diagnosis in patients with acute chest pain and non-diagnostic electrocardiography and enzymes. Myocarditis, tako tsubo syndrome, pericarditis and epicardial fat necrosis may simulate acute coronary disease. To know the MRI signs and pitfalls allow to rule out ischemia and get the right diagnosis. Moreover, coronary vasospasm may produce ischemic changes with or without infarct. Presence and distribution of late myocardial enhancement, edema and contractility alterations, are the most important myocardial features to differentiate ischemia from other cardiac causes of pain. In every cardiac MRI of a patient with acute chest pain must be evaluated the pericardium, thoracic aorta and epicardial fat, looking for non-cardiac causes of pain.

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Aortic Valve Imaging and 3D Contrast Enhanced MR Angiography Using Gadobenate Dimeglumine at 1.5T and 3T

**PURPOSE**

To systematically evaluate the performance of Gadobenate Dimeglumine for aortic valve (AV) imaging and 3D contrast enhanced (CE) angiography (MRA) of the aorta at 1.5T vs 3T in healthy controls and patients with bicuspid aortic valve (BAV).

**METHOD AND MATERIALS**

Pre- and post-contrast AV imaging using time-resolved (CINE) balanced SSFP MRI and 3D CE-MRA were performed in 85 subjects (n=36 healthy controls, n=49 patients) at 1.5T, 3T, or both (total 101 scans). Data analysis included image quality grading (4 point scale) and quantification of regional signal-to-noise ratio (SNR) and contrast-to noise ratio (CNR) in three subgroups: Group 1, subjects scanned at both the 1.5T and 3T (n=16); Group 2, patients with known or suspected BAV (n=49); Group 3, entire cohort (n=85).

**RESULTS**

For group 1, 3D CE-MRA demonstrated significantly increased SNR at 3T compared to 1.5T for all aortic regions (46-85% increase, p<0.04), but similar image quality for AV imaging. For group 2 and 3, SNR was similarly improved at 3T (group 2: 99-139%, p<0.001; group 3: 71-99%, p<0.001) with 3D CE-MRA. Furthermore, image quality grading revealed good to excellent image quality for 3D CE-MRA at both field strengths. For AV imaging, SNR and CNR significantly (p<0.001) benefited from performing imaging post Gadobenate Dimeglumine injection. In group 2, AV images were superior for the identification of valve morphology and BAV fusion patterns at 1.5T (insufficient image quality in 9% of subjects) compared to 3T (insufficient quality in 33%).

**CONCLUSION**

Surveillance MRI for the detection and monitoring of AV and aortic abnormalities with 2D CINE AV imaging and 3D CE-MRA using Gadobenate Dimeglumine is feasible at both 1.5T and 3T with good to excellent image quality. In particular, SNR was significantly improved at 3T as compared to 1.5T. For 2D CINE AV images, it was found that SNR and CNR significantly benefit by performing imaging post Gadobenate Dimeglumine injection. Furthermore, it was found that AV images based on SSFP were superior for the characterization of valve morphology and BAV fusion patterns at 1.5T compared to 3T.

**CLINICAL RELEVANCE/APPLICATION**

To establish the effect of MR field strength on 2D CINE SSFP AV images and 3D CE-MRA data of the aorta in BAV patients.

**Accurately Diagnosing Cardiac Amyloidosis: Recognizing Frequent Misinterpretations and Typical Cardiac Magnetic Resonance Imaging Characteristics**

**PURPOSE**

Cardiac amyloidosis is a rare disease and often unsuspected, making it a challenging imaging diagnosis. This study evaluates how well expert radiologists interpret cardiac magnetic resonance imaging (CMR) in patients with pathologically proven cardiac amyloidosis and assesses which of the typical CMR findings are most frequently encountered.

**METHOD AND MATERIALS**

Cardiac biopsies obtained between 2005 and 2014 were reviewed with 154 resultant cases of biopsy proven cardiac amyloidosis. 15 patients underwent pre-procedure contrast-enhanced CMR performed at our institution. Two readers in consensus evaluated the CMR for the presence of typical findings of cardiac amyloidosis as determined by literature review. CMR findings assessed included:
abnormal T1 time (inhomogeneous null point of myocardium and/or shorter than blood), abnormal late gadolinium enhancement (LGE), pericardial effusion, pleural effusion, concentric myocardial thickening, biatrial enlargement and atrio-ventricular (A-V) valve thickening. The original CMR interpretation and final diagnosis was also scored for accuracy.

RESULTS
Concentric myocardial thickening and abnormal LGE were present in 93% of biopsy-proven cases of cardiac amyloidosis. Abnormal T1 time occurred in 87% of the cases. Pericardial effusion, pleural effusions, and biatrial enlargement were less frequently observed (73%, 67%, and 60%, respectively). A-V valve thickening was not a sensitive indicator of cardiac amyloidosis, as it was present in only 13% of cases. Radiologists correctly interpreted 60% of the cases as most compatible with cardiac amyloidosis. In 13% an infiltrative disease was suggested. Hypertrophic cardiomyopathy (HCM) was the leading misinterpretation, occurring in 20% of the cases. In 7% the study was inaccurately interpreted as normal.

CONCLUSION
In 73% of biopsy-proven cases of cardiac amyloidosis expert cardiac radiologists accurately diagnosed cardiac amyloidosis by specifically suggesting amyloidosis or including it in the differential diagnosis of an infiltrative disease. The leading misinterpretation for cardiac amyloidosis is HCM. Cardiac amyloidosis should be considered when CMR demonstrates concentric myocardial thickening, abnormal LGE and abnormal T1 time.

CLINICAL RELEVANCE/APPLICATION
Accurately diagnosing cardiac amyloidosis on CMR is challenging; as such, radiologists need to recognize its frequent misinterpretations and typical CMR characteristics.

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

CA262-SD-THB5  Real-time Compressed Sensing Cine Imaging in Patients with Atrial Fibrillation: A Feasibility Study

Station #5
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PURPOSE
Cardiac magnetic resonance imaging relies on correct triggering for image acquisition. It is hampered in arrhythmic patients, but real-time sequences may overcome this problem. This study investigated whether a new real-time cine sequence improves cine imaging and allows reliable left ventricular volumetry in patients with atrial fibrillation.

RESULTS
Motion artifacts were significantly reduced (p<0.001) in the sparse sequence (median artifact severity, 1; range, 0 to 1) compared to the standard SSFP sequence (median artifact severity, 2; range, 1 to 3). Only a small difference of 9 ± 15 ml was seen for end-systolic volume (p=0.019) between both sequences, otherwise no significant volumetric differences were detected (end-diastolic volume, p=0.200; stroke volume, p=0.332; ejection fraction, p=0.136; myocardial mass, p=0.353). Intraclass correlation between both sequences was good to excellent. Inter-rater agreement was good to excellent for SSFP and excellent for sparse.

CONCLUSION
Real-time cine imaging reduces motion artifacts and enables reliable assessment of left ventricular volumes in patients with atrial fibrillation.

CLINICAL RELEVANCE/APPLICATION
Real-time cardiac magnetic resonance imaging can solve the trigger problem in arrhythmic patients.

CA262-SD-THB6  Surgical Ventricular Restoration (SVR): Have an Impact on Right Ventricular Remodelling?

Station #6
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Optimization of Functional Cardiac MRI Imaging to Avoid Common Image Artifacts

PURPOSE
Right ventricular (RV) dysfunction is an important predictor of long-term outcome in heart failure patients undergoing surgical ventricular restoration (SVR). While the impact of this procedure on left ventricle is already described, RV morphological changes remain almost unrecognized. The aim of our study was to combine a morphological parameter, RV remodeling index (RV mass/volume ratio), with functional evaluation to describe RV changes after SVR and the resulting impact on clinical outcome.

METHOD AND MATERIALS
We evaluated retrospectively 32 patients (mean age 65±9) who underwent CMR (1.5 T) before and 6 months after SVR. For each patient, RV and LV morpho-functional evaluations were performed using CMR, and echocardiographic estimation of PAPs was considered. Changes in NT-proBNP values, dosed before and 6 months after surgery at the time of scanning, were considered as markers of patients outcome.

RESULTS
Six months after SVR, EDV and ESV of left ventricle were significantly reduced (P<.001), while EF was significantly increased (P<.001). LV stroke volume did not show significant changes (P=.18). There was an increase in RV EDV (P=.05), probably due to the loss of the compressive effect exerted by the dilated LV. There was not significant difference of RV EF pre vs post (P=.54). There was no significant variation in RV remodeling index (P=.35). There was a significant reduction in NT-proBNP values compared with pre-surgical evaluation (P=.02). Changes in NT-proBNP levels were positively correlated with variations of PAPs. There was no correlation between changes in NT-proBNP levels and changes in RV ejection fraction (r=-1,013, P=.49), LV ejection fraction (r=-0.24, P=.49), RV stroke volume (r=-0.24, P=.19) and LV stroke volume (r=-0.21, P=.25).

CONCLUSION
Surgical ventricular restoration improves a benefit on left ventricle function and on patients outcome but is not correlated with any morphological or functional modification of right ventricle.

CLINICAL RELEVANCE/APPLICATION
The evaluation of RV in patients who underwent SVR is currently unrecognized. On the basis of our results, RV seems to behave as "bystander" in front of clinical improvements and LV modifications after this procedure.

TABLE OF CONTENTS/OUTLINE
Magnetic resonance imaging (MRI) has been established as the method of choice for evaluating cardiac function. Important cardiac functional parameters, e.g. ventricular volumes, mass, and ejection fraction, can be measured from the resulting images. Understanding the sources of these artifacts and means to correct for them is essential for proper MRI cardiac imaging and generation of sufficient diagnostic image quality. Herein, we describe and illustrate cases acquired with image artifacts due to inappropriate setting of the imaging parameters, as well as modifications of the imaging protocol to alleviate these artifacts.
PURPOSE
We are developing a computer-aided diagnosis (CAD) scheme for estimating the malignancy grade of hepatocellular carcinoma (HCC) using contrast-enhanced ultrasound (CEUS). In this study, observers estimated the malignancy grade of HCC with and without the cues provided by CAD.

METHOD AND MATERIALS
Informed consent and institutional review board approval were obtained. A total of 232 histologically confirmed cases of HCC were studied; 76 well differentiated (w-HCC), 133 moderately differentiated (m-HCC), and 23 poorly differentiated (p-HCC). In this observer study, CEUS vascular images acquired using the maximum intensity projection technique were displayed together with static B-mode and Kupffer-phase (defined as 10 minutes after injection) images. Five hepatologists independently assigned confidence ratings for the malignancy grade of each HCC. Each hepatologist read each case first without CAD and then immediately afterwards with CAD. The observers' rating data were evaluated by multi-reader multi-case receiver operating characteristic (ROC) analysis.

RESULTS
The overall sensitivity of CAD for discrimination between three histological types of HCC was 87.5% (203/232). For discrimination between w-HCC and m/p-HCC, the mean area under the ROC curve (AUC) for the 5 observers was significantly improved from 0.779±0.074 to 0.872±0.090 with CAD (p=0.0069). For discrimination between w/m-HCC and p-HCC, the mean AUC was also significantly improved from 0.713±0.107 to 0.863±0.101 with CAD (p=0.0321).

CONCLUSION
The use of our CAD scheme can significantly improve the diagnostic performance of hepatologists in discrimination among three histological types of HCC using CEUS.

CLINICAL RELEVANCE/APPLICATION
The CAD improves the ability of hepatologists to make discrimination among three histological types of HCC using CEUS and would be useful for noninvasively assessing the malignancy grade of HCC in personalized medicine.

PURPOSE
CT attenuation of the liver is known to vary significantly in ultralow dose CT reconstructed with model-based iterative reconstruction (MBIR) of conventional version compared to standard dose CT reconstructed with filtered back projection (FBP). We aimed to investigate the diagnostic performance of hepatic steatosis in ultralow dose CT reconstructed with new version of MBIR (MBIR3) comparing with conventional version of MBIR (MBIR2).

METHOD AND MATERIALS
Abdominopelvic CT of 86 patients (mean age, 65.2 ± 14.1 years; 55 males and 31 females; mean body weight, 63.0 ± 14.5 kg) who were prospectively enrolled for the evaluation of image quality of MBIR2 were retrospectively analyzed. In that study, reference
dose CT (RDCT), low dose CT and ultralow dose CT (ULDCT) were performed. From ULDCT and RDCT, images were reconstructed with MBIR3 and MBIR2 (UL-MBIR3 and UL-MBIR2) and FBP (R-FBP), respectively. Three regions of interest were placed on the liver. The mean CT attenuation of the liver (CT[L]) was calculated. For diagnosing hepatic steatosis, a criteria of CT[L]<48 Hounsfield Unit (HU) was applied to each image, and the result of R-FBP was used as a reference standard.

**RESULTS**

Dose-length products of RDCT and ULDCT were 422.1 ± 180.3 and 36.5 ± 13.3 mGy-cm, respectively. There was 91% reduction of DLP in ULDCT compared to RDCT. CT[L] of R-FBP, UL-MBIR3 and UL-MBIR2 were 55.7, 56.5 and 53.2 HU, respectively. There were significant differences between R-FBP vs UL-MBIR3 and R-FBP vs UL-MBIR2 (both p<0.01, paired t-test). Using Bland-Altman analyses, the bias (95% confidence interval) of UL-MBIR3 vs R-FBP and UL-MBIR2 vs R-FBP were 0.8 (0.30 to 1.30) and -2.5 (-3.0 to -2.1), respectively. And the limit of agreement (95% confidence interval) of UL-MBIR3 vs R-FBP and UL-MBIR2 vs R-FBP were 4.2 (3.3 to 5.1) and 4.6 (3.6 to 5.6), respectively. Applying diagnostic criteria to R-FBP, 13 patients were diagnosed as hepatic steatosis. The sensitivity, specificity and accuracy in UL-MBIR3/ UL-MBIR2 (with p-value, Mc Nemar's test) were 1.00/ 1.00 (p=1.000), 0.986/ 0.932 (p=0.046) and 0.988/ 0.942 (p=0.046), respectively, and significant improvements were seen in specificity and accuracy.

**CONCLUSION**

Diagnostic performance of hepatic steatosis in ultralow-dose CT improved with MBIR3 compared to MBIR2.

**CLINICAL RELEVANCE/APPLICATION**

Hepatic steatosis can be diagnosed with high specificity and accuracy in ultralow-dose CT reconstructed with MBIR3 compared to MBIR2.

**G393-SD-THB3 Magnetic Resonance Enterography Score: New Proposal to Asess Crohn's Disease Activity**

**Participants**

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**PURPOSE**

The aim of the current study is to determine the accuracy of Magnetic Resonance Enterography (MRE) in evaluating Crohn's disease activity identifying associations between clinical score (Harvey Bradshaw index- HBI), laboratory test (C-reactive protein- CRP) and imaging parameters as well as to assess the potentiality of MR-E to differentiate active from inactive CD using a MRE score of disease activity, making a correlation with HBI and CRP.

**METHOD AND MATERIALS**

We performed a retrospective study of seventy-seven patients with Crohn Disease. All patients underwent MRE and the images were analyzed for the location and length of the pathological segment (in centimeters), bowel wall thickness (in millimeters), presence of submucosal edema (hyperintesity on T2-weighted sequences), degree and pattern of contrast enhancement of intestinal wall, hyperemia of mesenteric vessels, hypervascular and enlarged (>1 cm) mesenteric lymph nodes, fibro-fatty proliferation and extra-luminal complications. The primary analysis was to determine associations between Magnetic Resonance Enterography parameters, Harvey Bradshaw index and C-reactive protein. Associations were testing using Chi-Squared test. Additional analysis was to elaborate a new Magnetic Resonance Enterography score researching a correlation with clinical and laboratory data. The elaboration of this score was based on the results of associations between C-reactive protein and Magnetic Resonance features. It was considered pathological a Magnetic Resonance Enterography score ≥4.

**RESULTS**

Significant associations were found between degree of contrast enhancement and C-reactive protein (p=0.009); comb sign and C-reactive protein (p=0.003); fibro-fatty proliferation and Harvey Bradshaw Index (p=0.023). No significant associations were found between other Magnetic Resonance Enterography parameters and C-reactive protein and clinical data. Magnetic Resonance Enterography score for Crohn Disease significantly correlates with CRP (r = 0.328; p= 0.005).

**CONCLUSION**

These results make Magnetic Resonance Enterography score for Crohn Disease a simple, important and useful instrument for evaluation of disease activity according to laboratory data.

**CLINICAL RELEVANCE/APPLICATION**

This study shows that MRE is not just usefull in detecting Crohn's disease but also for the evaluation of disease activity, thus it could give an important contribution to the mangement of the patients.

**G396-SD-THB4 Pharmacokinetic Quantification of the Liver Function using Gd-EOB-enhanced DCE-MRI in Patients with Portal Vein Embolization**

**Participants**

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GI394-SD-

Hyperattenuating serosa sign has the potential to further improve the differentiation ability of T4a from T3.

CLINICAL RELEVANCE/APPLICATION

possibility of misdiagnosis of T3 to T4a.

The hyperattenuating serosa sign with traditional signs can improve the discrimination performance of T4a from T3, and reduce the

CONCLUSION

the judgment of the serosa invasion (combined parameters, X2=5.107, P=0.038; traditional signs, X2=4.251, P=0.057).

The negative predictive value (NPV) for the judgement of serosa invasion by traditional CT signs was 43.8%(7/16), which increased

to 68.8% (11/16) after combining with the hyperattenuating serosa sign. The combined parameters outperformed traditional signs in

RESULTS

For non-embolized liver areas, mean KI was 5.09 ± 1.18 %/s and mean KE was 0.82 ± 0.32 %/s, MTT was 6.79 ± 1.17 s. Figure 1 shows differences in embolized and non-embolized liver areas after PVE in one patient. In contrast to earlier work on the pharmacokinetic modeling of Gd-EOB, we used both liver inlets for calculations as well as an image acquisition over up to 30 minutes. Additionally, using a two-compartment approach was especially important for proper description of arterial and portal venous phases of contrast medium enhancement.

CONCLUSION

The applied mathematical model allows spatially resolved quantification of hepatocyte function via the metabolic rate of Gd-EOB in the liver using data from patients with portal vein embolization. This approach has the potential to enable noninvasive liver function analysis.

CLINICAL RELEVANCE/APPLICATION

Gd-EOB-enhanced DCE-MRI using a pharmacological model may be used as an imaging-based liver function test to enable spatially resolved quantification of hepatocyte function.

GI397-SD-THB5

Hyperattenuating Serosa Sign on CT in Determining the Serosa Invasion of Gastric Cancers

Station #5

Participants

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PURPOSE

The paragastric inflammatory strands may mimic the cancer infiltration out of the serosa and lead to the overstaging of T3 tumors during the preoperative staging of gastric cancers. The purpose of our study was to evaluate the additional value of hyperattenuating serosa sign on CT in determining the serosa invasion in patients with gastric cancers.

METHOD AND MATERIALS

Thirty-three consecutive patients who underwent pre-operative CT scan and clinically diagnosed as cT4a gastric cancer, were enrolled in this retrospective study. Transverse and multiplanar reconstruction images were reviewed in consensus by two radiologists blinded. We hypothesized that the high density outer layer of the gastric wall may be associated with cancer involvement of the serosa, and refer to this sign as hyperattenuating serosa sign. The efficacy of the discrimination of T4a from T3 by traditional CT signs (ie, nodular or irregular outer layer of the gastric wall, haziness of the perigastric fat) and the traditional CT signs combined with hyperattenuating serosa sign were compared, by means of chi-square test.

RESULTS

The negative predictive value (NPV) for the judgement of serosa invasion by traditional CT signs was 43.8%(7/16), which increased to 68.8% (11/16) after combining with the hyperattenuating serosa sign. The combined parameters outperformed traditional signs in the judgment of the serosa invasion (combined parameters, X2=5.107, P=0.038; traditional signs, X2=4.251, P=0.057).

CONCLUSION

The hyperattenuating serosa sign of CT is associated with gastric cancer involvement of the serosa. The combination of hyperattenuating serosa sign with traditional signs can improve the discrimination performance of T4a from T3, and reduce the possibility of misdiagnosis of T3 to T4a.

CLINICAL RELEVANCE/APPLICATION

Hyperattenuating serosa sign has the potential to further improve the differentiation ability of T4a from T3.

GI394-SD-

The Prognostic Significance of Extramural Vascular Invasion Detected by Contrast-enhanced Multiple-
THB6  Comparison of CAIPIRINHA-VIBE, Radial-VIBE, and Conventional VIBE Sequences for Dynamic Contrast-enhanced (DCE) MRI at 3.0T: A Validation Study using a DCE-MRI Phantom
Station #6

Participants
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PURPOSE
To assess the difference in the progression-free survival (PFS) of patients with extramural venous invasion (EMVI)-positive and EMVI-negative colon cancer, determined by contrast-enhanced multiple-row detector computed tomography (ceMDCT).

METHOD AND MATERIALS
Pathology-proven colon cancer patients who underwent curative surgery and were then monitored with ceMDCT were included. Patients with synchronous metastases, other malignancies, or intussusception were excluded. Tumor and lymph node status, in accordance with the American Joint Committee on Cancer (AJCC)-7th Edition, AJCC stage, and tumor differentiation were determined from patients' pathological analyses. Two radiologists read the patients' ceMDCT scans and reached a consensus on EMVI presence, extramural tumor depth, and tumor location. EMVI was defined as tumor tissue within the venous wall beyond the muscularis propria layer. Disease progression was defined for each patient as pathology-confirmed metachronous metastases, local recurrence, or death. The associated factors of EMVI status were analyzed using chi-squared and Fisher's exact tests. Kaplan-Meier methods and Cox proportional hazards regression models were used to analyze PFS.

RESULTS
EMVI was seen in 67 (33.3%) of the 201 included patients, and it was significantly associated with extramural tumor depth (contingency coefficient =0.505, P<0.001). Extramural tumor depth was then excluded from multivariable analyses. In a Cox proportional hazards regression analysis, EMVI was identified as an independent prognostic variable of PFS with a hazard ratio (HR) of 3.54 (95% confidence interval [CI] 1.82-6.88, P<0.001). Median PFS times were 40.5 (95% CI 33.9-47.2) and 61.4 (95% CI 57.9-64.9) months for EMVI-positive and EMVI-negative patients, respectively (P<0.001). The EMVI-positive patients had significantly lower 1-year and 3-year PFS rates, 83.6% and 54.5% respectively, than the EMVI-negative patients, 97.8% and 92.4% respectively (odds ratio 8.6 and 9.7 respectively, P<0.001).

CONCLUSION
EMVI, detected on ceMDCT, may help when evaluating disease progression in colon cancer patients.

CLINICAL RELEVANCE/APPLICATION
(Dealing with CT imaging) "ceMDCT can demonstrate EMVI and is recommended for determining risk-stratification in colon cancer patients."

THB7  Comparison of CAIPIRINHA-VIBE, Radial-VIBE, and Conventional VIBE Sequences for Dynamic Contrast-enhanced (DCE) MRI at 3.0T: A Validation Study using a DCE-MRI Phantom
Station #7

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PURPOSE
Using a phantom, we intended to validate protocols of the radial acquisition of volumetric interpolated breath hold examination (Radial-VIBE) and the controlled aliasing in parallel imaging resulting in higher acceleration (CAIPIRINHA-VIBE) sequences for dynamic contrast-enhanced MRI (DCE-MRI) by comparing them to conventional-VIBE sequence.

METHOD AND MATERIALS
Using a DCE-MRI phantom containing 28 tubes filled with NiCl2 solutions of various concentrations, six minutes of dynamic series and T1-mapping with variable flip angle methods were acquired using conventional-VIBE, Radial-VIBE, and CAIPIRINHA-VIBE sequences on 3.0-T scanners. Signal stability and signal linearity were tested for dynamic series and the precision of R1 values were tested for T1-mapping series. The scans were repeatedly performed at two weeks and three months to test repeatability/reproducibility, assessed by within-subject coefficient of variation (WSCV).

RESULTS
Signal stability of dynamic series was excellent in all three sequences, in that sequential signal intensities were stable over six minutes. Regarding the signal linearity between the signal intensity and the R1 value in dynamic series, CAIPIRINHA-VIBE demonstrated the highest linear correlation (correlation coefficient r =0.963), followed by conventional-VIBE (r =0.959) and Radial-VIBE (r =0.953). Regarding the R1 precision assessed by correlation between known R1 values of phantom and measured R1 values on T1-mapping sequences, CAIPIRINHA-VIBE (r =0.985) was the most accurate method, followed by conventional-VIBE (r =0.861) and Radial-VIBE (r =0.442). CAIPIRINHA-VIBE showed excellent repeatability/reproducibility (WSCV, 1.79-6.71%) compared with Radial-VIBE (WSCV, 2.04-67.2%) and conventional-VIBE (WSCV, 3.4-31.9%).
CONCLUSION

In terms of signal stability, signal linearity, R1 precision, and their repeatability/reproducibility, CAIPIRINHA-VIBE demonstrated outstanding performance for DCE-MRI compared with Radial-VIBE and conventional-VIBE.

CLINICAL RELEVANCE/APPLICATION

CAIPIRINHA-VIBE is a robust sequence to be used in DCE-MRI in light of excellent signal stability, signal linearity, R1 precision, and repeatability/reproducibility in the phantom study.

Hepatobiliary Agent Technique: Maximizing Image Quality

Station #8

Awards
Certificate of Merit
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TEACHING POINTS

Hepatobiliary agents present many advantages over traditional extracellular contrast agents; however, specific technical challenges may hinder optimal acquisition in practice. Adjustments need to be made to existing liver MRI protocols to achieve best results.

TABLE OF CONTENTS/OUTLINE


Hepatic Arterioportal Shunts (APS): A Comprehensive Review of Mechanisms, Causes, Types, Imaging Features, and Differential Diagnosis

Station #9

Awards
Identified for RadioGraphics
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TEACHING POINTS

1. Learn causes of hepatic arterioportal shunts and their various mechanisms. 2. Learn the imaging appearance of various types of hepatic arterioportal shunts. 3. Learn how to differentiate hepatic arterioportal shunts from their mimics.

TABLE OF CONTENTS/OUTLINE

1. Review the mechanism of hepatic arterioportal shunts: trans-vasal, trans-sinusoidal, trans-plexal, trans-tumoral, and post-injury. 2. Review the various causes of hepatic arterioportal shunts. 3. Discuss the various types of hepatic arterioportal shunts and the corresponding CT and MR imaging manifestations. 4. Discuss the common mimics and differential diagnosis. 5. Discuss the role of imaging management and follow-up.

Honored Educators

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Temel Tirkes, MD - 2013 Honored Educator
Temel Tirkes, MD - 2014 Honored Educator
Kumaresan Sandrasegaran, MD - 2013 Honored Educator
Kumaresan Sandrasegaran, MD - 2014 Honored Educator

MRI of the Liver and Biliary System: Choosing the Appropriate Contrast Agent

Station #10

Awards
Identified for RadioGraphics
Participants
- Recognize that there are multiple different choices of intravenous contrast available when performing hepatobiliary MR imaging.
- Become familiar with the properties and MR imaging appearance of extracellular contrast agents and hepatobiliary agents, gadobenate dimeglumine (Gd-BOPTA) or gadoxetic acid (Gd-EOB-DTPA), when imaging the liver and biliary system.
- Know the appropriate usage of extracellular contrast agents in multiple different clinical scenarios, e.g. liver lesion detection, confirmation of a hemangioma identified at ultrasound or CT, routine metastatic workup, diagnosis and staging of primary liver cancers including HCC and cholangiocarcinoma, assessment of vessel patency, assessment of tumor response after loco-regional therapy.
- Know the appropriate usage of hepatobiliary agents in a myriad of different clinical scenarios, e.g. HCC surveillance in cirrhotic patients, evaluation of extent of hepatic metastatic disease, differentiation of FNH vs. hepatocellular adenoma, biliary anatomy and bile leak.

**TEACHING POINTS**

- Background of available MR contrast agents for imaging the liver.
- Clinical indications for utilizing an extracellular contrast agent.
- Clinical indications for utilizing a hepatobiliary contrast agent.
- Case examples.
- Decision tree for choosing the appropriate contrast agent.

**TABLE OF CONTENTS/OUTLINE**

1. Technical features and principles of DECT with particular focus to liver imaging.
2. Different vendor solutions for DECT.
3. DECT Protocols for liver imaging tailored to indications.
4. Current and emerging clinical applications of DECT in liver.
5. Potential pitfalls and challenges in DECT liver imaging in clinical practice.

**Honored Educators**

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Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator
The Effects of the Bismuth Breast Shield on Dual-Energy Computed Tomography: A Phantom Study

**METHOD AND MATERIALS**

Twenty four small balloons (approximately 10 mm) were filled with a mixture of water and iodine contrast (1% of iopamidol 370mg/ml) to mimic lung nodules. Balloons were located anterior and posterior to the lung of the multipurpose chest phantom. DECT (100kV with 89mAs and 140kV with 76mAs) was performed; without the breast shield (A scan) and with the breast shield starting from the localizer scan (B scan) and after the localizer scan (C scan). Afterwards, overlay HU values (the HU difference caused by iodine decomposition) were measured for each nodule at each scan. To measure radiation exposure, dosimeters were placed at the surface of the anterior chest wall (breast) and the lung center, respectively, and twelve DECTs were performed with the same protocol for each A, B, and C scan. The results between the A and B scan, and between the A and C scan were compared using the Wilcoxon signed-rank test.

**RESULTS**

For the overlay HU values of the anteriorly located nodules, the B and C scan values (72.3 ± 4.7 HU and 72.0 ± 5.9 HU, respectively) were significantly lower than the A scan value (99.7 ± 5.2 HU) (P = 0.002 for both). For the posteriorly located nodules, the B and C scan values (76.0 ± 4.7 HU and 76.5 ± 5.2 HU, respectively) were also significantly lower than the A scan value (101.5 ± 7.1 HU) (P = 0.002 for both). For radiation exposure, the measured radiation doses of the breast and lung on the B scan (3.3 ± 0.3 mGy and 5.0 ± 0.3 mGy, respectively) were significantly lower than on the A scan (4.3 ± 0.3 mGy and 5.5 ± 0.5 mGy, respectively) (P = 0.002 and 0.003, respectively). The radiation doses of the breast and lung on the C scan (3.7 ± 0.3 mGy and 5.3 ± 0.3 mGy, respectively) were also significantly lower than the A scan (P = 0.005 and 0.023, respectively).

**CONCLUSION**

Although the bismuth breast shield can decrease radiation exposure to the breast and lung during dual-energy CT, it can significantly affect the results of dual-energy analysis.

**CLINICAL RELEVANCE/APPLICATION**

As the bismuth breast shield can significantly affect dual-energy CT results, it should not be used for dual-energy CT. Instead, alternative methods should be considered to reduce radiation exposure to the breast.

Study of the Effects of Dose and Beam Hardening in Low-tube-voltage Computed Tomography (CT) about Optimization of the Energy

**METHOD AND MATERIALS**

Low-tube-voltage CT has been considered as a suitable technique for radiation dose reduction. In conjunction with the reduced dose provided by the low tube voltage, the method also offers increased organ tissue contrast when compared with that obtained when using a standard tube voltage (120 kVp), and better image quality because of the increased contrast enhancement of the contrast medium. However, there are also concerns that optimization of the image quality conversely increases the radiation dose. This study examines both dose and beam hardening effects in the abdominal area using a phantom with the objective of reducing the radiation dose in low-tube-voltage imaging.
The following measurements were conducted at each available tube voltage (80, 100, 120, and 135 kVp). Measurement of the aerial dose at the center, the dose at the phantom center and the peripheral dose when using an Unfors dosimeter and a radiation dosimetry phantom. Measurement of the change in the effective energy due to variations in the object depth. Measurement of the contrast-to-noise-ratio (CNR) of organ tissues such as the liver using a electron density phantom. Measurement of the contrast-to-noise-ratio (CNR) of contrast medium concentration using the diluted contrast medium phantom.

RESULTS
The peripheral dose is 75mGy (120kVp), 70mGy (80kVp), and the dose in the phantom center of 40mGy (120kVp), 25mGy (80kVp) when the aerial dose at the center is 140mGy, with the result being that the absorbed dose is large at 80kVp. Regarding the change in effective energy, the biggest result is that the rate of change of 80kVp is about 5% (at a depth of 150mm).

CONCLUSION
The effects of dosage and beam hardening during low-tube-voltage imaging indicate that there is not necessarily any advantage to the use of uniformly low energy. There is a concern that the target organ, depending on the patient’s physique, must be exposed to a higher dose than would be used in conventional imaging to ensure high image quality. As a result of this study, based on the effective energy and CNR, we have determined that a tube voltage of 100 kVp (47 keV) is effective for clinical use when performing low-tube-voltage imaging.

CLINICAL RELEVANCE/APPLICATION
(dealing with low-tube voltage CT) 'low-tube-voltage CT has been considered as a suitable technique for radiation dose reduction and is recommended optimize to image quality, depending on the physique.'

PH3286-5D-THB4 Are Prostate Target Margins Adequate for Combined Brachytherapy Followed by External Beam Treatments?

Station #4

Participants
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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 Gy (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 than ±2 mm. Dose and volume parameters for the targets and normal tissue are shown in the table below. Average Planned (Gy eq or cc)/Average Delivered (Gy eq or cc)/Average Planned/delivered Prostate D99 93.7±8.0/92.8±9.2/1.00±0.1 Seminal Vesicle D99 95.0±4.9/74.9±1.4/9.1±0.1/1.0 Lymph Nodes D94.5±1.1±4.1.41.0±2.0±02D1cc Rectal Wall D84.4±11.683.7±12.61.0±0.2 Rectal Wall V801.7±4.1±6.1±11.0±0.1 Urethra D9071.4±25.370.6±26.81.01±0.1 Lower Sphincter D90 67.4±15.466.7±16.21.0±0.1 Corpus Cavemosom D90.34±0.3±4.2±6.09.9±0.4 Internal Pudendal Artery D90 16.6±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.

PH3287-5D Comparison of Single and Dual Energy-based Techniques for Beam Hardening Correction in CT Measurements of the change in the effective energy due to variations in the object depth. Measurement of the contrast-to-noise-ratio (CNR) of organ tissues such as the liver using a electron density phantom. Measurement of the contrast-to-noise-ratio (CNR) of contrast medium concentration using the diluted contrast medium phantom.

PURPOSE
X-ray spectra are hardened when photons pass through material with high nuclear charge leading to artifacts in CT images. Dual Energy (DE) techniques allow for reduction of those artifacts by performing raw data based DE material decomposition (MDC). Alternatively, artifacts can be reduced by applying single energy-based iterative beam hardening corrections (IBHC).

METHOD AND MATERIALS
We assessed the performance in terms of beam hardening artifact reduction of each technique by applying it to measured data as well as simulated data. Anthropomorphic phantoms representing the base of the skull, pelvis, and heart (w/ and w/o iodine contrast media at different concentrations) were scanned or simulated, respectively. For the single energy acquisitions, voltages from 80-140 kV were evaluated, for DE 80/140 kV and 90/150Sn kV ("Sn" means prefiltration of the spectrum with 0.6 mm tin). CT images...
were reconstructed with standard reconstruction techniques w/ and w/o the respective beam hardening correction, i.e. MDC for DE and IBHC for single energy, respectively. The severity of artifacts was quantified in terms of the HU homogeneity of the soft tissue surrounding the sources of beam hardening.

RESULTS
Both techniques were able to realize soft tissue homogeneity of +/-3HU (iodine), and +/- 2 HU (bone), by reducing beam hardening artifacts in the soft tissue with initial errors up to 110 HU (iodine w/ high concentration at low kV) and up to 24 HU (bone). The results from simulations and measurements were in good agreement.

CONCLUSION
Beam hardening artifacts can be equally well reduced by means of an appropriate correction approach irrespectively of the acquisition technique, DE or single energy CT.

CLINICAL RELEVANCE/APPLICATION
There is no significant difference in terms of residual beam hardening artifacts after appropriate correction for CT images from DE and single energy CT acquisition.

PH284-SD-TH86 CT Scan Dosimetric Parameters Routine Monitoring: First Results of Radiation Dose Optimization Strategies Promptly Provided by a Multidisciplinary Team

Participants
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CONCLUSION
Radiation dose reduction, while saving image quality could be easily implemented with this approach. Furthermore, the availability of a dosimetric data archive provides immediate feedbacks, related to the implemented optimization strategies.

Background
JCIP Standards and European Legislation (EURATOM 59/2013) require the implementation of patient radiation protection programs in diagnostic radiology. Aim of this study is to demonstrate the possibility to reduce patients radiation exposure without decreasing image quality, through a multidisciplinary team (MT), which analyzes dosimetric data of diagnostic examinations.

Evaluation
Data from CT examinations performed with two different scanners (Siemens DefinitionTM and GE LightSpeed UltraTM) between November and December 2013 are considered. CT scanners are configured to automatically send images to DoseWatch© software, which is able to store output parameters (e.g. kVp, mAs, pitch) and exposure data (e.g. CTDIvol, DLP, SSDE). Data are analyzed and discussed by a MT composed by Medical Physicists and Radiologists, to identify protocols which show critical dosimetric values, then suggest possible improvement actions to be implemented. Furthermore, the large amount of data available allows to monitor diagnostic protocols currently in use and to identify different statistic populations for each of them.

Discussion
We identified critical values of average CTDIvol for head and facial bones examinations (respectively 61.8 mGy, 151 scans; 61.6 mGy, 72 scans), performed with the GE LightSpeed CT TM. Statistic analysis allowed us to identify the presence of two different populations for head scan, one of which was only 10% of the total number of scans and corresponded to lower exposure values. The MT adopted this protocol as standard. Moreover, the constant output parameters monitoring allowed us to identify unusual values in facial bones exams, due to changes during maintenance service, which the team promptly suggested to correct. This resulted in a substantial dose saving in CTDIvol average values of approximately 15% and 50% for head and facial bones exams, respectively. Diagnostic image quality was deemed suitable for clinical use by radiologists.

PH285-SD-TH87 Information-preserving Pseudo-enhancement Correction for Computer-aided Detection (CADe) in Dual-energy CT Colonography (DE-CTC)

Participants
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PURPOSE
To evaluate the effect of information-preserving pseudo-enhancement correction on the accuracy of computer-aided detection (CADe) in dual-energy CT colonography (DE-CTC).

METHOD AND MATERIALS
Twenty patients were prepared for a DE-CTC examination by use of one-day bowel preparation with 18 g of magnesium citrate and 50 ml of non-ionic iodine. The DE-CTC image acquisitions (SOMATOM Definition, Siemens Healthcare) were performed at 140 kVp and 80 kVp energies in supine and prone positions with 1-mm slice thickness. No intravenous contrast was used. An experienced
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 CADe 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.

Participants
Parinda Shah, MD, Chicago, IL (Presenter) Nothing to Disclose
Rohit S. Loomba, MD, Wauwatosa, WI (Abstract Co-Author) Nothing to Disclose
Gleb H. Gorelick, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Surya P. Nadimpalli, MD, Highland Park, IL (Abstract Co-Author) Nothing to Disclose

CONCLUSION

Overall, low tube voltage offers better arterial attenuation and better subjective arterial enhancement at a lower effective dose. This may come at the expense of signal to noise ratio of the MCA; however, there is no difference in subjective assessment of overall image quality. Thus, low tube voltage protocols should be utilized while performing CTA of the intracranial arteries given lowered radiation dose and improved arterial attenuation.

Background

CTA is a first line noninvasive method for evaluation of intracranial arterial disease. Optimal enhancement of these small caliber vessels is essential to accurate diagnosis, and dependent on multiple factors including tube voltage. Additionally, as tube voltage is a contributor to the patient radiation, judicious use is necessary. Multiple studies have been performed for optimization of tube voltage in CTA of the intracranial vessels with inconsistent results.

Evaluation

Data from six studies was pooled together. Studies were identified with systematic review querying the following databases: Pubmed, Medline, and Embase. Data was extracted for several endpoints for low (<100 kVp) and high (>=100 kVp) tube voltage. These endpoints included those related to attenuation of several cerebral vessels, image noise, signal to noise ratio, contrast to noise ratio, computed tomography dose index (CTDI), effective dose, dose length product (DLP), and subjective assessments of image quality. A total of 814 were included in this analysis, 370 in the low tube voltage and 444 in the high tube voltage groups. Meta-regression and publication bias analyses were also conducted.

Discussion

Low tube voltage contributes to improved attenuation of the internal carotid and middle cerebral arteries, brain parenchyma, subjective arterial enhancement, as well as decreased effective dose. No statistical difference noted with objective image noise, signal to noise ratio of ICA, contrast to noise ratio of ICA, CTDI, DLP, arterial sharpness, and overall image quality. High tube voltage contributes to improved signal to noise ratio of the MCA and subjective image noise.
Hot Topic Session: Musculoskeletal Applications of Dual Energy CT

Thursday, Dec. 3 3:00PM - 4:00PM Location: E353C

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

SPSH51A  MSK Applications of Dual Energy CT: Gout

Participants
Kenneth S. Lee, MD, Madison, WI (Moderator) Research Consultant, SuperSonic Imagine; Consultant, Echometrix, LLC; Royalties, Reed Elsevier
Mary G. Hochman, MD, West Roxbury, MA (Moderator) Stockholder, General Electric Company; Stock options, Nomir Medical Technologies, Inc; Author, UpToDate, Inc

LEARNING OBJECTIVES
1) Describe the basic theory and technique of dual energy CT for detection and localization of uric acid. 2) Highlight the current role for DECT in the current clinical algorithm for the diagnosis of gout. 3) Identify the value of DECT 3D tophus quantification in the management of gout.

ABSTRACT

Honored Educators

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Jeffrey J. Peterson, MD - 2012 Honored Educator

SPSH51B  MSK Applications of Dual Energy CT: Metal Artifact Reduction, Bone Marrow Edema and Tendon/Ligament Analysis

Participants
Savvas Nicolaou, MD, Vancouver, BC (Presenter) Institutional research agreement, Siemens AG

LEARNING OBJECTIVES
1) Briefly review the basic physics principles of DECT/Spectral imaging. 2) Explain the clinical utility of DECT in MSK Applications, with a focus on metal artifact reduction, bone marrow edema and tendon/ligament analysis.
Participants
Lei Xing, PhD, Stanford, CA (Moderator) Research Grant, Varian Medical Systems, Inc

LEARNING OBJECTIVES
1) Describe the current status of x-ray imaging modalities that are used in radiotherapy 2) Explain the roles and importance of 2D, 3D and 4D x-ray Imaging in radiotherapy. 3) Assess the limitation of current x-ray imaging modality in radiotherapy. 4) Explore the potential imaging technical advancement in radiotherapy.

ABSTRACT
Projection and Volumetric X-ray Imaging and Their Roles in Image-Guided Radiation Therapy

Participants
Ning Jeff Yue, PhD, New Haven, CT, (yuenj@rutgers.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the role of 3D and 4D PET/CT in radiation therapy planning. 2) Understand the role of PET/CT in treatment response assessment for adaptive radiation therapy. 3) Describe image guidance techniques using PET/CT in charged particle therapy.

Recent Advancements in PET/CT and PET/CT-Guided Radiation Therapy

Participants
Stephen R. Bowen, PhD, Seattle, WA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Present background knowledge of MR and MR simulation for radiation therapy. 2) Describe essential roles of MRI in radiation therapy treatment planning, target definition, treatment planning and verification, and therapeutic assessment. 3) Highlight recent advancements and emerging applications of MR imaging in radiation therapy.
Hot Topic Session: Cancer Screening: Breast Tomosynthesis, CT Colonography, Lung Cancer

Thursday, Dec. 3 3:00PM - 4:00PM Location: E451A

Participants
Paul P. Cronin, MD, MS, Ann Arbor, MI (Moderator) Nothing to Disclose

Sub-Events

**SPSH55A Imaging in Breast Cancer Screening**

Participants
Elizabeth S. Burnside, MD, MPH, Madison, WI (Presenter) Stockholder, NeuWave Medical Inc

**LEARNING OBJECTIVES**

1) To review the foundation and evolution of scientific investigation that supports evidence-based breast cancer screening. 2) To critically evaluate the methodologies currently being used to construct screening guidelines. 3) To understand the outcomes by which successful screening programs are measured. 4) To review and assess the current controversies of breast cancer screening.

**ABSTRACT**


**SPSH55B Imaging in Lung Cancer Screening**

Participants
Ella A. Kazerooni, MD, Ann Arbor, MI (Presenter) Nothing to Disclose

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/

Ella A. Kazerooni, MD - 2014 Honored Educator

**SPSH55C Imaging in Colon Cancer Screening**

Participants
David H. Kim, MD, Madison, WI (Presenter) Consultant, Viatronix, Inc; Co-founder, VirtuoCTC, LLC; Medical Advisory Board, Digital ArtForms, Inc; Stockholder, Cellectar Biosciences, Inc

**LEARNING OBJECTIVES**

1) Be able to compare/contrast image-based screening by CT colonography (CTC) against the other screening options for colorectal cancer. 2) Be familiar with the major trials that establish the performance profile of CTC. 3) Understand the rationale for the selective polypectomy strategy at CT colonography.
Participants

Sub-Events

**RC711A  SPECT/CT in Musculoskeletal Diseases**

Participants
Christopher J. Palestro, MD, New Hyde Park, NY *(Presenter)* Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the role of SPECT/CT in the workup of patients with malignancy. 2) Describe the role of SPECT/CT in musculoskeletal infection. 3) Use SPECT/CT to improve the accuracy of radionuclide studies for diagnosing musculoskeletal diseases.

**ABSTRACT**

RC711B  SPECT/CT in Endocrine Disorders and Others

Participants
Esma A. Akin, MD, Washington, DC *(Presenter)* Nothing to Disclose

**LEARNING OBJECTIVES**

1) Through clinical case examples, this activity aims to refresh knowledge of SPECT-CT applications with emphasis on neuroendocrine disorders as well as parathyroid imaging.

**ABSTRACT**
**Computer Aided Diagnosis (Development and Clinical Applications)**

**Thursday, Dec. 3 4:30PM - 6:00PM Location: E350**

**BR CT DI IN**

**AMA PRA Category 1 Credits™: 1.50**

**ARRT Category A+ Credits: 1.50**

**FDA**

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

**Participants**

Emanuele Neri, MD, Pisa, Italy (**Moderator**) Nothing to Disclose

Hiroyuki Yoshida, PhD, Boston, MA (**Moderator**) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

**LEARNING OBJECTIVES**

1) Understand needs of CAD in radiologic image interpretation. 2) Understand basic concept of CAD in assisting radiologists' image reading. 3) Understand the usefulness of CAD in improving radiologists' performance. 4) Learn historical review of CAD developments. 5) Learn CAD for detection and differential diagnosis of common cancers. 6) Learn ROC analysis of radiologists' performance without and with CAD in observer studies.

**ABSTRACT**

Computer-aided diagnosis (CAD) has become one of the major topics in medical imaging and diagnostic radiology. In this refresher course, the principles of CAD will be presented, together with current developments as well as clinical applications of CAD. CAD aims at improving radiologists' diagnostic accuracy, and it can be used as primary, concurrent, or second reader. In principle, the CAD performs a morphological recognition of the pathology (nodule, focal lesion, polyp, etc.) combined with quantitative information (MR signal intensity, CT density, contrast enhancement, volume, etc.). Many different types of CAD schemes have been developed for detection and/or characterization of various lesions in different imaging modalities, including conventional projection radiography, CT, MRI, and ultrasound imaging. Organs that are subjected to research for CAD include the breast, lung, colon, brain, liver, kidney, and the vascular and skeletal systems. For detection of breast cancer on mammograms, more than 10,000 commercial CAD systems have been used clinically in assisting radiologists worldwide. For detection of lung cancer, CAD schemes have been developed for detection of pulmonary nodules on chest radiographs and CT images. In addition, CAD schemes have been developed for differential diagnosis of distinction between malignant and benign lesions. For colon cancer, CAD schemes have been developed for detection of polyps in CT colonography. Observer performance studies with use of ROC analysis indicated an improved performance in radiologists' task for detection and/or classification of these lesions.

**URL**

**Sub-Events**

**RC753A Development of a CAD: From Benchtop to Clinic**

**Participants**

Ronald M. Summers, MD, PhD, Bethesda, MD, (rms@nih.gov) (**Presenter**) Royalties, iCAD, Inc; Research funded, iCAD, Inc;

**LEARNING OBJECTIVES**

1) To understand what radiology problems are amenable to computer aided detection. 2) To understand the steps required to develop and validate a radiologic computer-aided detection product. 3) To understand the current performance and future trends in computer-aided detection with respect to indications, algorithms, sensitivity, false positive rates and pitfalls.

**ABSTRACT**

**RC753B CAD for CT Colonography: Where Do We Stand?**

**Participants**

Daniele Regge, MD, Candiolo, Italy, (daniele.regge@ircc.it) (**Presenter**) Speakers Bureau, General Electric Company

**LEARNING OBJECTIVES**

1) Review interpretation pitfalls of CT colonography that could be overcome with CAD. 2) Present different reading paradigms of CAD for CT colonography and analyze their performances. 3) Summarize advantages and limitations of the use of CAD for CT colonography in different clinical settings.

**RC753C CAD for Breast Cancer Detection: Where Do We Stand?**

**Participants**

Ulrich Bick, MD, Berlin, Germany, (Ulrich.Bick@charite.de) (**Presenter**) Equipment support, Hologic, Inc; License agreement, Hologic, Inc; Royalties, Hologic, Inc; Equipment support, Toshiba Corporation; Institutional research collaboration, Siemens AG

**LEARNING OBJECTIVES**

1) To learn about different applications of computer-aided diagnosis (CAD) in breast imaging. 2) To understand the potential and risks of using CAD in mammography screening. 3) To realize the impact of CAD on soft-copy reading and work-flow
Participants
Kunio Doi, PhD, Chicago, IL, (k-doi@uchicago.edu) (Presenter) Shareholder, Hologic, Inc; License agreement, Hologic, Inc; License agreement, Deus Technologies, LLC; License agreement, Riverain Technologies, LLC; License agreement, Mitsubishi Corporation; License agreement, MEDIAN Technologies; License agreement, General Electric Company; License agreement, Toshiba Corporation; Research support, Deus Technologies, LLC; Research support, E. I. du Pont de Nemours & Company; Research support, Elcint Medical Imaging Ltd; Research support, FUJIFILM Holdings Corporation; Research support, General Electric Company; Research support, Hitachi, Ltd; Research support, Eastman Kodak Company; Research support, Konica Minolta Group; Research support, Mitaya Manufacturing Co, Ltd; Research support, Mitsubishi Corporation; Research support, Koninklijke Philips NV; Research support, Hologic, Inc; Research support, Riverain Technologies, LLC; Research support, Seiko Corporation; Research support, Siemens AG; Research support, 3M Company; Research support, Toshiba Corporation

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
**LEARNING OBJECTIVES**

1) To learn why structured reporting is important in the practice of lung cancer screening with CT. 2) To learn what the LUNGRADS structured reporting categories are and what management is associated with each category. 3) To understand how to evaluate lung nodules for reporting in the LUNGRADS coding scheme. 4) To learn basic practice audit variables to collect and follow to evaluate a lung cancer screening CT program.

**ABSTRACT**

Lung cancer is the leading cause of cancer death in the US for both men and women, exceeding the number of deaths from cancers of the breast, colon, and prostate combined. For each of these cancers, there are well established screening tests. Screening for current and former smokers with LDCT is the only method ever proven to reduce lung cancer mortality in this high risk population and it has also been shown to be cost effective. In December 2013 the USPSTF gave lung cancer screening with CT a grade ;B; recommendation for high risk older current and former smokers. To prepare radiologists to practice lung cancer screening with CT, the ACR Committee on Lung Cancer Screening formed a working group to develop LUNGRADS, which made its version 1.0; debut in 2014. Similar to BIRADS which is in ;, LUNGRADS provides practicing radiologists with a tool to use for categorizing abnormalities found on lung cancer screening CT exams, with management recommendations for each category. In this course we will review why structured reporting and management is important in lung cancer screening CT. As a public health screening tool, performing the exams with high quality, using standardized reporting and following standard management algorithms is important to minimize overdiagnosis, overutilization of diagnostic testing and interventional procedures ranging from percutaneous biopsy to bronchoscopy and surgery. The LUNGRADS categories try to follow BIRADS approach to coding when possible, recognizing that there are differences in screening for lung cancer and breast cancer. Exams are coded as incomplete (category 0), negative; for clinically active cancer (category 1), benign (category 2), probably benign (category 3) and suspicious (category 4). Additional modifiers such as ;S; can be used for clinically significant or potentially clinically significant findings (non lung cancer). Details of using this coding system and metrics to evaluate a screening practice will be discussed.
Significant Other Findings

Participants
Reginald F. Munden, MD, DMD, Houston, TX (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
See learning objectives under main course title.

ABSTRACT
View abstract under main course title.

Practice Metrics and Audit

Participants
William C. Black, MD, Lebanon, NH, (William.C.Black@Hitchcock.Org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

Active Handout: William C. Black

Panel Discussion

Participants
Quantitative Measures in Cardiac CT and MR Imaging—Do They Matter?

Friday, Dec. 4 8:30AM - 10:00AM Location: E350

CA BQ CT MR

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

FDA Discussions may include off-label uses.

LEARNING OBJECTIVES

ABSTRACT

Sub-Events

RC803A  Quantitative Assessment of the Cardiac Chambers and Its Clinical Significance

Participants

Bernd J. Wintersperger, MD, Toronto, ON, (bernd.wintersperger@uhn.ca) (Presenter) Speakers Bureau, Siemens AG; Research support, Siemens AG

LEARNING OBJECTIVES

1) Describe the approach of cardiac MR and CT in assessment of cardiac function and size
2) Understand important differences between various imaging strategies
3) Understand the impact and role of cardiac size and function on treatment decisions

ABSTRACT

Introduction: Cardiac performance is generally assessed by volumetric quantifications such as size and output. Follow-up and changes over time may allow identification of early disease onset, may trigger specific therapies and may allow prediction of patient prognosis and general outcome. While CT & MR imaging provide more accurate results, echocardiography remains the first line imaging modality. CT for functional evaluation should be considered a 3rd line option based on the added radiation exposure. Methods: Most important measures of cardiac function are end-diastolic volume (EDV), stroke volume (SV) and ejection fraction (EF). While the acoustic window may limit echocardiography, CT & MRI can easily cover all aspects of the atria and ventricles. In order to maintain accuracy and precision adequate imaging parameters with respect to coverage, spatial resolution and temporal resolution are required. Today's functional cardiac MR imaging is based on cine SSFP methods with cardiac short axis orientation for the left ventricle and short axis or transverse orientation for the right ventricle. Atrial volumetric assessment is performed rarely but might especially be of interest in patients with AV valve dysfunction or atrial sources of arrhythmia. While quantitative assessment of regional motion was previously limited to echocardiography or specific MR techniques (e.g. MR tagging), recent software developments also allow this information being derived from standard cine MRI. Conclusion: Based on its accuracy cardiac MR plays an increasingly important role in assessment of patients with cardiac diseases. Accurate and precise quantification of cardiac function is increasingly important in therapy decisions and therapy monitoring.

Handout: Bernd J. Wintersperger


RC803B  Quantitative Assessment Cardiac Valves on MRI

Participants

Jens Bremerich, MD, Basel, Switzerland, (jens.bremeric@usb.ch) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

ABSTRACT

Introduction: Echocardiography remains first line modality for imaging cardiac valves. In specific cases, however, MR provides complementary quantification of valvular function. Methods: Most relevant sequences for valve imaging are: 1) Black blood, 2) CineSSFP, and 3) VENCine. Black blood images are fast spin echo sequences. CineSSFP are used for quantification of valvular morphology and motion. Temporal resolution is typically 50 ms for a segmented breath hold sequence but may be further shortened by means of parallel imaging or non-breath hold sequences. VENCine is an excellent tool for flow volume and velocity quantification. Volumes are relevant to calculate regurgitant fraction of incompetent valves, velocities are used to calculate degree of stenosis relying on modified Bernoulli equation. Results: Aortic regurgitation is difficult to evaluate with Echocardiography but easily quantified on VENCine with excellent reproducibility. Regurgitant fraction is defined as Volume_{antegrad} / Volume_{retrograd} * 100 [%]. Aortic stenosis may also be quantified with MR by measuring the opening area on CineSSFP or by measuring peak velocity in the valve on VENCine and calculation with modified Bernoulli equation (AP = 4 * Vmax^2). Mitral regurgitation may also be quantified by MRI. Echocardiographic quantification relies predominantly on the extent of the regurgitant jet into the left atrium which is not a reliable sign on MRI, since extent of regurgitant jets depend on various sequence parameters such as field strength and echo time. Pulmonary regurgitation can also be quantified with MRI which is relevant in congenital heart disease such as after surgical repair in tetralogy of Fallot. Pulmonary stenosis, Tricuspid stenosis and regurgitation are no routine indications for MRI but are rather evaluated by echocardiography. Conclusion: Aortic regurgitation is an excellent indication for MRI, it enables accurate and
How to Quantify Valve Function on Cardiac CT

Participants
Paul Schoenhagen, MD, Cleveland, OH, (schoenp1@ccf.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the limited role of CT for assessment of valvular function. 2) Discuss clinical indications where anatomic and functional valvular with CT is indicated. 3) Describe data acquisition and analysis approach for valvular assessment.

ABSTRACT
CT is a predominantly anatomic imaging modality. Compared to predominantly functional modalities its temporal resolution is limited. In addition, functional/4-D imaging requires retrospective gated data acquisition and is associated with higher radiation exposure. The role of CT for functional valvular analysis is therefore limited to few clinical scenarios, where it can provide complementary information. The strength of CT in these situations is the ability for reconstruction in the acquired 3-D/4-D volume. A prominent example is transcatheter valve replacement/implantation but also assessment of prosthetic valves.

URL
Handout: Paul Schoenhagen

4D Flow MRI Quantification?

Participants
Christopher J. Francois, MD, Madison, WI (Presenter) Research support, General Electric Company

LEARNING OBJECTIVES
1) Describe MRI physics of 4D flow MRI. 2) Illustrate use of 4D flow MRI for basic hemodynamic function. 3) Demonstrate potential futures uses of 4D flow MRI for advanced hemodynamic analyses.

ABSTRACT
MRI flow imaging is based on flow-sensitive, phase contrast sequences. This presentation will introduce the basic MRI physics responsible for imaging flow, extending 1-directional flow imaging to 3-directional flow imaging used in 4D flow MRI. Examples from valvular and congenital heart disease will be used to illustrate the use of 4D flow MRI to quantify flow velocities and volumes. Although 4D flow MRI is still very much in the early developmental phase, published data comparing 4D flow MRI to established techniques for quantifying flow will be reviewed. The future potential for 4D flow MRI to be used to non-invasively quantify more advanced hemodynamic parameters will be demonstrated. Specifically, the use of 4D flow MRI to measure pressure gradients, pulse wave velocity, wall shear stress and kinetic energy will be covered.

Active Handout: Christopher Jean-Pierre Francois
Participants
Douglas W. Goodwin, MD, Lebanon, NH, (douglas.goodwin@hitchcock.org) (Moderator) Nothing to Disclose
Jenny T. Bencardino, MD, New York, NY (Moderator) Nothing to Disclose

ABSTRACT
Handout: Jenny T. Bencardino

Learning Objectives
1) Recognize a series of pitfalls encountered in shoulder MRI, including variations in normal anatomy and subtle frequently overlooked injuries and abnormalities. 2) Understand how imaging parameters can be manipulated to account for the inherent challenges of shoulder MR imaging. 3) Improve performance by adjusting patterns of image review.

Active Handout: Douglas W. Goodwin

Purpose
To determine if 3DMR osseous reformats of the shoulder are equivalent to 3DCT osseous reformats in patients with glenohumeral instability.

Method and Materials
Patients with glenohumeral instability, who were to be imaged with both CT and MRI, were prospectively selected. CT and 3TMR were performed within 24 hours of one another on 10 shoulders. Each MR study included an axial 3D isotropic VIBE sequence (acquisition time 4 minutes 15 seconds). The image data from the isotropic VIBE sequence was post processed using subtraction and 3D software. CT data was post processed using 3D software. The following measurements were obtained for both 3DCT and 3DMR post processed images: height and width of the humeral head and glenoid, Hill-Sachs size and percent humeral head loss (if present), Bankart size and percent glenoid bone loss (if present). Paired T-tests and two one-sided tests for equivalence were used to assess the differences between imaging modalities and equivalence.

Results
The measurement differences from the 3DC and 3DMR post processed images were not statistically significant: humeral height p=0.06, 95% CI [-0.03, 0.99], humeral width p=0.13, 95% CI [-0.14, 0.90], Hill-Sachs size p=0.42, 95% CI [-0.17, 0.37], percent humeral head loss p=0.93, 95% CI [-0.49, 0.37], glenoid width p=0.13, 95% CI [-0.01, 0.64], Bankart size p=0.43, 95% CI [-0.22, 0.42] and percent glenoid bone loss p=0.02, 95% CI [-0.52, 1.68]. The measurement difference for glenoid height was borderline, p=0.04, 95% CI [0.01, 0.43], however using any adjustment for multiple comparisons this failed to be significant. Using an equivalence margin of 1 mm for measurements and 1.5% for percent bone loss, the 3DMR and 3DCT post processed images were equivalent.

Conclusion
3DMR osseous models of the shoulder using a 3D isotropic VIBE sequence were equivalent to 3DCT osseous models and the differences between modalities were not statistically significant. This sequence can be added to MR examinations with only a minimal increase in imaging time and can be used to quantify humeral head and glenoid bone loss. This may eliminate the need for pre-surgical CT examinations pending continued recruitment to obtain a larger sample size.

Clinical Relevance/Application
3DMR osseous reformats are equivalent to and demonstrate no significant statistical difference from 3DCT osseous reformats, which
DCO patients treated surgically (74% vs. 47% p<0.001, chi-square). Imaging, acromioclavicular (AC) joint osteoarthritis was significantly more common in DCO patients treated conservatively than in 77% of DCO patients responded to conservative therapy, and 23% underwent surgery with resolution of symptoms. On follow-up (OR=18; 95%CI=11-31, p<0.001). High frequency (>1x/week) and duration (>5 years) of bench pressing further increased the risk. Compared to 209 lbs (±SD 60) in male bench pressers not affected by DCO (n=127; p<0.001, Mann-Whitney). Intense bench pressers who suffered from DCO (n=240), the mean bench pressing weight (maximum single repetition) was 283 lbs (±SD 57) in male bench pressers on a regular basis compared to 41% in the control group (p<0.001, chi-square). In male bench pressers between 20 and 40 years of age. The prevalence of DCO, the DCO grade (mild, moderate, severe), and fatty degeneration are negative prognostic factors for clinical and structural outcome after repair. The 5 point Goutallier classification (Clin Orthop Relat Res 1994) was subsequently simplified by Fuchs (J Shoulder Elbow Surg 1999) into a 3 point system. Thomazau (Acta Orthop Scand 1996) introduced a system based on the cross-sectional area (CSA) of the supraspinatus (SS) muscle on sagittal oblique (SAG) images with respect to the area of the SS fossa, reported as an occupation ratio (OR). Currently, there are no studies accounting for tendon retraction and its affect on grading.

PURPOSE

Many rotator cuff muscle classifications are in use, making it difficult to compare results and agree on treatment. Muscle atrophy and fatty degeneration are negative prognostic factors for clinical and structural outcome after repair. The 5 point Goutallier classification (Clin Orthop Relat Res 1994) was subsequently simplified by Fuchs (J Shoulder Elbow Surg 1999) into a 3 point system. Thomazau (Acta Orthop Scand 1996) introduced a system based on the cross-sectional area (CSA) of the supraspinatus (SS) muscle on sagittal oblique (SAG) images with respect to the area of the SS fossa, reported as an occupation ratio (OR). Currently, there are no studies accounting for tendon retraction and its affect on grading.

METHOD AND MATERIALS

This IRB approved, HIPAA compliant retrospective study was performed using radiology reports from a single institution. Search terms of 'retraction' or 'retracted' were applied to non-arthrogram MRI reports from Jan 2014-Jan 2015. Full-thickness SS tendon tears were included. Partial-thickness tears and post-operative cases were excluded. MRI exams were reviewed by an MSK radiologist. Degree of tendon retraction was recorded. Thomazau CSA and OR was recorded at the standard reference location on SAG images. OR was re-measured correcting for tendon retraction, medial to the reference location, obtaining a new (corrected) CSA. Fuchs grading was applied to both coronal (COR) and SAG planes. Paired Wilcoxon signed-ranks test was used to compare measurements. 25% of the cases were remeasured and independently measured by a second reader and reliability statistics were calculated.

RESULTS

79 patients were in the study group (71/150 excluded). Mean SS CSA at the standard vs corrected location was 4.0±1.6 cm² (mean±SD) vs 5.6±1.7 cm² (p<0.001). OR was 0.44±0.13 vs 0.62±0.12 (p<0.001). Standard Thomazau and corrected stages revealed a concordance of 17.7% (14/79). Concordance for SAG and COR Fuchs staging was 94% (74/79). Inter- and intra-observer reliability statistics were excellent for OR, corrected OR, Thomazau Stage, and SAG/COR Fuchs (ICC=0.832-0.997).

CONCLUSION

Accounting for tendon retraction is important in assessing SS atrophy and can significantly alter the grading using standard systems. Caution should be used when reporting these findings, as SS atrophy may be overestimated.

CLINICAL RELEVANCE/APPLICATION

Tendon retraction can result in overestimation of SS muscle atrophy, which may ultimately alter the decision to perform a cuff repair.

Effect of Rotator Cuff Tendon Retraction on Grading of Supraspinatus Muscle Atrophy and Fatty Degeneration

Participants
Vanessa M. Finato, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Eric Y. Chang, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Brady K. Huang, MD, San Diego, CA (Presenter) Nothing to Disclose

PURPOSE

To investigate the prevalence, imaging findings, treatment and outcome of distal clavicular osteolysis (DCO) in adults as well as the association with bench pressing intensity.

METHOD AND MATERIALS

Patients with atraumatic DCO were selected in a retrospective review of 4217 consecutive magnetic resonance imaging (MRI) shoulder reports of individuals between 20 and 40 years of age. The prevalence of DCO, the DCO grade (mild, moderate, severe), pain scale, bench pressing frequency (times per week and years of bench pressing), bench pressing weight (maximum single repetition and per body weight), conservative and surgical treatment outcome and the long-term sequelae on follow-up MRI were analyzed.

RESULTS

8% (342/4217) of patients between 20 and 40 years of age had atraumatic DCO and 9% of these were females. 82% of DCO patients were bench pressing on a regular basis compared to 41% in the control group (p<0.001, chi-square). In male bench pressers who suffered from DCO (n=240), the mean bench pressing weight (maximum single repetition) was 283 lbs (±SD 57) compared to 209 lbs (±SD 60) in male bench pressers not affected by DCO (n=127; p=0.001, Mann-Whitney). Intense bench pressing with a bench pressing weight (maximum single repetition) of more than 1.5 times the body weight was a risk factor for DCO (OR=18; 95%CI=11-31, p<0.001). High frequency (>1x/week) and duration (>5 years) of bench pressing further increased the risk. 77% of DCO patients responded to conservative therapy, and 23% underwent surgery with resolution of symptoms. On follow-up imaging, acromioclavicular (AC) joint osteoarthritis was significantly more common in DCO patients treated conservatively than in DCO patients treated surgically (74% vs. 47% p<0.001, chi-square).
Prevalence of DCO in adults undergoing shoulder MRI is 8%, and females are affected in 9% of cases. Bench pressing more than 1.5 times the body weight is a substantial risk factor. AC joint osteoarthritis is a long-term sequela of conservative, but not surgical treatment of DCO.

**CLINICAL RELEVANCE/APPLICATION**

DCO is associated with AC joint osteoarthritis on follow-up imaging. Maximum bench pressing weight should be kept below 1.5 times the body weight to prevent DCO.

**Non-contrast MRI Diagnosis of Adhesive Capsulitis**

Friday, Dec. 4 9:25AM - 9:35AM Location: E451A

*Participants*

Andrew S. Chi, MD, MS, Philadelphia, PA *(Presenter)* Nothing to Disclose

John Kim, MD, San Diego, CA *(Abstract Co-Author)* Nothing to Disclose

Suzanne S. Long, MD, Philadelphia, PA *(Abstract Co-Author)* Nothing to Disclose


Patent agreement, AprioMed AB Consultant, Zimmer Holdings, Inc

Adam C. Zoga, MD, Philadelphia, PA *(Abstract Co-Author)* Nothing to Disclose

**PURPOSE**

The MR arthrographic findings of adhesive capsulitis or frozen shoulder are well described. However, adhesive capsulitis most commonly occurs in patients age 45 to 60 years old, a population for whom direct MR arthrography is rarely ordered. We sought to investigate specific noncontrast MRI findings and constellations of MRI findings in patients with clinical adhesive capsulitis.

**METHOD AND MATERIALS**

A prospective assessment of a retrospective study group was performed. 31 non-contrast, non-arthrographic, shoulder MRI exams were divided into subject and control groups (mean age 55.8 years; 10 men, 20 women). Two blinded MSK radiologists evaluated the MRI exams for coracohumeral ligament thickness >2 mm, fatty infiltration of the rotator interval, and thickening/edema of the inferior joint capsule/axillary recess. Clinical diagnosis of adhesive capsulitis was provided by orthopedic surgery physical exams. One patient with clinical suspicion of adhesive capsulitis was excluded due to concomitant traumatic labral tear, leaving 15 subjects in each group.

**RESULTS**

A triad of MRI findings is associated with adhesive capsulitis. Adhesive capsulitis can be diagnosed on noncontrast shoulder MRI with high sensitivity/low specificity, intermediate sensitivity and specificity, or high specificity/low sensitivity based on the number of MRI criteria observed. Using a single criterion of coracohumeral ligament thickening, sensitivity is 76.7% and specificity is 53.3% for detection of adhesive capsulitis. Using two criteria of coracohumeral ligament thickening and fatty infiltration of the interval, sensitivity is 66.7% and specificity is 55.2%. Using all three criteria of coracohumeral ligament thickening, interval infiltration, and axillary recess thickening/edema, sensitivity is 23.3% and specificity is 86.7%.

**CONCLUSION**

Adhesive capsulitis can be accurately diagnosed on routine noncontrast shoulder MRI in conjunction with appropriate clinical criteria. The finding of a thickened coracohumeral ligament shows strong sensitivity for adhesive capsulitis while the constellation of coracohumeral ligament thickening, subcoracoid fatty infiltration of the rotator interval, and axillary recess thickening/edema yields great specificity for adhesive capsulitis.

**CLINICAL RELEVANCE/APPLICATION**

Routine noncontrast MRI findings in adjunct with clinical findings suspicious for adhesive capsulitis can provide accurate diagnosis without need for direct MR arthrography.

**Extraarticular Shoulder MRI**

Friday, Dec. 4 9:35AM - 10:00AM Location: E451A

*Participants*

David A. Rubin, MD, Saint Louis, MO *(Presenter)* Nothing to Disclose

**LEARNING OBJECTIVES**

1) Modify MR imaging protocols of the shoulder to address suspected abnormalities in the chest wall that may refer symptoms to the shoulder joint. 2) Detect injuries in the shoulder muscles and tendons outside of the rotator cuff, and identify salient features on MR images that guide clinical management. 3) Assess the rib cage using for radiographically- occult injuries.

**Postoperative Shoulder MRI**

Friday, Dec. 4 10:10AM - 10:30AM Location: E451A

*Participants*

Lawrence M. White, MD, FRCPC, Toronto, ON *(Presenter)* Advisory Board, Siemens AG

**LEARNING OBJECTIVES**

1) Understand the general principles of common shoulder surgical procedures and their expected postoperative appearance at MR imaging. 2) Review the value of MR imaging techniques in evaluation of the postoperative shoulder 3) Identify MR imaging features of complications or recurrent pathology of the postoperative shoulder

**ABSTRACT**

This presentation will cover the expected spectrum of findings in the postoperative shoulder following common modern surgical procedures.
**PURPOSE**

Post operative shoulder patients are often difficult to image due to scar tissue, metallic artifact, and residual irregularity of anatomic structures. We report the accuracy of MR imaging versus MR arthrography versus CT arthrography in assessment of the post operative shoulder in the same patient population.

**METHOD AND MATERIALS**

One hundred consecutive post operative conventional shoulder MR and MR arthrography exams performed on the same patients were reviewed retrospectively by two musculoskeletal radiologists. Nineteen of these patients also had CT arthrography performed. Exams were assessed for labral tears and supraspinatus tendon tears. All patients went on to arthroscopy.

**RESULTS**

Of these one hundred patients, thirty-two had SLAP (superior labral anterior to posterior) tears, sixteen had posterior labral tears, nineteen had anterior labral tears and forty-two had full thickness supraspinatus tendon tears on conventional MR exam. On MR arthrogram exam forty-six patients had SLAP tears, twenty-two had posterior labral tears, twenty-four had anterior labral tears and fifty-one had full thickness supraspinatus tendon tears. MR arthrogram detected fourteen SLAP tears, six posterior labral tears, five anterior labral tears and nine supraspinatus tendon tears not detected on conventional MR exam.

**CONCLUSION**

MR arthrography is more accurate than conventional MR in assessment of post-operative shoulder pathology. CT arthrography can detect additional pathology when there is metallic artifact in post operative patients. It is beneficial to inject a combination of gadolinium and CT contrast at arthrography so CT imaging can be performed post arthrography if metallic artifact precludes imaging shoulder pathology by MR.

**CLINICAL RELEVANCE/APPLICATION**

MR arthrography is more accurate than conventional MR in assessment of post operative shoulder pathology. It is beneficial to inject a combination of gadolinium and CT contrast at arthrography so CT imaging can be performed post arthrography if metallic artifact precludes imaging shoulder pathology by MR.

**RC804-09 Biomechanics of the Glenoid: How to Choose the Right Prosthesis for the Right Patient in Reverse Shoulder Arthroplasty?**

**PURPOSE**

Reverse shoulder arthroplasty has become popular in the treatment of excentrated arthrosis. However even with up-to-date prosthetic designs and surgical techniques, complications are still frequent. Variations of the glenoid in the general population regarding patient’s height, glenoid width and glenoid bone stock, have never been precisely assessed. This could help orthopaedic surgeons to choose the right reverse shoulder implant for one patient. The purpose of the study is 1) to provide a structural analysis of glenoid size and bone stock and 2) to optimize the selection of prosthetic size.

**METHOD AND MATERIALS**

Sixty-four slice MDCT of 50 normal shoulders were used for this study (Siemens Healthcare, Erlangen Germany). The biomechanics of the glenoid was assessed on PACS multiplanar and 3D reconstructions: we measured the surface of the largest circle covering the glenoid and being tangent to the inferior rim, the diameter of the circle, the height of the glenoid and the depth of the bone stock at nine representative target points. Glenoid were divided into 3 groups based on the diameter of the circle and correlation with patient’s height and bone stock was performed.

**RESULTS**

Patient’s were 62.42 +/- 12.87 year old and measured 166.96 +/- 9.63 cm. There was a significant correlation between patient’s height, glenoid surface and glenoid diameter. Glenoid can be subdivided into three size groups: small (diameter < 26mm), medium (diameter ranging from 26mm to 28mm) and big glenoid (diameter > 28mm). There was no correlation between patient’s height and glenoid height. Three target points had a bone stock correlated to glenoid size, whereas other target points did not.

**CONCLUSION**

Patients can be grouped into three distinct categories based on glenoid diameter but not on glenoid height. Glenoid bone stock and the length of the prosthetic screw is constant except antero-inferiorly.
CLINICAL RELEVANCE/APPLICATION
The knowledge of glenoid diameter may be useful to prevent mismatch of prosthetic shoulder implant by choosing between small, medium or big implants.

**RC804-10  Imaging of the Unstable Elbow**

Friday, Dec. 4 10:50AM - 11:15AM Location: E451A

**LEARNING OBJECTIVES**
1) List the primary stabilizing ligaments of the elbow. 2) Describe the role of the ulnar collateral ligament in the development of the valgus overload syndrome. 3) Discuss the bone and soft tissue injuries commonly found after posterior dislocation of the elbow.

**ABSTRACT**
Stability of the elbow depends heavily upon the medial and lateral collateral ligament complexes. This session will focus on the normal anatomy of these ligaments as well as the most common types of ligament pathology that result in elbow instability and the radiographic and MR imaging findings that are seen in these conditions.

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**RC804-11  The Legend of the Luschka's Tubercle and its Association with Snapping Scapulae: Osseous Morphology of Snapping Scapulae on 2D and 3D CT Images**

Friday, Dec. 4 11:15AM - 11:25AM Location: E451A

**PURPOSE**
To determine the osseous morphology of snapping scapulae on CT images in comparison with a control group.

**METHOD AND MATERIALS**
Two and three-dimensional CT images of scapulae of 34 patients with a snapping scapula were compared to a control group of 34 age and gender matched patients without a snapping scapula. Two blinded observers analyzed the following parameters: The presence of the so-called Luschka's tubercle was rated as yes or no. Measurements of the thickness and length of the superior angle of the scapula, the distance from the superior angle to the inferior angle, the depth of the subscapular fossa, the minimal distance between the scapula and rib cage, and the angle between the superior angle of the scapula and the subscapular fossa were obtained. The superior angle of the scapula was rated as concave or convex. Abnormalities of the rib cage and periscapular soft tissues were noted. The Fisher's exact test and Student's t-test served for data analysis.

**RESULTS**
In snapping scapula patients observer 1 did not find any Luschka's tubercle while observer 2 detected one Luschka's tubercle compared to two Luschka's tubercle in the control group for both observers (p-values>0.48). The superior angle of the scapula was significantly thicker in the snapping scapula group compared to the control group for both observers (observer 1: 4.8±1.3 mm versus 4.1±1.1 mm, observer 2: 5.1±1.6 versus 4.1±1.3 mm, p-values<0.02). The subscapular fossa was significantly deeper in snapping scapula patients compared to control group patients for both observers (observer 1: 21.9±5.0 mm versus 18.8±4.5 mm, observer 2: 28.6±5.9 mm versus 25.1±5.6 mm, p-values<0.035). The comparison of the remaining parameters did not differ significantly between the groups. No abnormalities of the rib cage and periscapular soft tissues were found in snapping scapula patients.

**CONCLUSION**
The superior angle of the scapula was significantly thicker and the subscapular fossa was significantly deeper in patients with a snapping scapula compared to control group patients. The Luschka's tubercle was rarely seen and not associated with a snapping scapula.

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**RC804-12  Ultrasound Elastography Assessment of Changes in Ulnar Nerve Stiffness with Elbow Flexion**

Friday, Dec. 4 11:25AM - 11:35AM Location: E451A

**PURPOSE**
CT images may detect subtle osseous variants in patients with a snapping scapula. Neither published original articles nor the present data suggest an association between the Luschka's tubercle and a snapping scapula.

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PURPOSE
The intraneural pressure of the ulnar nerve (UN) within the cubital tunnel increases during elbow flexion. The purpose of this study is to determine whether ultrasound elastography can detect corresponding changes in nerve stiffness at the cubital tunnel and at defined distances away from it.

METHOD AND MATERIALS
Institutional review board and informed consent were obtained. Prospective examination of the UN in twenty elbows for ten consecutive volunteers was performed with ultrasound elastography. Each UN was examined in four positions while the elbow was in full extension: at the cubital tunnel, 4 cm proximal, 4 cm distal, and 8 cm distal. The elbow was then placed in full flexion (145 degrees) for three minutes and the entire examination was repeated. All ultrasounds were performed by a single radiologist on a SonixTouch system (Analogic Corp., Peabody, MA, USA) with a 10 MHz linear array transducer. An acoustic coupler (C) (EZU-TECPL1, Hitachi-Aloka Medical) with a standardized elasticity was attached to the probe. Ultrasound radio-frequency (RF) signals were obtained at each time point with a compression-decompression cycle lasting 4-6 seconds. Inter-frame axial displacements of the UN were estimated offline using a 1D normalized cross-correlation-based motion estimation method (Luo and Konofagou 2010) on the RF signals. Based on these displacements, inter-frame strains were computed using a least-squares strain estimator (Kallel and Ophir 1997) and added together to obtain cumulative strains. UN stiffness at each interrogated position was semi-quantified as a mean cumulative strain ratio (C/UN).

RESULTS
P-values were calculated using a matched pairs t-test. The change in mean C/UN ratios +/- standard deviation from extension to flexion were as follows: At cubital tunnel: 1.31 +/- 0.98 to 2.41 +/- 0.88 (p-value < 0.00015) 4 cm proximal: 0.50 +/- 0.37 to 0.41 +/- 0.27 (p-value 0.24) 4 cm distal: 1.23 +/- 0.90 to 0.85 +/- 0.91 (p-value 0.14) 8 cm distal: 2.61 +/- 1.41 to 2.01 +/- 1.45 (p-value 0.10)

CONCLUSION
Increased UN stiffness within the cubital tunnel can be detected by ultrasound elastography shortly after elbow flexion. No significant changes are detected 4 cm proximal, 4 cm distal, and 8 cm distal.

CLINICAL RELEVANCE/APPLICATION
Ultrasound elastography can detect changes in ulnar nerve stiffness during elbow flexion without significant lag time. It has potential for diagnostic use in early nerve compression.

LEARNING OBJECTIVES
1) To review the normal MR anatomy of the distal triceps tendon and cubital tunnel at the elbow. 2) To describe the clinical syndromes that affect the distal triceps tendon and cubital tunnel including insertional triceps tendon tears, snapping triceps syndrome and cubital tunnel syndrome. 3) To review the MR findings associated with distal triceps tendon disease and cubital tunnel syndrome.

ABSTRACT
Honored Educators

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Jenny T. Bencardino, MD - 2014 Honored Educator
Participants
Mark E. Lockhart, MD, Birmingham, AL (mlockhart@uabmc.edu) (Coordinator) Nothing to Disclose
Reena C. Jha, MD, Washington, DC (Presenter) Nothing to Disclose
Maitray D. Patel, MD, Phoenix, AZ (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe current best practice recommendations for management of adnexal asymptomatic, incidental, and/or potentially physiologic findings on pelvic US, CT, and MR based on lesion characteristics and patient clinical factors. 2) Understand the reference lines and angles in pelvic MRI that are used in the evaluation of pelvic floor disorders. 3) Understand the typical imaging characteristics of the endometrium and myometrium according to patient age and stage of the reproductive cycle, and review associated benign pathology.

ABSTRACT
This session will present on topics related to pelvic imaging. At the conclusion of the three presentations, the participants should have an improved understanding of imaging characteristics of the ovaries and uterus, including endometrium. Also, the imaging parameters used in evaluation of pelvic floor abnormalities such as organ prolapse and structural abnormalities related to incontinence will be reviewed. In each lecture, the imaging characteristics of a variety of disease processes will be covered.

Active Handout: Maitray D. Patel
**RC811**

**Improving PET Interpretation (An Interactive Session)**

Friday, Dec. 4 8:30AM - 10:00AM Location: S505AB

CT NM

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

**Participants**

Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

**Sub-Events**

**RC811A  Mimics and Interpretive Pitfalls: Advanced Tricks of the Trade**

Participants
Eric M. Rohren, MD, PhD, Houston, TX (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Discuss interpretive pitfalls in FDG-PET/CT, including challenging and less-frequently encountered pitfalls. 2) Review strategies to avoid interpretive errors in FDG-PET/CT.

**ABSTRACT**

One of the challenges in the interpretation of FDG-PET/CT is the discovery of unexpected activity, and the determination whether such activity is related to the primary tumor, incidental second primary tumor, or a benign process. Avoidance of ‘false-positive’ interpretations is critical for the development and maintenance of a robust PET/CT practice. In this presentation, a broad range of case examples will be shown and discussed, to illustrate some of the most frequent and most challenging pitfalls encountered in a busy oncologic PET/CT practice.

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Eric M. Rohren, MD, PhD - 2015 Honored Educator

**RC811B  Impact of Patient Preparation**

Participants
Don C. Yoo, MD, Providence, RI (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the patient preparation issues with performing PET/CT. 2) Review recommendations on patient preparation prior to performing PET/CT. 3) Review the issues in performing PET/CT scans on diabetic patients and learn ways to optimize the glucose level.

**ABSTRACT**

F18-FDG PET/CT is a valuable tool for a variety of oncologic applications. The purpose of this educational activity is to discuss the importance of appropriate patient preparation prior to performing oncologic F18-FDG PET/CT scans. The recommendations from the American College of Radiology (ACR), the Society of Nuclear Medicine and Molecular Imaging (SNMMI), and the National Cancer Institute (NCI) for patient preparation will be discussed. Issues that will be discussed include fasting, limiting exercise, hydration, sedation, low carbohydrate meals, and diabetic patients. Patients are typically asked to fast for at least 4 hours before tracer injection for oncologic PET/CT scans. The ACR and SNMMI both recommend checking glucose levels on all patients prior to administration of F18-FDG. SNMMI guidelines recommend that patients with glucose of greater than 150-200 mg/dL should usually be rescheduled. Performing PET/CT scans in poorly controlled diabetic patients can result in a PET/CT scan with an altered biodistribution limiting interpretation of the study. In a poorly controlled diabetic patient with a glucose level of greater than 200 mg/dl, the study should usually be rescheduled if it does not critically affect patient care. Hyperglycemia will dilute the FDG uptake by tumors through competitive inhibition. Subcutaneous insulin should not be administered to a diabetic patient with high glucose within 4 hours of a PET/CT scan as insulin will stimulate FDG uptake by skeletal muscle resulting in an altered biodistribution which can severely limit interpretation.

**RC811C  Challenging Case Examples**

Participants
Esma A. Akin, MD, Washington, DC, (Eakin@mfa.gwu.edu) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) With the aid of challenging case examples, this activity aims improve PET-CT interpretation through recognition of pitfalls and variants. In addition, it aims to review typical as well as unusual examples of commonly encountered oncologic diagnoses.
LEARNING OBJECTIVES

1) Identify and describe the three main mechanisms of aortic dissection: flow obstruction due to local abnormalities (occlusive dissection flaps), blind ending false lumen with true lumen occlusion ('windsock'), or frank thrombosis. Side-branch malperfusion may also occur due to limited inflow: the classic situation is complete true lumen collapse in the upstream aorta, resulting in underperfusion of all downstream branches supplied by the true lumen. While local obstructions are most commonly treated by stent placement into the diseased side branch, inflow-lesions typically require surgical or endovascular repair of the upstream aorta.

Symptomatic dissections of the celiac, mesenteric, or renal arteries are relatively rare events, and typically present with acute abdominal or flank pain. Dissections of side branch arteries can lead to ischemic complications or to frank rupture with intra- or retroperitoneal hemorrhage. Patients presenting with mesenteric or renal artery dissection require a thorough workup to identify genetic disorders (notably Ehlers Danlos IV), inflammatory conditions (vasculitis), and other entities such as fibromuscular dysplasia and segmental arterial mediolysis (SAM). Imaging findings range from non-obstructive lesions such as intramural hematoma, double-barrel lumen, to partial or complete obstruction ('windsock'). Complications include rupture or ischemia. Spontaneous dissections may heal, or evolve into aortic branch aneurysms.

ABSTRACT

Dissections of aortic side branches is a common complication of Type A and Type B acute aortic dissection which substantially increases mortality. It is important to understand the pathophysiology and the two principle mechanisms of side branch malperfusion in aortic dissection: flow obstruction can be due to (A) local abnormalities, such as occlusive dissection flaps, blind ending false lumen with true lumen occlusion ('windsock'), or frank thrombosis. Side-branch malperfusion may also occur due to (B) limited inflow: The classic situation is complete true lumen collapse in the upstream aorta, resulting in underperfusion of all downstream branches supplied by the true lumen. While local obstructions are most commonly treated by stent placement into the diseased side branch, inflow-lesions typically require surgical or endovascular repair of the upstream aorta.

Symptomatic dissections of the celiac, mesenteric, or renal arteries are relatively rare events, and typically present with acute abdominal or flank pain. Dissections of side branch arteries can lead to ischemic complications or to frank rupture with intra- or retroperitoneal hemorrhage. Patients presenting with mesenteric or renal artery dissection require a thorough workup to identify genetic disorders (notably Ehlers Danlos IV), inflammatory conditions (vasculitis), and other entities such as fibromuscular dysplasia and segmental arterial mediolysis (SAM). Imaging findings range from non-obstructive lesions such as intramural hematoma, double-barrel lumen, to partial or complete obstruction ('windsock'). Complications include rupture or ischemia. Spontaneous dissections may heal, or evolve into aortic branch aneurysms.

Participants

Dominik Fleischmann, MD, Palo Alto, CA (Presenter) Research support, Siemens AG;

LEARNING OBJECTIVES

1) Discuss the various categories of mesenteric ischemia (arterial occlusive, embolic, venous thrombotic, and nonocclusive), and the pathophysiologic basis behind the imaging findings in each case. 2) Understand the basis behind modern CT protocols for mesenteric ischemia, particularly the biphasic examination with CT mesenteric angiography. 3) Demonstrate techniques to rapidly analyze a mesenteric CT angiographic dataset. 4) Review the CT signs of mesenteric ischemia and their sensitivity and specificity.

ABSTRACT

Mesenteric ischemia is a common cause of abdominal pain that can be divided into four categories: arterial occlusive, embolic, venous thrombotic, and nonocclusive. Each category has distinct pathophysiologic mechanisms and imaging findings. Arterial occlusive ischemia results from the occlusion of a major mesenteric artery by an atheromatous plaque or thrombus. Embolic ischemia occurs when an embolus lodges in a mesenteric artery, leading to ischemia in the territory of the affected vessel. Venous thrombotic ischemia results from the formation of a thrombus within a mesenteric vein or ayzgos system, leading to ischemia in the downstream territory. Nonocclusive ischemia occurs when there is a decrease in blood flow to the mesenteric circulation due to extrinsic compression or intraluminal stenosis.

For each category of ischemia, modern CT protocols are designed to evaluate the mesenteric vasculature. A biphasic examination with early and late phases provides detailed imaging of the mesenteric arteries and veins. The early phase images the arterial anatomy, while the late phase images the venous anatomy, allowing for the detection of thrombi, aneurysms, and other vascular lesions. CT findings include decreased attenuation and flow within the affected artery, dilatation of the distal mesenteric vessels, and hyperattenuation of the affected tissue.

Participants

Iain D. Kirkpatrick, MD, Winnipeg, MB, (kirkpatrick_iain@hotmail.com) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the various categories of mesenteric ischemia (arterial occlusive, embolic, venous thrombotic, and nonocclusive), and the pathophysiologic basis behind the imaging findings in each case. 2) Understand the basis behind modern CT protocols for mesenteric ischemia, particularly the biphasic examination with CT mesenteric angiography. 3) Demonstrate techniques to rapidly analyze a mesenteric CT angiographic dataset. 4) Review the CT signs of mesenteric ischemia and their sensitivity and specificity.
5) Evaluate the current literature on mesenteric ischemia and discuss optimal diagnostic criteria.

**ABSTRACT**

Acute mesenteric ischemia (AMI) is a life-threatening condition said to affect up to 1% of patients presenting with an acute abdomen, and it carries a mortality rate ranging between 59-93% in the published literature. Time to diagnosis and surgical treatment are the only factors which have been shown to improve mortality, and evidence shows that the clear test of choice for AMI is now biphasic CT. Water is preferably administered as a negative contrast agent, followed by CT mesenteric angiography and then a portal venous phase exam. Diagnostic accuracy is significantly improved by analysis of the CT angiogram for arterial stenoses or occlusions, evidence of emboli, or angiographic criteria of nonocclusive ischemia. It is the use of CT angiography in addition to routine portal phase imaging which has pushed the sensitivity and specificity of the test to >90% in recent published articles. Other nonangiographic CT findings that are relatively specific for AMI in the appropriate clinical setting include pneumatosis intestinalis, portal or mesenteric venous gas or thrombosis, and decreased bowel wall enhancement. Bowel wall thickening, mesenteric stranding, ascites, and mucosal hyperenhancement are more nonspecific findings which may also be seen. Nonocclusive schema may be the most difficult form to diagnose, and findings of shock abdomen can aid in identification. Knowledge of the patient’s clinical history is critical not only for the selection of an appropriate study protocol but also for interpretation of the imaging findings in context.

**RC812D Gastrointestinal Bleeding**

Participants
Jorge A. Soto, MD, Boston, MA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review the appropriate implementation of CT angiography in the evaluation of patients presenting with acute lower intestinal bleeding. 2) To describe the technical details that are necessary for acquiring good quality CT angiography examinations. 3) Illustrate the characteristic CT angiographic findings of active or recent bleeding with specific examples of multiple etiologies.

**ABSTRACT**

Acute gastrointestinal bleeding is a serious condition that may threaten a patient’s life depending on the severity and duration of the event. Precise identification of the location, source and cause of bleeding are the primary objectives of the diagnostic evaluation. Implementation of colonoscopy in the emergency setting poses multiple challenges, especially the inability to adequately cleanse the colon and poor visualization owing to the presence of intraluminal blood clots. Scintigraphy with technetium 99m-labeled red blood cells is highly sensitive but also has some limitations, such as the inability to precisely localize the source of bleeding and determine its cause. Properly performed and interpreted CT angiography examinations offer logistical and diagnostic advantages in the detection of active hemorrhage. A three-phase examination (non-contrast, arterial and portal venous) is typically performed. Potential technical and interpretation pitfalls should be considered and will be explained. The information derived from CT angiography helps direct therapy and select the most appropriate hemostatic intervention (when necessary): endoscopic, angiographic, or surgical. Precise anatomic localization of the bleeding point also allows a targeted endovascular embolization. The high diagnostic performance of CT angiography makes this test a good alternative for the initial emergent evaluation of patients with acute lower intestinal bleeding.

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Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator
Participants

LEARNING OBJECTIVES

1) An important aspect of Nuclear Medicine and Molecular Imaging is that the same core compound of the administered radiopharmaceutical can be labeled with both gamma emitters (for diagnostic) and beta (or alpha) emitters (for therapy), allowing for the targeted treatment of lesions. This is an expression of theranostics, the combination of therapy and diagnostics that is based on the specific tumor biology of each patient’s disease. This proposed session will provide several examples of such paired diagnostic studies and treatments using Nuclear Medicine methods.

Sub-Events

SPNM61A  Radioactive Iodine and Thyroid Cancer - Current Use and Controversies

Participants

Douglas Van Nostrand, MD, Washington, DC, (douglas.van.nostrand@medstar.net) (Presenter) Speakers Bureau, sanofi-aventis Group

LEARNING OBJECTIVES

1) Define remnant ablation, adjuvant treatment, and treatment of locoregional/distant metastases. 2) Discuss the indications and controversies of 131I for each. 3) Discuss the range of prescribed activity of 131I for each.

SPNM61B  Bone Scintigraphy and the Use of Radionuclides in the Management of Patients with Metastatic Castrate-Resistant Prostate Cancer

Participants

Hossein Jadvar, MD, PhD, Los Angeles, CA, (jadvar@med.usc.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To review bone scintigraphy with single photon and PET radiotracers in the imaging evaluation of patients with prostate cancer. 2) To summarize the results of the ALSYMPCA clinical trial for 223Ra dichloride therapy in patients with castrate resistant metastatic prostate cancer.

SPNM61C  Updates on the Use of PET/CT (and PET/MRI) and Radioimmunotherapy in NHL

Participants

Erik S. Mittra, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPNM61D  Peptide Receptor Radionuclide Imaging and Therapy: Where Are We in Europe and What Shall the US Do to Catch Up?

Participants

Frederik L. Giesel, MD, MBA, Heidelberg, Germany (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the concept of theragnostic. 2) Identify promising candidates for PRRT. 3) Challenges and limitations of PRRT. 4) Future perspective using alpha-emitters.

ABSTRACT

Well-differentiated neuroendocrine tumors (NETs) demonstrate modest responses to conventional chemotherapy due to their slow proliferation rate. However, the expression of somatostatin receptors by NET enables targeting with high affinity peptides. When these octreotide analogue peptides are labelled with beta emitters such as 90Y or 177Lu promising anti-tumor effects have been observed. The presentation will introduce the concept of theragnostic (68Ga-DOTATOC and 90Y/177Lu-DOTATOC) for improved patient stratefication. Today, PRRT is well established for a long time in NET-patients. However challenges and limitations will be discussed in regard to other systemic therapies such as everolimus or sunitinib. Finally, outlook will be given in regard to the novel of targeted alpha therapy in NET-patients and its implication to other tumor entities.

URL
Ghassan El-Haddad, MD, Tampa, FL, (ghassan.elhaddad@moffitt.org) (Presenter) Speaker Bureau, Bayer AG

LEARNING OBJECTIVES

View learning objectives under main course title.
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.
John V. Heymach, MD, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose

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 5.7cm (range 1.2 - 14.9cm) and mean volume was 44.9 cm3 (range 0.4 - 338 cm3). 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
Hyun Jung Yoon, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Inseuk Sohn, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ho Yun Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jae-Hun Kim, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yoon-La Choi, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyeseung Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Kyung S. Lee, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jihyoung 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 in 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
Sany Amari, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Francesco Facchinietti, 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 pseudoprogession 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. Knollmenn, 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
CONCLUSION

Image quality was diagnostic for all image series. Diagnostic confidence was scored significantly higher in PET/MR compared to PET/CT (mean score = 1.16 and 1.48, respectively; p<0.001). 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 agreement for T staging between PET/CT and PET/MR (kappa) was moderate (k=0.744 and k= 0.749, respectively). The ICC of agreement between PET/CT vs. PET/MR was calculated.

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 agreement for T staging between PET/CT and PET/MR was 0.89, whereas the ICC for N staging was 0.87. Inter-observer agreement of T and N stages (Cohen’s kappa) and interclass correlation coefficient (ICC) between PET/CT vs. PET/MR was calculated.

RESULTS

Median follow-up was 13.9 months (range 0-48 months). Actuarial local control (Kaplan-Meier-Plot) after 1, 2, 3, 4 years was 94%, 91%, 91%, 87%, respectively. Actuarial progression-free survival after 1, 2, 3, 4 years was 73%, 62%, 45%, 29%, respectively. Local relapse / tumor persistence as detected by CT or 18F-FDG-PET/CT was found in 4 patients: directly after SBRT in one patient (sarcoma), 5, 8 and 31 months after SBRT in the other patients. Regional and/or distant out of volume progression was found in 9 patients (in 4/8 pts. with NSCLC): 0, 0, 1, 3, 8, 14, 28 und 31 months after SBRT. 2 patients died during follow-up, 1 due to tumor progression (NSCLC), 1 due to pulmonary embolism (head and neck cancer). Clinical asymptomatic pneumonitis 12.5%. Grade 2 toxicity 8%.

CONCLUSION

Our preliminary data show a long term local control of 87% in the treated pulmonary lesions without severe side effects. Systemic progression is a major challenge, especially in patients with NSCLC.

CLINICAL RELEVANCE/APPLICATION

Critical is the correct patient selection for this treatment option.

SST03-08 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

Katharina Martini, Zurich, Switzerland (Presenter) Nothing to Disclose
Andreas A. Meier, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Isabelle Schmitt-Opitz, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Walter Weder, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Patrick Veit-Halbach, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Research Grant, Bayer AG; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, General Electric Company
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 tri-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-observer 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.
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 (Stomach Cancer and Masses)

Friday, Dec. 4 10:30AM - 12:00PM Location: E353B

SST05

Chemotherapy Response Evaluation for Late-stage Gastric Cancer by Spectral CT Imaging: Correlation with RECIST Criteria

Friday, Dec. 4 10:30AM - 10:40AM Location: E353B

Participants
Seong Ho Park, MD, Seoul, Korea, Republic Of (Moderator) Nothing to Disclose
Douglas R. Kitchin, MD, Middleton, WI (Moderator) Nothing to Disclose

Sub-Events

SST05-01 Chemotherapy Response Evaluation for Late-stage Gastric Cancer by Spectral CT Imaging: Correlation with RECIST Criteria

Friday, Dec. 4 10:30AM - 10:40AM Location: E353B

Participants
Yong Yu, Xianyang City, China (Presenter) Nothing to Disclose
Zhong Hui, MMed, Xianyang City, China (Abstract Co-Author) Nothing to Disclose
Yongjun Jia, MMed, Xianyang City, China (Abstract Co-Author) Nothing to Disclose
Yang Chuangbo, MMed, Xianyang City, China (Abstract Co-Author) Nothing to Disclose
Zhang Xirong, MMed, Xianyang City, China (Abstract Co-Author) Nothing to Disclose

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 un-resectable 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). The iodine concentration value before the chemotherapy and the IC reduction ratio after the chemotherapy between the good- and poor- response groups were analyzed statistically by independent-samples t test. The correlation between the IC reduction ratio and response was calculated using spearman correlation test.

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 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 responses 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.

SST05-02 'Gastric Comb Sign' for Prediction of Lymphovascular Invasion in Gastric Cancer on Contrast-Enhanced CT

Friday, Dec. 4 10:40AM - 10:50AM Location: E353B

Participants
Hyun-Jung Baek, Yang-San, Korea, Republic Of (Presenter) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Tae Un Kim, MD, Yangsan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Nam Kyung Lee, MD, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ga Jin Han, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
Gastric cancer is the fourth most common cancer and the second leading cause of cancer-related death worldwide. Although the depth of invasion and lymph node are independent prognostic factors for gastric cancer and associated with patient survival, several studies have reported that lymphovascular invasion (LVI) by cancer cells are associated with poor survival or early recurrence in gastric cancer. The role of CT for predicting LVI remains controversial. The purpose of our study was to evaluate CT findings for predicting LVI in gastric cancer.
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.

SST05-03 Gastrointestinal Stromal Tumours (GIST): A CT Proposal for Predicting the Risk of Malignancy

Friday, Dec. 4 10:50AM - 11:00AM Location: E353B

Participants
Maria A. Mazzei, MD, Siena, Italy (Abstract Co-Author) Nothing to Disclose
Nevada Goffi Squitieri, MD, Siena, Italy (Presenter) Nothing to Disclose
Carla Vindigni, Siena, Italy (Abstract Co-Author) Nothing to Disclose
Giulia Sadotti, Siena, Italy (Abstract Co-Author) Nothing to Disclose
Paola Mercuri, Siena, Italy (Abstract Co-Author) Nothing to Disclose
Lorenzo Righi, Siena, Italy (Abstract Co-Author) Nothing to Disclose
Susanna Guermini, MD, Siena, Italy (Abstract Co-Author) Nothing to Disclose
Francesco G. Mazzei, MD, Siena, Italy (Abstract Co-Author) Nothing to Disclose
Luca Volterrani, Siena, Italy (Abstract Co-Author) Nothing to Disclose

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 evaluated 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 intraloesional 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.

SST05-04 Neuroendocrine Carcinomas of the Stomach: CT, Clinical and Pathologic Findings in 32 Patients

Friday, Dec. 4 11:00AM - 11:10AM Location: E353B

Participants
Kyeong Ah Kim, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Chang Hee Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jae Woong Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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.
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 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).

**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
Eva Fallentin, MD, Kobenhavn, Denmark (Abstract Co-Author) Nothing to Disclose
Lene Bæksgaard, PhD, MD, Copenhagen, Denmark (Abstract Co-Author) Nothing to Disclose
Birgitte Federspiel, MD, Copenhagen, Denmark (Abstract Co-Author) Nothing to Disclose
Lars Bo Svendsen, DSc, MD, Copenhagen, Denmark (Abstract Co-Author) Nothing to Disclose
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

**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.
PURPOSE
To evaluate the accuracy of hydro-MDCT in the evaluation of gastric adenocarcinoma with subsequent surgical and histopathological specimen.

METHOD AND MATERIALS
65 patients with gastric adenocarcinoma diagnosed by endoscopy and biopsy, underwent hydro-MDCT (16 detectors). The distension of the gastric lumen was obtained after the oral administration of 500ml of water and i.v. injection of spasmolytic agent. The dynamic study was performed during arterial and portal phase.

RESULTS
Contrast-enhanced Hydro-MDCT always detected the gastric cancer as a focal or diffuse gastric wall thickening with or without abnormal enhancement. The tumor was pre-operatively classified as T1 stage in 11 cases, T2 in 21, T3 in 25 and T4 stage in 8. In 49/65 patients the assessment of local tumor extension on hydro-MDCT was identical to the histopathological results in defining the T category according TNM classification, with overall accuracy of 75%. We found overstaging in 12 and understaging in 4 cases. The local enlarged lymphnodes were always identified but MDCT results in the N stage were in agreement with histo-pathological samples in 69% of cases. For the evaluation of metastatic disease hydro-MDCT had an accuracy of 99%.

CONCLUSION
Hydro-MDCT is a reliable technique in the preoperative staging of gastric adenocarcinoma.

CLINICAL RELEVANCE/APPLICATION
Hydro-MDCT is a reliable technique in the preoperative staging of gastric adenocarcinoma.
**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.

**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
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.

**SST06-05 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**

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 in diagnosing T1b or greater cancer were calculated using permanent pathology as the reference standard.

**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.
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.

**Honored Educators**

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Krishna Prasad Shanbhogue, MD - 2012 Honored Educator

Krishna Prasad Shanbhogue, MD - 2013 Honored Educator

**SST06-06** Intraductal Papillary Mucinous Neoplasms (IPMN) of the Pancreas: Diagnostic Accuracy of Low-dose Abdominal MDCT Scan

Friday, Dec. 4 11:20AM - 11:30AM Location: E353C

**Participants**

Federica Leone, MD, Monza, Italy (Presenter) Nothing to Disclose

Davide Ippolito, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose

Pietro A. Bonomi, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose

Camillo R. Talei Franzesi, Milan, Italy (Abstract Co-Author) Nothing to Disclose

Pietro Allegranza, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose

Sandro Sironi, MD, Monza, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate the diagnostic accuracy of low-dose MDCT combined with iterative reconstruction algorithm (iDose4) in the assessment of intraductal papillary mucinous neoplasms (IPMN) of the pancreas, to determining the correct surgical approach.

**METHOD AND MATERIALS**

We retrospectively evaluated nineteen patients (13 men; mean age 70.7±13.1 years) with pancreatic IPMN and who underwent from January 2013 to March 2015 an abdominal MDCT examination on a 256-slice scanner (iCT; Philips), with low-dose scanning protocol (120 kV, mAs determined by x-, y- and z-axis dose modulation) and iDose4 reconstruction modulation. Standard Magnetic Resonance (MR) imaging examination was used as reference standard for diagnosis of IPMN. For every IPMN the following data and morphologic features were reported: location within the gland (head, uncinate process, neck, body, tail), number (multifocality), maximum diameter (measured either on axial images or multiplanar reconstructions), communication with the main pancreatic duct (MPD), maximum MPD diameter, presence of septa, wall thickening, mural enhancing nodules and close adjacency to the portal vein, according to surgical guidelines of International Association of Pancreatology.

**RESULTS**

Multiplanar CT reconstructions were performed and the imaging data were reviewed as axial and as MPR images: coronal, sagittal, and curved multi-slice, to evaluate the surgical criteria of malignancies and therefore the surgical approach. A total of 44 IPMN (26 in the tail, 8 in the body, 6 in the head, 2 in the neck) in 19 patients were evaluated (six in 8 cases, multiple in 11). The main lesion diameter was 14.4±6.8 mm; 22/44 (50%) demonstrated a distinct communication with MPD and MPD mean diameter was 2.7±0.7 mm. 5/44 (11%) lesions demonstrated inner septa and 10/44 (23%) wall thickening and 2/44 (4%) mural enhancing nodules. 8/44 (18%) of IPMN demonstrated close proximity to the portal vein.

**CONCLUSION**

Low-dose abdominal MDCT scans with iDose4 reconstruction algorithm are able to properly depict morphologic features of pancreatic IPMNs that may allow their proper characterization according to surgical guidelines.

**CLINICAL RELEVANCE/APPLICATION**

MDCT scans combined with iDose4 might represents a useful imaging technique, rapid and widely available, for the proper surgical assessment of pancreatic IPMN.

**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

Yue Cong, Beijing, China (Abstract Co-Author) Nothing to Disclose

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 diagnostic 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.

SST06-09  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

Koichi Hayano, MD, Boston, MA (Presenter) Nothing to Disclose
Lipika Goyal, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Andrew X. Zhu, MD, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Rahmi Oklu, MD, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Cinthia Cruz, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
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.

Dushyant V. Sahani, MD - 2012 Honored Educator
Dushyant V. Sahani, MD - 2015 Honored Educator
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 A (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 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 micro-cellularity in body tissues, the heterogeneity of tumor micro-cellularity can be quantified using k-means clustering of voxel-wise ADC to enable the early assessment and prediction 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 micro-cellularity 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). Adapative blending was used to stitch the wide volumes. Both scans modes 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 ilio-psoas muscle. For qualitative analysis, two independent experienced readers were asked to subjectively assess the presence of motion artifacts as well as the quality of the volumes matching by analysis 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 artifacts 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 radiation dose reduction (42%) while preserving image quality in comparison to helical scanning. The lack of overmatching with minimal overburring 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.
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 respiratory 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 1.3±0.28 x10-3mm2/s, respectively (p<0.0005). 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 tumors. 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.

STT07-05 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
T. Razik, New Delhi, India (Abstract Co-Author) Nothing to Disclose
Sanjay Sharma, MD, FRCR, New Delhi, India (Abstract Co-Author) Nothing to Disclose
Deepnarayan Srivastava, Delhi, India (Abstract Co-Author) Nothing to Disclose
Amlesh Seth, MBBS, MCHR, New Delhi, India (Abstract Co-Author) Nothing to Disclose
Arunk. 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). The patients all had their surgery done within 1 month of performing MRI. Tumour staging was assessed with the criteria at all 52 cases. Third order polynomial fitting was 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.
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% (7.9mSv vs. 5.0mSv) 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
Vishala Mishra, MBBS, Boston, MA (Abstract Co-Author) Nothing to Disclose
Sandeep S. Hedgire, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Yun Mao, MD, Chongqing, China (Abstract Co-Author) Nothing to Disclose
Duangkamon Praputtam, 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 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. Patients with bilateral tumors had a higher recurrence rate at 3, 12, and 24-month follow-ups while for unilateral tumors 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-yr 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**

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**CONCLUSION**

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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
Minako Maruyama, Izumo, Japan (Abstract Co-Author) Nothing to Disclose
Takashi Katsube, Izumo City, Japan (Abstract Co-Author) Nothing to Disclose
Shinji Andou, MD, Izumo, Japan (Abstract Co-Author) Nothing to Disclose
Tomomori Nakamura, Japan, Japan (Abstract Co-Author) Nothing to Disclose
Nobuko Yamamoto, MD, Izumo, Japan (Abstract Co-Author) Nothing to Disclose
Megumi Nakamura, 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 inexperience readers.

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

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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.
**SST08**

**Nuclear Medicine (Comparative Technologies)**

Friday, Dec. 4 10:30AM - 12:00PM Location: S505AB

[CT] [MR] [NM]

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

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**Participants**

William G. Spies, MD, Chicago, IL (*Moderator*) Nothing to Disclose
Don C. Yoo, MD, E Greenwich, RI (*Moderator*) Nothing to Disclose

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**Sub-Events**

**SST08-01**

**Does the Trinary Interpretation and Reporting Strategy for Lung Scintigraphy Work in a Nuclear Medicine Residency Program?**

Friday, Dec. 4 10:30AM - 10:40AM Location: S505AB

Participants

Charles M. Intenzo, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Sung M. Kim, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Andrew Newberg, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

**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 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.

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**SST08-02**

**Is there a Correlation between Glycolytic on [18F]-FDG-PET and Cell Density on Diffusion-weighted MRI in Lymphoma? Results of an [18F]-FDG-PET/MR Study**

Friday, Dec. 4 10:40AM - 10:50AM Location: S505AB

Participants

Chiara Giraudo, MD, Vienna, Austria (*Presenter*) Nothing to Disclose
Michael Weber, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Georgios Karanikas, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Matthias Pones, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Barbara Kiesewetter, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Markus Raderer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Marius E. Mayerhofer, MD, PhD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To determine, using [18F]-FDG-PET/MR, whether glycolytic activity, as expressed by SUV (standardized uptake values) on [18F]-FDG-PET, and cell density, as expressed by ADC (apparent diffusion coefficients) on diffusion-weighted MRI, are correlated in newly-diagnosed, untreated Hodgkin (HL) and Non-Hodgkin lymphoma (NHL).

**METHOD AND MATERIALS**

Patients with histologically proven lymphoma were enrolled in this prospective, IRB-approved study and underwent [18F]-FDG-PET/MR on a fully-integrated system, for staging. Fourteen nodal and 12 extranodal regions were evaluated separately. For each involved region, the lymphoma manifestation with the largest diameter was defined as target lesion, provided that it showed a focal tracer uptake and a restricted diffusion. Maximum and mean SUVs (SUVmax, SUVmean), and minimum and mean ADCs (ADCmin, ADCmean) were recorded. Spearman correlation coefficients (r), using a significance level of P<0.05, were used to assess the relationship between SUVs and ADCs. Patients with HL were the most numerous (n=9) and were also analyzed separately.
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 ADCmin, 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 ADCmin was \( r=0.094 \) (P=0.61), and between SUVmean and ADCmean was \( r=0.23 \) (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.

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. Schlarrmann, 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 PETMR 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: 3.74±0.28; PET/CT: 3.34±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:2.74±0.3; PET/CT 2.54±0.5; MRI alone: 1.94±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.

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 intra-surgery 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
To compare the diagnostic accuracy of integrated [18]F-fluordeoxyglucose positron emission tomography/magnetic resonance imaging (PET/MR) compared to [18]F-fluordeoxyglucose positron emission tomography/computed tomography (PET/CT) and magnetic resonance imaging (MRI) in squamous cell carcinoma of the head and neck area.

RESULTS

Multiple cases 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.

SST08-06  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

Benedit M. Schaarschmidt, MD, Dusseldorf, Germany (Presenter) Nothing to Disclose
Philipp Heusch, MD, Dusseldorf, Germany (Abstract Co-Author) Nothing to Disclose
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Christian Buchbender, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Gerald Antoch, MD, Duesseldorf, Germany (Abstract Co-Author) Nothing to Disclose
Axel Wetter, Essen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To compare the the diagnostic accuracy of integrated [18]F-fluordeoxyglucose positron emission tomography/magnetic resonance imaging (PET/MR) compared to [18]F-fluordeoxyglucose positron emission tomography/computed tomography (PET/CT) and magnetic resonance imaging (MRI) in squamous cell carcinoma of the head and neck area.
**METHOD AND MATERIALS**

In 25 HNSCC patients, [18F]-FDG PET/CT and subsequent integrated [18F]-FDG PET/MR was performed for initial tumor spread and recurrence diagnostics. Fused [18F]-FDG PET/CT, fused [18F]-FDG PET/MR and MR images alone were analyzed by two independent readers in random order under knowledge of the clinical indication. T- and N-Stage was determined in examinations performed for initial tumor diagnostics. In examinations performed for recurrence diagnostics, lesion were analyzed individually. Diagnostic accuracy of each modality was determined by using the histopathological results in initial tumor staging after tumor resection. In patients undergoing imaging for cancer recurrence, follow-up and results obtained by histopathological sampling were used. Using McNemar’s test, results were compared separately for T-stage, N-stage and recurrent lesions. p<0.017 was considered statistically significant after Bonferroni correction.

**RESULTS**

In twelve patients undergoing [18F]-FDG PET/CT and [18F]-FDG PET/MR for initial tumor staging, T-staging was accurate in 50% in MRI alone, 59% in [18F]-FDG PET/CT and 75% in [18F]-FDG PET/MR while N-staging was accurate in MRI alone in 75%, in 77% in [18F]-FDG PET/CT and in 71% in [18F]-FDG PET/MR. No significant differences were observed using in T- and N-staging between all three modalities (p>0.017, respectively). In thirteen patients undergoing hybrid imaging for cancer recurrence diagnostics, the diagnostic accuracy was 57% with MRI alone and 72% with [18F]-FDG PET/CT and [18F]-FDG PET/MR, respectively. Differences between all three modalities were insignificant (p>0.017, respectively).

**CONCLUSION**

No significant differences were observed between [18F]-FDG PET/MR, [18F]-FDG PET/CT and MRI in local tumor staging and cancer recurrence diagnostics.

**CLINICAL RELEVANCE/APPLICATION**

[18F]-FDG PET/MR is considered a highly accurate method in head and neck squamous cell carcinoma. Our data indicate that the advantage over MRI and [18F]-FDG PET/CT is not as obvious as expected in this initial study.

**SST08-07 Correlation of the Maximum Standardized Uptake Values and Apparent Diffusion Coefficient Values with Pathologic Prognostic Factors in Breast Carcinoma**

**Purpose**

to evaluate the combination of maximum standardized uptake values (SUVmax) of 18F-FDG PET/CT, and apparent diffusion coefficient (ADC) values of DWI with pathologic prognostic factors in breast carcinoma patients.

**Method and Materials**

The institutional review board of our hospital approved this retrospective study; the requirement for informed consent was waived. 181 patients with 183 mass-type invasive breast carcinomas (mean size 2.47 cm, range 1.0-13.0 cm) who underwent whole-body 18F-FDG PET/CT, 3-Tesla breast MRI including DWI, and immunohistochemical staining of the primary lesions before therapy. The primary tumor’s SUVmax and ADC were retrospectively measured using FDG-PET/CT and DWI by two experienced nuclear medicine physicians and two experienced radiologists, respectively. Histologic analysis was done on tumor size, axillary lymph node (LN) metastasis, nuclear grade, expression of estrogen receptors (ER), progesterone receptors (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 ADC mean 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 ADC mean values (correlation coefficient r=0.37, p<0.0001). 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=0.0059), and Ki-67 (p<0.0001). Meanwhile, ADC mean values were associated with tumor size (p=0.013), axillary LN metastasis (p=0.0038), TNM staging (p=0.0016), 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.

**Clinical Relevance/Application**

Primary tumor's SUVmax of pretreatment 18F-FDG PET/CT can be considered as a promising prognostic parameter that may identify highly aggressive breast carcinoma and a very important tool for determining the treatment plan.
BODY

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, adnexal 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

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 Tomophon™ (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 (ASiR-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 \((\pm 80\%)\). Compared to FBP, a statistically significant reduction in objective image noise was demonstrated [ASiR-V 50\% (range, 24-38\% noise reduction), ASiR-V 80\% (37-58\%), 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.

**SST14-03**  
**Tilt Angle Effects on Quality Control Phantom Measurements in Multi-Center CT Imaging Studies**

Friday, Dec. 4 10:50AM - 11:00AM Location: S403B

Participants
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Chao Wang, PhD, Iowa City, IA (Abstract Co-Author) Nothing to Disclose
John D. Newell JR, MD, Iowa City, IA (Abstract Co-Author) Research Consultant, Siemens AG; Research Grant, Siemens AG; Consultant, VIDA Diagnostics, Inc; Stock Options, VIDA Diagnostics, Inc; Consultant, GlaxoSmithKline plc;
Kung-Sik Chan, Iowa City, IA (Abstract Co-Author) Nothing to Disclose
Eric A. Hoffman, PhD, Iowa City, IA (Abstract Co-Author) Founder, VIDA Diagnostics, Inc; Shareholder, VIDA Diagnostics, Inc; Advisory Board, Siemens AG;

**PURPOSE**
Several multi-center and longitudinal CT studies are relying on monthly scanning of the COPDGene 1 Phantom to monitor temporal stability of individual scanners. This study investigates the effects of imperfect object positioning and provides guide lines for acceptable tilt angles.

**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.

**SST14-04**  
**Characterization of Tube Current Modulation in Terms of Transfer Functions with a Utilization for Performance Evaluation and Noise Prediction**

Friday, Dec. 4 11:00AM - 11:10AM Location: S403B

Participants
Yakun Zhang, MS, Durham, NC (Abstract Co-Author) Nothing to Disclose
James Winslow, PhD, Durham, NC (Abstract Co-Author) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (Presenter) Nothing to Disclose

**PURPOSE**
This study aims to develop a methodology to characterize the performance of tube current modulation (TCM) techniques in a vendor-generic way, and to broaden a methodology to predict mA and noise for clinical images acquired by TCM.

**METHOD AND MATERIALS**
The adult head and body cylindrical CTDI phantoms (16 and 32 cm in diameter respectively) were axially assembled together using a long rod. All inserts were placed in the periphery holes to create a solid uniform phantom. The phantom was imaged on a commercial CT (Siemens SOMATOM Definition Flash) with a tube current modulation setting of 300 reference mA, I31s kernel, and 1 mm thick slices. The output tube current for each slice was normalized by the pitch to obtain effective mA. This effective mA as a function of distance, where the transition from small to large section occur, was used to obtain an edge spread function (ESF).
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

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 (CTDvol = 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 (ADMERIE, 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

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 Multiplanar (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**

**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 experiment.

**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
RESULTS

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.

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.

BACKGROUND

ACRIN 6695’s primary objective was to determine whether CT perfusion (CTP) parameters are prognostic of progression-free survival at 6 months in a cohort of patients from the GOG-262 trial. The latter is a phase III trial on advanced stage ovarian cancer comparing standard to dose-dense paclitaxel/carboplatin with 91% of cohort also receiving bevacizumab. Multivariate analysis of ACRIN 6695 demonstrated association of CTP parameters with patient outcome. 76 subjects underwent 3 CTP studies comprised of dynamic contrast enhanced using a two-phase scanning protocol: 24 images at 2.8 s intervals followed by 8 images at 15 s intervals acquired using 120 kV and 50 mAs each image. Axial shuttle scanning mode was allowed but not required. To ensure protocol compliance and uniform image quality, a CT scanner certification process was implemented. Scanner accreditation required that images of a water phantom scan acquired using the trial CTP protocol be submitted to a central core lab where they were evaluated for the following variables: image interval, CT noise, spatial uniformity and temporal stability of CT number.

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.

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/

SST14-09 Quality Control Phantom Using 3D Printing Technology in Multi-modality System

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 complicate shapes by using 3D printing technology. The goal of this work was to design 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
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.
Vascular/Interventional (Innovation in Non-Vascular Interventions)

Friday, Dec. 4 10:30AM - 12:00PM Location: E350

GI CT IR

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

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
Jiawei Tsauo, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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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
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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;
purposes; GGOSS 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. GGOSS 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 GGO.

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 GGOs.

SST15-03 Efficacy and Safety of a Newly Designed, Fully Covered Self-expandable Metallic Stent for Malignant Esophageal Strictures

Friday, Dec. 4 10:50AM - 11:00AM Location: E350

Participants
Jung-Hoon Park, MS, RT, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Hyo-Young Song, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Wei-Zhong Zhou, Nanjing, China (Abstract Co-Author) Nothing to Disclose
Jiaywei Tsauo, 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 reduce the stent dysfunction rate, we developed a new self-expandable metallic stent (SEMS) with double step flanges at both ends coated with silicone and a main body externally covered with a polytetrafluoroethylene membrane. The purpose of this study was to investigate the efficacy and safety of the new SEMS for the palliation of malignant esophageal strictures.

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.

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
Hyo-Young Song, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jiaywei Tsauo, 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
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.

**SST15-06**

**Intervention Planning using a Laser Navigation System (LNS) for CT-guided Interventions: A Phantom and Patient Study**

Friday, Dec. 4 11:20AM - 11:30AM Location: E350

**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 and patients, we compared 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-Banerj, 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**

By decreasing kVp during CT-guided procedures, interventionalists may 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 minor complications.
minor complications.

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.

HONORED EDUCATORS

Peter R. Mueller, MD - 2012 Honored Educator
Peter R. Mueller, MD - 2013 Honored Educator

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

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

Sub-Events

**SST16-01** Patient Tailored Contrast Volume for Preoperative CT Angiography of the Aorta: A Prospective Study Based on Patient Heart Rate and Body Surface Area Differences
Friday, Dec. 4 10:30AM - 10:40AM Location: E352

Participants
Adriana Dubbeldam, MD, Leuven, Belgium (Presenter) Nothing to Disclose
Federica Zanca, PhD, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
Walter Coudyzer, Leuven, Belgium (Abstract Co-Author) Nothing to Disclose
Hilde Bosmans, PhD, Leuven, Belgium (Abstract Co-Author) Co-founder, Qaelum NV Research Grant, Siemens AG
Geert Maleux, MD, PhD, Leuven, Belgium (Abstract Co-Author) Speakers Bureau, Merit Medical Systems, Inc Speakers Bureau, W. L. Gore & Associates, Inc Speakers Bureau, Medtronic, Inc

**PURPOSE**
The quality of CT aortography is known to critically depend on contrast agent injection. Therefore, relatively high dose (historical and safe) injection protocols are being used. A recent retrospective analysis showed a large variability in contrast enhancement in the aorta, with Hounsfield units (HU) from 123 to 510, while all images remained of acceptable quality. This suggested that contrast doses could be lowered. Our aim is to test whether patient specific contrast dose calculation would allow to reduce contrast dose.

**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.

**SST16-02** Feasibility Study of Spectral CT Imaging Associated with Ultra-low Volume Contrast Medium for Aorta CTA: Compared with Conventional 120kVp
Friday, Dec. 4 10:40AM - 10:50AM Location: E352

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 vs 12.11±4.07 vs 13.23±1.89 in ascending aorta; 18.34±5.81 vs 12.19±3.85 vs 12.39±1.80 in descending aorta; 16.82±4.47 vs 11.55±3.71 vs 12.44±2.17 in celiac trunk; 17.27±4.73 vs 11.61±3.21 vs 12.51±1.94 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(358.47±69.56 vs 213.80±91.03 vs 374.46±34.23),(361.17±64.09 vs 216.22±37.65 vs 353.72±30.68),(336.89±55.70 vs 205.01±34.45 vs 354.28±43.96) and (333.57±54.62 vs 201.22±44.45 vs 356.99±54.62)HU for the set 1, 2 and 3. There were significant differences among the three groups (p<0.05) and between set 1 and 2, and set 2 and 3 (p>0.05). No significant difference was obtained between set 1 and 3(p=0.00). The amount of contrast agent for each patient in the study group was 28.87±4.24ml, 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 DiPoce, 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 80 kV, 700mAs. For each scan, 120 and 80 kV 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 polyenergetic 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 polyenergetic 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 polyenergetic 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.

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 invited 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 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 time-density curve(TDC). Perfusion parameters (blood volume [BV], blood flow [BF], and mean transit time [MTT]), and the TDC of the foot tissue were automatically calculated by the software for both feet.

RESULTS
1. 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
70 kVp CT perfusion could be a potential technique to determine the information about foot vascularization, and meanwhile, further study is needed to justify tailored contrast injection protocol.

**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
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**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
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**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
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

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PURPOSE
The GG quantifies 1st pass AAA CTA contrast variation; uniform enhancement (0.90.4 cm/yrr) 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=91.04±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.