Biomarkers Quantitative Imaging

SSA09

Science Session with Keynote: Gastrointestinal (Liver Fibrosis)

Sunday, Nov. 27 10:45AM - 12:15PM Room: E450B

GI BQ

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; Research Grant, Siemens AG; Research Grant, Guerbet SA; ;
Sudhakar K. Venkatesh, MD, FRCR, Rochester, MN (*Moderator*) Nothing to Disclose
Anthony E. Samir, MD, Boston, MA (*Moderator*) Consultant, Pfizer Inc Consultant, General Electric Company Consultant, PAREXEL International Corporation Research Grant, Koninklijke Philips NV Research Grant, Siemens AG Research Grant, Toshiba Corporation Research Grant, General Electric Company Research Grant, Samsung Electronics Co, Ltd Research Grant, Analogic Corporation Research support, SuperSonic Imagine Research support, Hitachi, Ltd

Sub-Events

SSA09-01 2D Ultrasound Shearwave for Staging Liver Fibrosis: Preliminary Results of a Prospective Multicentre European Study

Sunday, Nov. 27 10:45AM - 10:55AM Room: E450B

Participants
Adrian K. Lim, MD, FRCR, London, United Kingdom (*Presenter*) Luminary, Toshiba Corporation
Maxime Ronot, MD, Clichy, France (*Abstract Co-Author*) Nothing to Disclose
Giovanna Ferraioli, MD, Pavia, Italy (*Abstract Co-Author*) Speaker, Koninklijke Philips NV; Speaker, Hitachi Ltd; Speaker, Toshiba Corporation
Hans Peter Mueller, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Mireen Friedrich-Rust, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
David O. Cosgrove, MBBCh, FRCR, London, United Kingdom (*Abstract Co-Author*) Research Consultant, SuperSonic Imagine Research Consultant, Bracco Group Speakers Bureau, Toshiba Corporation
Carlo Filice, MD, Pavia, Italy (*Abstract Co-Author*) Speaker, Koninklijke Philips NV; Speaker, Hitachi, Ltd ; Research Grant, Bracco Group; Research Grant, Hitachi, Ltd; Research Grant, Toshiba Corporation; Research Grant, Esaote SpA
Valerie Vilgrain, MD, Clichy, France (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Ultrasound Shearwave (SW) speed measurements using Transient Elastography (TE) is an accepted non-invasive test of liver stiffness and indirectly the presence of significant liver fibrosis. Newer SW technologies have since been developed but have yet to be validated against this standard of care test.To assess the reliability and accuracy of 2D Ultrasound SW technology at grading the severity of Liver Fibrosis using TE as the gold standard.

METHOD AND MATERIALS

Centers from France, Germany, Italy and United Kingdom were involved. Patients were recruited prospectively with a variety of chronic liver diseases to have 2D Ultrasound Shearwave (ToSWE) (Toshiba Medical Systems) and TE (Echosens) performed on the same day.10 valid measurements were obtained from fasted patients (>8 hours) using both techniques and the median result in kPa was used for analysis. Based on a previous meta-analysis (Tsochatzis, et al. J Hepatol 2011) for staging liver fibrosis (F), TE cut-offs of 7.0, 9.5 and 12.0 kPa, were used to denote liver fibrosis stages of significant fibrosis (F≥2), advanced fibrosis (F≥3), and cirrhosis (F = 4) respectively. A TE value of < 7.0 kPa was used to denote no significant fibrosis (F0/F1). The measurements obtained from ToSWE were correlated with the TE-derived stages of fibrosis.

RESULTS

367 patients have been recruited to date, (215 M:152 F) with a mean age of 53 years (range: 21-88 years). The main etiologies of liver disease were HCV-related (64%) and HBV-related (23%). The rest comprised a mixture of ALD, AIH and NAFLD.350 datasets were complete showing excellent correlation of liver stiffness values between the ToSWE and TE techniques at all centres (R2 correlation range: 0.78-0.92). The mean elasticity values using ToSWE for each liver fibrosis stage as described above was: F0/F1 (n= 179: 6.0 ± 1.4 kPa), F2 (n = 54: 7.0 ± 3.0 kPa), F3 (n = 42: 9.2 ± 2.2 kPa) and F4 (n = 75: 16.7 ± 11.8 kPa). This was highly statistically significant between all groups (Mann Whitney U test: $p<0.001$ for all pairs).

CONCLUSION

The liver stiffness measurements using ToSWE correlates well with TE and can be used to distinguish patients with significant liver fibrosis non-invasively in the appropriate clinical setting.

CLINICAL RELEVANCE/APPLICATION

2D Shearwave elastography is a useful non-invasive tool for grading the severity of chronic liver disease and can be linked with current established treatment algorithms for TE.

SSA09-02 Comparison of Elastography Point Quantification with Transient Elastography in Patients with Chronic Viral Hepatitis and Nonalcoholic Fatty Liver Disease: A Prospective Study

Sunday, Nov. 27 10:55AM - 11:05AM Room: E450B

Awards

Student Travel Stipend Award

Participants
Savinay Kapur, MBBS,MD, Chandigarh, India (*Presenter*) Nothing to Disclose
Naveen Kalra, MBBS, MD, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose
Ajay Duseja, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose
Ashim Das, MD, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose
Yogesh Chawla, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose
Niranjan Khandelwal, MD, Chandigarh, India (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To measure liver stiffness using a novel ultrasound-based point shear-wave elastography technique – Elastography Point Quantification (ElastPQ) and to compare its diagnostic accuracy with transient elastography (TE) and liver histology in patients with chronic viral hepatitis (CVH) and nonalcoholic fatty liver disease (NAFLD).

METHOD AND MATERIALS

32 patients of chronic liver disease (CVH=15; NAFLD=17) were evaluated by ElastPQ (iU22 xMATRIX System, Philips) and TE (FibroScan®, Echosens) within 7 days of liver biopsy by two independent observers who were blinded to each other's observations and to the results of the biopsy. Within the CVH group (n=15), subgroup analysis was done in patients with end stage renal disease (ESRD) (n=8) and in patients without ESRD (n=7). Within the NAFLD group, subgroup analysis was done in patients with HBsAg carrier state (n=6) and without HBsAg carrier state (n=11). AUROC curves were calculated for ElastPQ and TE. The optimal cut-off values were determined using Youden's index. DeLong test was used to compare AUROC curves.

RESULTS

Liver stiffness measurement by ElastPQ correlated significantly with the stage of fibrosis (ρ= 0.826; $p<0.0001$). In the combined analysis of all patients, AUROCs of ElastPQ and TE for diagnosing any fibrosis (F>=1), significant fibrosis (F>=2) and severe fibrosis (F>=3) were 0.907, 0.959, 0.926 and 0.870, 0.770, 0.881, respectively, at optimal cut-off values of 5.37, 5.96, 8.42 kPa and 6.0, 8.8, 11.2 kPa, respectively. ElastPQ was superior to TE in diagnosing significant fibrosis in the combined analysis (p=0.0149) and in the CVH group (p=0.0391). The diagnostic accuracy of both ElastPQ and TE was excellent in NAFLD patients irrespective of their HBsAg carrier state. However the accuracy of both these techniques was poor in the CVH with ESRD subgroup. There was significant positive correlation between the two techniques (ρ=0.704; $p<0.0001$) with excellent intra-observer reproducibility of liver stiffness measurement by ElastPQ (Intraclass correlation coefficient=0.95).

CONCLUSION

ElastPQ is a good non-invasive diagnostic tool for evaluating liver fibrosis in patients of CVH and NAFLD comparing well with TE and liver biopsy. Its role in patients of CVH with ESRD needs further evaluation.

CLINICAL RELEVANCE/APPLICATION

ElastPQ can be effectively used for non-invasive assessment of liver fibrosis during routine sonographic evaluation of liver without the need of any additional equipment.

SSA09-03 Accuracy of Liver Surface Nodularity Quantification at MDCT as a Noninvasive Biomarker for Staging Liver Fibrosis

Sunday, Nov. 27 11:05AM - 11:15AM Room: E450B

Awards
Student Travel Stipend Award

Participants
Kyle Malecki, Ma, WI (*Presenter*) Nothing to Disclose
Meghan G. Lubner, MD, Madison, WI (*Abstract Co-Author*) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson;
Perry J. Pickhardt, MD, Madison, WI (*Abstract Co-Author*) Co-founder, VirtuoCTC, LLC; Stockholder, Cellectar Biosciences, Inc; Stockholder, SHINE Medical Technologies, Inc; Research Grant, Koninklijke Philips NV

PURPOSE

To investigate objective semi-automated measurement of liver surface nodularity (LSN) at MDCT for prediction of underlying liver fibrosis (stages F0-F4).

METHOD AND MATERIALS

We evaluated 367 total patients (mean age, 51.1 years; 191M/176F), including a healthy (F0) control group (n=119) and fibrosis stages F1 (n=47), F2 (n=38), F3 (n=67), and F4/cirrhosis (n=97). Contrast-enhanced abdominal MDCT scans (120 kVp, variable mA, PV phase) were assessed utilizing an independently validated semi-automated surface nodularity tool. A series of ≥10 consecutive ROI measurements along the anterior liver, totaling ≥80 cm in length, were made using the left lateral segment as default. All intermediate stages of fibrosis (F1-F3) were based on liver biopsy within one year of MDCT.

RESULTS

MDCT-based liver surface nodularity scores increased with stage of fibrosis: 2.01±0.28 for F0, 2.34±0.39 for F1, 2.37±0.39 for F2, 2.88±0.68 for F3, and 4.11±0.95 for F4. For discriminating significant fibrosis (≥F2), advanced fibrosis (≥F3), and cirrhosis (≥F4), ROC AUC were 0.902, 0.932, and 0.959, respectively. Sensitivity and specificity for significant fibrosis (≥F2; LSN threshold=2.38) was 80.2% and 80.2%; for advanced fibrosis (≥F3; LSN threshold=2.53) was 89.0% and 84.2%; and cirrhosis (≥F4; LSN threshold=2.81) was 97.9% and 84.8%.

CONCLUSION

Objective quantification of liver surface nodularity at MDCT allows for accurate discrimination between stages of hepatic fibrosis, especially at more advanced levels. Although the results are comparable to elastography, this simple semi-automated biomarker can be obtained retrospectively without additional equipment or patient time.

CLINICAL RELEVANCE/APPLICATION

Quantification of liver surface nodularity at MDCT can serve as a useful noninvasive biomarker for staging liver fibrosis and, unlike elastography or biopsy, can be obtained retrospectively.

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
Meghan G. Lubner, MD - 2014 Honored Educator
Meghan G. Lubner, MD - 2015 Honored Educator

SSA09-04 Staging Liver Fibrosis Induced by HBV Infection using Contrast-Enhanced Dual-Energy CT

Sunday, Nov. 27 11:15AM - 11:25AM Room: E450B

Awards
Student Travel Stipend Award

Participants
Ke Wang, MD, Beijing, China (*Presenter*) Nothing to Disclose
Hong Zhao, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Peter Lamb, Niskayuna, NY (*Abstract Co-Author*) Employee, General Electric Company
Ze Peng, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Xuedong Yang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Xiaojie Lin, Shanghai, China (*Abstract Co-Author*) Employee, General Electric Company
Guiqiang Wang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Xiaoying Wang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the utility of the contrast-enhanced Dual Energy Computed Tomography (DECT) for staging liver fibrosis induced by HBV infection.

METHOD AND MATERIALS

A total of 57 patients (45m/12f; mean age, 42; age range, 19–63) diagnosed as chronic hepatitis B and had undergone both liver biopsy (fibrosis stage S1-S4) and contrast-enhanced DECT were enrolled. The interval between biopsy and CT was one week to two months. The DECT consisted of a non-enhanced scan followed by arterial, portal venous and delayed phase scans at 25, 65 and 180 seconds after administration of contrast media (1.5 ml/kg, 320 mg/ml, 3.5 ml/s). The iodine concentration of aorta (αaorta) and liver parenchyma (αliver) was measured and the normalized iodine concentration (NIC, αliver/αaorta) was used to measure the severity of liver fibrosis. Two different methods were used to draw ROI in the liver parenchyma (①putting one single ROI under the 8th intercostal space- the place of liver biopsy; ②putting 4 ROIs in different segments of liver). Three different techniques were used to calculate the NIC on 4 different phases: Hounsfied Unit (HU), Iodine Material Density (MD) Map, and Iodine Multi-Material Decomposition (MMD) Map. NIC correlation with the fibrosis stage was determined via ANOVA and Spearman's rank correlation. Significance between fibrosis subgroups was determined via Tukey test. Bland-Altman analysis was used to determine the agreement between the two ROI methods.

RESULTS

Using method 1, only the NIC on delayed by using iodine MD and MMD map showed statistical significance between different liver fibrosis stages ($p<0.05$). The NIC measured on delayed phase by using iodine MD and MMD map showed reasonable correlation with fibrosis stage (Spearman r value was 0.6126 for MD and 0.7197 for MMD) (Figure 1, 2). The results of Tukey's test showed that the NIC values calculated from both the MD and MMD map can differentiate mild from severe fibrosis groups (Table 1). Method 2 showed similar result. There was good agreement between the two methods of ROI placement (Figure 3).

CONCLUSION

DECT provides a quantitative method to stage liver fibrosis, and can serve to supplement and augment the clinical management of patients with chronic HBV.

CLINICAL RELEVANCE/APPLICATION

DECT provides a noninvasive quantitative method to stage liver fibrosis, and can serve to supplement and augment the clinical management of patients with chronic HBV.

SSA09-05 Efficacy of T1 Mapping on Gd-EOB-DTPA-Enhanced MRI for Staging Liver Fibrosis in Chronic Hepatitis B Patients with Normal Alanine Transaminase <= 40 IU/L

Sunday, Nov. 27 11:25AM - 11:35AM Room: E450B

Participants
Li Yang I, MD, Shanghai, China (*Presenter*) Nothing to Disclose
Mengsu Zeng, MD, PhD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Ying Ding, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Shengxiang Rao, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Ruofan Sheng, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to retrospectively assess the diagnostic efficacy of T1 mapping on Gd-EOB-DTPA-enhanced MRI for liver fibrosis staging in chronic hepatitis B (CHB) patients with normal ALT level.

METHOD AND MATERIALS

This retrospective study included 100 CHB patients (mean age: 54.8 years; 82 men and 18 women) who underwent Gd-EOB-DTPA-enhanced MRI including T1 mapping. Liver function tests were performed and alanine transaminase (ALT) levels were ≤ 40 IU/L. T1 mapping was performed before and 20-min hepatobiliary phase (HBP) after injection of Gd-EOB-DTPA (Primovist, Bayer-Schering). Liver fibrosis stages were histologically determined according to Scheuer scoring system: S0 (n=18), S1 (n=13), S2 (n=15), S3 (n=12) and S4 (n=42). Pre-contrast and HBP T1 relaxation times were measured and the reduction rate (Δ%) of the T1 relaxation times was calculated. Spearman's rank correlation coefficients between T1 relaxation times and histological hepatic fibrosis stages were calculated and receivers operating characteristic (ROC) curves were built to assess the diagnostic performance of T1 mapping in staging liver fibrosis.

RESULTS

The HBP, Δ% of T1 relaxation times showed significant correlations with liver fibrosis stage (rho: 0.70, -0.61, respectively, both $P<0.05$). The area under ROC curves (AUROC) of pre-contrast, HBP, Δ% T1 relaxation time for the diagnosis of no (S=0), mild (S≤1), significant (S≥2), advanced fibrosis(S≥3) and cirrhosis (S=4) are shown in the Figs 1. The AUROCs of HBP and Δ% T1 relaxation time for identification of various degree of fibrosis were significantly greater than pre-contrast T1 relaxation times ($P< 0.05$).The sensitivities, specificities of HBP T1 relaxation times for identification of significant fibrosis were 81.48% and 84.78% at the cutoff of 212.4, and the sensitivities, specificities of Δ% of T1 relaxation times for prediction of significant fibrosis were 79.63% and 69.57% at the cutoff of 69.06%.

CONCLUSION

The Gd-EOB-DTPA-enhanced T1 mapping is accurate for staging liver fibrosis in CHB patients with normal ALT level.

CLINICAL RELEVANCE/APPLICATION

About one fifth of CHB patients with normal ALT concentrations had stages 2-4 fibrosis, which may lead to low positive predictive value of commonly used serum fibrosis markers, such as FIB-4 index and APRI.

SSA09-06 Failure of Liver MR Elastography: What Are the Predictive Factors?

Sunday, Nov. 27 11:35AM - 11:45AM Room: E450B

Participants
Mathilde Wagner, MD, PhD, Paris, France (*Presenter*) Consultant Olea Medical
Idoia Corcuera-Solano, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Grace C. Lo, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Steven J. Essess, MD, New York City, NY (*Abstract Co-Author*) Nothing to Disclose
Joseph H. Liao, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Cecilia Besa, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Maggie M. Fung, MEng, bethesda, MD (*Abstract Co-Author*) Employee, General Electric Company
James S. Babb, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Richard L. Ehman, MD, Rochester, MN (*Abstract Co-Author*) CEO, Resoundant, Inc; Stockholder, Resoundant, Inc;
Bachir Taouli, MD, New York, NY (*Abstract Co-Author*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA

PURPOSE

To determine technical failure rate of liver magnetic resonance elastography (MRE) and to assess the determinants of technical failure of liver MRE in a large series of patients.

METHOD AND MATERIALS

Seven hundred and eighty-one MRE examinations in 691 consecutive patients (mean age 58 y, 63% male) performed in a single center between 6/2013 and 8/2014 were retrospectively evaluated. MRE was acquired either on a 3.0T (n=443) or 1.5T system (n=338), using a Gradient-Recalled-Echo (GRE) MRE sequence (4 axial slices). Image analysis was performed by two observers. Technical failure was defined as no pixel with confidence index higher than 95% and/or no apparent shear waves imaged. The following parameters were noted: presence of cirrhosis, degree of ascites, steatosis, iron deposition and subcutaneous fat thickness. Logistic regression analysis was performed to assess the link between MRE technical failure and potential predictive factors of failure.

RESULTS

Failure occurred in 80 cases (10%). The technical failure rate for MRE exams at 1.5T was 4% (12/338), while it was higher, 15% (63/443), at 3.0T ($P<0.0001$). On univariate analysis, BMI, liver iron deposition, massive ascites, use of 3.0T, presence of cirrhosis, alcoholic liver disease were all significantly associated with MRE failure ($P<0.004$); while on multivariable analysis, only BMI, liver iron deposition, massive ascites and use of 3.0T were significantly associated with MRE failure ($P<0.004$). Presence of steatosis and subcutaneous fat had no significant impact on failure rate ($P>0.05$).

CONCLUSION

MR elastography with a GRE-based sequence at 1.5T had a low technical failure rate. Use of a GRE-based MRE sequence at 3.0T resulted in a substantially higher technical failure rate. Massive ascites and iron deposition are also independent factors associated with liver MRE failure.

CLINICAL RELEVANCE/APPLICATION

Technical failure rate of MR elastography with a GRE-based sequence is higher at 3.0T than at 1.5T; which provides motivation for the use of alternative sequences at 3.0T.

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. Ehman, MD - 2016 Honored Educator

SSA09-07 Reliability of ARFI Shear Velocity Cut-Off for Diagnosis of Cirrhosis in Chronic Hepatitis C: A 'Real World' Two Centre Simultaneous Biopsy-Controlled Study

Sunday, Nov. 27 11:45AM - 11:55AM Room: E450B

Participants
Nemi Gandy, MBBCh, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Phillip Lung, Middlesex, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Ounali Jaffer, MBBS, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Paul Tadrous, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Michael Heneghan, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Philip J. Shorvon, FRCR, FRCPC, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Paul S. Sidhu, MRCP, FRCR, London, United Kingdom (*Abstract Co-Author*) Speaker, Koninklijke Philips NV; Speaker, Bracco Group; Speaker, Hitachi, Ltd; Speaker, Siemens AG
David I. Sherman, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

Non-invasive liver fibrosis assessment with elastography recently received FDA clearance and is increasingly used as the sole diagnostic method to assess suitability for new anti-viral therapies in patients with HCV infection. As shear velocity (SV) cut-offs for Metavir F4 fibrosis with ARFI technique (virtual touch quantification™) are based upon historical studies, there is a need for disease specific, population adjusted data. We report results from a biopsy controlled study from two centres, designed to investigate optimal ARFI cut-offs for determining cirrhosis in our population.

METHOD AND MATERIALS

Our database of 96 patients with HCV infection obtained from two centres was interrogated. ARFI SV estimation was performed with 10 right lobe measurements. Fibrosis stage was confirmed in 84 by right lobe liver biopsy within 2 hours of ARFI, and cirrhosis was confirmed by B-mode US imaging criteria in the remaining 12. B-mode and histopathological data was collated retrospectively. Diagnostic performance of ARFI was determined by ROC analysis, using: a) reference SV cut-off values for Metavir stage, and b) optimal SV thresholds for cirrhosis derived from our local data, including subgroup analysis.

RESULTS

Three subgroups were analysed: 1) all 96 cases, including 20 patients with co-pathology (HBV, NAFLD, or ALD); 2) 76 cases with HCV only; 3) 84 cases who had simultaneous biopsy. Cirrhosis was present in 26, 20 and 14, respectively. Predictive accuracy for Metavir F4 using the reference threshold of 1.75 m/sec was 90%, 92% and 88% in groups 1, 2 and 3, respectively. Using new thresholds and ARFI mean SVs required a higher cutoff of 1.99 in group 1 compared with 1.64 in groups 2 and 3 to achieve accuracies of 87% – 93%, whereas more consistent performance across all groups was achieved with median SVs at a cutoff of 1.89, achieving accuracies of 93%, 96% and 92%, respectively.

CONCLUSION

These “real world” data confirm high predictive accuracy of ARFI for Metavir F4 cirrhosis in our local HCV cohort. Optimal performance was seen for median SV cutoff of 1.89 m/sec. However, adjustment of diagnostic thresholds may be necessary when making treatment decisions for less selected populations and in patients with co-existent pathology.

CLINICAL RELEVANCE/APPLICATION

ARFI has high predictive accuracy for Metavir F4 cirrhosis in real world HCV patients. However, population specific diagnostic thresholds are recommended to optimise accuracy.

SSA09-08 Liver Inflammation and Fibrosis (LIF) Scores in a Large Population Study: Normal values by Body Mass Index and Liver Fat

Sunday, Nov. 27 11:55AM - 12:05PM Room: E450B

Participants
Catherine Kelly, MSc,DPhil, Oxford, United Kingdom (*Abstract Co-Author*) Employees, Perspectum Diagnostics
Matt Kelly, PhD, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics
Rajarshi Banerjee, MD,DPhil, Oxford, United Kingdom (*Presenter*) CEO, Perspectum Diagnostics
Stella Kin, MSc, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics
Miranda Phillips, BSC, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics
Amy Herlihy, PhD, Oxford, United Kingdom (*Abstract Co-Author*) Employee, Perspectum Diagnostics

PURPOSE

Multiparametric MRI is increasingly used in the non-invasive assessment of liver physiology, with recent application in the assessment of fatty liver disease (FLD). FLD is characterised by the presence of elevated liver fat which can develop into steatohepatitis and fibrosis. Normal values for hepatic fat (specifically proton density fat fraction - PDFF) are widely established. The Liver Inflammation and Fibrosis (LIF) score is a novel metric for assessing liver inflammation and fibrosis, based on T1 mapping technology corrected for liver iron content. It has been shown to predict clinical outcomes. The purpose of this study was to describe the normal values of LIF using data from the world's largest prospective liver imaging study.

METHOD AND MATERIALS

Three thousand and seventy-one participants aged from 40-59 underwent a multiparametric MRI scan as part of the UK Biobank imaging study. All data were collected on a 1.5T Siemens Aera. The proton density fat fraction (PDFF) and LIF score were calculated from the MRI data.Normality in terms of liver health was defined as a BMI < 25 (BMI is a risk factor for non-alcoholic fatty liver disease) and PDFF<5% (the clinical threshold for steatosis).

RESULTS

Out of the 3071 initial subjects, 1687 (55%) of the population were defined as obese (BMI > 25) and 618 (20%) had a PDFF measurement of greater than 5%, suggestive of fatty liver disease. This is in agreement with previous reported estimates. 1289 (42%) of the subjects were defined as normal (where PDFF<5% and a BMI < 25). The distribution of LIF values in three populations (not obese, no steatosis and no steatosis AND not obese) is shown in the Figure. For the normal population, the LIF score ranged from 0.3334 and 2.632 with a median value of 0.82 (IQR 0.7106-0.9529) and a mean value of 0.8802 (std dev 0.28).

CONCLUSION

The normal range of LIF values in a population with no indicators for fatty liver disease is 0.7106-0.9529 [IQR] with an upper limit of normal of 1.45 (mean + 2 sd).

CLINICAL RELEVANCE/APPLICATION

The normogram presented in this study can serve as a benchmark for other studies using the LIF score to assess the normality of their population. Previous studies have shown that a cutoff value of 2 predicts clinical outcomes (Pavlides et al. 2016) with a negative predictive value of 100%. This suggests that maintaining a healthy BMI and liver fat percentage reduces the likelihood of suffering from liver-related clinical outcomes.

SSA09-09 Gastrointestinal Keynote Speaker: Image-based Liver Fibrosis Quantification

Sunday, Nov. 27 12:05PM - 12:15PM Room: E450B

Participants
Claude B. Sirlin, MD, San Diego, CA (*Presenter*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Guerbet SA; ;

SSA22

Physics (MR-Techniques)

Sunday, Nov. 27 10:45AM - 12:15PM Room: S405AB

BQ MR PH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: .50

FDA Discussions may include off-label uses.

Participants
Chen Lin, PhD, Indianapolis, IN (*Moderator*) Nothing to Disclose
Edward F. Jackson, PhD, Madison, WI (*Moderator*) Nothing to Disclose

Sub-Events

SSA22-01 Dual-Echo Dixon Imaging in the Presence of Large Field Inhomogeneities

Sunday, Nov. 27 10:45AM - 10:55AM Room: S405AB

Awards
Trainee Research Prize - Fellow

Participants
Eric Stinson, PhD, Rochester, MN (*Presenter*) Nothing to Disclose
Phillip M. Young, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Joel G. Fletcher, MD, Rochester, MN (*Abstract Co-Author*) Grant, Siemens AG; ;
Joshua D. Trzasko, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Stephen J. Riederer, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this work is to demonstrate dual-echo Dixon imaging with a novel cost-based, graph-cuts-guided optimization that allows for successful separation of fat and water images in regions of high B0 inhomogeneity.

METHOD AND MATERIALS

Dual-echo Dixon imaging under a linear signal model is an inherently underdetermined problem with two complex knowns (the two images at different echo times) and five real-valued unknowns (magnitude and initial phase of both water and fat and the inhomogeneity in the main magnetic field, ΔB0). By constraining the initial phase, φ0, of the water and fat images to be equal, the now nonlinear problem has only four real-valued unknowns (magnitude of water and fat, φ0, and ΔB0). Therefore, to find the maximum likelihood solution, the minimum of a four-dimensional cost function must be found. Additionally, to avoid signal swaps, the solutions for ΔB0 and φ0 must be unwrapped before reconstructing the water and fat images.In this work, we utilize nested variable projection to reduce the four-dimensional cost function to that of one dimension (solved for ΔB0). When the maximum likelihood solutions have been found, ΔB0 and φ0 are unwrapped via minimization of a regularized cost function that promotes smoothness. The greedy binary optimization is guided by graph cuts, and allows for large B0 inhomogeneities to be resolved.This reconstruction algorithm was used to reconstruct dual-echo CE-MRA images for the thighs and pelvic images depicting perianal fistulas.

RESULTS

Images from a dual-echo CE-MRA study in the thighs depict a successful water/fat separation despite absolute ΔB0 values greater than 2500 Hz near the edge of the field-of view. The largest ΔB0 values in this thigh study represent field inhomogeneities of ~20 parts per million. Similar separation results are seen in the pelvis, demonstrating successful separation in a smaller field-of-view within which the field is more homogenous.

CONCLUSION

Dual-echo Dixon imaging with a constrained phase signal model and a regularized graph-cuts-guided optimization is able to successfully separate images of fat and water signals in the presence of large inhomogeneities in the main magnetic field.

CLINICAL RELEVANCE/APPLICATION

Fat suppression allows visualization of pathologies obscured by fat signal, but is confounded by large B0 inhomogeneities. The method described here performs well even with large B0 inhomogeneities.

SSA22-02 Magnetic Resonance Fingerprinting: Mitigating the Bias in the Quantification of T1 and T2 Caused by Macromolecules

Sunday, Nov. 27 10:55AM - 11:05AM Room: S405AB

Participants
Tom Hilbert, Lausanne, Switzerland (*Abstract Co-Author*) Employee, Siemens AG
Florian Knoll, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Tiejun Zhao, PhD, Pittsburgh, PA (*Abstract Co-Author*) Employee, Siemens AG
Kai Tobias Block, PhD, New York, NY (*Abstract Co-Author*) Royalties, Siemens AG
Jean-Philippe Thiran, PhD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Gunnar Krueger, DPHIL, Lausanne, Switzerland (*Abstract Co-Author*) Employee, Siemens AG
Tobias Kober, Lausanne, Switzerland (*Abstract Co-Author*) Employee, Siemens AG
Daniel Sodickson, MD, PhD, New York, NY (*Abstract Co-Author*) Royalties, General Electric Company License agreement, General Electric Company Royalties, Bruker Corporation License agreement, Bruker Corporation Research collaboration, Siemens AG
Martijn A. Cloos, PhD, New York, NY (*Presenter*) Nothing to Disclose

PURPOSE

In this work we aim to mitigate the bias in the quantification of T1 and T2 caused by macromolecules when using magnetic resonance fingerprinting (MRF).

METHOD AND MATERIALS

Magnetization transfer (MT) effects can bias the estimation of T1 and T2 in MR and are caused by dipolar effects and chemical exchange between free water and macromolecules. We used a radial MRF sequence to measure the T1 and T2 in the brain of a healthy volunteer at 3T. The same measurement was performed with three different RF pulse durations (5 ms, 2 ms, and an interleaved mix of both). The first two measurements were reconstructed using the traditional method, whereas the last scan was reconstructed using a new prototype algorithm which includes a specialized MT model.

RESULTS

In the conventional fingerprinting sequence, the white-matter T2 values show a dependence on the RF pulse duration (48 ms for the long and 35 ms the short pulses). Moreover, compared to the values reported in the literature (~60 ms), both configurations significantly underestimate the true T2. Using a mix of different RF pulse durations in combination with the proposed algorithm, an MT bias map can be extracted which enables a more accurate measurement of T2 (~60ms).

CONCLUSION

Here we demonstrate that the quantification of relaxation parameters using fingerprinting is sensitive to MT effects and show that this bias can be mitigated by varying the RF pulse duration in the sequence and incorporating a MT model into the reconstruction process.

CLINICAL RELEVANCE/APPLICATION

Unlike weighted images, quantitative imaging enables intra- and inter-subject comparison. Unbiased quantitative measures promise benefits to diagnosis, staging and monitoring of pathology and therapy.

SSA22-03 Motion Imaging in Thoracic and Abdominal MRI using a Self-Navigated Cartesian Compressed Sensing Acquisition and Reconstruction Scheme

Sunday, Nov. 27 11:05AM - 11:15AM Room: S405AB

Participants
Thomas Kuestner, DIPLENG, Stuttgart, Germany (*Presenter*) Nothing to Disclose
Sergios Gatidis, MD, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian Wuerslin, Stanford, CA (*Abstract Co-Author*) Research Grant, General Electric Company
Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Petros Martirosian, PhD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Fritz Schick, MD, PhD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Bin Yang, PhD,DIPLENG, Stuttgart, Germany (*Abstract Co-Author*) Nothing to Disclose
Nina Schwenzer, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Holger Schmidt, PhD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Respiratory motion is a main source of image artifacts in thoracic and abdominal MRI that can strongly deteriorate image quality. The purpose of this study was to implement and evaluate a Compressed Sensing-based acquisition and reconstruction scheme for motion imaging in thoracic and abdominal MRI under free-movement (respiration, cardiac motion).

METHOD AND MATERIALS

The proposed method consists of an acquisition and a reconstruction step.
A 3D T1-weighted gradient echo (GRE) sequence is acquired using a sparse variable-density Poisson-Disc k-space sampling in a short scan time of 90s under free-movement. The acquired k-space data is retrospectively gated according to an extracted self-navigation signal which captures the periodic respiratory motion. An additionally acquired ECG signal allows performing a cardiac motion-correction simultaneously. The gates are subsequently jointly reconstructed using Compressed Sensing techniques yielding a respiratory and cardiac motion-resolved 4D (3D+time) image. A single 3D motion-corrected image can be derived by image registration.
The method is evaluated for 20 healthy volunteers on a 3T PET/MR scanner. Image quality of MR images acquired using the proposed method is compared to a standard GRE sequence without motion correction and to a breath-hold image using statistical features. In addition, subjective image quality is rated by five radiologists on a 3-point score (3:best).

RESULTS

The proposed method achieves significant quantitative and qualitative improvement in image quality with perceptible reduction of motion artifacts (respiration and heart). Motion-corrected images are of similar image quality as breath-hold/triggered acquisitions with an average score of 2.6 and good motion resolvability (liver-lung boundary slope steepness improvement over free-movement images of 288%±150%).

CONCLUSION

MR motion imaging using a Cartesian Compressed Sensing acquisition and reconstruction scheme with self-navigation is feasible and achieves a marked reduction of motion artifacts in free-movement acquisitions in a short scan time.

CLINICAL RELEVANCE/APPLICATION

The proposed method may contribute to more robust motion imaging and correction, yielding a better diagnostic image quality in anatomic areas with repetitive motion.

SSA22-04 Automated Quantification of Intermuscular Adipose Tissue on Thigh MRI of Varying Severities of Muscle Disease

Sunday, Nov. 27 11:15AM - 11:25AM Room: S405AB

Participants
William Kovacs, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Chia-Ying Liu, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Nuria Carrillo, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Ronald M. Summers, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Royalties, iCAD, Inc; ;
Jianhua Yao, PhD, Bethesda, MD (*Abstract Co-Author*) Royalties, iCAD, Inc
Isabella Nogues, BA, Bethesda, MD (*Presenter*) Nothing to Disclose

PURPOSE

Our goal is to develop a system capable of quantifying the amount of muscle, subcutaneous (SAT) and intermuscular (IMAT) adipose tissue on thigh MRI in cases of severe muscle disease.

METHOD AND MATERIALS

A sequence of advanced image processing algorithms is developed to classify tissues and identify fascia lata in the thighs. Our program first separates left and right thighs and applies the N4ITK algorithm to correct intensity inhomogeneities inherent in T1 weighted MRI. Fuzzy c-means is then used to separate muscle and adipose tissues. The bone is identified via histogram analysis and region growing. A thin-line gradient filter is passed over the image, and potential fascia lata points are identified as the max response along rays from the thigh's center to its boundary. A contour to separate the SAT and IMAT is constructed by checking each ray and connecting the potential fascia points. Outliers are removed in this contour based on neighborhood information, and a piecewise smooth Bernstein polynomial is fitted to obtain the fascia lata boundary.We tested our method on the T1 sequence of the thighs of 38 patients (aged 41±11, and 17 male and 21 female) with GNE myopathy at varying degrees of thigh muscle involvement (9 Mild, 23 Moderate, 6 Severe). Of these, 12 patients (4 of each group) had 3 slices manually segmented as reference.

RESULTS

Based on our automatic segmentation, we found that the IMAT percentage of the thigh was 13±3%, 24±7%, and 36±8% in mild, moderate, and severe groups, respectively. Comparisons between manual and automated segmentation reveal a varying amount of agreement depending on the level of severity of the muscle involvement. We achieved Dice coefficients of 0.95±0.01, 0.91±0.03, and 0.68±0.07 for muscle, SAT, and IMAT, respectively, in mild group, of 0.94±0.01, 0.92±0.05, and 0.83±0.03 in moderate group, and 0.76±0.23, 0.90±0.02, and 0.87±0.03 in severe group. The R2 value between manual and automated measurements for the percentage of muscle, SAT, and IMAT in the thigh were 0.99, 0.97, and 0.96, respectively for the validation set.

CONCLUSION

We have demonstrated an automated and robust method to distinguish between the SAT and IMAT of the thigh, thus making it capable of quantifying the different tissue types regardless of disease severity.

CLINICAL RELEVANCE/APPLICATION

The proposed system provides consistent quantification of thigh tissue composition and can be used to effectively study and track muscle disease.

SSA22-05 Automated Image Quality Assessment in Whole-Body MRI

Sunday, Nov. 27 11:25AM - 11:35AM Room: S405AB

Participants
Sergios Gatidis, MD, Tubingen, Germany (*Presenter*) Nothing to Disclose
Annika Liebgott, MSc, Stuttgart, Germany (*Abstract Co-Author*) Nothing to Disclose
Holger Schmidt, PhD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Nina Schwenzer, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Petros Martirosian, PhD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Fritz Schick, MD, PhD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Bin Yang, PhD,DIPLENG, Stuttgart, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Kuestner, DIPLENG, Stuttgart, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

MR image quality is highly variable due to numerous influencing factors and possible artifacts. Automated assessment of image quality may enable efficient optimization of MRI acquisition. The purpose of this study was to implement and evaluate a machine learning framework for automated analysis of whole-body MRI data.

METHOD AND MATERIALS

The proposed algorithm consists of a training phase with feature extraction, feature reduction and training of a classifier.
Image foreground and background were segmented prior to feature extraction using level set segmentation. A variety of image features (intensity-based, gradient-based and texture-based features) were obtained from each MR data set describing an image in a high-dimensional space. After feature reduction using principal component analysis, a Support Vector Machine was trained to categorize image quality into one of five classes (1: very high quality, 5: very poor quality). Subjective quality ratings given independently by 5 radiologists were used as ground truth labels in the training phase.
This method was applied on 2911 randomly selected MR images from different acquisition protocols of head/neck, thoracic and abdominal regions. 70% of these images were randomly used as a training set and 30% as test set.
Classification accuracy was measured as the percentage of correctly classified samples in the test set.

RESULTS

Ground truth image quality was classified by the radiologists with the following distribution: 1:10%; 2:21%; 3:29%; 4:28%; 5:12%. We observed varying classification accuracy depending on the amount and selection of features used. Optimal classification

accuracy of 92% was observed using a total of 3039 features and 36 principal components. Most classification errors occurred between classes 1 (very good quality) and 2 (good quality).

CONCLUSION

Automated assessment of MR image quality is feasible using a machine learning approach and yields a high classification accuracy.

CLINICAL RELEVANCE/APPLICATION

The presented method can contribute to automated optimization of MR image quality in clinical practice or assisted image acquisition and reading and thus possibly improve diagnostic efficacy.

SSA22-06 Changing Temporal Resolution of DCE-MRI Radial VIBE Data by ICTGV Reconstruction

Sunday, Nov. 27 11:35AM - 11:45AM Room: S405AB

Participants
Matthias Schloegl, Graz, Austria (*Abstract Co-Author*) Nothing to Disclose
Martin Holler, Graz, Austria (*Abstract Co-Author*) Nothing to Disclose
Kristian Bredies, Graz, Austria (*Abstract Co-Author*) Nothing to Disclose
Rudolf Stollberger, PhD, Graz, Austria (*Presenter*) Nothing to Disclose

PURPOSE

To explore the adjustment of the temporal resolution of DCE-MRI after data acquisition by a new iterative reconstruction technique.

METHOD AND MATERIALS

his fully HIPAA-compliant study uses raw data of already acquired golden angle radial DCE-MRI scans and reconstructs dynamic image series with different temporal resolution with a new reconstruction technique based on infimal convolution total generalized variation (ICTGV). Data acquisition was performed for DCE liver scan at 3Tesla with a 12 element body array coil. A 3D radial VIBE sequence (stack of stars) was performed with 30 slice encodings and 600 spokes per slice. With a standard compressed sensing GRASP algorithm a spatial resolution of 1x1x3 mm (matrix = 384x384x30) and a temporal resolution of 2.6s would be obtained. ICTGV was used to retrospectively reconstruct a dynamic series with a higher temporal resolution by grouping number of consecutive spokes. This approach was compared for the same undersampled number of projections with low-rank sparse (L+S) reconstruction and the GRASP technique.

RESULTS

DCE-series were reconstructed by using 8, 14, and 21 spokes- per-frame (spf) resulting in a temporal resolution of 0.94, 1.7 and 2.6 s. For 8 and 14 spokes, the standard GRASP reconstruction delivered a noisy image quality suffering from aliasing artifacts. L+S and ICTGV suppressed the aliasing artifacts much better and preserved also tiny image details (see Fig. for 8 spokes). The analysis of the arterial input function shows a marked temporal blurring for the L+S reconstruction. The AIF determined from ICTGV reconstruction shows the best SNR, the highest peak value and a pronounced second pass (see Fig.).

CONCLUSION

ICTGV outperformed both alternative algorithms in spatial and temporal SNR and allows calculating dynamic 3D data with high temporal resolution to better characterize the contrast-agent related functional signal changes. Therefore ICTGV reconstruction is able to improve the data basis for subsequent quantitative analysis.

CLINICAL RELEVANCE/APPLICATION

The investigated method allows combining high spatial and high temporal resolution and a retrospective adjustment depending on specific patho-morphological requirements.

SSA22-07 Assessment of the Accuracy, Repeatability, and Efficiency of Accelerated Variable Flip Angle T1 Mapping Techniques Using a NIST-traceable MR System Phantom

Sunday, Nov. 27 11:45AM - 11:55AM Room: S405AB

Participants
Alexander Antolak, Madison, WI (*Presenter*) Nothing to Disclose
Edward F. Jackson, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Assess the accuracy and repeatability of a variable flip angle (VFA) 3D-FSPGR T1 mapping method using a recently commercialized NIST/ISMRM MR System Phantom with and without parallel imaging and with 2 to 7 flip angles.

METHOD AND MATERIALS

The NIST/ISMRM MR System Phantom, produced by High Precision Devices, Inc (Boulder, CO), contains, among other inserts, an array of 14 spheres with T1 values ranging from 23 to 2033 ms at 1.5 T. The NiCl2 solutions used to fill the spheres are prepared and maintained by NIST to ensure stability and accuracy. The phantom was imaged 3 times over 4 days on a GE HDxt 1.5 T MR scanner using a 3D-FSPGR sequence with 7 flip angles from 2 to 30 degrees and 4 averages. In addition, parallel imaging was applied with no averaging, and subsets of the 7 flip angle data, with and without parallel imaging, were used to investigate the impact of decreased acquisition times on T1 measurement accuracy and repeatability. T1 calculations were performed in Matlab using a nonlinear least squares fit. The mean T1 value, standard deviation, and percent deviation from nominal T1 values were computed for each T1 sphere in the phantom.

RESULTS

For all cases, the minimum deviation from nominal T1 values was 14%. The deviation increased for larger T1 values, up to a maximum of 30%. Total scan time for the 4 average T1 mapping protocol using 7 flip angles was approximately 18 minutes. Parallel imaging with an acceleration factor of 2 and no averaging provided similar results to the 7 flip angle, 4 average protocol while decreasing the imaging time by a factor of 8. T1 mapping accuracy was also maintained using only 3 flip angles instead of 7 (with

and without parallel imaging). Using 3 flip angles and parallel imaging together decreased the imaging time from approximately 18 minutes to 1 minute. The maximum coefficient of variation across all 3 acquisitions for any T1 sphere and acquisition strategy was 5%.

CONCLUSION

Highly repeatable estimates of T1 relaxation times can be obtained when using parallel imaging and as few as 3 flip angles, significantly improving the efficiency of T1 measurements. Parallel imaging, with acceleration factors of 2, have minimal impact on repeatability and accuracy.

CLINICAL RELEVANCE/APPLICATION

To be clinically relevant, T1 measurements should be acquired efficiently and with known accuracy and repeatability. Parallel imaging had no significant impact on the quality of such measures.

SSA22-08 fMRI in All Plane Orientations with Decreased Image Distortion Using A 2D RF Pulse for Field-of-View Reduction

Sunday, Nov. 27 11:55AM - 12:05PM Room: S405AB

Awards
Student Travel Stipend Award

Participants
Muge Karaman, PhD, Chicago, IL (*Presenter*) Nothing to Disclose
Yi Sui, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Ying Xiong, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Xiaohong J. Zhou, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To demonstrate the use of a 2D excitation radio-frequency (RF) pulse for fMRI over a reduced field-of-view (rFOV) to reduce image distortion in a focused region in not only an axial, but also sagittal and coronal planes that are conventionally prohibitive due to excessive image distortion.

METHOD AND MATERIALS

A 2D RF pulse was designed and incorporated into a single-shot echo planar imaging (ssEPI) sequence. The pulse features a tilted excitation profile to enable multi-slice imaging and simultaneous lipid suppression. With IRB approval, fMRI experiments were carried out on five healthy human subjects at 3T with a 32-channel head coil using a flashing checkerboard visual activation or a finger tapping task (5 epochs of 30s on and 30s off). For comparison, both a commercial full FOV (fFOV) and the proposed rFOV sequences were used. The visual cortex experiments (VCEs) were performed in the axial and sagittal planes with the same in-plane resolutions of $1.875\times1.875mm^2$. The motor cortex experiments (MCEs) were performed in the axial and coronal planes with in-plane resolutions of $1.875\times1.875mm^2$ and $1.875\times1.5mm^2$, respectively. The activation *t*-maps were calculated using SPM12 and superimposed on 3D T1-weighted anatomical or EPI images.

RESULTS

The activated voxels from the axial, sagittal, or coronal VCEs and MCEs in the rFOV images were substantially better registered to the T1-weighted images than those in the fFOV images due to the reduced image distortion. In the coronal-MCEs, the false positive activations on the skull decreased noticeably in the rFOV compared to the fFOV acquisition. The close resemblance between the rfOV coronal-MCE activation and the reformatted coronal view of the fFOV axial-MCE activation provides further evidence demonstrating the benefit of using the proposed rFOV technique over the fFOV sequence in the coronal plane without suffering from intensity discontinuity imposed by slice reformatting.

CONCLUSION

The proposed rFOV ssEPI sequence outperformed the conventional ssEPI sequence particularly in non-axial planes where the excessive distortion often makes EPI-based fMRI prohibitive.

CLINICAL RELEVANCE/APPLICATION

This rFOV technique provides flexibility in selecting acquisition planes without suffering from excessive image distortion, allowing fMRI to be performed in a plane that best matches the activation regions.

SSA22-09 Volumetric Respiratory-Resolved and Cardiac--Resolved MR Flow Imaging

Sunday, Nov. 27 12:05PM - 12:15PM Room: S405AB

Participants
Joseph Y. Cheng, PhD, Stanford, CA (*Presenter*) Research support, General Electric Company
Marcus T. Alley, PhD, Stanford, CA (*Abstract Co-Author*) Research funded, General Electric Company; Research Consultant, Arterys Inc
John Pauly, Stanford, CA (*Abstract Co-Author*) Research support, General Electric Company
Michael Lustig, PhD, Berkeley, CA (*Abstract Co-Author*) Nothing to Disclose
Shreyas S. Vasanawala, MD, PhD, Stanford, CA (*Abstract Co-Author*) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;

PURPOSE

Volumetric cardiac-resolved MR flow imaging (4D flow) enables the assessment of flow, function, and anatomy from a single sequence. This technique simplifies and shortens congenital heart disease (CHD) MRI exams. Modern accelerated imaging techniques enable the acquisition to be performed in a practical 5–15 min scan. With patients freely breathing, the impact of respiration on cardiac flow quantification is typically ignored. The purpose of this work is to develop an ultra-high-dimensional flow imaging technique (ND flow) to evaluate the impact of respiration on cardiac flow quantification.

METHOD AND MATERIALS

With IRB approval and informed consent, pediatric patients were imaged with MRI, ferumoxytol administration, and general anesthesia. A Cartesian 4D flow sequence is modified to include intrinsic navigators and pseudo-random variable-density k-t sampling. The EKG and navigation signals are used to retrospectively sort the data into respiratory and cardiac phases. A compressed-sensing-based parallel imaging method is used to reconstruct this highly-subsampled dataset. The proposed technique is compared to conventional 4D flow with and without respiratory motion compensation through soft-gating (SG). Velocity images are corrected for background phase errors, and flow is quantified in the superior and inferior vena cava (SVC and IVC).

RESULTS

Using the proposed ND flow in a 3-yr-old female, 0.75–0.84 L/min (mean 0.74 L/min) for the SVC and 0.15–0.69 L/min (mean 0.44 L/min) for the IVC were observed for total blood flow as a function of respiration. For conventional 4D flow, a flow of 0.40 L/min (with and without SG) in the IVC and a flow of 0.72 (no SG) and 0.75 L/min (with SG) in the SVC were measured. Respiratory-dependent flows were also measured in a 10-yr-old male: 0.72–2.0 L/min (mean 1.4 L/min) for SVC and 0.48–1.1 L/min (mean 0.9 L/min) for IVC. For conventional 4D flow, 1.33 and 1.49 L/min (without and with SG) in the SVC and 0.98 and 1.0 L/min (without and with SG) in the IVC were measured.

CONCLUSION

Respiratory-induced blood flow variations has been demonstrated using ND flow. This technique will provide a tool to investigate specific CHDs, how anesthesia impacts flow measurements, and the relationship between respiratory and cardiac systems.

CLINICAL RELEVANCE/APPLICATION

Respiration may impact cardiac flow quantification, and we present a tool to evaluate and study this effect for potentially more accurate blood flow measurements.

RC115

The Biology of Breast Cancer

Sunday, Nov. 27 2:00PM - 3:30PM Room: N228

BR BQ

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

Participants
Cherie M. Kuzmiak, DO, Chapel Hill, NC, (Cherie_kuzmiak@med.unc.edu) (*Moderator*) Research Grant, FUJIFILM Holdings Corporation;

LEARNING OBJECTIVES

ABSTRACT

Sub-Events

RC115A Breast Cancer Genomics

Participants
Cherie M. Kuzmiak, DO, Chapel Hill, NC, (Cherie_kuzmiak@med.unc.edu) (*Presenter*) Research Grant, FUJIFILM Holdings Corporation;

LEARNING OBJECTIVES

1) Understand the molecular classification of breast cancer and comparison with clinical definitions. 2) Learn some of the main genomic features and clinical and treatment outcomes that stratify with the molecular subtypes.

ABSTRACT

RC115B Breast Imaging for Improved Understanding of Genetic Risk & Cancer Biology

Participants
Elizabeth S. Burnside, MD, MPH, Madison, WI, (eburnside@uwhealth.org) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the different types of genetic information that are being measured and used for the clinical care of breast cancer. 2) Convey that cancer development and evolution depends on both genetics and environment influences. 3) Demonstrate that imaging has the potential to better understand biology, capturing the complex combined influence of genetics and environment. 4) Illustrate the move toward personalized medicine in breast cancer and the role of imaging.

ABSTRACT

RC115C Imaging Appearance of Breast Cancer Subtypes

Participants
Karen S. Johnson, MD, Durham, NC, (karen.johnson2@dm.duke.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify known mammographic, sonographic, and MRI features of different immunohistochemical and molecular subtypes of breast cancer.

SPSH20

Hot Topic Session: MSK Quantitative Imaging Biomarkers: MRI and Beyond

Monday, Nov. 28 7:15AM - 8:15AM Room: E450A

MK BQ MR US

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

FDA Discussions may include off-label uses.

Participants

Sub-Events

SPSH20A MR Diffusion in the MSK System

Participants
Mark R. Robbin, MD, Cleveland Hts, OH, (mark.robbin@uhhospitals.org) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Apply MRI physics concepts of diffusion-weighted imaging techniques to clinical imaging Describe the current techniques and applications of diffusion-weighted imaging in evaluating musculoskeletal neoplasms Examine new techniques and applications of diffusion-weighted imaging.

SPSH20B Quantitative Techniques to Characterize MSK Tissue Structure and Function

Participants
Martin Torriani, MD, Boston, MA, (mtorriani@mgh.harvard.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Introduce concepts of how to perform quantitative musculoskeletal techniques focusing on 1H-MR spectroscopy. 2) Review current applications of MR spectroscopy with focus on muscle (sarcopenia, fatty infiltration, atrophy).

ABSTRACT

URL

SPSH20C Quantitative Musculoskeletal Ultrasound Elastography: Shear Wave Speed Measurements

Participants
Kenneth S. Lee, MD, Madison, WI, (klee2@uwhealth.org) (*Presenter*) Grant, General Electric Company; Research support, SuperSonic Imagine; Research support, Johnson & Johnson; Consultant, Echometrix, LLC; Royalties, Reed Elsevier

LEARNING OBJECTIVES

1) Introduce the basic concepts of quantitative musculoskeletal ultrasound elastography using shear wave speed measurements. 2) Review the current applications of quantitative musculoskeletal elastography using shear wave speed measurements with focus on the tendon and muscle.

Active Handout:Kenneth S. Lee

http://abstract.rsna.org/uploads/2016/16002357/ACTIVE SPSH20C 2016 RSNA Quantitative US Imaging slide submission.pdf

MSMI21

Molecular Imaging Symposium: Basics of Molecular Imaging

Monday, Nov. 28 8:30AM - 10:00AM Room: S405AB

BQ MI MR US

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

FDA Discussions may include off-label uses.

Participants
Jan Grimm, MD, PhD, New York, NY (*Moderator*) Nothing to Disclose
Zaver M. Bhujwalla, PhD, Baltimore, MD (*Moderator*) Nothing to Disclose

Sub-Events

MSMI21A MI Using Radioactive Tracers

Participants
Jan Grimm, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) In this course, we will discuss the various radio tracers and their applications in Molecular Imaging studies. Participants will understand in which situations to use which radio tracers, what to consider when developing the imaging construct and what controls to obtain for nuclear imaging studies. Examples will contain imaging with small molecules, with antibodies and nanoparticles as well as with cells in order to provide the participants with examples how o correctly perform their imaging studies. Most of the examples will be from the oncology field but their underlying principles are universally applicable to other areas as well.

ABSTRACT

Nuclear Imaging is currently the only true "molecular" imaging method utilized in clinic. It offers quantitative imaging of biological processes in vivo. Therefore, it is not surprising that it is also highly frequented in preclinical imaging applications since it is currently the only true quantitative imaging method. Multiple agents have been developed, predominantly for PET imaging but also for SPECT imaging.In this talk, we will discuss the application of radio tracers to molecular imaging and what to consider. Common pitfalls and mistakes as well as required measures to avoid these will be discussed. We will discuss various examples of imaging constructs, ranging from small molecules to antibodies, nanoparticles and even cells. In addition, the imaging modalities will also briefly discussed, including PET, SPECT and Cherenkov imaging.

MSMI21B Molecular MRI and MRS

Participants
Zaver M. Bhujwalla, PhD, Baltimore, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To define the role of MRI and MRS in molecular and functional imaging and cover specific applications in disease processes. 2) The primary focus will be advances in novel theranostic approaches for precision medicine.

ABSTRACT

With an array of functional imaging capabilities, magnetic resonance imaging (MRI) and spectroscopy (MRS) techniques are valuable in obtaining functional information, but the sensitivity of detection is limited to the 0.1-1 mM range for contrast agents and metabolites, respectively. Nevertheless, MRI and MRS are finding important applications in providing wide-ranging capabilities to tackle key questions in cancer and other diseases with a 'molecular-functional' approach. An overview of these capabilities and examples of MR molecular and functional imaging applications will be presented with a focus on theranostic imaging for precision medicine.

MSMI21C Nanoparticles

Participants
Heike E. Daldrup-Link, MD, Palo Alto, CA, (heiked@stanford.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand important safety aspects of USPIO. 2) Recognize the value of immediately clinically applicable iron oxide nanoparticles for tumor MR imaging applications. 3) Learn about intrinsic immune-modulating therapeutic effects of USPIO.

ABSTRACT

NanoparticlesNanoscale materials can be employed to develop novel platforms for understanding, diagnosing, and treating diseases. Integrating nanomedicine with novel multi-modality imaging technologies spurs the development of new personalized diagnostic tests and theranostic (combined diagnostic and therapeutic) procedures. This presentation will provide an overview over the safety, diagnostic applications and therapeutic implications of clinically applicable ultrasmall superparamagnetic iron oxide nanoparticles (USPIO). USPIO which are currently used for clinical applications include ferumoxytol (Feraheme), an FDA-approved iron supplement, and ferumoxtran-10 (Combidex/Sinerem), which is currently undergoing renewed clinical trials in Europe. Safety considerations for these agents will be discussed. Since USPIO are not associated with any risk of nephrogenic sclerosis, they can be used as alternative contrast agents to gadolinium chelates in patients with renal insufficiency or in patients in whom creatinine lab values are not available. Both ferumoxytol and ferumoxtran-10 provide long lasting blood pool enhancement, which can be used

for MR angiographies and tissue perfusion studies. Subsequently, USPIO are slowly phagocytosed by macrophages in the reticuloendothelial system (RES), which can be used to improve MRI detection of tumors in liver, spleen, lymph nodes and bone marrow. A slow phagocytosis by tumor associated macrophages (TAM) in the tumor microenvironment can be used to grade tumor-associated inflammation and monitor the efficacy of new cancer immunotherapies. This opens opportunities for new discoveries in the area of cancer immunology and immunotherapy. TAM imaging concepts could represent a significant breakthrough for clinicians as a new means for risk stratification and as a new gold-standard imaging test for tracking treatment response in TAM-directed immunotherapy trials, which are currently entering clinical applications.

MSMI21D Contrast Ultrasound

Participants
Steven B. Feinstein, MD, Chicago, IL (*Presenter*) Research support, General Electric Company; Consultant, General Electric Company;

LEARNING OBJECTIVES

1) Inform: Clinical utility and safety of contrast enhanced ultrasound (CEUS) imaging. 2) Educate: Current diagnostic and therapeutic approaches. 3) Introduce: Newer concepts for combined diagnostic and therapeutic applications.

ABSTRACT

Contrast-Enhanced Ultrasound (CEUS) provides a novel, multi-faceted approach to diagnostic imaging and localized drug/gene delivery systems. The value-added proposition of CEUS centers on the pillars of safety, effectiveness, and economics. Specifically, in the field of diagnostic imaging, 3D CEUS ultrasound technology challenges the established formats CT, MR, and PET. CEUS provides distinct advantages including real-time volumetric imaging, unparalleled spatial and temporal resolution, economies of scale and all without exposure to unnecessary, ionizing radiation. Our efforts to develop 3D and contrast-enhanced ultrasound imaging continues to provide academic leadership while advancing the clinical field of cardiovascular medicine, urology (prostate imaging), and cancer (monitoring and therapy). In the evolving field of the ultrasound therapeutics, CEUS provides a novel, localized delivery system for ethical drugs and nucleic acids; all effectively delivered without viral-mediated agents. Further, the global installed base of ultrasound along with the safety record and ease of patient access highlights the utility of CEUS as a truly competitive, therapeutic delivery modality.In April 1, 2016, the USA FDA approved CEUS for liver imaging in adults and children. This is likely to have a major, paradigm chage in healthcare in the USA.

MSMI21E Quantitative Imaging Biomarkers

Participants
Richard L. Wahl, MD, Saint Louis, MO (*Presenter*) Consultant, Nihon Medi-Physics Co, Ltd;

LEARNING OBJECTIVES

1) Identify at least one method of quantitatively assessing anatomic tumor response . 2) Identify at least one method of quantitatively assessing metabolic tumor response using FDG PET . 3) Identify an MRI quantitative metric which is associated with cellularity of biological processes and which can be used in response assessments.

ABSTRACT

Radiology initially developed as an analog imaging method in which non quantitative data were interpreted in a "qualitative and subjective" manner. This approach has worked well, but modern imaging also is digital, quantitative and has the opportunity for more quantitative and objective interpretations. This lecture will focus on a few areas in which quantitative imaging is augmenting qualitative image assessments to lead to more precise interpretation of images. Examples of such an approach can include measuremental of tumor "metabolic" activity using formalisms such as PERCIST 1.0; methods of assessment of tumor size and volumes using the RECIST 1.1 and emerging formalisms and metrics of tumor heterogeneity, density, receptor density, diffusion, vascular permeability and elasticity using techniques incuding PET/SPECT, MRI, CT and ultrasound. With quantitative imaging, the opportunity to move from qualitative methods to precise in vivo quantitative pheontyping is a real one, with a quantitative "phenome" complementing other "omics" such as genomics. However, the quality of quantitation may vary and close attention to technical methodologies and process are required to have reliable and accurate quantitation. The RSNA QIBA effort will be briefly reviewed as one approach to achieve precise quantiative phenotyping. Examples of the use of quantitative phenotyping to inform patient management will 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/

Richard L. Wahl, MD - 2013 Honored Educator

MSRO24

BOOST: CNS-Oncologic Anatomy and Contouring Review: Emphasis on Molecular Markers and Role of MR/PET Imaging (An Interactive Session)

Monday, Nov. 28 8:30AM - 10:00AM Room: S103CD

NR BQ MI MR NM RO

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

Participants
Rajan Jain, MD, Hartsdale, NY (*Presenter*) Consultant, Cancer Panels; Royalties, Thieme Medical Publishers, Inc
Michael D. Chan, MD, Winston-Salem, NC (*Presenter*) Advisory Board, NovoCure Ltd
Christina I. Tsien, MD, Saint Louis, MO (*Presenter*) Speaker, Merck & Co, Inc

LEARNING OBJECTIVES

1) Describe how to differentiate gliomas from lymphoma, metastases as well as non-neoplastic etiologies such as demyelinating lesions: Role of functional imaging modalities. 2) Describe imaging characteristics of gliomas based on genomic differences: Imaging phenotype genotype correlation. 3) Advanced imaging techniques as a surveillance tool in post-therapy gliomas with emphasis on genomic markers.

ABSTRACT

Recent advances in glioma genomics have significantly changed our understanding of tumor biology and hence, affected how these patients are treated. Similarly, integrating imaging data with genomic markers has also helped create better prognostic and predictive biomarkers which offer promising future for personalized medicine. This session will highlight a multi-disciplinary approach with the focus on advanced imaging and genomics markers before and after therapy in gliomas.

RC220

Imaging Evaluation, Target Delineation and Response Evaluation for Skull Base and Spinal Stereotactic Radiosurgery/Radiotherapy

Monday, Nov. 28 8:30AM - 10:00AM Room: S404CD

NR BQ RO

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

Participants
Simon S. Lo, MD, Seattle, WA, (simonslo@uw.edu) (*Moderator*) Research support, Elekta AB; Travel support, Accuray Incorporated; Speaker, Accuray Incorporated;

LEARNING OBJECTIVES

After the course, participants should be able to discuss:1. Imaging Evaluation, Target Delineation and Response Evaluation for Stereotactic Radiotherapy for Skull Base Tumors.2. Imaging Evaluation, Target Delineation and Response Evaluation for Stereotactic Body Radiotherapy for Spinal Metastases.

ABSTRACT

Sub-Events

RC220A Imaging Evaluation of Skull Base and Spinal Tumors

Participants
Pejman Jabehdar Maralani, MD, FRCPC, Toronto, ON (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To demonstrate the role of various imaging modalities for detection and follow up of spinal and skull base metastasis. 2) To demonstrate the role of imaging in pre-radiation planning with a focus on SBRT.

ABSTRACT

The aim of this presentation is to discuss the diagnostic performance of plain film, CT scan, bone scan, MRI and PET for detection and follow up of spinal and skull base bony metastasis. We will discuss the lasts trends and limitations regarding each modality. We also discuss dedicated role of imaging in planning for SBRT.

RC220B Target Delineation and Response Evaluation for Skull Base Stereotactic Radiosurgery/Radiotherapy

Participants
Lia M. Halasz, MD, Seattle, WA, (lhalasz@uw.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize the challenges of target and normal structure delineation in the skull base. 2) Identify imaging modalities helpful to target and normal structure delineation. 3) Review data on pseudoprogression after radiation therapy to skull base tumors.

ABSTRACT

The aim of this session is to understand the challenges of target delineation and response evaluation in the treatment of skull base tumors. We will discuss helpful imaging modalities to aid in contouring and the issue of pseudoprogression in determining response.

RC220C Target Delineation for Spinal Stereotactic Radiosurgery/Radiotherapy

Participants
Kristin J. Redmond, MD, MPH, Baltimore, MD (*Presenter*) Research support, Elekta AB

RC220D Response Evaluation for Spinal Stereotactic Radiosurgery/Radiotherapy

Participants
Sten Myrehaug, MD, FRCPC, Toronto, ON (*Presenter*) Speakers Bureau, Pfizer Inc; Speakers Bureau, Novartis AG

LEARNING OBJECTIVES

1) Appreciate the challenges of spine response determination. 2) Issue of radiographic pseudoprogression. 3) Clinical trials and incorporation of response criteria.

ABSTRACT

The aim of this session is to understand the challenges of response determination with spine SBRT. In particular the issues of radiographic changes following high dose radiation. Clinical trials are in flux and determining how to handle response which will be discussed.

RC254

Precision Medicine through Image Phenotyping

Monday, Nov. 28 8:30AM - 10:00AM Room: S404AB

CA CH VA BQ IN

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

Participants

Ella A. Kazerooni, MD, Ann Arbor, MI, (ellakaz@umich.edu) (*Moderator*) Nothing to Disclose
Ella A. Kazerooni, MD, Ann Arbor, MI, (ellakaz@umich.edu) (*Presenter*) Nothing to Disclose
Eliot L. Siegel, MD, Baltimore, MD, (esiegel@umaryland.edu) (*Presenter*) Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Dell Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc; Research, TeraRecon, Inc ; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;
John J. Carr, MD, MS, Nashville, TN (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn what the term precision medicine means. 2) To understand how informatics intersects with clinical radiology to enable precision medicine in practice. 3) To learn through concrete examples how informatics based radiology precision medicine impacts health

ABSTRACT

Biomarkers have been emrabced by both the scientific and regulatory communities as surrogates end points for clinical trials, paving the way for their widespread use in medicine. The field of imaging biomarkers has exploded, and the their integration into clinical practice relies heaving on and intersects with the field ofbioinformatics.. Once specific biomakers are show to have value, easily integrating them into the digital environment of the radiologist and communcating them to the health care providers and or directly to patients effeiciently and seamlessly is important for their value and impact on health to be realized. Culturally, it is taking radiologists from the era of description and largely qualitative reporting, into a quantitative future state, and leveraging informatics to extract information from imaging alone ot together with data available in the electronic medical record is essential for future sucess in this new world. To get there, understanding the impact of this approach as a value of our services, and standardization of imaging technques along the lines of what the RSNA QIBA initiative is designing, are essential, so that imaging biomarkers are robust, accurate and reprodicbile. Embraching this approach enables and facilitates new appracohes, relationships of imaging and IT researchers, vendors and consumers, to fully realize the possiblities. This course willdiscuss and describe the overall constructs, and use tangible exams of using this in practice today and for the future.

Honored Educators

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Ella A. Kazerooni, MD - 2014 Honored Educator

SSC01

Cardiac (Non-Ischemic Cardiomyopathy)

Monday, Nov. 28 10:30AM - 12:00PM Room: S502AB

CA BQ MR

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

FDA Discussions may include off-label uses.

Participants
Konstantin Nikolaou, MD, Tuebingen, Germany (*Moderator*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Balazs Ruzsics, MD, PhD, Charleston, SC (*Moderator*) Nothing to Disclose
Friedrich D. Knollmann, MD, PhD, El Dorado Hls, CA (*Moderator*) Nothing to Disclose
Karin E. Dill, MD, Evanston, IL (*Moderator*) Nothing to Disclose

Sub-Events

SSC01-01 Assessment of the Estimated 5-year Risk of Sudden Cardiac Death (SCD) by Quantitative Cardiac Magnetic Resonance Sequences in Patients with Hypertrophic Cardiomyopathy (HCM)

Monday, Nov. 28 10:30AM - 10:40AM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Maxim Avanesov, MD, Hamburg, Germany (*Presenter*) Nothing to Disclose
Julia Munch, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Julius M. Weinrich, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Lennart Well, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Dennis Saring, Wedel, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian Stehning, Hamburg, Germany (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Enver G. Tahir, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Ulf K. Radunski, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Kai Muellerleile, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Monica Patten, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gunnar K. Lund, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We evaluated the ability of clinical and quantitative cardiac magnetic resonance (CMR) parameters including T1 mapping and extracellular volume (ECV) imaging to identify hypertrophic cardiomyopathy (HCM) patients at increased calculated risk for sudden cardiac death (SCD) estimated by a novel HCM Risk-SCD score.

METHOD AND MATERIALS

The study was approved by our local IRB. CMR was performed in 65 HCM patients and 16 controls at 1.5T scanner. Myocardial fibrosis was assessed independently by 2 observers on 3 short axes at the basis, center and apex of the left ventricle. Fibrosis was quantified on late gadolinium enhancement (LGE) images in %LV using 3 standard deviations (SD) above signal intensity of reference myocardium and the full width at half maximum (FWHM) method. T1 and ECV maps were generated by 3(3)5 modified Look-Locker inversion recovery sequence. Multivariate and receiver operating curve analysis evaluated the best parameter to identify patients with increased SCD risk of ≥4%, thus advising a prophylactic ICD implantation.

RESULTS

Nineteen HCM patients (29%) had an increased SCD risk of ≥4%. From all clinical and CMR parameters, only LGE (FWHM) and global ECV discriminated between patients with low (<4%) and increased (≥4%) risk for SCD. On multivariate analysis global ECV correlated best with the HCM risk score. The best performance was obtained for global ECV with an area under the curve (AUC) of 0.83 [0.71-0.91]. LGE (FWHM) was inferior to ECV with an AUC of 0.67 [0.54-0.79], P<0.05). ECV resulted in a sensitivity and specificity of 74% (49-91%) and 82% (69-88%) to identify HCM patients at increased SCD risk.

CONCLUSION

Global ECV is the best of all clinical and CMR parameters and superior to LGE to identify HCM patients with increased risk for SCD. Therefore ECV may serve as additional parameter for non-invasive risk stratification in patients with HCM.

CLINICAL RELEVANCE/APPLICATION

ECV might have the potential to facilitate current risk prediction models for sudden cardiac death in HCM and can be of additional value in patients with reduced acoustic window on echocardiography or unclear medical history, which potentially limits the accuracy of the HCM Risk-SCD score.

SSC01-02 Comprehensive Cardiac Magnetic Resonance for Short-Term Follow-Up in Acute Myocarditis

Monday, Nov. 28 10:40AM - 10:50AM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Julian A. Luetkens, MD, Bonn, Germany (*Presenter*) Nothing to Disclose
Rami Homsi, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Darius Dabir, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Daniel Kuetting, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian F. Marx, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Jonas Doerner, MD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose
Ulrike Schlesinger-Irsch, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Rene Andrie, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Alois Martin Sprinkart, MSc, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Frederic Carsten Schmeel, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian Stehning, Hamburg, Germany (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Rolf Fimmers, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Juergen Gieseke, DSc, Bonn, Germany (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Claas P. Naehle, MD, Bonn, Germany (*Abstract Co-Author*) Consultant, Medtronic, Inc
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

PURPOSE

Cardiac magnetic resonance (CMR) can detect inflammatory myocardial alterations in patients suspected of having acute myocarditis. There is limited information about the degree of normalization of CMR parameters during the course of the disease and the time window during which quantitative CMR should be most reasonably implemented for diagnostic work-up.

METHOD AND MATERIALS

Ethics commission approval was obtained for this prospective study and written informed consent was obtained from all subjects. 24 patients with suspected acute myocarditis and 45 control subjects underwent CMR. Initial CMR was performed 2.6±1.9 days after admission. Myocarditis patients underwent CMR follow-up after 2.4±0.6, 5.5±1.3 and 16.2±9.9 weeks. CMR protocol included assessment of standard Lake Louise criteria, T1 relaxation times, extracellular volume fraction, and T2 relaxation times. A generalized linear model and independent 2-sample Student t test were used for group comparisons.

RESULTS

Group differences between myocarditis patients and control subject were highest in the acute stage of the disease ($P<0.001$ for all parameters). There was a significant and consistent decrease in all inflammatory CMR parameters over the course of the disease ($P<0.01$ for all parameters). As an indicator of myocardial edema, myocardial T1 and T2 relaxation times were the only single parameters showing significant differences between myocarditis patients and control subjects on 5.5±1.3 week follow-up (T1:986.5±44.4ms vs. 965.1±28.1ms; $P=0.022$, T2:55.5±3.2ms vs. 52.6±2.6ms; $P=0.001$).

CONCLUSION

In patients with acute myocarditis, CMR markers of myocardial inflammation demonstrated a rapid and continuous decrease over several follow-up examinations. CMR diagnosis of myocarditis should therefore be sought in an early stage of the disease. Myocardial T1 and T2 relaxation times were the only parameters of active inflammation/ edema which could discriminate between myocarditis patients and control subjects even at convalescent stages of the disease.

CLINICAL RELEVANCE/APPLICATION

CMR should be performed early to reliably detect inflammatory myocardial alterations. Repetitive CMR can monitor disease activity and may help to identify patients with persistent myocarditis.

SSC01-03 Detection of Myocardial Tissue Characterization Using Cardiac Magnetic Resonance T1 Mapping and Late Gadolinium Enhancement in; Hypertropic Cardiomyopathy

Monday, Nov. 28 10:50AM - 11:00AM Room: S502AB

Participants
Huayan Xu, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Zhi gang Yang, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Yingkun Guo, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Chunchao Xia, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Lei Li, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To investigate the myocardial tissue characterization by using cardiac magnetic resonance(CMR) T1mapping and late gadolinium enhancement (LGE) in hypertrophic cardiomyopathy (HCM), and further compare the reproducibility of these two techniques.

METHOD AND MATERIALS

Thirty-two HCM patients and 28 healthy volunteers were enrolled in and underwent CMR examination. Modified Look-Locker Inversion recovery T1 maps and phase sensitive inversion recovery LGE images were acquired on matching short axis of basal, middle and apex segments. Parameters including native T1 values, post- contrast T1 values, extra-cellular volume(ECV) of T1maps and LGE extents(%) were measured by software(cmr42; Circle Cardiovascular Imaging Inc.Calgary; Canada). LGE extents(%) was automatically calculated by greater than 2SD threshold of normal myocardium.

RESULTS

In HCM, native T1 values were increased and post T1 values were decreased in comparison with normal controls(native T1, 1387.38±115.50 vs. 1257.53,$p=0.000$; post T1, 492.34±74.21 vs. 499.19±34.63,$p=0.000$). ECV of HCM subjects were significantly increased(39.88±10.89 vs. 28.49±3.53,$p=0.000$). LGE extent (Average, 47.34± 23.57%) was found in HCM ones. By Pearson correlation analysis, native T1 value and ECV were positively related to LGE extent(native T1, $r=0.251$,$p=0.008$;ECV, $r=o.344$,$p=0.000$,respectively).No significant relationship was found between post T1 value and LGE extent. By Intra-class correlation coefficient(ICC) analysis, inter-and intra- observer agreement representing the reproducibility of T1mapping and LGE were obtained.Inter- and intra-observer agreement of LGE was moderate(Inter-observer：ICC, 0.680; Intra-observer: ICC,

0.790).Inter- and intra-observer agreement of native T1 value,post T1 value was improved and excellent high (Inter-observer: ICC=0.997, 0.999 and 0.994, respectively; Intra-observer: ICC=0.996, 0.998 and 0.995).

CONCLUSION

CMR T1 mapping and LGE were established tools for myocardium firosis detection.In HCM patients, native T1 , ECV and LGE representing myocardium fibrosis were all higher than normal ones. However, the reproducibility of T1mapping was improved compared with LGE.

CLINICAL RELEVANCE/APPLICATION

LGE cannot detect fibrosis well in diffused fibrosis and the results can change with the different choosing of normal reference myocardium. T1 mapping may be a well modality of myocardium fibrosis by acquiring the T1 values and ECV with high reproducibility.

SSC01-04 Characterization of Left Ventricular Remodeling in Professional Soccer Players: Can we Prevent Sudden Cardiac Death Using CMR?

Monday, Nov. 28 11:00AM - 11:10AM Room: S502AB

Participants
Enver G. Tahir, MD, Hamburg, Germany (*Presenter*) Nothing to Disclose
Jacob Schmidt-Holz, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gunnar K. Lund, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Kai Muellerleile, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Jitka Starekova, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Jin Yamamura, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Dennis Saring, Wedel, Germany (*Abstract Co-Author*) Nothing to Disclose
Cyrus Behzadi, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Marc Regier, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Regular physical activity over a long time period leads to a cardiac adaptation described as “athlete’s heart”. The purpose of this study was to determine the effects of intensive daily training in a specific type of sports- professional soccer, in regard to morphological and functional left ventricular parameters assessed by cardiac magnetic resonance imaging (CMR) and to compare these with non-athletic healthy volunteers.

METHOD AND MATERIALS

CMR was performed in 21 male professional soccer players from the German Bundesliga team squad of the Hamburger SV and 15 age-, sex- and weight-matched untrained controls at 1.5 T (Achieva, Philips) during the active season. For quantitative CMRI, an electrocardiographically triggered steady-state free precession (SSFP) cine sequence (TR/TE, 3.2/1.6ms; pixel-size, 1.7mm×1.7mm) was performed in short- and long-axis views. Quantitative analysis included end-diastolic (EDV) and end-systolic volumes (ESV), stroke volume (SV), left ventricular ejection-fraction (EF) as well as end-diastolic (EDMM) and end-systolic myocardial mass (ESMM). CMRI data were analyzed by two independent observers using the HeAT-Software. Data are given as the mean of both observers.

RESULTS

In professional soccer players a significant increase of the following parameters was determined compared to non-athletes: EDV (229 ±24 ml vs. 196 ±30 ml, P< 0.04), ESV (96 ±16 ml vs. 82 ±11 ml, P< 0.04) and LV mass (189 ±34 g vs. 143 ±19 g, P= 0.001). Stroke volume (133 ±19 ml vs. 115 ±23 ml, P= ns) and LV ejection fraction (0.58% vs. 0.58%, P= ns) were similar in both groups. The professional soccer players had a significantly lower resting heart rate than non-athletes (50 beat/min vs. 64 beat/min, P= 0.01).

CONCLUSION

Long-term training in professional soccer players is characterised by left ventricular adaptation leading to an increase in functional parameters and myocardial mass. CMRI allows an objective quantitative assessment and might help to differentiate physiologic cardiac adaptations from inherited hypertrophic cardiomyopathy.

CLINICAL RELEVANCE/APPLICATION

CMR imaging enables studies to the mechanisms of LV adaptation in professional soccer players and may help to differentiate physiological changes to high-level exercise from inherited cardiomyopathy.

SSC01-05 New Insights into Arrhythmogenic Mitral Valve Prolapse (MVP): A Cardiac Magnetic Resonance (CMR) Study

Monday, Nov. 28 11:10AM - 11:20AM Room: S502AB

Participants
Mariangela Cava, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Diego Palumbo, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Antonio Esposito, MD, Milan, Italy (*Presenter*) Nothing to Disclose
Giovanni La Canna, 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

MVP is a commonly observed condition, due to improper leaflets atrial prolapse; often asymptomatic, it may bring significant complications, as severe ventricular arrhythmias, also without hemodynamic impairment, but the causes of electrical instability remain under-estimated and still unknown. Our aim was to explore the potential CMR role in evaluation of MVP combining the assessment of ventricular and mitral functions and anatomy with the evaluation of structural alterations as potential substrate for

arrhythmogenic risk.

METHOD AND MATERIALS

We enrolled 29 pts (47.2±17 y, 20F, 9M); CMR protocol consisted in evaluation of ventricular (LV and RV) function, myocardial edema (T2-STIR) and late gadolinium enhancement (LGE). Imaging post-processing included MVP assessment: prolapsed distance of posterior valve leaflet (maximum leaflet excursion beyond the mitral annular plane during systole) was measured (MVPE).

RESULTS

All patients showed systolic mitral valve leaflets excursion towards left atrium > or equal 2 mm, with mean MVPE of 8.2±5 mm.Mean mitral indexed annular diameter (MADi) was 23.3±5.12 mm; MADi and MVPE were directly related (p=0.028).During systole, a bulging of LV inferior wall near mitral valve annulus in 18 cases was recorded.Patients with bulging had greater MVPE (10.7±4.8 vs 4.2±2 mm p<0.001) and MADi (25.3±4.4 vs 19.6±4.4 mm p=0004).17 patients showed LGE, in 4 cases involving the posterior papillary muscle (PP), in 7 cases the infero-lateral LVwall (IBW), in 6 cases both.Patients showing LGE in PP frequently had systolic bulging (90% of cases, p=0.044) and showed greater MVPE (12.9±4.7 vs 5.8±3.4 p<0.001).In 17 cases patients suffered from arrhythmic events (2 VF, 9 NSVT, 5 LBBB, 1 AV-block) ; these events were significantly related with presence of ventricular LGE (p=0.006).

CONCLUSION

Mitral valve leaflets excursion has been characterized by CMR and was greater in patients with systolic bulging of LV base.The presence of LGE was related with frequent bulging and greater MPVE (when located on PP muscle) and more frequent in patients suffering from arrhythmic events.

CLINICAL RELEVANCE/APPLICATION

Cardiac magnetic resonance represents a reliable tool to characterize MVP, depicting mitral valve and ventricular features and identifying potentially arrhythmogenic LGE substrate.

SSC01-07 Myocardial T1 Mapping and Extracellular Volume Assessment in Left Ventricular Non-Compacted Miocardiopathy

Monday, Nov. 28 11:30AM - 11:40AM Room: S502AB

Participants
Jose de Arimateia B. Araujo Filho, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose
Antonildes N. Assuncao Jr, MD,MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Marcelo D. Melo, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Camila R. Lima, MD,MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Natally d. Horvat, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Carolina S. Reiser, MD, Porto Alegre, Brazil (*Abstract Co-Author*) Nothing to Disclose
Vera M. Salemi, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Cesar H. Nomura, MD, MSc, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Jose R. Parga, MD, Curitiba, Brazil (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Evaluate the usefulness of native T1 Mapping and extracellular volume (ECV) quantification by MR (Magnetic Resonance) in characterizing myocardial abnormalities, mainly diffuse fibrosis in compacted myocardial areas, in patients with left ventricular non-compaction (LVNC), comparing those with and without late gadolinium enhancement (LGE) and left ventricular dysfunction (LVD).

METHOD AND MATERIALS

T1-mapping and LGE was performed in 32 patients with LVNC (diagnosed by Jenni ecocardiographic and Petersen MR criteria) and 16 normal subjects on a 1.5 T MR (PhilIps Achieva). LGE images were acquired 10-15 minutes after the intravenous injection of gadolinium. Assessment of segmental T1 values was performed on matching short axis slices, using the shortened modified Look-Locker inversion recovery (Sh-MOLLI). A region of interest was draft in the midseptum compacted myocardial, avoiding areas with LGE+, and in the LV cavity blood pool. T1 was measured pre-contrast and 15-20 min after the contrast injection and the ECV was obtained for each subject.

RESULTS

Late gadolinium enhancement (LGE) was present in 11 of the 32 LVNC patients (34%) and most often located in the anteroseptal e inferoseptal segments, mainly with mid-myocardial distribution. LVNC patients had higher native T1 (p = 0.001) an ECV (p<0.001) compared with controls, excluding areas of macroscopic fibrosis. ECV was significantly higher in LGE(+) subjects versus LGE(-) LVNC patients (0.325 ± 0.035 vs. 0.265 ± 0.028, p<0.001) and controls (0.325 ± 0.035 vs. 0.237 ± 0.018, p<0.001) - *Figure*. Although the mean native T1 and ECV were higher in the left ventricular dysfunction group compared with controls and LVNC patients with normal left ventricular function, this difference was not statistically significant (p estimated in 0.648 and 0.9 respectively).

CONCLUSION

Measurement of ECV and native T1 can provide an important non invasive assessment of interstitial myocardial involvement in LVNC and can be more sensitive than LGE imaging to detect diffuse fibrosis in these patients.

CLINICAL RELEVANCE/APPLICATION

Recent studies have correlated T1 Mapping and extracellular volume assessment by MR with diffuse fibrosis in some cardiomiopathies, with prognostic relevance, but not still in LVNC.

SSC01-08 Cardiac Magnetic Resonance Late Gadolinium Enhancement in Patients with Genetic Dilated Cariomyopathy

Monday, Nov. 28 11:40AM - 11:50AM Room: S502AB

Participants

Alexandra Sousa, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose
Teresa Pinho, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose
Paulo Canedo, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose
Luis Lopes, Almada, Portugal (*Abstract Co-Author*) Nothing to Disclose
Olga Azevedo, Guimaraes, Portugal (*Abstract Co-Author*) Nothing to Disclose
Antonio Jose B. Madureira, MD, Porto, Portugal (*Presenter*) Nothing to Disclose
Adriana Belo, Coimbra, Portugal (*Abstract Co-Author*) Nothing to Disclose
Jose Silva-Cardoso, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose
Jose Machado, Porto, Portugal (*Abstract Co-Author*) Nothing to Disclose
Elisabete Martins, Oporto, Portugal (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Dilated cardiomyopathy (DCM) has an estimated prevalence of 1:2500 in adult population, with genetic etiology explaining 30-50% of "idiopathic" cases. Genetic causality is difficult to identify because of the scarcity of distinctive red flags. In recent years, cardiac magnetic resonance (CMR) has emerged as a valuable imaging modality in this field. However, it´s utility in diagnosing genetic DCM remains largely unknown. In this work we aimed to describe CMR findings in genetically characterized DCM patients.

METHOD AND MATERIALS

We included patients with idiopathic and familial DCM, that underwent a comprehensive CMR with a 3-T scanner (Siemens, Erlangen, Germany), as part of their diagnostic work-up. Left ventricular (LV) volumes, ejection fraction (LVEF) and mass were measured using dedicated software (ARGUS Software™, Siemens Healthcare Global). LV late gadolinium enhancement (LGE) presence, pattern and location were assessed; extensive fibrosis was defined as LGE presence in >2 LV segments.Molecular analysis included LMNA/C, MYH7, MYBPC3, TNNT2, ACTC1, TPM1, CSRP3, TCAP, SGCD, PLN, MYL2, MYL3, TNNI3, TAZ and LBD3 genes.

RESULTS

We analyzed 73 patients, 47% with familial DCM, 53% men. Mean LVEF was 34±11% and LV end-diastolic volume of 128±34mL. LGE was present in 40% and non-compaction in 13%. We identified 21 genetic variants in 19 distinct patients (11 presented pathogenicity criteria).Comparing patients with or without genetic variants, we observed no difference in CMR parameters. Focusing on patients with the more frequent mutations, in MYBPC3, TNNT2 and MYH7 genes, we found only a trend toward an association of MYH7 mutations with LGE (p=0.057) – with a significant predilection for septum involvement (p=0.042), and with non-compaction (p=0.057).

CONCLUSION

LGE might have some utility in clinical recognition of patients with genetic DCM, namely those with MYH7 mutations, although additional studies are warranted to confirm these findings. Nevertheless, the exclusion of other causes of LV dysfunction and the use of more recent CMR tools, support the continued exploration of this technique in the evaluation of genetic/familial DCM patients.

CLINICAL RELEVANCE/APPLICATION

In patients with dilated cardiomyopathy, main CMR findings are not substantially different between patients with and without positive genetic test.

SSC01-09 Native Myocardial T1 Mapping and Extracellular Volume by Cardiac Magnetic Resonance Imaging in Subclinical Cardiomyopathy in Patients with Systemic Lupus Erythematosus

Monday, Nov. 28 11:50AM - 12:00PM Room: S502AB

Participants
Rui Wu, PhD, Shanghai, China (*Presenter*) Nothing to Disclose
Lian-Ming Wu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Rong-Zhen Ou Yang, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Dongaolei An, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Binghua Chen, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Jianrong Xu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to assess the utility of T1 mapping and extracellular volume for detecting the myocardial fibrosis in subclinical cardiomyopathy in patients with SLE.

METHOD AND MATERIALS

Twenty-five SLE patients without previous cardiac symptoms (21 female; mean age 38±14 years) and fifteen controls without obvious cardiovascular disease (9 female; mean age 37±12 years) underwent CMR at 3.0-T. The CMR sequence included cine, T1-maping, late gadolinium enhancement. Mean T1 value, ECV and circumferential strain parameters were determined for each subject.

RESULTS

Fibrosis on LGE was found in 15 SLE patients (60%) while none of controls. SLE patients had significantly higher native T1 values (1207±77 ms vs. 1131±26 ms; $p = 0.001$) and expansion of ECV (29.5±2.8% vs. 24.1±3.3%, $p < 0.001$) compared with controls. Left ventricular volumes, mass, stroke volumes and ejection fraction were not statistically significant between SLE patients and controls. Peak circumferential strain (-13.8±4.0% vs. -17.4±2.2%, $p = 0.003$) were significantly impaired in SLE patients. Native myocardial T1 values and ECV showed well correlation with peak circumferential strain in SLE patients ($r = 0.503$, $p = 0.01$; $r = 0.599$, $p = 0.002$, respectively).

CONCLUSION

SLE patients with subclinical cardiomyopathy had significantly higher native T1 values and expansion of ECV and associated reduction in peak systolic circumferential strain compared with normal control. Native T1 mapping and ECV may offer potential value to detect the myocardial fibrosis, aiming at preventing the progress of cardiomyopathy and receiving treatment early in SLE

patients.

CLINICAL RELEVANCE/APPLICATION

Native T1 mapping and ECV may offer as a novel biomarker to prevent the progress of cardiomyopathy and receiving treatment early in SLE patients.

SPSP21

Imagen Cuantitativa (Biomarcadores) En La Práctica Clínica: Sesión del Colegio Interamericano de Radiología (CIR) en Espanol/Quantitative Imaging and Biomarkers in Clinical Practice: Session of the Interamerican College of Radiology (CIR) in Spanish

Monday, Nov. 28 1:30PM - 4:30PM Room: E451A

BR CA GI MK NR BQ MR

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 3.50

FDA Discussions may include off-label uses.

Participants
Pablo R. Ros, MD, PhD, Cleveland, OH (*Moderator*) Nothing to Disclose
Jose L. Criales, MD, Mexico City, Mexico (*Moderator*) Nothing to Disclose
Miguel E. Stoopen, MD, Mexico City, Mexico (*Moderator*) Nothing to Disclose

Sub-Events

SPSP21A Bienvenida/Welcome

Participants
Pablo R. Ros, MD, PhD, Cleveland, OH (*Presenter*) Nothing to Disclose
Miguel E. Stoopen, MD, Mexico City, Mexico, (mstoopen@ctscanner.mx) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

Coordinator

ABSTRACT

Coordinator no abstract

URL

Coordinator

SPSP21B La Imagen Medica Personalizada y Precisa/Precise and Personalized Medical Imaging

Participants
Luis Marti-Bonmati, MD, PhD, Godella, Spain, (Luis.Marti@uv.es) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand what imaging biomarkers are and how they can improve diagnosis and treatment follow-up. 2) To describe the different types of biomarkers. 3) To analyze the process of biomarkers development, including validation, qualification and standardization.

ABSTRACT

Imaging seems ideally suited to flourish as a quantitative science. Quantitative imaging biomarkers extract and measure objective biological characteristics from any type of medical images, being resolved in space, through parametric images, and in time, as response maps. As medical imaging does not destroy the evaluated samples, test-retest evaluations are feasible, allowing the repetition of experiments and measurements as frequently as desired. Each voxel in a computer derived image represents both the location and the value of a specific calculated parameter (morphological, biological, response) obtained by the application of mathematical or simulation models to the source images. These synthetic parametric maps represent the new paradigm in clinical radiology and should be considered as virtual biopsies, showing different morphological and biopathological abnormalities. Biomarkers can be classified as prognostic, if accuracy of patient diagnosis or prognosis is improved; predictive, if the most beneficial treatment can be defined; response, when the beneficial outcomes can be shown after treatment; and monitoring, to detect relapse or toxicity.

URL

SPSP21C Esclerosis Múltiple : Seguimiento Cuantitativo/Multiple Sclerosis: Quantitative Follow Up

Participants
Leonardo Vedolin, MD, PhD, Sao Paulo, Brazil, (leonardovedolin@hotmail.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To describe basic background about quantitative MRI techniques applied to multiple sclerosis. 2) To discuss how quantitative MRI techniques contribute to monitoring of MS progression.

ABSTRACT

Multiple sclerosis (MS) is a chronic demyelinating and neurodegenerative disease that affects the central nervous system (CNS). Brain and spine MRI are most important paraclinical tool for the diagnosis of MS as conventional MRI techniques, such as T2/FLAIR weighted and gadolinium-enhanced T1-weighted sequences are highly sensitive for detecting focal active white matter lesions. However, these techniques are not specific enough to detect diffuse injuries in both grey and white matter. Pathological and imaging data indicated that lesion pattern and timely detection of tissue damage could help identify patients with an increased risk

of developing severe disability and cognitive impairment. In this context, advanced quantitative MR tools have been used to access brain and spinal cord lesions in MS. Proton magnetic resonance spectroscopy (MRS) has been used in patients with CIS to identify tissue damage apart from the visible T2 lesions. Diffusion tensor imaging and magnetization transfer imaging have also revealed differences in normal-appearing brain tissue between patients with CIS and controls. Additionally, double inversion recovery (DIR) sequence, quantitative susceptibility mapping and phase sensitive inversion recovery (PSIR) are promising technique to monitor cortical damage and disease progression in patients with MS. The purpose of this lecture are (1) to describe basic background regarding quantitative MRI techniques applied to multiple sclerosis and (2) to discuss how quantitative MRI techniques contribute to monitoring of MS progression.

URL

SPSP21D **Preguntas/Q & A**

Participants

SPSP21E **Resonancia Magnética en las Cardiopatias/Non-invasive Evaluation of Cardiac Disease by MRI**

Participants
Aloha Meave, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

SPSP21F **Enfermedad Hepática por Depósito (Esteatosis, Fibrosis, Cirrosis y Hemocromatosis)/Liver Storage Disease (Steatosis, Fibrosis, Cirrhosis, and Hemochromatosis)**

Participants
Manuela Franca, MD, Porto, Portugal, (mariamanuela.franca@gmail.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the most common imaging features related to different liver storage diseases. 2) Understand that fat, iron and fibrosis commonly co-exist in different diffuse liver diseases. 3) Apply the best MR imaging techniques to assess and to quantify liver steatosis and iron overload, and to stage liver fibrosis/cirrhosis. 4) Discuss the clinical relevance of MR imaging biomarkers in different clinical scenarios of liver diseases, emphasizing the role of MR biomarkers on follow up of patients and treatment monitoring, taking hemochromatosis as a clinical example.

ABSTRACT

Different amounts of fat, iron deposits and fibrosis can be found in different diffuse liver diseases. Because liver biopsy has several limitations, MR imaging biomarkers have been developed for fat and iron quantification, and to stage liver fibrosis.Quantification of proton density fat fraction (PDFF) can be accurately performed with multi-echo chemical shift encoded (MECSE) gradient echo MR sequences, which must be corrected for T1 relaxation, T2* decay effect, noise and fat spectral complexity. Quantification of liver iron content is needed to detect and stage iron overload, and also to monitor iron-reducing treatments. Iron MR quantification may be performed with R2/R2* relaxometry techniques. Also, MECSE-MR sequences allow to simultaneously quantifying PDFF and R2* of liver parenchyma. MR elastography can detect and stage significant or advanced fibrosis and cirrhosis, with high accuracy.All of these MR measurements are increasingly being used as non-invasive biomarkers of hepatic steatosis, siderosis and fibrosis.

URL

SPSP21G **Preguntas/Q & A**

Participants

SPSP21H **Presentación del CIR/CIR Update**

Participants
Miguel A. Pinochet, MD, Santiago, Chile (*Presenter*) Nothing to Disclose
Dante R. Casale Menier, MD, Ciudad Juarez, Mexico (*Presenter*) Nothing to Disclose

SPSP21I **Cáncer de Próstata: Marcadores en Diagnóstico y Seguimiento/Prostate Cancer: Biomarkers in Diagnosis and Follow Up**

Participants
Ivan Pedrosa, MD, Dallas, TX (*Presenter*) Nothing to Disclose

SPSP21J **Osteoartrosis: Evaluación Cuantitativa del Cartílago Articular/Osteoarthritis: Cartilage Quantitative Evaluation**

Participants
Nicolas Zilleruelo, MD, Santiago, Chile, (nzilleruelo@alemana.cl) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Assess the potential of technological innovations and advances to enhance clinical practice and problem-solving. 2) Identify the different quantitative techniques in the study of articular cartilage. 3) Practical applications of these quantitative techniques and discuss their clinical relevance.

SPSP21K **Preguntas/Q & A**

Participants

SPSP21L **Evaluación de la Respuesta Precoz a la Terapia Neoadyuvante en el Cáncer de Mama con Biomarcadores de Imagen/Early Response Evaluation to Neoadjuvant Chemotherapy in Breast Cancer with Imaging Biomarkers**

Participants
Julia Camps Herrero, DIPLPHYS, Alzira, Spain, (juliacamps@gmail.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To know the diagnostic accuracy of Diffusion MRI in the evaluation of early response to Neoadjuvant Chemotherapy (NAC). 2) To learn the proof of principle and proof of mechanism of Diffusion Tensor MRI (DTI) as an Imaging Biomarker. 3) To learn about the results of early response evaluation to NAC with DTI.

ABSTRACT

Dynamic contrast-enhanced (DCE) Breast MRI is the standard imaging modality in the response evaluation to neoadjuvant chemotherapy (NAC). Diagnostic accuracy of DCE-MRI in response evaluation to NAC is limited to around 70% in published meta-analysis with very few studies dealing with early response evaluation and DCE-MRI.Diffusion MRI has been show to be a solid imaging biomarker in the evaluation of response to neoadjuvant chemotherapy (NAC) and a recent meta-analysis (Wu, Breast Cancer Res Treat, 2012) showed that it adds sensitivity to the high specificity provided by DCE-MRI. Pickles et al showed in 2006 that diffusion changes precede size reduction in neoadjuvant treatment of breast cancer (Magnetic Resonance Imaging, 2006).Diffusion Tensor imaging (DTI) is a three-dimensional technique, one must apply diffusion gradients along at least 6 non co-linear, non coplanar directions in order to provide enough information. The mammary ducts are anisotropic structures which need non-scalar or multiple ADC measurements in order to characterize the orientation-dependent water mobility in this tissues. These multiple ADC measurements are provided by DTI. We show our preliminary results in more than 30 patients treated with NAC in which we performed an early evaluation after the first two cycles of treatment with DTI, proving that the prediction of response to NAC is earlier and more accurate than the response evaluation with DCE-MRI.

URL

SPSP21M **Respuesta Oncológica: Imagen Híbrida/Oncologic Response: Hybrid Imaging**

Participants
Andres Kohan, MD, Capital Federal, Argentina, (andres.a.kohan@gmail.com) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List current hybrid imaging methods for assessing tumor response. 2) Identify which method is best to be used in specific clinical scenarios. 3) Assess oncologic response through hybrid imaging.

ABSTRACT

URL

SPSP21N **Preguntas/Q & A**

Participants

SPSP21O **Clausura/Closing**

Participants
Jose L. Criales, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose
Jorge A. Soto, MD, Boston, MA (*Presenter*) Royalties, Reed Elsevier
Pablo R. Ros, MD, PhD, Cleveland, OH (*Presenter*) Nothing to Disclose

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

SSE01

Breast Imaging (MRI Response to Treatment)

Monday, Nov. 28 3:00PM - 4:00PM Room: Arie Crown Theater

BR BQ MR

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

FDA Discussions may include off-label uses.

Participants
Nola M. Hylton, PhD, San Francisco, CA (*Moderator*) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (*Moderator*) Research Grant, Hologic, Inc;

Sub-Events

SSE01-01 Multiparametric Baseline Contrast Enhanced Magnetic Resonance Imaging (CE-MRI) for Prediction of Pathologic Complete Response (pCR) to Neoadjuvant Chemotherapy (NAC) in Breast Cancer

Monday, Nov. 28 3:00PM - 3:10PM Room: Arie Crown Theater

Awards
Student Travel Stipend Award

Participants
Maryam Etesami, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Nathaniel Braman, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Christina Dubchuk, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Prateek Prasanna, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Anant Madabhushi, PhD, Piscataway, NJ (*Abstract Co-Author*) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (*Abstract Co-Author*) Research Grant, Hologic, Inc;

PURPOSE

Imaging based pretreatment prediction of response to NAC in locally advanced breast cancer patients can improve patient selection for NAC and determining prognosis. We have investigated the role of baseline multiparametric DCE-MRI for prediction of pCR in different breast cancer receptor subtypes.

METHOD AND MATERIALS

We retrospectively studied 75 biopsy proven breast cancer patients who had DCE-MRI with diffusion weighted imaging (DWI) prior to NAC followed by breast surgery. The morphology (tumor size, type, and margin), multi-focality of malignancy, qualitative enhancement (pattern and curve type) and quantitative enhancement kinetics (Ktrans, Kep, and Ve calculated by Tofts model), absolute apparent diffusion coefficient (ADC) and normalized ADC (tumor ADC divided by normal glandular tissue ADC), and receptor subtype (luminal [ER/PR+] and non-luminal [triple negative/HER2+]) were assessed for prediction of pCR versus no pCR. Binary logistic regression was used for univariate and multivariate analysis.

RESULTS

Twenty two patients (29%) had pCR. In univariate analysis, smaller tumor size (p=.03), lower normalized ADC (p=.01), circumscribed margin (p=.04), lower Ktrans (p=.05), lower Ve (p=.04), and non-luminal receptor (p=.003) were significantly correlated with pCR. In multivariate analysis, tumor size (p=.02), normalized ADC (p=.03), and receptor subtype (p=.04) remained significantly correlated with pCR; whereas, Ktrans (p=0.07) and Ve (p=.08) became near-significantly correlated with pCR. Following classifying patients based on receptor subtypes, none of the evaluated parameters were significantly correlated with pCR in luminal subtype. In non-luminal subtype, lower normalized ADC (p=.02) and lack of multifocality (p=.02) were significantly correlated with pCR. Absolute tumor ADC, qualitative enhancement parameters, and Kep were not significantly different in pCR versus no pCR in any group.

CONCLUSION

On baseline DCE-MRI, tumor morphology (size and margin), DWI with normalized ADC, and quantitative enhancement kinetics (Ktrans and Ve) may be predictive of pCR to NAC in breast cancers. These predictive measures are stronger in triple-negative and HER2-enriched subtypes compared to luminal subtype.

CLINICAL RELEVANCE/APPLICATION

Baseline DCE-MRI with DWI and quantitative pharmacokinetics is valuable in pretreatment prediction of breast cancer response to NAC and can improve patient selection for NAC.

SSE01-02 Simpsons Diversity Index as a Biomarker of Quantification of Vascular Heterogeneity for Prediction of Overall Survival after Neoadjuvant Treatment for Locally Advanced Breast Cancer

Monday, Nov. 28 3:10PM - 3:20PM Room: Arie Crown Theater

Participants
Stylianos Drisis, MD, Brussels, Belgium (*Presenter*) Nothing to Disclose
Marc P. Lemort, MD, Louvain La Neuve, Belgium (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate Simsons diversity index as a biomarker for quantification of heterogeneity of vascular permeability as a biomarker of overall survival (OS) after to neoadjuvant treatment for locally advanced breast cancer.

METHOD AND MATERIALS

Two MRI examination were performed, one baseline and control examination after two of three cycles of anthracyclines regiment for 48 patients. Quantitive DCE-MRI was performed and Ktrans was categorized as Kt 2sd, 3sd and 4sd corresponding to 2, 3 and 4 sd more than Ktrans value of the mammary gland. Then, Simsons' index was calculated according to the following formula: 1-((kt2sd*(kt2sd-1)+kt3sd*(kt3sd-1)+kt4sd*(kt4sd-1))/(Σ(kt2sd:kt4sd)*(Σ(kt2sd:kt4sd)-1)))The continuing variable of Simsons index was then converted to 4 quadrilles (group 1 representing the lowest and group 4 the highest vascular heterogeneity. OS was calculated using the Kaplan Mayer statistical analysis and comparison of survival curves was performed by Logrank test.

RESULTS

At MRI1 Simpsons index group1 and group2 showed better OS than group3. The comparison of group1 versus group3 showed a p = 0,09 and for group2 versus group3 p = 0,15. At MRI2 Simpsons index group1 and group2 showed better OS than group3. The comparison of group1 versus group3 showed a p = 0,06 and for group2 versus group3 p = 0,23. However group4 had similar OS at MRI as group1.

CONCLUSION

Vascular permeability heterogeneity can be quantified with a known Simpsons index. This quantification showed good correlation with 5 years OS for groups 1, 2 and 3.

CLINICAL RELEVANCE/APPLICATION

Heterogeneous tumors tend to show resistance during neoadjuvant treatment. By quantifying heterogeneity of vascular permeability we could possibly predict heterogeneous molecular background and select patients for alternative treatments.

SSE01-03 Lesion to Background Signal Enhancement Ratio on Breast MRI is Useful in Distinguishing Presence of Residual Tumor versus No Residual Tumor after Neoadjuvant Chemotherapy

Monday, Nov. 28 3:20PM - 3:30PM Room: Arie Crown Theater

Participants
Sooyeon Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Nariya Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
In-Ae Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Ui Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Soo-Yeon Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Bo Ra Kwon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
So Min Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Su Hyun Lee, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung Min Chang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate whether the lesion to background signal enhancement ratio (SER) on dynamic contrast enhanced (DCE)-MRI is useful in distinguishing residual tumor versus no residual tumor as well as minimal invasive tumor versus residual DCIS on histopathology after neoadjuvant chemotherapy (NAC).

METHOD AND MATERIALS

Between 2009 and 2015, 861 consecutive women who had undergone NAC, DCE-MRI, and subsequent surgery were identified. Among them, a total of 221 women (mean age 47.9, range 26-82 years) with no residual tumor (n= 75), residual DCIS (n= 51) or minimal invasive tumor ≤ 5mm (n=95) on histopathology were included. To compare the mean SER (signal intensity of the lesion / signal intensity of normal parenchyma) and lesion size on MRI according to the presence of residual tumor, independent sample t-test and multivariate logistic regression analysis were performed. Area under the receiver operating characteristic curve (Az) was used to evaluate performance of SER.

RESULTS

Mean SER of residual tumor (minimal invasive tumor plus DCIS) was higher than that of no residual tumor (1.72±0.40 vs. 1.49±0.32, P<0.001). Mean SER of residual DCIS was not different that of minimal invasive tumor (1.78±0.36 vs. 1.69±0.41, P=0.181). Mean MRI lesion size of residual tumor was larger than that of no residual tumor (2.42±1.97cm vs. 1.37±1.57cm, P<0.001). In multivariate analysis, higher SER (OR, 6.206, 95% CI, 2.512-15.331, P<0.001) and larger lesion size on MRI (OR, 1.576; 95% CI, 1.249-1.988, P<0.001) were independently associated with the presence of residual tumor. Az value of SER in distinguishing residual tumor versus no residual tumor was 0.662 (95% CI: 0.595-0.724) with an optimal cut-off point of 1.7 yielding maximal sum of sensitivity and specificity.

CONCLUSION

Lesion to background SER on MRI was useful in distinguishing presence of residual tumor from no residual tumor after NAC, however, it was not useful in distinguishing minimal invasive tumor from residual DCIS.

CLINICAL RELEVANCE/APPLICATION

When an enhancing lesion shows its SER < 1.7 on DCE-MRI after NAC, the lesion has high possibility of pathologic complete response, which might be helpful in deciding surgical extent.

SSE01-04 Computerized Texture Analysis of Locally Advanced Breast Cancers on Pre Treatment MRI May Identify Triple-Negative Tumors and Help Predicting Response to Neo-Adjuvant Chemotherapy

Monday, Nov. 28 3:30PM - 3:40PM Room: Arie Crown Theater

Participants
Foucauld Chamming's, MD, PhD, Montreal, QC (*Presenter*) Speaker, Supersonic Imagine
Yoshiko Ueno, MD, PhD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose

Romuald Ferre, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Caroline Reinhold, MD, MSc, Montreal, QC (*Abstract Co-Author*) Consultant, GlaxoSmithKline plc
Benoit P. Gallix, MD, PhD, Montpellier, France (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate whether texture analysis of breast cancers on pre-treatment Magnetic Resonance Imaging (MRI) may identify tumor sub-types and predict Pathologic Complete Response (pCR) to Neo Adjuvant Chemotherapy (NAC).

METHOD AND MATERIALS

Institutional review board was obtained. 85 patients with 86 Locally Advanced Breast Cancers (LABC) who underwent breast MRI before NAC were included in this retrospective study. 2D texture analysis was performed using TexRAD® software on T2-weighted (T2W) and one minute post-contrast non-subtracted T1-weighted (T1W) MRI with filtering technique. Quantitative parameters were compared between Triple Negative Breast Cancers (TNBC) and non-TNBC and between complete and non-complete responders using Mann Whitney U test. Multivariate logistic regression (LR) analysis with stepwise selection was used to determine independent parameters and to build a prediction model for identification of TNBC. Prediction performance of this model was assessed using Receiving Operator Curves (ROC) analysis.

RESULTS

sixteen (19 %) tumors were Triple Negative Breast Cancers (TNBC). pCR was achieved in thirty tumors (35%). On univariate analysis, mean (P=0.006), Mean Proportion of Positive pixel (mpp) (P=0.038), skewness (P=0.018) and kurtosis (P=0.005) on T2W and kurtosis on post-contrast T1W (P=0.0037) showed significant difference between the TNBC and non-TNBC groups. Kurtosis on T2W (P=0.008) showed a significant difference between the pCR and non-pCR groups. On multivariate analysis, kurtosis on T2W (P=0.033; Odd Ratio (OR): 1.44, 95% Confidence Interval (CI): [1.02-2.34]) and post contrast T1W (P=0.009; OR: 3.31 [1.32-9.92]) were independent parameters for identification of TNBC. A multivariate model incorporating T2W and post-contrast T1W kurtosis showed good performance (area under the curve: 0.815; sensitivity: 75%; specificity: 72%; Accuracy: 72%) for the identification of TNBC.

CONCLUSION

Among quantitative parameters derived from texture analysis of LABC on pre-treatment MRI, kurtosis appears to be significantly associated with pathologic response to NAC and to be a promising biomarker for the identification of TNBC.

CLINICAL RELEVANCE/APPLICATION

Computerized texture analysis of breast cancers on pre-treatment MRI might be used to better characterize tumors and improve selection of patient before neo adjuvant chemotherapy.

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/

Caroline Reinhold, MD, MSc - 2013 Honored Educator
Caroline Reinhold, MD, MSc - 2014 Honored Educator

SSE01-05 Triple Negative Breast Cancer: MRI Characteristics and Clinico-pathologic Factors Associated with Response to Neoadjuvant Chemotherapy

Monday, Nov. 28 3:40PM - 3:50PM Room: Arie Crown Theater

Participants
Hye J. Eom, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of the study was to investigate the findings of MRI and clinico-pathologic factors associated with response to neoadjuvant chemotherapy in patients with triple negative breast cancer (TNBC).

METHOD AND MATERIALS

Our institutional review board approved this retrospective study. Between Jan 2009 and Dec 2009, 74 TNBC patients who had baseline MRI, completed neoadjuvant chemotherapy, and underwent surgery in our consititute. Clinico-pathologic factors of the tumor including tumor type, nuclear grade, histologic grade, Ki-67 index, axillary LN involvement, and stage were evaluated. Pathological CR (pCR) was defined as the absence of invasive cancer. Near pCR was defined as presence of only a very small residual invasive cancer of less than 0.3 cm in diameter or of a small number of scattered tumor cells. Morphologic characteristics of the tumor, kinetics and pattern of tumor volume reduction on follow-up MRI were evaluated. Tumor characteristics such as size, presentation of the tumor being mass or non-mass, shape, margin and internal enhancement characteristics of the tumor, and kinetic curve assessment were defined and assessed according to BI-RADS lexicon. Additional MRI features such as presence of intratumoral necrosis, T2 signal intensity, multiplicity, background parenchymal enhancement, and amount of fibroglandular tissue were evaluated. All Clinical-pathologic and MRI findings were compared between the patients with pCR including near pCR and non-pCR.

RESULTS

Among 74 patients, 19 patients (26%) showed pCR. Nuclear grade (p=0.017), histologic grade (p=0.008), and presence of axilla lymph node involvement (p=0.023) showed statistical significance difference between pCR and non-pCR group. Shape of the tumor

at baseline MRI (p=0.039) and pattern of reduction at follow-up MRI (p=0.024) showed significant difference. At multivariate analysis, shape of the tumor was independently associated with recurrence. Patients in the group were likely to have irregular shape compared with those in non-pCR group (OR 3.61).

CONCLUSION

In this study, an association between pathologic response to neoadjuvant chemotherapy and MRI characteristics and clinico-pathologic factors were found in patients with triple negative breast cancer.

CLINICAL RELEVANCE/APPLICATION

MRI characteristics, changes on follow-up MRI and clinico-pathologic factors may be helpful in assessing response to neoadjuvant chemotherapy in patients with triple negative breast cancer.

SSE01-06 Assessment of Treatment Response to Neoadjuvant Chemotherapy in Breast Cancer using non-Mono-Exponential Diffusion Models: A Feasibility Study

Monday, Nov. 28 3:50PM - 4:00PM Room: Arie Crown Theater

Participants
Reem Bedair, MBChB,MSc, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Andrew N. Priest, DPhil, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Andrew Patterson, PhD, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Mary A. McLean, PhD, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Martin J. Graves, PhD, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Roido Manavaki, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
oshaani Abeyakoon, FRCR, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Andrew B. Gill, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
John R. Griffiths, DPhil, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Presenter*) Research Grant, GlaxoSmithKline plc; Research Grant, General Electric Company; Research Grant, Hologic, Inc

PURPOSE

To assess the utility of the mono-exponential (ME), bi-exponential (BE) and stretched-exponential (SE) models in evaluating response of breast tumours to neoadjuvant chemotherapy (NACT) at 3T.

METHOD AND MATERIALS

Thirty-six female patients (median age; 53 years) with invasive breast cancer undergoing NACT were prospectively enrolled for diffusion-weighted MRI (DW-MRI) in this IRB-approved study prior to the start of treatment. For assessment of early treatment response, changes in parameters were evaluated on the mid-treatment MRI in 22 patients. DW-MRI was performed using 8 b-values (0, 30, 60, 90, 120, 300, 600, 900 s/mm2). Apparent diffusion coefficient (ADC), tissue diffusion coefficient (Dt), vascular fraction (f), distributed diffusion coefficient (DDC) and alpha (α) parameters were derived. Regions of interest were drawn on the largest tumour diameter and data was analysed on a voxel-wise basis. T-tests compared the baseline and change in parameters between response groups. Receiver operator characteristics (ROC) curves for response prediction were generated. Repeatability was assessed at inter- and intra-observer levels.

RESULTS

All patients underwent the baseline MRI whereas 22 lesions were available at mid-treatment. Sixteen patients demonstrated complete response while 20 were non-responders. At pre-treatment, the mean diffusion coefficients showed significant differences between groups ($p<0.05$). On ROC analysis, DDC showed a larger area under the curve (0.756) compared to ADC and Dt. The DDC cut-off to differentiate response groups ($1.141\times10\text{-}3mm2/s$) yielded the highest measures of sensitivity (81%) and specificity (72%). At mid-treatment, increase in ADC and DDC showed significant differences between response groups (p=0.03, p=0.04). However the change in Dt was not significant (p=0.14). The decrease in f in responders was substantially different from the increase in non-responders (p=0.05). Responders also showed larger increase in α, although non-significant (p=0.68). Overall, the SE parameters showed excellent repeatability.

CONCLUSION

DW-MRI is sensitive to baseline and early treatment changes in breast cancer using non-mono-exponential models and the SE model can potentially monitor such changes.

CLINICAL RELEVANCE/APPLICATION

Multi-exponential models offer imaging biomarkers, which can potentially provide insights to the cellular compartments and membranes and may become more sensitive to treatment-induced tissue changes.

SSE02

Breast Imaging (Quantitative Imaging and CAD)

Monday, Nov. 28 3:00PM - 4:00PM Room: E450A

BR BQ DM IN

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

FDA Discussions may include off-label uses.

Participants
Sungheon G. Kim, PhD, New York, NY (*Moderator*) Nothing to Disclose
Robert M. Nishikawa, PhD, Pittsburgh, PA (*Moderator*) Royalties, Hologic, Inc; Research Consultant, iCAD, Inc;

Sub-Events

SSE02-01 Concurrent CAD for Digital Breast Tomosynthesis

Monday, Nov. 28 3:00PM - 3:10PM Room: E450A

Participants
Richard A. Benedikt, MD, San Antonio, TX (*Presenter*) Nothing to Disclose
Cynthia A. Swann, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Aaron D. Kirkpatrick, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Alicia Toledano, DSc, Kensington, MD (*Abstract Co-Author*) Consultant, iCAD, Inc
Senthil Periaswamy, PhD, Nashua, NH (*Abstract Co-Author*) Director of Research, iCAD, Inc
Justin E. Boatsman, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Jonathan Go, Nashua, NH (*Abstract Co-Author*) Sr. Vice President, iCAD, Inc
Jeffrey W. Hoffmeister, MD, Nashua, NH (*Abstract Co-Author*) Employee, iCAD, Inc; Stockholder, iCAD, Inc

PURPOSE

Digital Breast Tomosynthesis (DBT) is more accurate than Full-Field Digital Mammography (FFDM) alone, but prolongs reading time. A reader study evaluated the concurrent use of a Computer-Aided Detection (CAD) system to shorten reading time, while maintaining performance.

METHOD AND MATERIALS

A CAD system was developed to detect suspicious soft tissue lesions (masses, architectural distortions and asymmetries) in DBT planes. Rather than marking lesions, detected locations are extracted from the DBT planes and blended into the corresponding 2D synthetic image. Thus, lesions can be efficiently viewed in a CAD-enhanced 2D synthetic image without overlapping tissue. Twenty (20) radiologists retrospectively reviewed 240 cases in a multi-reader, multi-case (MRMC) crossover design. An enriched DBT sample included 67 malignancies in 60 patients and compared reading with CAD versus without CAD. All readers reviewed all cases with and without CAD in 2 visits separated by a memory washout period of at least 4 weeks. Radiologist performance was assessed by measuring Area Under the Receiver Operating Characteristic (ROC) Curve (AUC) for malignant lesions with CAD versus without CAD. Reading time, sensitivity, specificity and recall rate were also assessed.

RESULTS

Reading time improved 29.2% with use of CAD (95% CI: 21.1%, 36.5%; $p < 0.01$). Reader performance was non-inferior with CAD, for nonlinferiority margin delta = 0.05. Average AUC increased by 0.007 (95% CI: l0.013, 0.028; non-inferiority $p < 0.01$), from 0.839 without CAD to 0.846 with CAD. Average sensitivity increased with CAD from 0.847 without CAD to 0.870 with CAD (95% CI: -0.006, 0.053); showing a 0.032 increase in average sensitivity for soft tissue densities (95% CI: l0.002, 0.066), from 0.837 without CAD to 0.869 with CAD. Average specificity decreased from 0.525 without CAD to 0.507 with CAD (-0.018; 95% CI: -0.041, 0.005), and average recall rate for non-cancers increased from 0.476 without CAD to 0.494 with CAD (0.018; 95% CI: -0.005, 0.041).

CONCLUSION

Concurrent use of CAD results in a 29.2% faster reading time with non-inferiority of radiologist performance compared to reading without CAD.

CLINICAL RELEVANCE/APPLICATION

Concurrent use of CAD maintains high performance of DBT with a significant reduction in reading time.

SSE02-02 Dynamic Textural Analysis of Pre-treatment DCE-MRI Predicts Pathological Complete Response to Neoadjuvant Chemotherapy in Breast Cancer

Monday, Nov. 28 3:10PM - 3:20PM Room: E450A

Awards
Student Travel Stipend Award

Participants
Nathaniel Braman, Cleveland, OH (*Presenter*) Nothing to Disclose
Maryam Etesami, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Prateek Prasanna, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Christina Dubchuk, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (*Abstract Co-Author*) Research Grant, Hologic, Inc;
Anant Madabhushi, PhD, Piscataway, NJ (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Fewer than 30% of breast cancer patients who undergo neo-adjuvant chemotherapy (NAC) prior to surgery achieve pathological complete response (pCR). A pre-treatment dynamic contrast-enhanced MR imaging (DCE-MRI) biomarker predictive of pCR would enable more precise prognosis assessment and NAC targeting. We explore radiomic analysis of computer-extracted dynamic texture features at two DCE-MRI enhancement phases as a means of predicting breast cancer NAC response from baseline imaging.

METHOD AND MATERIALS

75 1.5T DCE-MRI scans prior to NAC were retrospectively analyzed. 22 patients had histology-confirmed pCR, while 53 had partial or non-response (NR). Computer-extracted texture features (Haralick, Co-occurrence of Local Anisotropic Gradient Orientations (CoLIAGe), and Laws) were separately extracted from initial and peak enhancement phases. The 5 most distinguishing features were selected by interaction capping and used to train a random forest classifier in a 3-fold cross-validation setting. Ability to predict pCR was assessed by area under the receiver operating characteristic curve (AUC) among all patients and within luminal (ER/PR+, 9 pCR, 41 NR) and non-luminal (triple-negative and HER2+, 13 pCR, 12 NR) patient subgroups.

RESULTS

Initial post-contrast phase texture features were effective in predicting pCR within luminal lesions (AUC = .863 ± .051), as well as identifying responders without separation by subtype (.831 ± .044). Prediction of pCR from initial phase was less reliable within the non-luminal group (AUC = .743 ± .087), yet peak contrast features better entified non-luminal responders than within luminal or all subtype groups (.831± .060 vs. .732 ± .054 and .679 ± .043). Top distinguishing features for the luminal group were homogeneity-based: standard deviation of CoLIAGe energy and sum variance, Haralick inverse difference moment. Non-luminal studies were partially identified by similar homogeneity features like CoLIAGe energy, but also by Laws energy features that detect "spottiness" and edges.

CONCLUSION

Dynamic textural analysis of DCE-MRI phases was shown to successfully predict pCR to NAC in luminal and non-luminal breast cancers.

CLINICAL RELEVANCE/APPLICATION

The ability to identify patients who will achieve pCR to NAC from baseline DCE-MRI texture features may provide a pre-treatment indicator of pathological complete response to neo-adjuvant chemotherapy, avoiding both under and over treatment of breast cancer subtypes.

SSE02-03 Could 'Deep Learning' Reduce Unnecessary Biopsies of Mammographic Microcalcifications?

Monday, Nov. 28 3:20PM - 3:30PM Room: E450A

Participants
Karen Drukker, PhD, Chicago, IL (*Presenter*) Royalties, Hologic, Inc
Benjamin Q. Huynh, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Maryellen L. Giger, PhD, Chicago, IL (*Abstract Co-Author*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Corporation;
Bonnie N. Joe, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Karla Kerlikowske, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Jennifer S. Drukteinis, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Bo Fan, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Serghei Malkov, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Jesus A. Avila, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Leila Kazemi, RT, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
John A. Shepherd, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate whether a machine learning technique known as deep learning, which selects image pixel data directly (rather than human-designed features) in the extraction of image descriptors, has potential to reduce breast biopsies of benign mammographic microcalcifications without associated findings.

METHOD AND MATERIALS

The HIPAA compliant dataset contained diagnostic mammography images of biopsy-sampled BIRADS 4 and 5 lesions in 107 patients for whom the lesion was visible only as microcalcifications. There were 21 patients with breast cancer (7 invasive and 14 in situ), and 86 with benign lesions. For each image a 256x256 region of interest containing the microcalcification was selected by an expert radiologist. The region of interest was used directly as input to a deep learning method trained on a very large independent set of non-medical images. The image descriptors thus extracted were subsequently used in a nested leave-one-out-by-case (i.e., patient) model selection and classification protocol. The number of benign breast biopsies that could be avoided at zero loss in sensitivity to diagnose cancer was evaluated for the deep learning method and compared to that obtained based on a subjective probability of malignancy assigned by an expert radiologist as part of this study. Here, bootstrapping was used to assess statistical significance.

RESULTS

At 100% sensitivity, on average, the numbers of benign biopsies that could be avoided were 38 of 86 by the deep learning-based method and 11 of 86 based on the probability of malignancy assigned by the radiologist. The deep learning-based method operated at 44% specificity (95% confidence interval [34-55%]) and the study radiologist at 13% [6-20%] ($p<.001$). Note that clinical specificity for this dataset was zero since all lesions underwent biopsy.

CONCLUSION

There seems to be great potential for the application of deep learning methods as an aid to radiologists in the analysis of medical images.

CLINICAL RELEVANCE/APPLICATION

Reducing the number of unnecessary breast biopsies without loss in diagnostic sensitivity is an important step towards improved breast cancer diagnosis and cost reduction.

SSE02-04 Quantitative Characteristics of Background Parencymal Enhancement in Longitudinal Breast DCE-MRIs of Healthy Women

Monday, Nov. 28 3:30PM - 3:40PM Room: E450A

Participants
Aly Mohamed, PhD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
David Gur, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Brenda F. Kurland, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Margarita L. Zuley, MD, Pittsburgh, PA (*Abstract Co-Author*) Research Grant, Hologic, Inc;
Wendie A. Berg, MD, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Rachel Jankowitz, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Jules H. Sumkin, DO, Pittsburgh, PA (*Abstract Co-Author*) Institutional research agreement, Hologic, Inc; Advisory Board, General Electric Company
Shandong Wu, PhD, MSc, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Breast DCE-MRI background parenchymal enhancement (BPE) has been reported to be associated with breast cancer risk. It became clinically important to understand key characteristics of BPE in developing it as a potential risk biomarker. In this study we investigated quantitative statistics and temporal variations of BPE in a longitudinal breast DCE-MRI dataset acquired from healthy women.

METHOD AND MATERIALS

We retrospectively identified 251 longitudinal breast DCE-MRI scans (earliest on Sep 2004 and latest on Dec 2015) from 93 women (31% have BRCA1/2 mutations) who underwent high-risk breast MRI screening at our institution (2-6 sequential scans per woman). For all the 251 scans, the average age-at-scan was 48.8±7.2 YO (range 26-67), the average between-scan time was 419±165 days (range 171-1605), and 134 (53%) were pre-menopausal with the rest post-menopausal. All 93 women remain breast cancer-free at the time of analysis. Fully automated computerized methods were applied to quantify BPE from the first post-contrast sequence at both bilateral and unilateral level. A quantitative BPE measure (BPE%) was derived as the percentage of the volume of enhanced voxels (at least 20% relative enhancement) over the fibroglandular tissue relative to the volume of fibroglandular tissue. A set of descriptive statistics were computed for BPE%, and variability of BPE% between sequential scans was measured by the intraclass correlation coefficient (ICC) in a linear mixed effects model.

RESULTS

For all 251 scans, mean BPE% was 25.1% ±13.7 (range 1.1% - 83.9%); the Pearson's correlation coefficient of BPE% between left (mean 27.4%±14.7) and right breasts (mean 24.2%±14.1) was 0.85; mean BPE% was 29.7%±15.0 (range 9.2% - 83.9%) for pre-menopausal and 20.9%±10.9 (range 1.1% - 67.0%) for post-menopausal scans (unpaired t-test $p<0.0001$). For 71 (or 48) women who had at least 2 (or 3) sequential scans, ICC of BPE% was 0.63 (or 0.46), and temporal variations of BPE% between longitudinal scans are shown in the figure.

CONCLUSION

In longitudinal DCE-MRI scans of breast cancer-free women, BPE% is highly correlated bilaterally, significantly higher among pre- than post-menopausal women, and the mean value decreases with aging.

CLINICAL RELEVANCE/APPLICATION

Quantitative characterization of BPE in longitudinal MRIs of healthy women will help determine BPE's temporal variability and reproducibility, building baseline measures for its use as a risk biomarker.

SSE02-05 Applying Data-driven Imaging Biomarker in Mammography for Breast Cancer Screening

Monday, Nov. 28 3:40PM - 3:50PM Room: E450A

Participants
Eun-Kyung Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hyo-Eun Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Employee, Lunit Inc
Bong Joo Kang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yu Mee Sohn, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Chan Wha Lee, Goyang-si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sun Young Min, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Minhong Jang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Officer, Lunit Inc
Anthony S. Paek, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) CEO, Lunit Inc

PURPOSE

To assess feasibility of data-driven imaging biomarker (DIB; an imaging biomarker that is derived from large-scale medical image data by using deep learning technology) in mammography and evaluate its potential for detection of breast cancer.

METHOD AND MATERIALS

We collected 9,757 digital mammograms from five institutions. 3,228 cancer cases were confirmed by pathology. 6,529 normal cases were defined by BIRADS final assessment category 1 without developing malignancy for 2 years. Each case includes 4 views of mammograms. 800 cases were randomly chosen as validation (n=400) and test (n=400) sets, and the remainder (2428 for cancer, 5,729 for normal) were used for training. The core algorithm of DIB-M (DIB for mammography) is deep convolutional neural network; a deep learning algorithm specialized for images. It learns discriminative features directly from training data according to the final task (cancer detection). For each case in training data, the probability of cancer inferred from DIB-M is compared with the

ground-truth diagnosis result (cancer: 1, normal: 0). Then the model parameters for DIB-M are updated based on the error between the prediction and the ground-truth. Training proceeds to minimize the prediction error of the entire training set, and the final DIB-M performed the best on the validation set is used for evaluation. We performed the experiment with 3 different random-split datasets to verify performance consistency.

RESULTS

AUC was 0.813 and 0.814 for the validation and test sets, respectively. Accuracy at threshold 0.5 was 72.9% (validation) and 73.4% (test). Sensitivity (specificity) according to different thresholds for the test set is: 0.940 (0.383), 0.810 (0.635), 0.690 (0.778), 0.505 (0.903), and 0.313 (0.983) with respect to the thresholds 0.1, 0.3, 0.5, 0.7, and 0.9. ROC curves according to 3 random sets were similar (Fig.1).

CONCLUSION

This research showed the potential of DIB-M as a screening tool for breast cancer. Further studies using a large number of high-quality data including benign cases are needed to further investigate its feasibility as a screening tool.

CLINICAL RELEVANCE/APPLICATION

Unlike previous computer-aided detection (CAD) algorithms, DIB-M is purely based on data-driven features from a large-scale mammography data instead of manually designed features. With further validation, DIB-M may help radiologists to diagnose breast cancer with higher accuracy and efficiency.

SSE02-06 Computer-Aided Detection (CAD)-Generated Kinetic Features of Preoperative Breast MR Imaging: Association with Disease-Free Survival of Patients with Invasive Breast Cancer

Monday, Nov. 28 3:50PM - 4:00PM Room: E450A

Participants
Jin You Kim, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyun Jung Kang, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Seung Hyun Lee, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Tae Hong Lee, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To retrospectively investigate whether the kinetic features of breast cancers assessed with computer-aided detection (CAD) at preoperative magnetic resonance (MR) imaging are associated with disease-free survival in patients with invasive breast cancer.

METHOD AND MATERIALS

This is an institutional review board-approved retrospective study, with a waiver of informed consent. Between January 2012 and February 2013, 330 consecutive women (mean age, 52.9 years; age range, 32-88 years) with newly diagnosed invasive breast cancer who had undergone preoperative MR imaging and curative surgery were identified. We retrospectively reviewed all preoperative MR images using a commercially available CAD system and noted the following kinetic parameters for each lesion: peak enhancement (the highest pixel signal intensity in the first post-contrast series), angio-volume (the total volume of the enhancing lesion), and delay enhancement profiles (the proportions of washout, plateau, and persistent-enhancing component within a tumor). Cox's proportional hazards modeling was used to identify associations between CAD-generated kinetic features and disease-free survival, after controlling for clinicopathological variables.

RESULTS

A total of 31 recurrences developed at a median follow-up time of 42 months (range, 3-50 months). The mean peak enhancement was significantly higher in patients with recurrences than in those who remained disease-free (553.65 ± 686.59 vs. 249.89 ± 263.25, P=0.020). Multivariate Cox's analysis showed that a higher peak enhancement (hazard ratio [HR]=1.001, 95% confidence interval [CI]=1.000-1.002, P=0.009) and presence of lymphovascular invasion (HR=2.433, 95% CI=1.086-5.449, P=0.031) were independently, and significantly, associated with poorer disease-free survival.

CONCLUSION

A higher CAD-measured peak enhancement at preoperative breast MR imaging was independently associated with poorer disease-free survival of patients with invasive breast cancer.

CLINICAL RELEVANCE/APPLICATION

Kinetic features assessed by applying computer-aided detection (CAD) to preoperative breast MR images can be used to identify a subgroup of breast cancer patients at high risk of recurrence.

SPSI24

Special Interest Session: Translating Quantitative Imaging from Academia to the Practice of Precision Medicine

Monday, Nov. 28 4:30PM - 6:00PM Room: E351

BQ

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

Participants
Edward F. Jackson, PhD, Madison, WI (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of QIBA in the translation of quantitative imaging applications from academia to the practice of precision medicine. 2) Understand the QIBA process and the underlying metrological approaches. 3) Appreciate the key deliverables of the QIBA process with regard to standardization of quantitative image biomarkers. 4) Appreciate how QIBA is contributing to the documentation of the value of quantitative imaging and its necessity in the practice of precision medicine.

LEARNING OBJECTIVES

1) Understand the role of QIBA in the translation of quantitative imaging applications from academia to the practice of precision medicine. 2) Understand the QIBA Process and the underlying metrological approaches. 3) Appreciate the key deliverables of the QIBA process with regard to standardization of quantitative imaging biomarkers. 4) Appreciate how QIBA is contributing to the documentation of the value of the quantitative imaging and its necessity in the practice of precision medicine.

Sub-Events

SPSI24A An Overview of QIBA

Participants
Edward F. Jackson, PhD, Madison, WI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

SPSI24B An Introduction to the QIBA Process and Metrology

Participants
Kevin O'Donnell, Pacifica, CA (*Presenter*) Employee, Toshiba Corporation;

LEARNING OBJECTIVES

View learning objectives under the main course title.

SPSI24C QIBA Deliverables: Science and Process

Participants
Paul E. Kinahan, PhD, Seattle, WA (*Presenter*) Research Grant, General Electric Company; Co-founder, PET/X LLC

LEARNING OBJECTIVES

View learning objectives under the main course title.

SPSI24D The Road Ahead: The Role of QIBA in Demonstrating the Value of Quantitative Imaging

Participants
Daniel C. Sullivan, MD, Durham, NC, (daniel.sullivan@duke.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the future activities that RSNA and other imaging-related organizations plan to help move the profession of radiology from a primarily qualitative interpretation paradigm to a more quantitative-based interpretation model. 2) Understand why extracting objective measurements from clinical scans is increasingly necessary for quality assurance activities in radiology and for the development of decision-support tools. 3) Describe why measurements from imaging scans are necessary for the development of therapies for many chronic diseases. 4) List several measurements from imaging scans that are needed in clinical practice.

URL

http://www.rsna.org/QIBA/

RC303

Cardiac Series: Emerging Cardiac MR and CT Imaging Techniques

Tuesday, Nov. 29 8:30AM - 12:00PM Room: S504AB

CA BQ CT MR

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

Participants
Konstantin Nikolaou, MD, Tuebingen, Germany, (konstantin.nikolaou@med.uni-tuebingen.de) (*Moderator*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
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 Spectral Detector CT

Tuesday, Nov. 29 8:30AM - 8:55AM Room: S504AB

Participants
Suhny Abbara, MD, Dallas, TX, (Suhny.Abbara@UTSouthwestern.edu) (*Presenter*) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

LEARNING OBJECTIVES

1) Describe the technical characteristics of dual and single energy approaches resulting in spectral CT images. 2) Describe the potential applications of dual layer spectral detector cardiovascular CT.

ABSTRACT

Spectral energy CT images can be acquired via several routs, including dual scan, rapid kV switching, Dual source, split beam, and dual layer, as well as photon counting. This presentation will review the general differences between the various approaches and will then focus on dual layer spectral detector CT and its potential applications in cardiovascular imaging

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

RC303-02 Triple-Rule-Out CT Angiography with Prospective ECG-trigger Dual-Energy Spectral Imaging and Low Concentration Contrastmedium

Tuesday, Nov. 29 8:55AM - 9:05AM Room: S504AB

Participants
Qi Yang, Xianyang, China (*Presenter*) Nothing to Disclose
Taiping He, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose
Yong Yu, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose
Haifeng Duan, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose
Tian Xin, MMed, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the use of low dose Spectral imaging mode with low concentration contrast medium in triple-rule-out CT angiography (CTA).

METHOD AND MATERIALS

Forty consecutive patients (HR<65BPM) with acute chest pain were randomly assigned into two groups to undergo triple-rule-out CTA on a Discovery CT750HD scanner. 20 patients in the study group (group A) were examined using prospective ECG-triggering dual-energy Spectral CT mode with a biphasic contrast injection of Iohexol (300mgI/ml). Images were reconstructed at 65keV with 60%ASiR. The control group (group B) of 20 patients underwent a conventional 120kVp retrospective ECG-gated spiral CT with auto mA and contrast concentration of 350mgI/ml. 120 kVp images were reconstructed with 40%ASiR. Region-of-interest was placed on coronary artery, pulmonary artery, thoracic aorta and muscle to measure CT number and standard deviation, and to calculate the contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR) for arteries. Two experienced radiologists also evaluated image quality double-blindly using a 4-point scoring system on MIP and VR images. Kappa test was used to test the interobserver consistency. The effective dose was obtained. Measurements between the two groups were statistically compared.

RESULTS

The CT number, SNR, CNR, subjective score of the two groups were statistically the same ($p>0.05$), and the agreement between the two observers were excellent ($k>0.80$). There was a significant difference in CTI

CONCLUSION

Spectral CT with prospective ECG-triggering and low concentration contrast medium reduces both radiation dose and contrast dose while maintaining image quality in triple-rule-out CT angiography compared with the conventional scanning protocol

CLINICAL RELEVANCE/APPLICATION

Prospective ECG-triggering Spectral CT may be used in triple-rule-out CT angiography

RC303-03 Multicenter Study of Utility of Left and Right Ventricular Strain Analysis for Diagnosis of Arrhythmogenic Right Ventricular Dysplasia (ARVD/C)

Tuesday, Nov. 29 9:05AM - 9:15AM Room: S504AB

Awards
Student Travel Stipend Award

Participants
Mounes Aliyari Ghasabeh, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Anneline S. te Riele, MD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Manijeh Zarghampour, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Cynthia James, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Crystal Tichnell, MSc, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Brittney Murray, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Bharath Ambale Venkatesh, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Elzbieta Chamera, baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Joao A. Lima, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Toshiba Corporation
Birgitta K. Velthuis, MD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
David A. Bluemke, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Research support, Siemens AG
Harikrishna Tandri, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Hugh Calkins, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ihab R. Kamel, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG
Stefan L. Zimmerman, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Purpose: ARVD/C is a challenging diagnosis. The aim of this study was to assess regional and global wall motion using cardiac MRI strain analysis in suspected ARVD/C patients.

METHOD AND MATERIALS

Method: Retrospective, multi-center, international, IRB-approved and HIPPA compliant study. We enrolled 397 consecutive ARVD-suspected patients with MRI examinations who had been referred to two different tertiary centers in the United States and Holland for ARVD evaluation. After complete Task Force Criteria work-up, patients were divided into five groups: 1: definite ARVD, 2: at-risk (mutation positive without symptomatic disease), 3: structural heart disease (not ARVD), 4: electrical heart disease and 5: normal subjects. Regional and global strain analysis was performed on cine SSFP CMR images (Myocardial Tissue Tracking, Toshiba, Tokyo, Japan). RV and LV longitudinal strains were measured on long axis views. Short-axis views were used for circumferential strain measurements.

RESULTS

Results: There were 67, 74, 55, 78, and 123 patients in groups 1-5, respectively. RV global longitudinal strain was significantly worse in ARVD patients compared to all other groups. Mean strain values for RV and LV are summarized in table 1. The at-risk group showed strain values between ARVD and normal patients. LV strain was worst in the structural heart disease group, and similar between other groups. Longitudinal strains showed stronger differences between groups than circumferential strains, both for the RV and LV. By ROC analysis, RV basal longitudinal strain was the best parameter for ARVD diagnosis. A cutpoint of -27 was 82% sensitive and 83% specific for differentiating ARVD from groups 3,4, and 5 combined (at-risk group excluded).

CONCLUSION

Conclusion: In a large, multicenter study of patients referred to tertiary care centers for possible ARVD, RV longitudinal strain analysis was able to reliably differentiate between ARVD and non-ARVD patients. At-risk patients showed RV functional decline, with strain values midway between normals and phenotypically positive ARVD.

CLINICAL RELEVANCE/APPLICATION

Clinical relevance/Application: RV longitudinal strain analysis by MRI shows promise as an objective, quantifiable measure for diagnosis of ARVD and may have utility as an adjunct to current Task Force Criteria.

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
Stefan L. Zimmerman, MD - 2012 Honored Educator

Stefan L. Zimmerman, MD - 2015 Honored Educator

RC303-04 **Non-binary Myocardial Infarct Quantification Technique Accounting for Partial Volume Averaging Predicts Segmental Left Ventricular Myocardial Contraction**

Tuesday, Nov. 29 9:15AM - 9:25AM Room: S504AB

Participants
Balazs Ruzsics, MD, PhD, Charleston, SC (*Presenter*) Nothing to Disclose
Pal Suranyi, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Rob J. van der Geest, PhD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Moritz H. Albrecht, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; ; ;
Taylor M. Duguay, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Gabriel A. Elgavish, PhD, Birmingham, AL (*Abstract Co-Author*) Owner, Elgavish Paramagnetics, Inc; Consultant, Elgavish Paramagnetics, Inc; President, Elgavish Paramagnetics, Inc
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Consultant, Guerbet SA

PURPOSE

Binary myocardial infarct (MI) quantification techniques do not take partial volume averaging into consideration, resulting in an overestimation in MI size. Non-binary approaches, such as Percent Infarct Mapping (PIM), are able to address these shortcomings. The aim of this study was to investigate the influence of true MI content determined by PIM on segmental myocardial contraction.

METHOD AND MATERIALS

Twenty patients (57±11 years, 16 males) with prior MI underwent 1.5T MRI (Avanto, Siemens). Short-axis balanced steady-state free-precession (bSSFP) cine imaging, post-contrast (0.1mmol/kg gadobenate-dimeglumine) T1-mapping (modified Look-Locker inversion recovery (IR), scheme 4(1)3(1)2), and late gadolinium enhancement (LGE) imaging (bSSFP with IR pulse) were performed. Myocardial contraction was quantified as radial wall thickening (RWT) using the centerline method according to the 17-segment model. Segmental MI content was calculated based on both T1 and LGE images applying the previously described PIM algorithm (PIMT1 and PIMLGE, respectively) using an in-house developed application. MI was also quantified based on LGE images using a binary approach (full-width at half-maximum, FWHM). Relationship between MI percentage (MI%) and RWT was tested using a linear regression.

RESULTS

Sixteen segments were excluded due to image artifacts. MI was observed in 69 of the remaining 324 segments. The FWHM method measured significantly higher global MI% compared to PIMT1 and PIMLGE (13.3±3.1%, 8.3±2.9%, and 8.7±3.5%, respectively, P=0.0024), as well as higher segmental MI% (66.1±26.1%, 47.4±18.0%, and 44.9±16.7%, respectively, P=0.0009). Average RWT in the normal and MI segments was 149.6±47.3% and 43.1±46.4%, respectively (P<0.0001). Strong correlation between MI% and RWT was observed using PIMT1 (r=-0.605, P=0.0012) and PIMLGE (r=-0.757, P<0.0001) methods, while the correlation was weaker using the binary FWHM threshold (r=-0.399, P=0.0319).

CONCLUSION

Both PIMT1 and PIMLGE showed good correlation with segmental myocardial contraction. The PIM-based methods measured lower MI% due to their ability to account for partial volume averaging. Non-binary approaches may become preferred techniques for quantitative LGE evaluation.

CLINICAL RELEVANCE/APPLICATION

Non-binary MI quantification is able to account for partial volume averaging thus provides more reliable MI measurement and better prediction of segmental myocardial contraction.

RC303-05 **Quantifying Regional Myocardial Function-Strain, Torsion and Twist**

Tuesday, Nov. 29 9:25AM - 9:50AM Room: S504AB

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 principles of regional myocardial function assessment.2) Compare different imaging approaches for quantification of regional myocardial function.3) Identify possible applications of regional function analysis in clinical cardiac imaging.

ABSTRACT

Active Handout:Bernd J. Wintersperger

http://abstract.rsna.org/uploads/2016/16001381/RC303 05 RC Strain, Torsion and Twist .pdf

LEARNING OBJECTIVES

1) Describe the principles of regional myocardial function assessment. 2) Compare different imaging approaches for quantification of regional myocardial function. 3) Identify possible applications of regional function analysis in clinical cardiac imaging.

ABSTRACT

A complex joint effort of the entire heart muscle is required in order to provide normal ventricular output. While the evaluation of global cardiac function and volumes aims at assessment of the gross ventricular status, measures of regional myocardial function aim at a more detailed analysis of the myocardial function. Parameters of regional myocardial function generally describe the relationship between force and resulting deformation of finite elements. Furthermore, such regional parameters are used to describe these relationships along various directions of the cardiac axis and coordinate system. Different modalities (Echo, MRI, CT) have been proposed for the assessment of such parameters. While in MRI regional parameters have predominately been used for research purposes, the development of speckle-tracking echocardiography (STE) and its evaluation has pushed towards clinical applications of regional myocardial functional parameters. The clinical use of such techniques may allow for earlier identification of subclinical pathology and as such may trigger therapy decisions at earlier time points.

RC303-06 **Integrated Electroanatomic Mapping With Three-Dimensional Computed Tomographic Images for Real-Time Guide to Ablations:Comparison with Standard Procedure**

Tuesday, Nov. 29 9:50AM - 10:00AM Room: S504AB

Participants
Anna Palmisano, MD, Milan, Italy (*Presenter*) Nothing to Disclose
Antonio Esposito, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Caterina Colantoni, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Sofia Antunes, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Aim of the study was to validate a CT acquisition protocol and image post-processing for the creation of 3D model of the heart containing information about cardiac anatomy and myocardial scar substrate of ventricular tachycardia (VT), than to compare the performance of VT ablation guided by electroanatomic map (EAM) merged with CT-3D model versus ablation guided by EAM only, that is the clinical standard procedure.

METHOD AND MATERIALS

Eighty-seven patients with recurrent VT were enrolled. 32 patients underwent standard ablation; 55 patients underwent DE-CT before VT-ablation, including an angiographic-scan and a delayed-scan (80kV). A 3D-model of the heart, representing the cardiac cavities, aortic root, left ventricular wall and myocardial scar, was obtained by the fusion of angiographic and delayed scan, separately segmented. The 3D-model were uploaded on CARTO®system and co-registered with EAMs using CARTO-merge. Agreement between low voltages at EAM and scar at CT was evaluated, and time of procedure (TOP), complication and success rate between standard and CT-3D model guided ablation

RESULTS

CT identified segments characterized by low voltages with good sensitivity (76%), good specificity (86%), and very high negative predictive value (95%). Point-by-point quantitative comparison revealed good correlation between the average area of scar detected at CT and at bipolar mapping (CT:4,901mm2, bipolar voltages –EAM:4,070mm2; R: 0.78;p<0.0001). 70% and 84% of low-amplitude bipolar points were mapped at a maximum distance of 5 mm and 10 mm from CT-segmented scar, respectively. TOP was 258±84 minutes for standard procedures and 204±60 minutes for CT-EAM guided ablations (p=0.012). A significant difference was found in the TOP for most complex procedure performed with both endo-epicardial approach (p=0.04). o significant differences were observed in term of procedural complication and success rate.

CONCLUSION

CT merged with EAM may be an effective tool for reduction of TOP and real-time guidance of VT ablation.

CLINICAL RELEVANCE/APPLICATION

Delayed enhancement CT resulted affective for identification of myocardial scars substrate of VT. Moreover, CT-3D model may be effective for real time guiding of EAM and radio frequency ablation

RC303-07 **Predicting the Size of Left Atrial Appendage Occluder using a Printed MDCT 3D Model- A Proof of Concept**

Tuesday, Nov. 29 10:00AM - 10:10AM Room: S504AB

Participants
Orly Goitein, MD, Ramat Gan, Israel (*Presenter*) Research Grant, Koninklijke Philips NV
Noam Fink, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose
Victor Guetta, Tel Hashomer, Israel (*Abstract Co-Author*) Nothing to Disclose
Eli Konen, MD, Ramat Gan, Israel (*Abstract Co-Author*) Research Consultant, RadLogics Inc
Roy Beinart, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
David Goitein, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose
Elio Di Segni, MD, Tel Hashomer, Israel (*Abstract Co-Author*) Nothing to Disclose
Michael Glikson, MD, Tel Hashomer, Israel (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Background: LAA occlusion is an effective alternative to oral anticoagulation in non valvular atrial fibrillation patients. The LAA varies significantly in size, morphology and spatial orientation making percutaneous occlusion challenging. MDCT provides three dimensional (3D) datasets allowing accurate imaging. Our objective was to evaluate the ability of printed 3D LAA models based on MDCT datasets in predicting LAA

occluder size.

METHOD AND MATERIALS

Patients planned for LAA occluder implantation were included. All patients underwent MDCT before implantation; this data was used for creating and printing 3D LAA models. Three cardiologists (informed which type of occluder was inserted) were asked to use the 3D models in vitro to predict the size of the device by fitting the device into the model. The chosen device size was compared with the actual device implanted during the procedure.

RESULTS

This retrospective study cohort included 29 patients (78±7 years, 64% males). Watchman™ and ACP™ devices were deployed in 17 and 12 patients, respectively. Two procedures were aborted (Watchman™) all three physicians predicted it. There was poor agreement between the 3D models and the inserted device for Watchman™ devices; Lin's concordance correlation coefficient 0.3 (95% CI -0.13, 0.76) as compared with a very good correlation between the 3D models and the inserted device for ACP™ devices; Lin's concordance correlation coefficient 0.8 (95% CI 0.5, 1.0). Average intra-class correlation for Watchman™ and ACP™ devices were 0.816 (95% CI 0.559 ,0.933) and of 0.915 (95% CI 0.559 ,0.933), respectively.

CONCLUSION

LAA printed 3D models were accurate in predicting both device size for ACP™ device and procedure failures. However, no such correlation was demonstrated for predicting Watchman™ device size. Further studies are required in order to evaluate the potential role of printed 3D LAA models in assisting LAA occluder procedures.

CLINICAL RELEVANCE/APPLICATION

LAA occluder is challenging due to the diverse anatomy of the appendage. Printed models based on MDCT data might help device selection and procedure planning.

RC303-08 **T1 and T2 Mapping Cardiovascular Magnetic Resonance to Differentiate Acute from Chronic Myocardial Infarction**

Tuesday, Nov. 29 10:10AM - 10:20AM Room: S504AB

Awards
Student Travel Stipend Award

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
Sebastian Bohnen, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Kai Muellerleile, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Christian Stehning, Hamburg, Germany (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Ulf K. Radunski, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Bernhard Schnackenburg, PhD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gunnar K. Lund, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Quantitative tissue characterization by novel T1 and T2 Mapping CMR techniques could provide incremental information to differentiate acute from chronic myocardial infarction (MI). We investigated the clinical utility of an approach using novel Mapping techniques in comparison to standard T2-weighted CMR to discriminate acute from chronic MI.

METHOD AND MATERIALS

Sixty-seven patients with first reperfused AMI were enrolled. T2w, T2, T1 mapping and late gadolinium enhancement (LGE) CMR were obtained at 2 time points after AMI at 8 ±5 days after infarction (baseline) and 6 ±1.4 months. CMR acquisitions were performed on end-diastolic LV short-axes. Myocardial T2 relaxation times were quantified using a free-breathing, navigator-gated multiecho sequence. Myocardial T1 relaxation times were measured using the modified Look-Locker inversion recovery sequence before and after administration of 0.075 mmol/kg gadobenate dimeglumine. T2, T1, and ECV maps were generated using a plug-in for OsiriX software (Pixmeo, Bernex, Switzerland). Two experienced observers independently placed regions of interest in the infarcted areas using LGE as a reference standard. A T2w-ratio was generated using the formula: T2w-ratio = Mean SIinfarct / Mean SIremote.

RESULTS

Native T1 had an almost perfect discriminative performance to differentiate between acute (baseline CMR) and the chronic stage (6 months follow-up) with an AUC of 0.984. The AUC of native T1 was significantly superior to the T2w-ratio with an AUC of 0.906 (P<0.05) and to T2 with an AUC of 0.903 (P<0.05). ECV of infarcted myocardium had a poor discriminative performance with an AUC of 0.655, which was significantly inferior compared to native T1, T2w-ratio and T2, respectively (P<0.001). The optimal cutoff of ≥1138 ms for native T1 provided a sensitivity and specificity of 96% and 100%, respectively. The optimal cutoffs for the other CMR parameters were: ≥3.3 for T2w-ratio, ≥69ms for T2 and ≥39% for ECV.

CONCLUSION

Native T1 of infarcted myocardium is the best discriminator between acute and chronic myocardial infarction and should preferably be used as an objective and truly quantitative parameter to differentiate between the acute and chronic stage of myocardial infarction.

CLINICAL RELEVANCE/APPLICATION

Major clinical application would be identification of the culprit lesion in patients presenting with recent myocardial infarction and multi-vessel disease.

RC303-09 **Multiparametric Myocardial MR Mapping (T1, T2 and T2*)**

Tuesday, Nov. 29 10:30AM - 10:55AM Room: S504AB

Participants
Kate Hanneman, MD, FRCPC, Toronto, ON, (kate.hanneman@uhn.ca) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the basic methods of myocardial T1, T2 and T2* mapping and the advantages and limitations of each technique. 2) Explain the role of myocardial MR mapping as a diagnostic and prognostic tool to quantify disease and detect diffuse myocardial abnormalities. 3) Identify findings of common diseases on T1, T2 and T2* maps.

RC303-10 **Doppler Ultrasound Triggering for Cardiac Magnetic Resonance Imaging at 7 Tesla: Initial Results**

Tuesday, Nov. 29 10:55AM - 11:05AM Room: S504AB

Participants
Fabian Kording, Hamburg, Germany (*Presenter*) Nothing to Disclose
Christian Ruprecht, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Bjoern Schoennagel, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Mathias Kladeck, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Jin Yamamura, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Juliane Schelhorn, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Kai Nassenstein, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Stefan Maderwald, PhD, MSc, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Harald H. Quick, PhD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Oliver Kraff, MSc, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

A prerequisite for cardiac magnetic resonance imaging (CMR) is adequate synchronization of image acquisition with the cardiac cycle. However, ECG is an inherently electrical measurement and distortions increase with higher magnetic field strengths. The purpose of this work was to evaluate the feasibility of Doppler Ultrasound (DUS) for CMR image synchronization at 7T.

METHOD AND MATERIALS

A custom build cardiotocograph was used to derive DUS signals. In order to reduce common-mode currents effects, six cable traps tuned to 297 MHz were placed within the transmission line. A sufficient MR compatibility was evaluated using field probes and by flip angle maps. Cardiac MRI was performed at a 7T (Magnetom 7T, Siemens Healthcare GmbH, Germany) in 3 healthy subjects. The ultrasound transducer was placed in an apical location under the RF coil. The E-wave in early diastole was selected as a trigger time point. For validation of the trigger signal, ECG, pulse, and DUS signals were recorded simultaneously outside of the MR room and compared in terms of RR interval length and time delay. Breath hold 2D cine FLASH sequences were acquired in short axis and four chamber view. To assess the image quality, endocardial blurring (EB) was measured in the left ventricle as a mean over all cardiac phases.

RESULTS

The maximal measured change in the E-and H-field distribution with and without transducer was 5 %. As a consequence, no interferences were observed between DUS and MRI in the B1 maps and during CMR imaging. The validation of the DUS trigger signal resulted in a high correlation to the ECG signal of r = 0.99. The DUS signal showed a mean time delay compared to the R-wave of 516±20 ms and a similar variation of 51 ms. Analysis of endocardial blurring between ventricular blood and myocardium resulted in 3.4±0.8 pixel.

CONCLUSION

Doppler Ultrasound was applied as a new trigger method in cardiac MRI at 7T. The DUS transmission line and transducer were approved for RF safety and successfully tested for CMR image synchronization at 7T. In future, this method needs to be evaluated in more detail in a larger patient population.

CLINICAL RELEVANCE/APPLICATION

With the merit of not being influenced by the electromagnetic field of the MRI, DUS may provide a reliable trigger method for cardiac imaging at high field strength.

RC303-11 **Estimates of Fractional Flow Reserve from Coronary CT Angiography Using Contrast Opacification Gradients to Determine Coronary Branch Flow Distribution**

Tuesday, Nov. 29 11:05AM - 11:15AM Room: S504AB

Participants
Satoru Kishi, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Andreas Giannopoulos, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Nahoko Kato, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Joao A. Lima, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Toshiba Corporation
Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose

Dimitris Mitsouras, PhD, Boston, MA (*Presenter*) Research Grant, Toshiba Corporation;
Anji Tang, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Andrea L. Vavere, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To validate a CT-FFR algorithm that can be reproduced by the readership with or without a proprietary basis, and to determine changes in CT-FFR accuracy for different methods to estimate the distribution of coronary blood flow in the coronary tree.

METHOD AND MATERIALS

The following four-step CT-FFR algorithm was retrospectively applied to 61 patients with 320-detector row CTA and invasive FFR: coronary lumen segmentation, myocardial segmentation with estimation of blood flow based on myocardial mass, estimation of the relative distribution of coronary blood flow to each coronary branch, and computational fluid dynamic simulation. Diagnostic performance of CT-FFR was tested for three different strategies to estimate the relative distribution of blood flow. The first two, Murray's Law and Huo-Kassab's rule, used coronary diameter, and the third used contrast opacification gradients to estimate resting-state flow. The algorithms were compared using the area under the receiver operating characteristic curve (AUC) to detect FFR<=0.8. Correlation coefficients and Bland-Altman limits of agreement with invasive FFR were also calculated.

RESULTS

Two patients were excluded from analysis due to motion artifact. FFR was measured on average 36.5 days after CTA. 25 lesions (41%) had FFR<=0.8. AUC to detect FFR<=0.8 was significantly higher using the contrast gradient (AUC=0.95), than using the Huo-Kassab (AUC=0.88, p=0.033) or Murray law models (AUC=0.87, p=0.041, Figure). Correlation coefficients were highest for the gradients (Spearman ρ=0.81), followed by the Huo-Kassab (ρ=0.67) and Murray law models (ρ =0.65). Bland-Altman limits of agreement were narrowest for the gradients (-0.181–0.150), followed by the Huo-Kassab (-0.246–0.152) and Murray law models (-0.286–0.260).

CONCLUSION

A simple, transparent four-step CT-FFR algorithm accurately detects a significant FFR<=0.8, the invasive gold-standard to determine the need for percutaneous coronary intervention. Estimating the relative blood flow distribution in a coronary tree using coronary contrast gradients can improve CT-FFR accuracy.

CLINICAL RELEVANCE/APPLICATION

Cardiovascular imagers can perform CT-FFR using a simple four-step approach with or without a proprietary basis to accurately detect a significant FFR0.8.

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/

Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

RC303-12 The Extracellular Volume Fraction using Contrast-enhanced T1 Mapping Cardiac Magnetic Resonance Imaging is Constant with Hematocrit Change: Evaluation with an Anemic Rat Model

Tuesday, Nov. 29 11:15AM - 11:25AM Room: S504AB

Participants
Yoo Jin Hong, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Pan Ki Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joshua Jinhan Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Donghyun Hong, MS, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Chul Hwan Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jin Young Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Byoung Wook Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim of this study was to evaluate the stability of extracellular volume fraction (ECV) based on cardiac magnetic resonance imaging (CMR) according to hematocrit (Hct) change using a rat model of anemia.

METHOD AND MATERIALS

Sixteen adult male Sprague-Dawley rats (weight, 300–500 g) underwent pre-model CMR without intervention. Six days after the MR scan, anemia was modeled and post-model CMR scanning was performed. For modeling anemia, an experienced veterinarian withdrew 15% of the total circulating blood by volume from the tail vein and replaced it by Hartmann's solution. A Hct drop of more than 15% was regarded as successful modeling of anemia. All CMR, including cine, pre T1, and post T1 mapping, were performed using a 9.4T MR scanner (Bruker Biospin Co., Billerica, MA). Pre- and post-T1 values were measured from 6 segments of the mid-LV and the LV cavity. The partition coefficient and ECV were calculated. After post-model MR scanning, all rats were sacrificed and histology was performed on their hearts.

RESULTS

After anemia modeling, the Hct level was 46.4% ± 4.09% (range: 39–54%), which was significantly lower than pre-modeling levels (59.0% ± 3.37%, range: 56–65%, $p < 0.001$). The mean Hct drop was 22%. The LVEF of the pre-modeling group was not significantly different from the post-modeling group (72.5% ± 2.6% vs. 72.7% ± 4.5%, respectively; $p = 0.83$). Post-contrast T1 values in the LV cavity in the anemia group were significantly lower than the pre-model group (629.6 ± 175.3 vs. 721.7 ± 104.1, respectively; $p = 0.02$). The partition coefficient of the anemia group was significant lower than the pre-model group (30.2 ± 3.5 vs. 37.4 ± 5.4, respectively; $p < 0.001$). The ECV of the anemia group was not significantly different from the pre-model group (15.9 ± 2.vs. 15.6 ± 2.1, respectively; $p = 0.70$).

CONCLUSION

CMR ECV is stable according to Hct change in a rat model of anemia; this supports the constant linear equilibrium between myocardial extracellular interstitial space and intravascular plasma.

CLINICAL RELEVANCE/APPLICATION

Anemia is a very common clinical condition in patients with heart failure. It is clinically important to evaluate the stability of ECV in anemic patients. Contrast enhanced T1 mapping MRI is simple, non-invasive, and safe. ECV based on contrast enhanced T1 mapping could be a robust tool for monitoring myocardial characteristics in patients with anemia.

RC303-13 Assessment of Left Ventricular Regional Wall Motion on the Basis of MR Sequences Featuring Sparse Data Sampling and Iterative Reconstruction (SSIR) with and without Breath-hold Commands - Segment-based Analysis

Tuesday, Nov. 29 11:25AM - 11:35AM Room: S504AB

Awards
Student Travel Stipend Award

Participants
Sonja Sudarski, MD, Mannheim, Germany (*Presenter*) Nothing to Disclose
Thomas Henzler, MD, Mannheim, Germany (*Abstract Co-Author*) Research support, Siemens AG; Speaker, Siemens AG
Holger Haubenreisser, Mannheim, Germany (*Abstract Co-Author*) Speaker, Siemens AG Speaker, Bayer AG
Johannes Budjan, MD, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Stefan O. Schoenberg, MD, PhD, Mannheim , Germany (*Abstract Co-Author*) Institutional research agreement, Siemens AG
Theano Papavassiliu, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the accuracy of regional wall motion (RWM) assessment using a 2D-real-time-CINE-TrueFISP MR-sequence featuring sparse data sampling and iterative reconstruction (SSIR) acquired with and without breath-hold commands at 3 Tesla in patients scheduled for LV analysis.

METHOD AND MATERIALS

60 patients prospectively underwent a segmented multi-breath-hold cine sequence as reference standard (RS) and a prototype undersampled SSIR-sequence acquired once during a single breath-hold (SSIR-sBH) and once during free shallow breathing (SSIR-non-BH). RWM was visually assessed in 16 segments (basal segments 1-6; mid-cavity segments 7-12; apical segments 13-16) as normal wall motion, hypokinetic, akinetic or dyskinetic segments.
On SSIR datasets for each segment compared to the RS the percentage of correctly evaluated, false worse and false better evaluated segments was assessed. To compare concordance of RWM evaluation, weighted Cohen's kappa testing for each of the 16 myocardial wall segments evaluated was performed.

RESULTS

In the final analysis of 52 patients, of the 832 analyzed segments, 603 segments were rated as normal, 186 segments were rated as hypokinetic and 43 segments akinetic in RS readout. None of the analyzed segments was dyskinetic. Agreement of RWM-assessment with the RS was similar for SSIR-sBH and SSIR-non-BH (86% agreement vs. 85%). Segment-based analysis showed equally high rates of RWM rated as false better, false worse and equal to the RS (around 5%, 10% and 85%) and a tendency in SSIR datasets to underestimate wall motion of septal segments, yet not reaching statistical significance.

CONCLUSION

Segment-based analysis of regional wall motion assessment with SSIR-data at 3 Tesla leads to similar results as RWM assessment on the basis of the RS sequences. Yet, a tendency to underestimate RWM in septal segments was observed with SSIR-data irrespective of breath-hold commands.

CLINICAL RELEVANCE/APPLICATION

Left ventricular regional wall motion assessment with SSIR-data at 3 Tesla leads to similar results compared to the reference standard sequences.

RC303-14 Valvular Flow Quantification with Phase Contrast Imaging (2D, 4D)

Tuesday, Nov. 29 11:35AM - 12:00PM Room: S504AB

Participants
Christopher J. Francois, MD, Madison, WI, (cfrancois@uwhealth.org) (*Presenter*) Research support, General Electric Company

Active Handout:Christopher Jean-Pierre Francois

http://abstract.rsna.org/uploads/2016/16001383/RC30314 RSNA2016_ValveFlowQuantification_handouts.pdf

LEARNING OBJECTIVES

1) Describe the physics of imaging blood flow with MRI from 2D to 4D phase contrast MRI. 2) Classify the categories of valve disease that can be characterized using MRI. 3) Illustrate how phase contrast MRI is used to assess normal and abnormal valve function.

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.Normal cardiac valve anatomy and function will be reviewed and serve as a basis to classify valvular heart disease – including congenital abnormalities, valvular stenosis and valvular regurgitation. The presentation will initially focus on the use of standard 2D phase contrast MRI for quantifying the severity of disease.The future potential for 4D phase contrast MRI to be used to quantify velocities and flow in patients with valvular disease will be described. In addition, more advanced hemodynamic parameters that can be quantified with 4D phase contrast MRI will be identified.

RC311

Nuclear Medicine Series: Assessment of Cancer Treatment Response: Updates

Tuesday, Nov. 29 8:30AM - 12:00PM Room: S505AB

BQ NM OI

AMA PRA Category 1 Credits ™: 3.50
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

Participants
Haesun Choi, MD, Houston, TX, (hchoi@mdanderson.org) (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) The currently available response evaluation criteria of solid tumors and its limitations. 2) New concept of response evaluation of solid tumors. 3) Future of response evaluation of solid tumors.

ABSTRACT

Sub-Events

RC311-01 Response Assessment Recommendations in Solid Tumors: RECIST vs PERCIST

Tuesday, Nov. 29 8:30AM - 9:00AM Room: S505AB

Participants
Heather Jacene, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To compare anatomic and metabolic imaging for response assessment. 2) To discuss limitations of current widely used criteria for assessing response. 3) To discuss the benefits and limitations of metabolic imaging for response assessment.

ABSTRACT

RC311-02 Fasting Glucose Level Observations in Oncologic FDG PET - A 10 Year Multi-Institutional Review Based on NCTN Clinical Trials

Tuesday, Nov. 29 9:00AM - 9:10AM Room: S505AB

Participants
Katherine Binzel, PhD, Columbus, OH (*Presenter*) Nothing to Disclose
David Poon, BS, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Preethi Subramanian, MS, BEng, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Tim Sbory, BS, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Marcel M. Knopp, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Chadwick L. Wright, MD, PhD, Lewis Center, OH (*Abstract Co-Author*) Nothing to Disclose
Jun Zhang, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

While it is standard practice to determine the blood glucose level at the time of FDG PET imaging, no current assessment reports on trends and observations and changes exist. We utilized access to the clinical trial data of the National Clinical Trial Network to develop a 10 year perspective.

METHOD AND MATERIALS

Patient blood glucose levels (BGL) are routinely determined as point of care testing to insure eligibility as most FDG PET protocols require a confirmation that the level is not above 200 mg/dl. Within the quality assurance assessment we perform for clinical trials within the NCI cooperative groups (NCTN), we record and assess the BGL. We developed query tools and pivot tables to assess the distribution and changes over time for BGL. We analyzed a portfolio of 5 clinical trials that include FDG PET within the last 10 years and evaluated more than 2000 examinations.

RESULTS

The distribution of fasting BGLs for each study included in our analysis were fairly similar. In general, BGLs were found to be within the limit of 200 mg/dL required for compliance within each clinical trial protocol. We found trends that point to population differences in regard to disease state and therapeutic status. Consistently, more than 90% of subjects had a BGL less than 150 at the time of injection, A representative trial including 411 FDG PET examinations found an average BGL at 107 ± 24 mg/dL, range was between 59 and 212 mg/dL. The majority of subjects had a BGL below 110 at the time of injection, less than one third of subjects had a BGL above 110, and only 8% had a BGL above 150. Overall, only 0.5% of studies had BGL above the threshold level. There were no significant trends founds relating BGL to recorded fasting time.

CONCLUSION

On average, blood glucose levels of patients enrolled in these clinical trials were below 110 mg/dL at the time of injection. Overall protocol compliance is exceptional, however stricter BGL limits could be achieved with a reduced threshold at 150 mg/dl without greatly impacting recruitment if reduced glycolytic status variability would be desired especially for quantitative assessments.

CLINICAL RELEVANCE/APPLICATION

Compliance to blood glucose thresholds in clinical trials and practice is high. Opportunity exists to refine guidelines if more

compliance to blood glucose thresholds in clinical trials and practice is high. Opportunity exists to refine guidelines if more normoglycolytic populations are desirable for quantitative imaging.

RC311-03 Feasibility of Ultra-Early Treatment Response Assessment in Non-Hodgkin Lymphoma by Means of [18F]-FDG-PET/MR: Do Changes in Glucose Metabolism and Cell Density Occur Simultaneously?

Tuesday, Nov. 29 9:10AM - 9:20AM Room: S505AB

Participants
Marius E. Mayerhoefer, MD,PhD, Vienna, Austria (*Presenter*) Nothing to Disclose
Daniela Senn, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Alexander Haug, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Chiara Giraudo, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Markus Raderer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine, in patients with Non-Hodgkin lymphoma (NHL), whether (1) quantitative assessment of treatment response by [18F]-FDG-PET/MR is possible with the first 72 h, or the first week, after initiation of the first cycle of rituximab-based immunochemotherapy; and (2) whether treatment-induced changes in glucose metabolism and cell density occur simultaneously.

METHOD AND MATERIALS

Patients with histologically proven diffuse large B-cell lymphoma (DLBCL) or follicular lymphoma (FL) were included in this prospective IRB-approved study. Patients underwent [18F]-FDG-PET/MR before, and then 48-72 h (follow-up 1, FU-1), as well as one week (FU-2) after initiation of the first cycle of R-CHOP (for DLBCL), or R-BENDA (for FL). For the up to 3 lesions per patient, matched ROIs were used to assess standardized [18F]-FDG uptake values (SUVmax, SUVmean), and apparent diffusion coefficients (ADCmin, ADCmean) derived from free-breathing EPI-DWI (b50, b800), at each time point (baseline, FU-1, FU-2). ANOVA and pairwise post-hoc tests were used to test for significant changes in SUVs and ADCs between baseline and FU-1, and baseline and FU-2. Rates of change were also compared between FU-1 and FU-2, and Pearson correlation coefficients were calculated.

RESULTS

Eighteen patients (DLBCL, 8; FL, 10) with 36 lesions were analyzed. Lesion-based mean rates of change between baseline and FU-1 were -41.8%, -37.4%, +37.2%, and +26.1%, for SUVmax, SUVmean, ADCmin, and ADCmean, respectively; whereas mean rates of change between baseline and FU-2 were -54.7%, -51.2%, +73.0%, and +55.2%, for SUVmax, SUVmean, ADCmin, and ADCmean, respectively. These changes between baseline and FU-1, and baseline and FU-2, were statistically significant for all quantitative parameters ($P<0.001$). A substantial, significant negative, correlation was observed between baseline-to-FU-1 SUVmean and ADCmean changes ($r=-0.63$); whereas a significant, moderate, negative correlation was also observed between baseline-to-FU2 SUVmean and ADCmean changes ($r=-0.48$).

CONCLUSION

In Non-Hodgkin lymphoma, significant changes of glucose metabolism and cell density occur as early as 48-72 hours after initiation of the first cycle of rituximab-based immunochemotherapy, and can be captured by [18F]-FDG-PET/MR.

CLINICAL RELEVANCE/APPLICATION

In Non-Hodgkin lymphoma, [18F]-FDG-PET/MR may enable assessment of treatment response within the first 72 hours after treatment initiation.

RC311-04 Role of TRIPLET FDG-PET in Lymphoma (HL and DLBCL): If Interim PET is Negative is END of Therapy PET Mandated?

Tuesday, Nov. 29 9:20AM - 9:30AM Room: S505AB

Participants
Shanker Raja, MD, Bellaire, TX (*Presenter*) Nothing to Disclose
Sharad P. George, MD, Dhahran, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose
Shaima H. Shousha, MD, MBBCh, Muharraq, Bahrain (*Abstract Co-Author*) Nothing to Disclose
Imran K. Tailor, MD, MBBS, Riyadh, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose
Belal M. Albtoosh, BSN, Riyadh, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose
Mohammed O. Al Harbi, Riyadh, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose
M Salman, Riyadh, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose
Abdullah S. Aldosary, MBBS, Riyadh, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Introduction: FDG-PET in staging lymphomas has been validated, while the role of triplet [triPET @ (baseline (basP), interim (intP) and end of Rx (endRxP)] in pt. management strategies is evolving. Compelling data favors the inclusion of intP in PET-directed adaptive therapies in HL; however, for DLBCL the role of intP is questionable. We evaluated the role of triPET in pts. with lymphoma.

METHOD AND MATERIALS

Methods Retrospective review of PET archives revealed a total of 37 pts (HL=22, DLBCL=15). Majority of the HL and DLBCL were Rxed with ABVD and RCHOP respectively. TriPET were acquired per accepted protocol, the images were reviewed by an expert (SR) and a novice (SH). SUVmax and Deauville scores (DSc) were obtained from five target lesions, the avg -composite SUVmax & DSc were computed for each pt. Statistical analyses were performed with the composite maxSUV (cSUV) and Deauville scores (cDSc) (EXCEL). Following statistics were performed (separately and combined in HL and DLBCL); mean+SD, PPV and NPV for CR Vs. progressive disease (PD) on intP using the variables cSUV and cDSc and delta change (DELT). Median PFS was the clinical endpoint for response.

RESULTS

Results: In HL median PFS 17 months, 86% overall survival. In DLBCL median PFS 15 months, 93% overall survival. At baseline

SUVmax in all pts was 15.0+/-5.2, (HL12.9+/-4.6 vs DLBCL 18.0+/-4.7; t-test p 0.003). Using cut off thresholds for intP to predict CR at cSUV <=2.0, , cDSC <=2.0 and DELT >=80%,. In HL: for cSUV- PPV 67%, NPV 95%; for DELT of cSUV PPV 100%, NPV 95%; for cDSC-PPV 30%, NPV 100%. In DLBCL: for cSUV- PPV 25%, NPV 100%; for DELT of cSUV PPV 33%, NPV 100%; for cDSC- PPV 50%, NPV 100%.

CONCLUSION

Conclusion: The results from our series suggest that intP has a promising role in managing HL as well as DLBCL. As opposed to recent work from other groups, in our modest cohort a negative intP in DLBCL had a NPV of 100% across cSUV, cDSc and DELT, with regards to CR Vs progressive disease; it appears that if intP is –ve then endofRxP is not mandated. In the results for HL subset, the role of intP parallels the emerging results from other groups. Our results need to be validated in a larger series, and alternate different management strategies.

CLINICAL RELEVANCE/APPLICATION

Clinical relevance: If our results in DLBCL are corroborated in larger series by other groups, a neg. intP would suffice and potentially preclude/defer end of therapy PET.

Handout:Shanker Raja

http://abstract.rsna.org/uploads/2016/16015014/RSNA2016_Lymphoma_TRIPET.pdf

RC311-05 Question and Answer

Tuesday, Nov. 29 9:30AM - 9:40AM Room: S505AB

Participants

RC311-06 Imaging Response - Earning Biomarker Status

Tuesday, Nov. 29 9:40AM - 10:10AM Room: S505AB

Participants
Terence Z. Wong, MD, PhD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Compare and contrast prognostic, predictive, and pharmacodynamic biomarkers. 2) Understand the difference between integrated and integral biomarkers in clinical trials. 3) Discuss advantages and limitations of imaging biomarkers.

ABSTRACT

Serum, pathological, and imaging biomarkers are becoming increasingly important to define potential biological targets, select which patients may benefit from a particular targeted agent, and to follow patients during and following therapy. Traditionally, imaging has not been formally recognized as a biomarker, and standardization of quantitative imaging techniques remains a major challenge. However, functional and quantitative imaging techniques are now being used routinely to evaluate early response to therapy. Unlike conventional cytotoxic chemotherapy, targeted therapy can be cytostatic and selects only susceptible populations of cells. Imaging response criteria is therefore often different from standard anatomic (RECIST, WHO) criteria, and the response may be heterogeneous. In the future, both serum and imaging biomarkers will have an increasingly important role in managing patients undergoing conventional and targeted therapy.

RC311-07 Treatment Response Evaluation with 18F-FDG PET/CT and 18F-NaF PET/CT in Multiple Myeloma Patients Undergoing High-dose Chemotherapy and Autologous Stem Cell Transplantation

Tuesday, Nov. 29 10:10AM - 10:20AM Room: S505AB

Participants
Christos Sachpekidis, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Jens Hillengass, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Hartmut Goldschmidt, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Uwe Haberkorn, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Antonia Dimitrakopoulou-Strauss, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Heinz-Peter W. Schlemmer, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Frederik L. Giesel, MD, MBA, Heidelberg, Germany (*Presenter*) Patent application for F18-PSMA-1007

PURPOSE

NaF PET/CT is suggested as a potential valuable tool in the assessment of MM. The aim of this study was to assess the combined use of the radiotracers FDG and NaF in treatment response evaluation of a group of multiple myeloma (MM) patients undergoing high-dose chemotherapy (HDT) followed by autologous stem cell transplantation (ASCT) by means of static (whole-body) and dynamic PET/CT (dPET/CT).

METHOD AND MATERIALS

35 patients with primary, previously untreated MM were enrolled in the study. All patients underwent PET/CT scanning with FDG and NaF before and after therapy. Treatment response by means of FDG PET/CT was assessed according to the EORTC 1999 criteria. NaF PET/CT therapy response assessment was based on visual evaluation of the patients' scans. Clinical criteria served as gold standard.

RESULTS

5 MM patients had a negative baseline FDG PET/CT scan and were excluded from the statistical analysis. Of the remaining 30 patients, 4 demonstrated complete response (CR) and 26 demonstrated non-CR (13 patients near complete response-nCR, 4 patients very good partial response-VGPR, 9 patients partial response-PR). After treatment, FDG PET/CT was negative in 15/30 patients and positive in 15/30 patients, showing a sensitivity of 57.7% and a specificity of 100%, in comparison to clinical criteria. Regarding NaF PET/CT, 5/30 pts (16.7%) had a negative baseline scan, thus failed to depict MM. NaF PET/CT depicted 56/129 18F-

FDG positive lesions (43%). Follow-up NaF PET/CT showed persistence of 81.5% of the baseline 18F-NaF positive MM lesions after treatment, despite the fact that 64.7% of them had turned to 18F-FDG negative. Dynamic FDG and NaF PET/CT studies showed that SUVaverage, SUVmax, as well as the kinetic parameters K1, influx and FD from reference bone marrow and skeleton responded to therapy with a significant decrease ($p<0.001$).

CONCLUSION

FDG PET/CT demonstrated satisfactory results in treatment response evaluation of MM. On the other hand, NaF PET/CT does not seem to aid significantly in treatment response evaluation of MM patients undergoing HDT and ASCT, at least in an early phase.

CLINICAL RELEVANCE/APPLICATION

Our study confirms the role of FDG PET/CT and at the same time stresses the limitations of NaF PET/CT in treatment response evaluation of MM patients.

RC311-08 Investigation of Quantitative [I-123] MIBG SPECT/CT in a Pediatric Population with Neuroblastoma

Tuesday, Nov. 29 10:20AM - 10:30AM Room: S505AB

Participants
Samuel L. Brady, MS, PhD, Memphis, TN (*Presenter*) Nothing to Disclose
Barry L. Shulkin, MD, MBA, Memphis, TN (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

SPECT has traditionally been regarded as a non-quantitative imaging modality. With recent advances in reconstruction and attenuation correction algorithms, quantitation in SPECT/CT is available. In this study a manufacturer-independent quantitative SPECT/CT reconstruction algorithm was investigated.

METHOD AND MATERIALS

Our institutional IRB deemed this study to be exempt from informed consent. All data were managed in compliance with HIPPA. 106 [I-123] MIBG SPECT/CT examinations were retrospectively reconstructed using SUV SPECT® (HERMES Medical Solutions Inc., Montreal Quebec), where 43 examinations were imaged using a GE Infinia Hawkeye 4, and 63 were imaged using a Siemens Symbia Intevo. Inter-scanner SUV analysis of nine regions of normal [I-123] MIBG tissue uptake (left/right parotids, left/right sub mandibular gland, left ventricle of the heart, liver, left/right adrenal glands, and the bladder) was conducted. Intra-patient SUVmean variability was calculated by measuring normal liver uptake within patients scanned on both scanners. Additionally, neoplastic tissue present in the examination data was quantified using SUVmax and trended with time.

RESULTS

A total of 44 patients (22 male) with median age of 3.9 years (range 0.8-17.4 years) were analyzed. Inter-scanner SUV variability measured no statistical difference (average p-value of 0.38) among the nine normal tissues analyzed. Intra-patient liver SUVmean varied by no more than 14% as calculated for 25 patients (87 examinations) scanned on both scanners. In one clinical example a posterior thoracic tumor was evaluated over eight time points (2/2015-2/2016) and demonstrated a 74% (3.1/12.0) reduction in SUVmax with treatment.

CONCLUSION

The results demonstrate low intra-patient measurement variability for scanner-independent quantitative SPECT/CT SUV analysis in a pediatric population with neuroblastoma. Furthermore, quantitative SPECT/CT may offer the opportunity for objective analysis of tumor response using the conventional single photon emitting agent [I-123] MIBG, by normalizing the uptake to injected dose, patient weight, and injection to imaging interval as is done for PET.

CLINICAL RELEVANCE/APPLICATION

Quantitative SPECT/CT may assist inter-institutional trials that require tumor response measurement using single photon emitting radiotracers and facilitate evaluation using radionomic techniques.

RC311-09 Imaging of Osteosarcoma using Bone Scintigraphy, Sodium Fluoride-18-PET/CT and Fluoro-18-Deoxyglucose PET/CT - Evaluation of Treatment Response in a Phase I Trial with Radium-223 Therapy

Tuesday, Nov. 29 10:30AM - 10:40AM Room: S505AB

Participants
Kalevi J. Kairemo, MD,PhD, Houston, TX (*Presenter*) Nothing to Disclose
Eric M. Rohren, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gregory C. Ravizzini, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Arvind Rao, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Homer A. Macapinlac, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Vivek Subbiah, MD, Houson, TX (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim was to investigate the role of different imaging modalities in a phase I clinical trial of radium-223 (223RaCl2) in the treatment of patients (N=18) with high-risk relapsed bone-forming osteosarcoma (NCT01833520).

METHOD AND MATERIALS

Patients received 1–6 cycles of 223RaCl2, doses varied from 6.84 MBq to 57.81 MBq. Bone scintigraphy, FDG-PET or sodium fluoride-18 (NaF) PET was used to characterize the disease. All 18 patients had multiple lesions. Bone scintigraphy and FDG-PET or NaF-PET studies could be compared in 10 patients at two time points. Lesion number, locations, and volumes were analyzed using FDG-PET and NaF-PET. We also developed a measure in analogue to PERCIST analyze response in NaF-PET, called NAFCIST.

RESULTS

Of the 18 patients, 17 had bone lesions. In four of the seven patients with multiple skeletal lesions (>5), FDG-PET and NaF-PET studies could be compared. The skeletal tumor locations varied in our patient population: two patients lesions in the skull, seven in the extremities, 10 patients in pelvis, 12 in the spine, and nine patients in the ribs. The FDG-PET and NaF-PET studies could be compared in all four patients who had multiple lung lesions (>5): the lung volume, calcified lung nodules, and pathologic NaF and FDG volumes varied substantially. Most of the patients (14/18) had soft-tissue metastases, and at least some of the metastases were calcified in all 14 patients. Soft-tissue lesions were found in lungs, brain, liver and lymph nodes. In many patients, the soft-tissue lesions were extensions of bone tumors. Overall response was seen in only one patient, but 4 patients experienced mixed responses, in which most often the bone lesion decreased in intensity, and the surrounding soft tissues increased in intensity. The NaF-PET response criteria (NAFCIST change) demonstrated a correlation with changes in alkaline phosphatases, and with cumulative administered activity.

CONCLUSION

NAFCIST may be a new tool for high-risk osteosarcoma response evaluation, because NaF demonstrates also soft tissue metastases in osteosarcoma (lung, liver, brain, lymph node), and 5 lesions in multiple organs can be found. Our results indicate that NaF-PET is an essential part of osteosarcoma staging and NaF PET and FDG PET are complementary in osteosarcoma.

CLINICAL RELEVANCE/APPLICATION

We have developed new criteria for osteosarcoma response evaluation based on fluoride-PET.

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/

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

RC311-10 Question and Answer

Tuesday, Nov. 29 10:40AM - 10:50AM Room: S505AB

Participants

RC311-11 Challenges of Solid Tumor Measurements and Techniques to Address This

Tuesday, Nov. 29 10:50AM - 11:20AM Room: S505AB

Participants
Haesun Choi, MD, Houston, TX, (hchoi@mdanderson.org) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) The currently available response evaluation criteria of solid tumors and its limitations. 2) New concept of response evaluation of solid tumors. 3) Future of response evaluation of solid tumors.

ABSTRACT

LEARNING OBJECTIVES

1) The currently available response evaluation criteria of solid tumors and its limitations. 2) New concept of response evaluation of solid tumors. 3) Future of response evaluation of solid tumors.

ABSTRACT

RC311-12 Comparison of Novel Multi-level Otsu and Conventional PET Segmentation Methods for Measuring FDG Metabolic Tumor Volume in Patients with Soft Tissue Sarcoma

Tuesday, Nov. 29 11:20AM - 11:30AM Room: S505AB

Participants
Inki Lee, MD, Madison, WI (*Presenter*) Nothing to Disclose
Hyung-Jun Im, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Meiyappan Solaiyappan, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Steve Cho, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

There are various strategies that may be used for PET tumor segmentation. We have developed a novel and highly consistent segmentation algorithm using a multi-level Otsu PET method (MO-PET) (JNM 2015 May 1;56(supplement 3):452). We evaluated the reliability of MO-PET compared to conventional PET segmentation methods for measuring FDG PET metabolic tumor volume (MTV) in patients with soft tissue sarcoma (STS).

METHOD AND MATERIALS

Clinical and imaging data were obtained from the NCI Cancer Imaging Archive (http://dx.doi.org/10.7937/K9/TCIA.2015.7GO2GSKS). Forty-eight STS patients with FDG PET/CT and MR prior to therapy were analyzed. MTV of the tumor using MO-PET was compared to other conventional methods (absolute SUV threshold values of 2.0, 2.5 or 3.0, and percentage of SUVmax values of 30%, 40%, 50% or 60%). The reference volume was defined as an MR based gross tumor volume (GTV), which was contoured on T2-weighted fat-suppression images. Intra-class analysis and Bland-Altman analysis were performed to evaluate the correlation and agreement of MTV to GTV.

RESULTS

MTVs obtained using each parameter including SUV 30%, 2.0, 2.5, 3.0, and MO-PET were highly correlated with the GTV in intra-

class correlation analysis (all p<0.01 except for SUV 30% p<0.05). MO-PET had the highest correlation of MTV to GTV with a correlation coefficient of 0.93. The highest correlation coefficient using absolute and percent SUV threshold was 2.0 and 30% (correlation coefficients; 0.79 and 0.42, respectively). The Bland-Altman bias results showed highest agreement for MTV using MO-PET with GTV (26.0 ± 489.6 cm3) compared to other methods (SUV 2.0 with -69.3 ± 765.8 cm3 and SUV 30% with -255.0 ± 876.6 cm3).

CONCLUSION

PET MTV segmented with MO-PET method showed higher correlation and agreement with MRI-based GTV in comparison to conventional percent and absolute SUV-based PET segmentation methods. MO-PET is a reliable and consistent method for measuring tumor MTV.

CLINICAL RELEVANCE/APPLICATION

Quantitation of tumor metabolic burden using the MO-PET segmentation method shows promise for future clinical applications.

RC311-13 Pilot Comparison of 4DST and FDG PET/CT for Early Therapy Monitoring of Advanced Non Small Cell Lung Cancer

Tuesday, Nov. 29 11:30AM - 11:40AM Room: S505AB

Participants
Ryogo Minamimoto, MD, PhD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Masatoshi Hotta, Shinjyuku-ku, Japan (*Presenter*) Nothing to Disclose
Miyako Morooka, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Masashi Kameyama, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuo Kubota, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Jun Toyohara, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

4'-[Methyl-11C] Thiothymidine (4DST) PET-CT provides DNA synthesis imaging, which represented higher correlation with proliferation of advanced non small cell lung cancer (NSCLC) compared to FDG. The aim of this prospective study is to evaluate the potential of 4DST for early therapy monitoring of advanced NSCLC, and comparing the result to the assessments with CT and FDG PET-CT.

METHOD AND MATERIALS

The patients pathologically diagnosed with advanced NSCLC scheduled to receive platinum-doublet chemotherapy (PDC) were eligible. 4DST and FDG PET-CT scan, and CT were performed at baseline and after 2 cycles of PDC. Patients were evaluated after 2 cycles of PDC by RECIST 1.1 (response evaluation criteria in solid tumors) based on CT measurements, EORTC (European Organization for Research and Treatment of Cancer criteria) and PERCIST 1.0 (PET Response Criteria in Solid Tumors) based on PET-CT measurements. 4DST PET-CT was evaluated according to modified EORTC criteria (difference of SUVmax as -35% > was regarded as inadequate therapeutic response). The reference standard for the assessment of patient's prognosis was based on the medical records and the follow-up radiographic assessments.

RESULTS

A total of 20 patients were included in this study. Three patient showed PD before early interim PET, finally 17 patients (male: 13, female 4, mean age: 72 ± 7, range: 56-84) were used for the analysis. The results of prognosis for patients after following up of average four months were 12 patients of recurrence and five patients without disease progression. 4DST had a significantly higher PPV (75%, p < 0.001) to predict disease progression than RECIST (50%), EORTC (25%) and PERCIST (33%). No difference in NPV was found between 4DST (80%) and RECIST (100%), EORTC (100%), and PERCIST (100%)

CONCLUSION

4DST PET/CT had a potential for early therapy monitoring of advanced NSCLC.

CLINICAL RELEVANCE/APPLICATION

4DST PET/CT had a potential for early therapy monitoring of advanced NSCLC.

RC311-15 Question and Answer

Tuesday, Nov. 29 11:50AM - 12:00PM Room: S505AB

Participants

RC315

Breast Series: MRI Emerging Technology in Breast Imaging

Tuesday, Nov. 29 8:30AM - 12:00PM Room: Arie Crown Theater

BR BQ MR

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

Participants
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Moderator*) Research Grant, GlaxoSmithKline plc; Research Grant, General Electric Company; Research Grant, Hologic, Inc
Habib Rahbar, MD, Seattle, WA, (hrahbar@uw.edu) (*Moderator*) Research Grant, General Electric Company

LEARNING OBJECTIVES

Sub-Events

RC315-01 Screening MRI

Tuesday, Nov. 29 8:30AM - 8:50AM Room: Arie Crown Theater

Participants
Constance D. Lehman, MD, PhD, Boston, MA (*Presenter*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company

RC315-02 Unenhanced Magnetic Resonance Screening using Fused Diffusion-weighted Imaging and Maximum Intensity Projection in Patients with Personal History of Breast Cancer

Tuesday, Nov. 29 8:50AM - 9:00AM Room: Arie Crown Theater

Participants
Ji-Won Kang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ki Chang Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the diagnostic performance of unenhanced abbreviated protocols (AP) consisting of fused DWI using T1-weighted imaging (T1WI) with DWI maximum intensity projections (DWI MIPs), compared with conventional protocol (CP) consisting of dynamic contrast-enhanced T1WI with MIPs in the screening setting of patients with personal history of breast cancer.

METHOD AND MATERIALS

We conducted a retrospective observational reader study in 351 patients with personal history of breast cancer. Three breast radiologists reviewed the two sets of AP and CP images as follows: First, three readers reviewed the DWI MIP initially to search for the significant lesion and then reviewed the remaining images of AP to characterize the detected lesion on DWI MIPs and establish BIRADS final assessment. Second, MIPs of CP was evaluated, and then the remaining images of CP were assessed. Time to make each decision was measured and recorded.

RESULTS

MRI acquisition time was 5 minutes for the AP and 15 minutes for the CP. For AP, average times to read the DWI MIP and complete AP images were 5.51 and 22.14 seconds, respectively. For CP, average times to read MIP and complete CP images were 7.80 and 39.62 seconds, respectively. Ten in-breast recurrences (7 invasive ductal carcinomas and 3 ductal carcinoma in situs) were diagnosed. Among them, one DCIS was missed by all three readers, which were calcifications alone on mammography and not visible on MRI. On DWI MIP, three readers detected 9, 8, and 9 of 10 cancers, respectively and negative predictive values (NPVs) were 99.6%, 99.3%, and 99.6%, respectively. Complete AP showed sensitivities of 80%, 90%, and 80% and specificities of 94.9%, 93.2%, and 95.2%, respectively. On CP MIP, three readers detected 9, 8, and 9 of 10, respectively, and NPVs were 99.6%, 99.3%, and 98.6%, respectively. Complete CP showed sensitivities of 90.9 %, 90.0 %, and 80.0 % and specificities of 93.8%, 93.8%, and 96.3%, respectively.

CONCLUSION

An unenhanced AP showed short acquisition time of 5 minutes, and DWI MIP showed high NPVs more than 99% across three readers. Diagnostic performance of complete AP was equivalent to that of CP in the screening of patients with personal history of breast cancer.

CLINICAL RELEVANCE/APPLICATION

Diagnostic performance of an unenhanced AP was equivalent to that of CP with short acquisition time and no usage of contrast material in the screening of patients with personal history of breast cancer.

RC315-03 Head-to-head Comparison of Diffusion-weighted Imaging to Dynamic Contrast-Enhanced Magnetic Resonance Imaging of the Breast: Stand-Alone or Complimentary Parameter for Breast Cancer Detection?

Tuesday, Nov. 29 9:00AM - 9:10AM Room: Arie Crown Theater

Participants
Katja Pinker-Domenig, MD, Vienna, Austria (*Presenter*) Nothing to Disclose
Elizabeth J. Sutton, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Michael Weber, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Nina Purvis, MSc,PhD, New York City, NY (*Abstract Co-Author*) Nothing to Disclose
Sunitha Thakur, PhD, MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Thomas H. Helbich, MD, Vienna, Austria (*Abstract Co-Author*) Research Grant, Medicor, Inc Research Grant, Siemens AG Research Grant, C. R. Bard, Inc
Maxine S. Jochelson, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Diffusion weighted imaging (DWI) is increasingly used in clinical practice and together with dynamic contrast-enhanced MRI (DCE-MRI) as multiparametric (MP) MRI achieves excellent sensitivities and increases specificity. The aim of this study was to assess whether DWI can be used as a stand-alone parameter for breast cancer detection and to compare it to DCE-MRI and MP MRI.

METHOD AND MATERIALS

In this two-center study prospectively populated data-bases were searched for patients with a BI-RADS 0,4/5 finding, who underwent MP MRI of the breast with DCE-MRI and DWI and subsequent histopathologic verification. 100 patients were randomly selected and MP MRI data was retrospectively evaluated by two experienced readers in consensus. All DCE images and DWI with ADC maps were randomly assessed in an independent review, i.e readers assessed DWI without being provided DCE-MRI and vice-versa. Examinations were classified as either normal or abnormal (suspicious finding, further assessment necessary). A BI-RADS rating (1-5) was assigned. Lesion size and ADC values were recorded. MP MRI with DWI and DCE-MRI was assessed using a reading method that adapted ADC-thresholds to the BI-RADS classification. Histopathology was used as the reference standard. Appropriate statistical tests were used to assess sensitivity, specificity, and diagnostic accuracy.

RESULTS

There were 42 malignant and 58 benign tumors. DCE-MRI was the most sensitive test for breast cancer detection with a sensitivity of 100%. DWI as a stand-alone parameter was significantly less sensitive with 80% (p=0.001) but more specific with 78.6% compared to DCE-MRI with 66.7%. Diagnostic accuracy was 80% for DWI and 86% for DCE-MRI respectively. Except for a mucinous carcinoma and a ILC, missed cancers with DWI (11/42) were consistently lesions <12mm. When both parameters where used complementary as MP MRI, sensitivity with 96.7% was not significantly different from DCE-MRI (p=0.45) and specificity almost as good as DWI with 76.2% (p=1) resulting in the best diagnostic accuracy of 88%.

CONCLUSION

DWI cannot be used as a stand-alone parameter for breast cancer detection with sensitivities decreasing in smaller lesions. MP MRI with DWI and DCE-MRI achieves the best diagnostic accuracy for breast cancer detection.

CLINICAL RELEVANCE/APPLICATION

Radiologist should be aware that DWI should not be used as a stand-alone parameter for breast cancer detection but used complementary to DCE-MRI.

RC315-04 High Risk Breast Cancer Screening with an Ultrafast High Spatiotemporal Resolution MRI Sequence; Less Costly and as Reliable as a Full Diagnostic MRI Protocol

Tuesday, Nov. 29 9:10AM - 9:20AM Room: Arie Crown Theater

Participants
Jan Van Zelst, MD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Albert Gubern-Merida, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Suzan Vreemann, MSc, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Jeroen Veltman, MD, Hengelo, Netherlands (*Presenter*) Nothing to Disclose
Monique D. Dorrius, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Claudette E. Loo, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Katya M. Duvivier van Hoof, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited Consultant, QView Medical, Inc Shareholder, QView Medical, Inc Director, ScreenPoint Medical BV Shareholder, ScreenPoint Medical BV
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Research agreement; Siemens AG; Research agreement, Seno Medical Instruments, Inc

PURPOSE

High costs of breast cancer screening with MRI are mainly due to the costs of MRI itself. TWIST is an ultrafast dynamic contrast enhanced MRI (UDCE) sequence with a temporal resolution of 4.3s and a diagnostic spatial resolution, thus allowing morphologic and kinetic evaluation of breast lesions. A dynamic TWIST series can be obtained in 102s and may decrease the costs of breast MRI substantially compared to a standard full diagnostic protocol (FDP) that typically takes about 15-20 minutes.
The purpose of our study is to investigate whether breast cancer screening with an UDCE only is as accurate as screening with a FDP.

METHOD AND MATERIALS

The need for informed consent was waived by the IRB. Women at >20% risk who underwent a hybrid breast MRI screening protocol including a standard FDP (T1w dynamic contrast-enhanced (VIBE) series, T2w imaging and diffusion weighted imaging) and a UDCE on a 3-Tesla scanner (SIEMENS, Erlangen, Germany) with a dedicated 16-channel breast coil were eligible for this study. We included all screening exams with a screen-detected malignant (n=31) or benign (n=54) lesion between 2011 and 2015. Furthermore, 115 randomly selected normal exams with >2 years of negative follow-up were included.Four dedicated breast radiologists were asked to read all 200 exams twice in two separate reading sessions; once reading the FDP (without UDCE) and once only the UDCE series. Reading sessions were at least 4 weeks apart and the reading modes and order of the cases were

randomized for each reader. Suspicious findings were scored using the BI-RADS scoring system and a likelihood scale from 0-100. Multi-case-multi-reader ROC analysis was used to evaluate reader performance. McNemar tests were used to compare the mean sensitivity and specificity.

RESULTS

The mean AUC for the FDP was 0.87 and 0.89 for UDCE only reading (p=0.21). Readers worked on a slightly different operating point of the ROC curve; the mean sensitivity of UDCE vs FDP was slightly lower (80 vs 85%; p=0.1), while the specificity was significantly higher (81 vs 77%; p=0.001), respectively.

CONCLUSION

UDCE only is as accurate as a standard FDP for screening women at increased risk of developing breast cancer.

CLINICAL RELEVANCE/APPLICATION

Ultrafast high spatiotemporal resolution MRI such as a UDCE can be performed within 102 seconds, substantially decreasing the time needed to perform accurate breast MRI and thus the costs.

RC315-05 Breast MRI: Is Background Parenchymal Enhancement (BPE) Predicted By Serum Sex Hormone Levels?

Tuesday, Nov. 29 9:20AM - 9:30AM Room: Arie Crown Theater

Participants
Glen Lo, MBBS, Perth, Australia (*Presenter*) Nothing to Disclose
Rachel P. Fleming, MD, Etobicoke, ON (*Abstract Co-Author*) Nothing to Disclose
Anabel M. Scaranelo, MD, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Karina Bukhanov, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Divjot Minhas, , ON (*Abstract Co-Author*) Nothing to Disclose
Hadas Moshonov, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Pavel Crystal, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Background parenchymal enhancement (BPE) at breast magnetic resonance imaging (MRI) has been shown to be associated with breast cancer risk. The factors responsible for BPE were not sufficently studied. Our study aimed to evaluate a correlation between BPE and plasma sex hormone levels and ability to predict BPE based on a combination of sex hormone levels.

METHOD AND MATERIALS

Eligible MRI studies included high-risk screening and diagnostic studies. Exclusion criteria were prior breast carcinoma or radiation therapy and current anti-oestrogen medication (e.g. tamoxifen).MRI studies were performed on Siemens units at 1.5 T or 3 T with standard protocol (T1 and T2-weighted imaging without and with fat saturation, diffusion-weighted imaging and ADC maps) with Gadavist enhancement (0.1 mmol/kg at 2.0 mL/s with 20 mL saline flush, scanning at 35 s, 1, 2 and 6 min).MRI studies were post-processed on an automated viewing platform to calculate BPE (MultiView software, HOLOGIC).Serum drawn at time of MRI measured estradiol, progesterone, follicular stimulating hormone (FSH), luteinizing hormone (LH) and prolactin.Patient demographic data collected included MRI indication, menopausal status, menarche, HRT use, date of LMP (day of cycle), prior oophorectomy, height and mass (BMI).

RESULTS

86 women were enrolled, with sex hormone levels measured and automated BPE measurement obtainable. Median age was 49 years (29-70). We observed a negative correlation between each sex hormone and BPE, however, none of these correlations were statistically significant: estradiol (r=0.05, p=0.63); progesterone (r=0.003, p=0.98); FSH (r=-0.05, p=0.63); LH (r=-0.1, p=0.36); prolactin (r=0.02, p=0.85).Based on multiple regression (with stepwise selection), there was no combination of sex hormones that could significantly predict BPE.

CONCLUSION

We observed no association between individual or combination serum sex hormone levels and BPE.

CLINICAL RELEVANCE/APPLICATION

Our results suggest that factors other than blood sex hormones may play a significant role in predicting background parenchymal enhancement (BPE). Our study does not provide direct support for current practice of scheduling breast MRI during the second week of the menstrual cycle.

RC315-06 Diagnostic MRI

Tuesday, Nov. 29 9:30AM - 9:50AM Room: Arie Crown Theater

Participants
Elizabeth A. Morris, MD, New York, NY (*Presenter*) Nothing to Disclose

RC315-07 Estimation of T2* Relaxation Time of Breast Cancer: Correlation with Clinical, Imaging and Pathological Features

Tuesday, Nov. 29 9:50AM - 10:00AM Room: Arie Crown Theater

Participants
Mirinae Seo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jung Kyu Ryu, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Geon-Ho Jahng, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Shin Ahn, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sun Jung Rhee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to estimate the T2* relaxation time in breast cancer and to evaluate the relationship of the T2* value of breast cancer with clinical-imaging-pathological features.

METHOD AND MATERIALS

Between January 2011 and July 2013, 107 consecutive women with 107 breast cancers underwent multi-echo T2* weighted imaging on a 3.0 T clinical magnetic resonance image system. The Student's t-test and one-way analysis of variance (ANOVA) were used to compare the T2* values of cancer for different groups based on clinical-imaging-pathological features (age at diagnosis, menopausal status, symptoms at diagnosis, family history, mammographic density, calcification at mammography, lesion location, size, and signal intensity on T2-weighted image (T2WI) at MRI, pathologic subtype, LN metastasis, histologic grade, ER, PR, HER2, p53, Ki-67, CK 5/6, and molecular subtype). In addition, multiple linear regression analysis was performed to find independent predictive factors associated with T2* values.

RESULTS

The mean T2* value of 92 invasive cancers was significantly longer than that of 15 ductal carcinomas in situ (DCIS) (p=0.029). Signal intensity on T2-weighted MR images (T2WI) and histologic grade of invasive breast cancers showed significant correlation with T2* relaxation time in univariate and multivariate analysis. Breast cancer group with higher signal intensity compared with breast parenchyma on T2WI showed longer T2* relaxation time (p=0.006). Cancer group with higher histologic grade showed longer T2* relaxation time (p=0.014).

CONCLUSION

T2* value was significantly longer in invasive cancer than DCIS. In invasive cancers, T2* relaxation time was significantly longer in cancer with high histologic grade and high signal intensity on T2WI. Based on these preliminary data, quantitative T2* mapping is a potentially useful technique for the characterization of breast cancer.

CLINICAL RELEVANCE/APPLICATION

Quantitative T2* mapping is a potentially useful technique for the characterization of breast cancer in yielding information of the tumor microstructure.

RC315-08 Feasibility Analysis of Early Temporal Kinetic features in an Abbreviated MRI Protocol as a Surrogate Marker for Tumor Type, Grade, and Prognosis

Tuesday, Nov. 29 10:00AM - 10:10AM Room: Arie Crown Theater

Awards
Trainee Research Prize - Fellow

Participants
Laura Heacock, MD, MS, New York, NY (*Presenter*) Nothing to Disclose
Yiming Gao, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Alana A. Lewin, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Neeti Bagadiya, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Amy N. Melsaether, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
James S. Babb, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Samantha L. Heller, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the role of early temporal kinetics in differentiating invasive ductal carcinoma (IDC) and ductal carcinoma in situ (DCIS) by tumor grade, tumor type and prognostic markers.

METHOD AND MATERIALS

In this institutional review board-approved study, 152 women with 178 pathology-proven lesions underwent breast DCE-MRI on a 3.0T magnet with a 7 channel breast coil. The protocol consisted of pre-contrast, first post-contrast and subtraction images. Lesion size, shape, morphology, initial enhancement ratio (IER; % signal increase over baseline at the first post-contrast acquisition), pathology, axillary metastases, Oncotype DXscore, background parenchymal enhancement (BPE) and peritumoral BPE were evaluated. Statistical analysis included Fisher's exact tests, Mann-Whitney U tests and Spearman rank correlation.

RESULTS

Cancers were 76% (135/178) IDC and 24% (43/178) DCIS. For IDC, 57% (77/135) were estrogen receptor/progesterone receptor-positive (ER/PR+), 21% (28/135) were triple negative breast cancer (TBNC) and 22% (31/135) were human epidermal growth factor receptor 2-positive (HER2+). IER was higher for IDC than DCIS (p<0.001) and for high-grade DCIS and IDC compared to low-grade DCIS (p<0.001). IER increased as tumor grade increased (r=0.38, p<0.001), as ki-67 increased (r=0.28, p=0.002), as BPE increased (r=0.31,p<0.001), and as size increased (r=0.37, p<0.001). Mean IER was higher for IDC with positive nodes (211% [82-452%]) than for no nodes (156% [44-359%], p=0.00) and for HER2+ (mean=213% [100-359%]) and TNBC (mean=227% [110-452%]) than for ER/PR+ tumors (mean=164% [54-298%], p=0.026). There was no correlation between Oncotype DX score and IER. There was no correlation between BPE/peritumoral BPE and size, tumor grade, ki-67, or positive axillary nodes.

CONCLUSION

High IER at the first post-contrast imaging can differentiate high-grade malignancy, HER2+/TNBC cancers, axillary invasion, and high ki-67 tumors, all predictors of tumor recurrence after therapy. There is a growing clinical interest in an abbreviated breast MRI protocol for breast cancer screening; IER is an important temporal kinetic marker that can be easily assessed with such a protocol.

CLINICAL RELEVANCE/APPLICATION

Initial enhancement ratio (IER) correlates with likelihood of a biologically significant breast cancer and is easily incorporated into screening abbreviated breast MRI (AB-MRI).

RC315-09 Electronic Property Tomography (EPT): A New Breast MRI Application for Differentiating between Malignant and Benign Breast Lesions

Tuesday, Nov. 29 10:10AM - 10:20AM Room: Arie Crown Theater

Participants
Keiko Tsuchiya, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Naoko Mori, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Deepa Sheth, MD, Chicago, IL (*Presenter*) Nothing to Disclose
David V. Schacht, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Ulrich Katscher, Hamburg, Germany (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Hiroyuki Abe, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the diagnostic value of Electronic Property Tomography (EPT) in differentiating malignant from benign breast lesions

METHOD AND MATERIALS

EPT is a method that maps the conductivity and permittivity using phase-based conductivity images reconstructed from clinical MR sequences. The causes of elevated conductivity in tumors are the presence of necrosis and cell membrane breakdown, increased cell membrane charge, increased sodium concentration, and changes in water content. We obtained phase images reconstructed from the 3D TSE sequence (TR/TE=2000/210 ms, voxel size=0.7x0.7x0.8mm^3) using a 3T system (Philips Achieva TX) with a 16 channel breast coil. A tissue conductivity map was then made from phase images using the EPT technique. 69 patients with 32 benign and 51 malignant breast lesions were enrolled in this study. All malignant lesions and 24 benign lesions were confirmed pathologically, and 8 benign lesions were confirmed by clinical follow-up for more than 2 years. The lesions were segmented semi–automatically on pre/post–contrast subtraction images, and the segmented volume of the lesions was registered to the phase images. Subsequently, reconstruction of the conductivity map was performed. The conductivity reconstruction was made only inside the lesions. The mean conductivity of benign and malignant breast lesions was compared. Statistical analysis was performed using paired Wilcoxon and Mann–Whitney U tests.

RESULTS

The mean conductivity of malignant lesions was -0.0964±1.80403 S/m, and that of benign lesions was 1.3017±1.21225 S/m. There was a statistically significant difference between two groups (p= 0.0001). The corresponding ROC yielded an AUC of 75% (Sensitivity, specificity, PPV and NPV were 71, 79, 84 and 63% using the cut-off point of 0.88512 S/m).

CONCLUSION

Our study revealed that there was a statistically significant difference in mean conductivity between benign and malignant breast lesions. The result suggests that EPT could be useful in differentiating benign and malignant breast lesions.

CLINICAL RELEVANCE/APPLICATION

The novel technique of EPT has the potential to differentiate benign and malignant breast lesions.

RC315-10 Dual-Parametric MR Imaging with Read-Out Segmented Diffusion-Weighted and High Temporal Resolution Dynamic Contrast-Enhanced Imaging Improves the Differentiation of Breast Lesions

Tuesday, Nov. 29 10:20AM - 10:30AM Room: Arie Crown Theater

Awards
Student Travel Stipend Award

Participants
Yanqiong Chen, MD, Shanghai, China (*Presenter*) Nothing to Disclose
Bin Wu, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Hui Liu, Shanghai, China (*Abstract Co-Author*) Employee, Siemens AG
Yan Xu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Caixia Fu, Shenzhen, China (*Abstract Co-Author*) Employee, Siemens AG
Dan Wang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Jian Mao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Ya Jia Gu, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the clinical value of a dual-parameter classification method in differentiating benign and malignant breast lesions using RS-DWI and quantitative DCE.

METHOD AND MATERIALS

One hundred and seven patients with 125 breast lesions were scanned with DCE-MRI (a prototype TWIST-Dixon VIBE sequence was used to achieve a temporal resolution of 5.3 s) and RS-DWI (RESOLVE, b = 50, 800 s/mm2) in a 3T MR scanner. ADC was calculated inline and Ktrans was calculated using a commercially available software package. Volume of interest was semi-automatically delineated on the last phase of DCE. ADC map was rigidly registered into DCE images. For each ADC and Ktrans 1D histogram, the following parameters were calculated for the entire tumor volume: the mean, median, low quantile, upper quantile, kurtosis and skewness. A 2D histogram (Ktrans-ADC) was also generated using a dual-parameter mapping package, and then the 2D parameters were calculated from the normalized Ktrans-ADC map. Each parameter was correlated with a pathologic result, and its Receiver Operating Characteristic was calculated.

RESULTS

All the patients underwent breast lumpectomy or radical resection after MR imaging. Breast lesions included 98 malignant and 27 benign lesions. For ADC analysis, AUC of median, low quantile and skewness had statistically diagnostic value in ROC test (mean: 0.738, low quantile: 0.713, upper quantile: 0.572, kurtosis: 0.509, skewness: 0.703); for Ktrans histogram, AUC value of mean, upper quantile and kurtosis had diagnostic value (mean: 0.841, low quantile: 0.585, upper quantile: 0.807, kurtosis: 0.642,

skewness: 0.601); for dual-parametric Ktrans-ADC 2D histogram approach, all the parameters had diagnostic value (Xm: 0.852, Ym: 0.743, kurtosis: 0.809, skewness: 0.803).

CONCLUSION

The major limitation of DCE MR imaging in breast disease is that benign lesions like fibroadenoma can also cause a local perfusion increase. The implementation of dual-parametric MR imaging in combination with DCE MR imaging and DWI optimizes the diagnostic accuracy in our study of breast tumors at 3T. Further investigation on the clinical usage of dual-parameter analysis in a larger population base is a necessity, and it also might be useful in classifying pathological subtypes of breast cancer and monitoring the changes of neoadjuvant chemotherapy.

CLINICAL RELEVANCE/APPLICATION

To improve the diagnostic value of MRI in breast lesions.

RC315-11 Difference in Enhancement Pattern between Malignant and Benign Non-Mass Enhancement Lesions at Very Early Post-Contrast Phase on Ultra-Fast Breast MRI

Tuesday, Nov. 29 10:30AM - 10:40AM Room: Arie Crown Theater

Participants
Hiroyuki Abe, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Andrea L. Magee, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Naoko Mori, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Keiko Tsuchiya, Otsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Deepa Sheth, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
David V. Schacht, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Gregory S. Karczmar, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Federico Pineda, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Kirti M. Kulkarni, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the kinetic data of benign and malignant breast non-mass enhancement lesions in the ultra-early phase after contrast injection, using a whole breast ultrafast (UF) MR scanning technique.

METHOD AND MATERIALS

29 non-mass enhancing breast lesions (biopsy-proven 12 benign and 17 malignant lesions) were obtained with an acquisition protocol of UF-MRI, consisting of pre and 8 post-contrast bilateral, fat-suppressed T1 weighted images of the whole breasts, with temporal resolution of 7 second on a Philips Achieva 3T-TX. Regular scans (temporal resolution of 75 second) were followed immediately after UF-MRI. The size of malignant lesions ranged from 15 to 112 mm (mean 46 mm) and that of benign lesions ranged from 9 to 34 mm (mean 22 mm). All benign lesions were proven by MR-guided biopsy, and all malignant lesions were surgically excised and confirmed with surgical pathology. The kinetic curve of the highest enhancing voxel in each lesion during the UF phase (0 – 56 sec) was assessed with a commercially available CAD system (Dynacad). To compensate for differences in time-of-arrival of contrast media, time points in the ultrafast scans were relative to the initial contrast enhancement in the descending aorta: we referred to the time point when the aorta began to enhance as 'C1', and referred to subsequent time points as 'C2,' 'C3,' etc. Enhancement rate (ER: % increase in signal after contrast injection) and area under the kinetic curve (kinetic-AUC) of UF-MRI and Signal enhancement rate (SER) of the regular scans were compared between malignant and benign lesions. Wilcoxon test and ROC test were performed for statistical analysis.

RESULTS

ER and kinetic-AUC both showed significant differences between malignant and benign non-mass lesions ($p<0.0001$ at C2 – C5), but SER of the regular scans did not show a significant difference. With ROC analysis, area under curve for ER was over 0.94 at C2 – C5, and that for kinetic-AUC was over 0.94 at C3 – C6.

CONCLUSION

The kinetic curve obtained during the very early post-contrast phase was quite useful in differentiating malignant and benign non-mass enhancement breast lesions. Kinetic data from a voxel of the highest enhancement in a lesion is critical to performing this task.

CLINICAL RELEVANCE/APPLICATION

The kinetic curve of a voxel of the highest enhancement in a lesion obtained from Ultrafast MRI is useful in differentiating malignant and benign non-mass enhancement breast lesions.

RC315-12 Quantitative Breast MRI

Tuesday, Nov. 29 10:50AM - 11:10AM Room: Arie Crown Theater

Participants
Despina Kontos, PhD, Philadelphia, PA, (Despina.Kontos@uphs.upenn.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review fundamendal principles of quantitative breast MRI. 2) Identify key factors that affect quality and standardization of quantitative breast MRI measures. 3) Describe emerging clinical applications of quantitative breast MRI in diagnostic interpretation, prognostication, and evaluation of response to treatment.

ABSTRACT

RC315-13 Breast Cancer Heterogeneity Assessed by Texture Analysis in Magnetic Resonance Imaging: Its Relationship with Survival Outcomes

Tuesday, Nov. 29 11:10AM - 11:20AM Room: Arie Crown Theater

Participants
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jungmin Bae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine the relationship between tumor heterogeneity assessed by magnetic resonance imaging (MRI) texture analysis and survival outcomes in patients with primary breast cancer.

METHOD AND MATERIALS

This study was approved by the institutional review board, and the need for informed consent was waived. Between January 2010 and August 2010, texture analysis of the entire primary tumor was performed using T2-weighted and contrast-enhanced T1-weighted subtraction MR images obtained from 203 patients for preoperative staging. Histogram-based uniformity and entropy were calculated. To dichotomize texture parameters for survival analysis, the 10-fold cross-validation method was used to determine cutoff points in the receiver operating characteristic curve analysis. The Cox proportional hazards model and Kaplan-Meier analysis were used to determine the association of MRI texture parameters and morphologic or volumetric information obtained from MRI or clinicopathological variables with recurrence-free survival (RFS).

RESULTS

There were 26 events, including 22 recurrences (10 locoregional and 12 distant) and 4 deaths, after a mean follow-up time of 56.2 months. In multivariate analysis, higher N stage (RFS hazard ratio, 11.15 [N3 stage]; P = 0.003), triple-negative subtype (RFS hazard ratio = 16.91; P < 0.001), high risk of T1 entropy (less than the cutoff value, RFS hazard ratio = 4.55; P = 0.018), and T2 entropy (equal to or higher than the cutoff value, RFS hazard ratio = 9.84; P = 0.001) were associated with worse outcomes.

CONCLUSION

Patients with more heterogeneous breast cancers on T2-weighted images (higher entropy) and less heterogeneous tumors on contrast-enhanced T1-weighted subtraction images (lower entropy) exhibited poorer RFS.

CLINICAL RELEVANCE/APPLICATION

No study determined whether tumor texture is related to survival outcomes based on preoperative breast MRI. Our study suggests that magnetic resonance imaging texture analysis for measurements of tumor heterogeneity can be used as an additional risk stratification method for patients with primary breast cancer.

RC315-14 Predicting Level of Tumor Infiltrating Lymphocyte in Patients with Triple Negative Breast Cancer: Usefulness of Breast MRI Computer-aided Detection & Diagnosis

Tuesday, Nov. 29 11:20AM - 11:30AM Room: Arie Crown Theater

Participants
Seon Jeong Oh, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
You Jin Ku, Incheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jin Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Gyungyub Gong, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Triple negative breast cancer (TNBC) is a heterogeneous malignancy with varying prognosis. Recently, the importance of tumor-infiltrating lymphocytes (TILs) has been determined. That is, increased TILs positively correlated with the pathological complete response and patient survival.The purpose of this study is to evaluate the usefulness of MRI computer-aided detection & diagnosis (CAD) in TNBC patients for prediction of tumor infiltrating lymphocyte.

METHOD AND MATERIALS

We retrospectively enrolled 60 lesions in 59 patients with TNBC (mean age, 48.7 years; range, 25-81 years) who underwent dynamic contrast-enhanced MRI. The CAD for all lesions were obtained, and the analyzed quantitative kinetic features included degree of initial peak enhancement; enhancement profiles including lesion percentages of washout, plateau and persistent enhancement; worst kinetic curve and predominant kinetic curve.According to level of TIL, we divided the tumors into two groups (<50% TILs as the low TIL group and ≥50% TILs as the high TIL group). Kinetic parameters in low TIL group versus high TIL group were compared using student t-test and chi-square test. We developed empirical model to predict high TIL group and low TIL group using logistic regression analysis and receiver operating characteristics (ROC) analysis

RESULTS

There were 48 low TIL and 12 high TIL lesions. Among enhancement profiles of MRI CAD, persistent portion of tumors were negatively correlated with the TIL level of tumor (mean proportion of persistent on high TIL group was 43%, p = 0.003). The persistent-washout value of low TIL group was significantly higher than that of high TIL group (p = 0.008). The odds ratios were 0.944 (95% confidence interval (CI), 0.896-0.982; p=0.012) for persistent and 0.971 (95% CI, 0.948-0.991; p=0.008) for persistent -washout value. The area under the receiver operating characteristic curve (AUC) was >0.7 with the optimal cutoff values of 26 for persistent and -19 for persistent-washout.

CONCLUSION

The prediction model using quantitative kinetic parameters, particularly plateau proportion and plateau-washout value, could be helpful for identifying TIL level of patient with triple negative breast cancer and may be used as an imaging biomarker to guide the

treatment plan.

CLINICAL RELEVANCE/APPLICATION

Kinetic parameters acquired by MRI CAD can be a useful tool for assessing TIL level of patient with triple negative breast cancer.

RC315-15 Quantitative Radiogenomics: Association between Breast MRI Functional Tumor Volume and Oncotype DX Recurrence Score

Tuesday, Nov. 29 11:30AM - 11:40AM Room: Arie Crown Theater

Participants
Lina Nayak, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Kimberly M. Ray, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Genevieve A. Woodard, MD, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Bonnie N. Joe, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Nola M. Hylton, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Elissa R. Price, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Jessica Gibbs, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Iryna Lobach, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
David Newitt, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Rick Baehner, MD, San Francisco, CA (*Abstract Co-Author*) Stockholder, Agendia BV

PURPOSE

To investigate the association between MRI functional tumor volume (FTV), a non-invasive quantitative measure of contrast kinetics, and breast cancer recurrence risk as determined by a validated gene expression assay.

METHOD AND MATERIALS

This is an IRB-approved, HIPAA-compliant retrospective review of 82 patients with ER+ HER2- invasive breast cancer treated at our institution between 2005 and 2013 who underwent breast MRI and an Oncotype DX (ODx) assay (Genomic Health, Inc.) at the time of diagnosis. MRI signal enhancement ratio (SER), a relative measure of contrast uptake and washout, was calculated on a per-voxel basis. Functional tumor volume (FTV) was defined as the volume of enhancing voxels above an initial enhancement level of 70%. Fraction of Washout and Plateau (FWP) was defined as the volume of enhancing voxels with "washout" or "plateau" kinetics (SER > 0.9) divided by FTV. Fraction of Washout (FW) was defined as the volume of voxels with "washout" kinetics only (SER > 1.3) divided by FTV. Concordance between ODx score and MRI parameters was examined using Spearman correlation correlation ρ, χ^2 tests, and linear regression models.

RESULTS

FTV measurements [mean(cm3) +/-SD] for patients with high, intermediate and low risk ODx scores were 3.7 ± 3.84, 2.7 ± 3.9 and 1.95 ± 2.39, respectively. ODx scores were significantly associated with FTV (β=1.4, p=0.006,R^2=0.31) in a model adjusted for age, tumor size (measured on MRI), tumor grade, and lymph node status. In a subset of tumors measuring 14-25mm (25-75th percentile of observed tumor size), FWP and ODx scores were concordant (ρ=0.34,p=0.025) . FW alone was not significantly correlated with ODx score.

CONCLUSION

Higher FTV is significantly associated with higher ODx score, independent of patient age, tumor size, tumor grade or lymph node status. Larger FWP is significantly correlated with higher ODx score for tumors 14-25 mm in size, which represent the majority of tumors in our dataset.

CLINICAL RELEVANCE/APPLICATION

Quantitative MRI FTV measurements may serve as imaging biomarkers of breast cancer recurrence risk.

RC315-16 Evaluating Breast Cancer by Using Mono-exponential, Bi-exponential, Stretched-exponential Diffusion-weighted MR Imaging and Diffusion Kurtosis MR Imaging

Tuesday, Nov. 29 11:40AM - 11:50AM Room: Arie Crown Theater

Participants
Kun Sun, Shanghai, China (*Presenter*) Nothing to Disclose
Xu Yan, Shanghai, China (*Abstract Co-Author*) Employee, Siemens AG
Caixia Fu, Shenzhen, China (*Abstract Co-Author*) Employee, Siemens AG
Fuhua Yan, MS, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To quantitatively compare the potential of various diffusion parameters obtained from mono-exponential, bi-exponential, and stretched-exponential diffusion weighted imaging and diffusion kurtosis imaging in evaluating breast cancer.

METHOD AND MATERIALS

Institutional review board approval and written informed consent were obtained. Both diffusion-weighted-imaging and diffusion-kurtosis-imaging were performed in 94 patients with pathologically proven breast lesions by using a 1.5 T MRI unit. Apparent diffusion coefficient(ADC) was by using a mono-exponential model. Diffusion coefficient(D), pseudo-diffusion coefficient(D*) and perfusion fraction(f) were calculated by using a bi-exponential model. A water molecular diffusion heterogeneity index(α) and distributed diffusion coefficient(DDC) were calculated by using a stretched-exponential model. Mean diffusivity(MD) and mean kurtosis(MK) was calculated from diffusion kurtosis images. All values were compared between benign and malignant breast lesions and different proliferative breast cancer. Student t test, Wilcoxon signed-rank test, ROC curves, and Spearman correlation were used for statistical analysis.

RESULTS

ADC,D,DDC,and MD were significantly lower in malignant lesions than in benign lesions(respectively: P < .0001),α, D* and MK were

ADC,D,DDC,and FD were significantly lower in malignant lesions than in benign lesions(respectively; P < .0001).α, D* and MK were significantly higher in malignant lesions than in benign lesions(respectively; P < .0001).Both MD and MK had significantly greater AUC (0.967 and 0.960) than D*,α, and f(0.677 vs 0.692 vs 0.522) in the differentiation of benign and malignant lesions(P < .0001). In patients with invasive breast cancer, kurtosis and water molecular diffusion heterogeneity index was positively correlated with expression of the Ki-67 protein(r=0.55 and 0.43).

CONCLUSION

DKI model may provide additional information and improve the characterizing of breast lesions compared with conventional diffusion parameters. The kurtosis and water molecular diffusion heterogeneity index derived from DKI and stretched Exponential DWI may be helpful for the preoperative differentiation of proliferative activity of breast cancer.

CLINICAL RELEVANCE/APPLICATION

Non-Gaussian water diffusion with use of DKI and SE, as compared with conventional mono- and bi-exponential DWI, could lead to a substantial improvement in the diagnosis of breast disease.The K and α value derived from the DKI and SE model may be helpful for the preoperative differentiation of proliferative activity of breast cancer.

RC315-17 Magnetic Resonance Spectroscopy of Breast Cancer for Assessing Early Treatment Response: Results from the ACRIN 6657 MRS Trial

Tuesday, Nov. 29 11:50AM - 12:00PM Room: Arie Crown Theater

Participants
Patrick J. Bolan, PhD, Minneapolis, MN (*Presenter*) Research Consultant, Breast-Med, Inc
Eunhee Kim, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
Benjamin A. Herman, MS, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Gillian M. Newstead, MD, Chicago, IL (*Abstract Co-Author*) Medical Advisory Board, Bayer AG Consultant, Three Palm Software LLC Consultant, VuCOMP, Inc Medical Advisor, Quantitative Insights, Inc
Mark A. Rosen, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Mitchell D. Schnall, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Etta D. Pisano, MD, Charleston, SC (*Abstract Co-Author*) Researcher, Koninklijke Philips NV; Researcher, FUJIFILM Holdings Corporation; Researcher, Alan Penn & Associates, Inc; Stockholder, NextRay, Inc; Board Member, NextRay, Inc
Paul T. Weatherall, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Constance D. Lehman, MD, PhD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company; Medical Advisory Board, General Electric Company
Michael G. Garwood, PhD, Minneapolis, MN (*Abstract Co-Author*) Stockholder, Steady State Imaging, LLC
Michael Nelson, MD, Minneapolis, MN (*Abstract Co-Author*) I hold license and patents on a breast marker named VizMark
Douglas Yee, MD, Minneapolis, MN (*Abstract Co-Author*) Nothing to Disclose
Sandra Polin, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Laura J. Esserman, MD, , (*Abstract Co-Author*) Nothing to Disclose
Constantine Gatsonis, PhD, Providence, RI (*Abstract Co-Author*) Consultant, WILEX AG Consultant, Endocyte, Inc
Gregory J. Metzger, PhD, Minneapolis, MN (*Abstract Co-Author*) Nothing to Disclose
David Newitt, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Savannah C. Partridge, PhD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
Nola M. Hylton, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To estimate the accuracy of predicting response to neoadjuvant chemotherapy (NACT) in patients with locally advanced breast cancer using magnetic resonance spectroscopy (MRS) measurements made very early in treatment.

METHOD AND MATERIALS

The HIPAA-compliant protocol and the informed consent process were approved by the American College of Radiology and local-site institutional review boards. 119 women with invasive breast cancer of 3 cm or greater undergoing NACT with a paclitaxel-based regimen in followed by an anthracycline-cyclophosphamide regimen were enrolled between September 2007 and April 2010. Each site received MRS-specific training and was required to submit MRS measurements with acceptable accuracy and spectral quality from a trial-specific spectroscopy phantom prior to enrolling patients. MRS measurements of the concentration of choline-containing compounds ([tCho]) were performed prior to the first chemotherapy regimen (time point 1, TP1) and 20-96 hours after the first cycle of treatment (TP2). The change in [tCho] was assessed for its ability to predict pathologic complete response (pCR) and radiologic response using the area under the receiver operating characteristic curve (AUC) and logistic regression models.

RESULTS

Of the 119 subjects enrolled, only 29 cases (24%) with 8 pCRs provided usable data for the primary analysis. Technical challenges in acquiring quantitative MRS data in a multi-site trial setting limited the capture of usable data. In this limited data set, the decrease in tCho from TP1 to TP2 had poor ability to predict either pCR (AUC = 0.53, 95% CI: [0.27, 0.79]) or radiologic response (AUC = 0.51, 95% CI: [0.27, 0.75]). An exploratory analysis found that water T2 (measured by MRS) was more easily measured (data yield 59%, 60/102) and was associated with pathologic complete response ($p < 0.01$).

CONCLUSION

The technical difficulty of acquiring quantitative MRS data in a multi-site clinical trial setting led to a low yield of analyzable data, which was insufficient to accurately measure the ability of early MRS measurements to predict response to NACT. These findings suggest that further technical developments are needed to produce more robust methods for breast MRS.

CLINICAL RELEVANCE/APPLICATION

The low data yield of this study suggests that current methods used for acquiring quantitative magnetic resonance spectroscopy data in the breast are not sufficiently robust for use in clinical practice.

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/

Mitchell D. Schnall, MD, PhD - 2013 Honored Educator

RC321

Advances in CT: Technologies, Applications, Operations-Quantitative CT (QIBA)

Tuesday, Nov. 29 8:30AM - 10:00AM Room: E352

BQ CT PH

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

Participants
Ehsan Samei, PhD, Durham, NC (*Coordinator*) Research Grant, General Electric Company; Research Grant, Siemens AG
Norbert J. Pelc, ScD, Stanford, CA (*Coordinator*) 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 ;

Sub-Events

RC321A Volumetry

Participants
Michael F. McNitt-Gray, PhD, Los Angeles, CA (*Presenter*) Institutional research agreement, Siemens AG Research support, Siemens AG

Active Handout:Michael F. McNitt-Gray

http://abstract.rsna.org/uploads/2016/16001076/RC321 Volumetry.pdf

RC321B Material Identification

Participants
Daniele Marin, MD, Durham, NC, (daniele.marin@duke.edu) (*Presenter*) Research support, Siemens AG

LEARNING OBJECTIVES

1) Review different dual-energy CT imaging techniques for material identification. 2) Provide an overview of clinically available applications of material identification using dual-energy CT. 3) Identify factors that can affect the reproducibility of quantitative measurements of material composition using dual-energy CT.

ABSTRACT

RC321C Texture Characterization

Participants
Samuel G. Armato III, PhD, Chicago, IL, (s-armato@uchicago.edu) (*Presenter*) Consultant, Aduro Biotech, Inc
Maryellen L. Giger, PhD, Chicago, IL (*Presenter*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Corporation;

LEARNING OBJECTIVES

1) Understand the concept of texture-based image characterization. 2) Identify radiologic tasks in CT that could benefit from image texture analysis. 3) Describe the limitations of these techniques.

SSG04

Gastrointestinal (CT Technique and Contrast)

Tuesday, Nov. 29 10:30AM - 12:00PM Room: E352

GI BQ CT SQ

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

Participants
Vahid Yaghmai, MD, Chicago, IL (*Moderator*) Nothing to Disclose
Naveen Kulkarni, MD, Milwaukee, WI (*Moderator*) Nothing to Disclose
Christine O. Menias, MD, Chicago, IL (*Moderator*) Nothing to Disclose

Sub-Events

SSG04-01 Fine Focal Spot CT Improves Image Quality in Abdominal CT Imaging

Tuesday, Nov. 29 10:30AM - 10:40AM Room: E352

Participants
Yin P. Goh, MBBS, Clayton, Australia (*Presenter*) Nothing to Disclose
Sidney M. Levy, MBBS, BMedSc, Melbourne, Australia (*Abstract Co-Author*) Nothing to Disclose
Kenneth K. Lau, MBBS, FRANZCR, Melbourne, Australia (*Abstract Co-Author*) Nothing to Disclose
Keat Y. Low, MBBS, FRANZCR, Melbourne, Australia (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

CT tubes usually have two focal-spot sizes, with the finer focal spot providing higher spatial resolution. The aim of this retrospective study is to compare the image quality of the abdominal viscera between fine focal spot size (FFSS) and standard focal spot size (SFSS).

METHOD AND MATERIALS

All contrast-enhanced CT abdomen and pelvis (CTAP) of all adult patients between June and September 2014 were included. Two blinded radiologists assessed the margin clarity of the abdominal viscera and the detected lesions using a 5-point grading scale. Cohen’s kappa test was used to examine the inter-observer reliability amongst the two reviewers for organ margin clarity. Mann-Whitney U test was used to assess the statistical differences of the margin clarity of the abdominal viscera and the detected lesions between the two groups.

CONCLUSION

FFSS improves the image quality in abdominal CT imaging in terms of better organ and lesion margin clarity.

SSG04-02 Effect of Different Reconstruction Algorithms of MDCT Examinations for Quantitative Imaging Features: Comparison with Liver Parenchyma, Focal Liver Lesion and Renal Cyst

Tuesday, Nov. 29 10:40AM - 10:50AM Room: E352

Participants
Su Joa Ahn, Seoul , Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung Hoon Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sang Joon Park, PhD, 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 determine whether different reconstruction algorithms affect quantitative features of CT imaging in liver parenchyma, focal liver lesions and renal cysts.

METHOD AND MATERIALS

We included 300 adult patients (192 men, 108 women; mean age, 58 years) who underwent MDCT with one CT scanner. Among 300 patient, normal liver parenchyma without chronic liver disease nor malignant disease (n=200), well circumscribed focal liver lesion (n=100; 81 metastases, 9 hepatocellular carcinoma, 6 hemangioma, 4 hepatic abscess), and renal cysts larger than 1cm (n=34) were included. All CT images were reconstructed with filtered back projection (FBP), adaptive statistical iterative reconstruction (IRT), and iterative model reconstruction (IMR) algorithms. Computerized texture analysis was performed by extracting 16 quantitative imaging features including histographic parameter (mean attenuation, standard deviation, skewness, kurtosis, entropy, homogeneity), volumetric parameter (volume, effective diameter, surface area) , and morphologic features (sphericity, discrete compactness, GLCM moments, GLCM ASM, GLCM IDM, GLCM Contrast, GCLM entropy) using semi-automatic segmentation of target lesions.

RESULTS

Different reconstruction algorithms had a significant effect on quantitative imaging features. IMR had more significant effect on than IRT. IRT had a significant effect on five, eight, and three of the features for liver parenchyma, focal liver lesion, and renal cysts ($P < .005$), whereas IMR had a significant effect on seven, 11, and five of the features for respectively ($P < .005$). Focal liver lesion had more significant effect on different reconstruction algorithms (eight on IRT, 11 on IMR) than liver parenchyma (five on IRT, seven on IMR) or renal cysts (three on IRT, five on IMR). Although quantitative imaging features were significantly affected by different reconstruction algorithms, the volumetric features did not effect on reconstruction algorithm ($p > .03$).

CONCLUSION

Different reconstruction algorithms affect quantitative features of CT imaging. In focal liver lesion, reconstruction algorithms show

Different reconstruction algorithms affect quantitative features of CT imaging. In focal liver lesion, reconstruction algorithms show more significant effect on the quantitative features than liver parenchyma or renal cysts.

CLINICAL RELEVANCE/APPLICATION

Because of different reconstruction algorithms affect quantitative features of CT imaging, imaging quantification using uniform reconstruction algorithms would be increased their reliability level.

SSG04-03 Sub-Second High-Pitch Abdominopelvic CT Angiography With Ultra-Low Dose Contrast Media (<30 mL) at 80kV: A Feasibility Study

Tuesday, Nov. 29 10:50AM - 11:00AM Room: E352

Awards
Student Travel Stipend Award

Participants
Faezeh Sodagari, MD, Chicago, IL (*Presenter*) Grant, Siemens AG
Alan L. Goodwin, RT, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Jeremy D. Collins, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Vahid Yaghmai, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate homogeneity of vascular enhancement and image quality in sub-second high-pitch abdominopelvic CT angiography (CTA) with ultra-low dose contrast media at 80 kV.

METHOD AND MATERIALS

In this HIPAA-compliant IRB-approved prospective study, twelve patients underwent high-pitch sub-second abdominopelvic CTA at 80kV with ultra-low dose (<30 mL) of non-ionic iodinated contrast media (iopamidol 370) in a large academic institution. All scans were performed using third generation dual source CT scanner. The homogeneity of the intravascular contrast attenuation at suprarenal aorta, infrarenal aorta, and right common iliac artery was assessed. Image noise, contrast-to-noise ratio, and signal-to-noise ratio were measured to assess the objective image quality. Subjective image quality was evaluated on a 5-point scale (1 = unacceptable; 5 = excellent). Volume CT dose index (CTDIvol) was extracted from dose reports to assess radiation dose. Repeated-measures analysis of variances was used for data analysis. Significance was set at 0.05.

RESULTS

Six men and 6 women with the mean ± standard deviation (SD) age of 64.2 ± 13 years and the mean weight of 75.8 ± 16.2 kg were included in this study. The patients received 15 to 28 mL of contrast with a mean of 20 ± 3.4 mL. The mean CTDIvol was 3.8 ± 1.1 mGy. Mean CNR and SNR were 9.2 ± 4.9 and 9.9 ± 4.1, respectively. Mean image noise was 24.4 ± 5.0 Hounsfield units (HU). All images had diagnostic image quality with the median subjective image quality score of 4 (Good). The contrast attenuation was homogeneous across suprarenal aorta, infrarenal aorta, and right common iliac artery levels with the mean attenuation of 228.6 ± 74.3, 249.3 ± 59.7, and 249.2 ± 56.1 HU, respectively (P = 0.16).

CONCLUSION

Abdominopelvic CTA with ultra-low dose (<30 mL) contrast at 80kV is technically and clinically feasible with good diagnostic image quality and homogenous attenuation across vascular levels.

CLINICAL RELEVANCE/APPLICATION

This study shows the potential for reducing the contrast dose to as low as 15 mL for high-pitch abdominopelvic CT angiography at 80kV. This may have clinical implications in abdominopelvic CT angiography in patients with renal impairment.

Honored Educators

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

Vahid Yaghmai, MD - 2012 Honored Educator
Vahid Yaghmai, MD - 2015 Honored Educator

SSG04-04 Low-kV CT Can Reduce the Frequency of Acute Adverse of Intravenous Iodine Contrast Medium

Tuesday, Nov. 29 11:00AM - 11:10AM Room: E352

Participants
Tomoki Maebayashi, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Satoru Takahashi, MD, Suita, Japan (*Presenter*) Nothing to Disclose
Tatsuya Nishii, MD, PhD, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Atsushi K. Kono, MD, PhD, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Noriyuki Negi, RT, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Kiyosumi Kagawa, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Erina Suehiro, RT, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Wakiko Tani, RT, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Toshinori Sekitani, MS, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Hideaki Kawamitsu, MD, 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

PURPOSE

Acute adverse reactions of CM are either allergy-like reactions or physiologic reactions. Although dose and concentration of CM

unlikely affect allergic-like contrast reactions, physiologic reactions (chemotoxic or osmotoxic reactions) are often dose and concentration dependent. Because recently introduced low-kV CT has enabled the reduction of contrast dosage in daily clinical practices, the incidence of acute adverse events would decrease in low-kV post-contrast body CT (CECT).The purpose of this retrospective study was to compare the incidence of acute adverse events in low-kV CT with reduced CM and conventional CT with full-dose CM.

METHOD AND MATERIALS

Routine CECT in 3rd generation dual-source CT has been acquired at 70 kV with 60% dose of 270 mgI/Kg CM (70 kV protocol), while in remaining scanners it has been acquired at 120 kV with a standard dose of 450 mgI/Kg CM (120 kV protocol) in our institution. Because injection duration and scan delay time are fixed for routine CECT, iodine deliver rate at 70 kV protocol is also 60% of 120 kV protocol. Between January 20, 2015 and February 26, 2016, contrast reaction reports and medical records of patients were reviewed.

RESULTS

1,317 patients underwent with 70 kV protocol, while 4,234 with 120 kV. Mean body weight in 70 kV protocol was smaller than 120 kV protocol ($p<.001$). Mean injection dose and rate of CM for 70 kV protocol (50.6±9.4 mL, 1.1±0.2 mL/sec) were significantly smaller than those for 120 kV protocol (82.1±15.2 mL, 1.8±0.3 mL/sec), respectively ($p<.001$).Among all 5,551 patients, allergic-type reactions occurred in 64 (1.15%) of patients, while physiologic reaction in 28 (0.50%): 86 (93%) reactions were mild and 6 (7%) were moderate. Seven (0.52%) patients showed allergic-type reactions in 70 kV protocol, while 57 (1.35%) in 120 kV protocol ($p<.05$; $\chi 2$). Three (0.22%) patients demonstrated physiologic reaction in 70 kV protocol, while 25 (0.59%) in 120 kV protocol ($p=.16$; $\chi 2$).

CONCLUSION

Low kV CT with reduced CM injection may decrease the incidence of acute adverse events, especially allergic-like reaction.

CLINICAL RELEVANCE/APPLICATION

Although further larger prospective study is essential, reduced CM dosage with low-kV CT may reduce the chance of adverse events.

SSG04-05 Prospective Evaluation of Reduced Dose Computed Tomography for the Detection of Low-contrast Liver Lesions: Direct Comparison with Concurrent Standard Dose Imaging

Tuesday, Nov. 29 11:10AM - 11:20AM Room: E352

Awards
Student Travel Stipend Award

Participants
B. Dustin Pooler, MD, Madison, WI (*Presenter*) Nothing to Disclose
Meghan G. Lubner, MD, Madison, WI (*Abstract Co-Author*) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson;
David H. Kim, MD, Middleton, WI (*Abstract Co-Author*) Consultant, Viatronix, Inc; Co-founder, VirtuoCTC, LLC; Medical Advisory Board, Digital ArtForms, Inc; Stockholder, Cellectar Biosciences, Inc
Oliver T. Chen, MD, Frederick, MD (*Abstract Co-Author*) Nothing to Disclose
Ke Li, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Guang-Hong Chen, PhD, Madison, WI (*Abstract Co-Author*) Research funded, General Electric Company Research funded, Siemens AG
Perry J. Pickhardt, MD, Madison, WI (*Abstract Co-Author*) Co-founder, VirtuoCTC, LLC; Stockholder, Cellectar Biosciences, Inc; Stockholder, SHINE Medical Technologies, Inc; Research Grant, Koninklijke Philips NV

PURPOSE

To prospectively compare diagnostic performance of reduced-dose (RD) contrast-enhanced CT (CECT) with standard-dose (SD) CECT for detection of low-contrast liver lesions.

METHOD AND MATERIALS

70 adults with non-liver primary malignancies underwent abdominal SD-CECT immediately followed by RD-CECT, aggressively targeted at 60-70% dose reduction. SD series were reconstructed using FBP. RD series were reconstructed with FBP, ASIR, and MBIR. Three readers—blinded to clinical history and comparison studies—reviewed all series, identifying liver lesions ≥4 mm. Non-blinded review by two experienced abdominal radiologists—assessing SD against available clinical and radiologic information—established the reference standard.

RESULTS

RD-CECT mean effective dose was 2.01±1.36 mSv (median, 1.71), a 64.1±8.8% reduction. Pooled per-patient performance data were (sensitivity/specificity/PPV/NPV/accuracy) 0.91/0.78/0.60/0.96/0.81 for SD-FBP, compared with RD-FBP 0.79/0.75/0.54/0.91/0.76; RD-ASIR 0.84/0.75/0.56/0.93/0.78; and RD-MBIR 0.84/0.68/0.49/0.92/0.72. ROC AUC values were 0.896/0.834/0.858/0.854 for SD-FBP/RD-FBP/RD-ASIR/RD-MBIR, respectively. RD-FBP ($P=0.005$) and RD-MBIR ($P=0.047$) AUC were significantly lower than SD-FBP; RD-ASIR was not ($P=0.084$). Reader confidence was lower for all RD series ($P<0.001$) compared with SD-FBP, especially when calling patients entirely negative.

CONCLUSION

Aggressive CT dose reduction resulted in inferior diagnostic performance and reader confidence for detection of low-contrast liver lesions compared to SD. Relative to RD-ASIR, RD-FBP showed decreased sensitivity and RD-MBIR showed decreased specificity.

CLINICAL RELEVANCE/APPLICATION

Aggressive CT dose reduction may result in mischaracterization of low-contrast liver lesions at contrast-enhanced CT, including both false positive and false negative casese.

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
Perry J. Pickhardt, MD - 2014 Honored Educator

SSG04-06 Contrast Agent Dose Reduction in Combination with Low-Tube Voltage and Adaptive Statistical Iterative Reconstruction Algorithm in CT Enterography: Effect on Image Quality and Radiation Dose

Tuesday, Nov. 29 11:20AM - 11:30AM Room: E352

Participants
Cui Feng, MD , Wuhan, China (*Presenter*) Nothing to Disclose
Zhen Li, MD, PhD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim of the study was to investigate the image quality and radiation exposure of contrast enhanced CT enterography with low-tube-voltage, low-concentration contrast agent combined with adaptive statistical iterative reconstruction (ASIR).

METHOD AND MATERIALS

From October 2015 to February 2016,137 patients (65 female,72 male,mean age 54±14years) underwent contrast enhanced CT enterography using a 64-slice MDCT scanner (Discovery CT750 HD,GE Healthcare,USA).All the cases were randomly assigned into two groups.Group A (n=79) were examined on CT with low-tube-voltage according to BMI (BMI<23kg/m2, 80-kVp; BMI≥23kg/m2,100-kVp),and low-concentration contrast agent (270mgI/mL).The raw data were reconstructed with standard filtered back projection (FBP) and 50%ASIR respectively.Group B (n=58) underwent conventional CT at 120-kVp,350 mgI/mL contrast agent with FBP.The CTDIvol, DLP were recorded,effective dose(ED) and total contrast medium dosage were calculated and compared. The CT value,SNR,CNR of the bowel wall, gastrointestinal lesions,mesenteric vessel were assessed and compared statistically.The subjective image quality was assessed by two radiologist using five-point Likert scale(1=poor;2=acceptable;3=moderate;4=good;5=excellent).

RESULTS

There were 63 gastrointestinal cancers,21 gastrointestinal inflammation proved pathologically by surgery or endoscopy.Compared with group B,CTDIvol,ED,DLP and total iodine contrast medium dosage in group A were decreased by 25.2%,25.7%,25.7%,26.07% respectively.The average qualitative image quality score of FBP image of group A(4.02±0.39),50% ASIR image of group A(4.02±0.37) were lower than FBP image of group B (4.21±0.55),the difference was not statistically significant(P>0.05).SD of 50%ASIR image of group A was significantly lower than FBP image of group A (13.18+2.687 vs.15.69±3.60,p<0.001).CT value,CNR and SNR were significantly higher in SMA,SMV,gastrointestinal lesions in 50 % ASIR image of group A (P<0.05).

CONCLUSION

Compared with conventional protocol,CT enterography performed at low tube voltage and low-concentration contrast agent combined with 50% ASIR produced diagnostically acceptable image quality with a mean ED of 6.34 mSv and a total iodine dose reduction of 26.07%.

CLINICAL RELEVANCE/APPLICATION

Contrast agent dose reduction ,low tube voltage with ASIR is feasible in contrast enhanced CT enterography,reduce the radiation dose and the risk of contrast induced nephrology (CIN), without impairment of image quality.

SSG04-07 Reduction of Patient Radiation Dose with a New Organ based Dose Modulation Technique for Chest Abdomen Pelvis CT

Tuesday, Nov. 29 11:30AM - 11:40AM Room: E352

Participants
Marie Fillon, MD, Lyon, France (*Presenter*) Nothing to Disclose
Philippe Coulon, PhD, Suresnes, France (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Salim Si-Mohamed, Bron, France (*Abstract Co-Author*) Nothing to Disclose
Aurelie Vuillod, Lyon, France (*Abstract Co-Author*) Nothing to Disclose
Paul Klahr, PhD, Cleveland, OH (*Abstract Co-Author*) Researcher, Koninklijke Philips NV
Loic Boussel, MD, Lyon, France (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In a single scan for chest, abdomen and pelvis (CAP) CT, using standard Automatic Exposure Control (AEC), the requirement for contrast resolution in the liver is setting the target image quality for the whole scan, and, as a result, the radiation dose. The purpose of this study was to evaluate dose reduction and image quality resulting from a new organ based dose modulation system allowing setting different image quality in the liver than in the chest and the pelvis.

METHOD AND MATERIALS

Our retrospective study included 37 patients who had CAP CT scans for oncology follow up in less than a year time difference, on 2 scanners, one using standard AEC (Standard AEC) and one using new Liver DoseRight Index organ based dose modulation system (Liver DRI). For each acquisition, average Water Equivalent Diameter (WED), CT Dose Index (CTDI) and Size-Specific Dose Estimates (SSDE) were calculated for the total scan and for lung, breast, liver and pelvis area. Signal to Noise Ratio (SNR) was measured in the muscle at each anatomic level and diagnostic confidence was evaluated by 2 radiologists. Quantitative and qualitative variables were compared using respectively paired t-test and Wilcoxon signed rank tests with Bonferroni correction.

RESULTS

While no significant WED difference was observed between the two scans (all p-values > 0.05), patient radiation dose was

While no significant WED difference was observed between the two scans (all p-values > 0.05), patient radiation dose was significantly reduced with Liver DRI compared to Standard AEC (all p-values <0.01) in the total scan, lung, breast and pelvis area, with a CTDI reduction of respectively 26.9%, 22.6%, 24.0% and 30.6% and a SSDE reduction of 23.2%, 20.5%, 22.6% and 28.7%. There was no significant dose reduction (p>0.08) in the liver area. SNR reduction was only significant (p<0.02) in the pelvis (4.2±1.2 vs 5.2±1.7). There was no significant difference (p>0.05) in diagnostic confidence between the 2 types of scan, in any of the anatomic regions with a good inter-observers correlation (kappa=0.72).

CONCLUSION

Liver DoseRight Index organ based dose modulation technique allows significant dose reduction compared to standard AEC while preserving diagnostic image quality in all CAP body areas.

CLINICAL RELEVANCE/APPLICATION

Liver DoseRight Index organ based dose modulation technique allows an optimization of dose and image quality in the different body areas individually and thus decreases the total radiation exposure in Chest Abdomen Pelvis CT.

SSG04-09 Photon-Counting-Detector CT for the Evaluation of Non-contrast Enhanced Abdominal Imaging in Patients

Tuesday, Nov. 29 11:50AM - 12:00PM Room: E352

Awards
Trainee Research Prize - Fellow

Participants
Roy Marcus, MD, Rochester, MN (*Presenter*) Institutional research agreement, Siemens AG; Research support, Siemens AG
Joel G. Fletcher, MD, Rochester, MN (*Abstract Co-Author*) Grant, Siemens AG; ;
Shannon P. Sheedy, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Jeff L. Fidler, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Zhoubo Li, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Zhicong Yu, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Felicity Enders, 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

PURPOSE

To assess in patients the overall clinical image quality of routine unenhanced abdominal CT on a preclinical photon-counting-detector CT (PCCT) compared to the conventional CT using energy integrating detectors.

METHOD AND MATERIALS

Thirty patients received a routine unenhanced exam of the abdomen on a commercial 2nd generation dual-source CT (SOMATOM Flash, Siemens Healthcare) in dual energy mode (DECT). DECT scans were acquired using 80/140Sn kV or 100/140Sn kV, dependent on patient size. PCCT scans were acquired at 140 kV in macro-mode with energy thresholds set at 25 and 75 keV. CTDIvol values were matched between exams. 5 mm slices at 2.5 mm interval with reconstructed for both scanners using filtered back projection and a D30 kernel. Low threshold PCCT images (25–140 keV) and mixed DECT (mDECT) images were evaluated by 3 abdominal radiologists in a blinded side-by-side comparison. After evaluating solid and hollow abdominal organs, readers independently selected one of the datasets as their preference according to a 2-point scale (1=preferred but no effect on diagnostic confidence; 2=definitely preferred and resulted in improved diagnostic confidence); ties were not allowed. Overall preference was decided by a majority rules criterion. Patient size was recorded as diameter at the level of the right renal vein.

RESULTS

There was no overall preference regarding the subjective image quality for routine unenhanced abdominal CT (16 cases preferred for PCCT vs. 14 cases for mDECT). On a per reader basis, the preference showed a nonsignificant trend towards PCCT (p= 0.28). Subjective image preference was not patient size dependent (p=0.81).Both modalities performed equally in displaying small structures and parenchymal lesions, such as para aortal lymph nodes or parenchymal masses. However PCCT was beneficial in better demarcating small low attenuation structures such as biliary and pancreatic ducts, and reducing the osseous blooming effect.

CONCLUSION

No difference was found in image quality between PCCT images and conventional DECT mixed images for non-enhanced abdominal CT. PCCT appears promising for displaying small low attenuation structures. Patient's size did not influence reader preference.

CLINICAL RELEVANCE/APPLICATION

PCCT has previously been shown to offer improved contrast-to-noise ratio for iodine imaging. This study demonstrated clinical benefit for unenhanced imaging as well.

SSJ15

Musculoskeletal (Quantitative Techniques)

Tuesday, Nov. 29 3:00PM - 4:00PM Room: E450B

MK BQ MR

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

Participants
Thomas M. Link, MD, PhD, San Francisco, CA (*Moderator*) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, InSightec, Ltd; Research Grant, InSightec Ltd; Royalties, Springer Science+Business Media Deutschland GmbH; Consultant, Springer Science+Business Media Deutschland GmbH; Research Consultant, Pfizer Inc;
Jean-Francois Budzik, MD, PhD, Lille, France (*Moderator*) Nothing to Disclose

Sub-Events

SSJ15-01 MRI-Based Bone Models in the Knee: An Analysis of Manual and Automated Modeling Techniques

Tuesday, Nov. 29 3:00PM - 3:10PM Room: E450B

Participants
Ales Neubert, Herston, Australia (*Abstract Co-Author*) Nothing to Disclose
Katharine Wilson, MS, Vail, CO (*Presenter*) Nothing to Disclose
Craig Engstrom, Herston, Australia (*Abstract Co-Author*) Nothing to Disclose
Rachel K. Surowiec, MSc, Vail, CO (*Abstract Co-Author*) Nothing to Disclose
Anthony Paproki, Herston, Australia (*Abstract Co-Author*) Nothing to Disclose
Nicholas S. Johnson, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose
Stuart Crozier, Herston, Australia (*Abstract Co-Author*) Nothing to Disclose
Jurgen Fripp, Herston, Australia (*Abstract Co-Author*) Nothing to Disclose
Charles P. Ho, MD, PhD, Vail, CO (*Abstract Co-Author*) Research funded, Siemens AG Research funded, Smith & Nephew plc Research funded, Arthrex, Inc Research funded, Ossur HF Scientific Advisory Board, Rotation Medical, Inc

PURPOSE

Bone modeling with magnetic resonance imaging (MRI) rather than computed tomography (CT) would offer clinical advantages in reducing patient exposure to the ionizing radiation of CT and potential evaluation of hard and soft tissues within the same joint model. We evaluated the feasibility of MRI-based bone modeling of the knee with 3 sequences compared to a gold standard CT-based model, using both manual and automated segmentation techniques.

METHOD AND MATERIALS

An in-vitro left knee specimen was imaged using CT (axial, 2.0mm slice thickness, 0.49x0.49 in-plane resolution) and three MRI sequences (PDFS SPACE, T1 VIBE, T2 TRUFISP; sagittal, 0.7mm slice thickness, up to 0.63x0.63 resolution) at 3.0 T. For each dataset the distal femur, proximal tibia and patella were manually segmented using imaging software and automatically segmented using custom-designed and published software. 3D mesh models of each bone were reconstructed. Two comparisons were made of the models: i) manually segmented MRI vs. manually segmented CT, and ii) automatically segmented MRI vs manually segmented CT. For each comparison the bone models were registered using an iterative closest points algorithm and the mean distance between the models was calculated.

RESULTS

Sub-millimeter agreement was found for all manually segmented MRI-based bone models when compared to the manually segmented CT models. MRI models tended to be slightly smaller than CT models, particularly within concave regions, i.e. depressions of the tibial plateau. The automated software was capable of sub-millimeter agreement in creating MRI-based models from the SPACE and VIBE sequences, with slightly less agreement for the TRUFISP sequence. (Figure 1)

CONCLUSION

MRI-based bone models of the knee demonstrated sub-millimeter agreement with manually segmented CT bone models. This was true for the manually segmented MRI models of all 3 sequences tested (SPACE, VIBE, TRUFISP), as well as for the automatically segmented MRI models of the SPACE and VIBE sequences. The current study indicates that MRI can be used for successful 3D bone modeling and may offer clinical advantages for comprehensive evaluation and automated modeling of the knee joint.

CLINICAL RELEVANCE/APPLICATION

MRI-based bone models are a feasible alternative to CT, avoiding unneeded radiation to patients. Automated modelling techniques would allow for direct application into the standard clinical workflow.

SSJ15-02 Quantitative Dual-energy Computed Tomography-based Molecular Imaging of Hemosiderin in Pigmented Villonodular Synovitis

Tuesday, Nov. 29 3:10PM - 3:20PM Room: E450B

Participants
Steven D. Hajdu, MD, Lausanne, Switzerland (*Presenter*) Nothing to Disclose
Stephane Cherix, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Patrick Omoumi, MD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Igor Letovanec, MD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Laurent Guiral, BSC, Buc, France (*Abstract Co-Author*) Employee, General Electric Company
Francis R. Verdun, PhD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Hannes A. Rudiger, MD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose

Fabio Becce, MD, Lausanne, Switzerland (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the feasibility of dual-energy computed tomography (DECT) in the detection and quantification of hemosiderin deposits in patients with known intra-articular knee masses detected on previous magnetic resonance imaging (MRI) examinations. To quantify the iron content of the two types of pigmented villonodular synovitis (PVNS).

METHOD AND MATERIALS

Twelve consecutive patients (seven males, mean age of 38 years) with single or multiple intra-articular knee masses previously detected on MRI underwent single-source DECT scans using a rapid tube-voltage-switching technique. Semi-automated volumetric tumor segmentation was performed using proprietary post-processing software. A specific color-coding protocol with two-material differentiation was applied using a pre-defined threshold of 4 to 10 mg/cm3 based on a previous phantom study with various known iron concentrations. Tumor volume and iron content were quantified. Iron/tumor volume ratio was subsequently calculated. Histopathological analysis from all 12 surgically resected masses was used as the reference standard.

RESULTS

All 12 masses showed hemosiderin deposits on color-coded DECT images, and all contained iron foci at histopathology. Seven lesions were giant cell tumors of tendon sheath (localized-type PVNS), two were diffuse-type giant cell tumors, and three were classified as other: two arteriovenous malformations and one tendon sheath fibroma. Among both PVNS types, mass volumes ranged from 2.9cm3 to 26.6cm3 with a mean of 8.7cm3 for the localized types, and from 51.2cm3 to 128.2cm3 with a mean of 89.7cm3 for the diffuse types, respectively. Iron volume ranged from 0.6cm3 to 3.8cm3 with a mean of 2cm3 (corresponding to approximately 10mg) for the localized types, and from 14.6cm3 to 34cm3 with a mean of 24.3cm3 (corresponding to approximately 121.5mg) for the diffuse types, respectively (p=0.055). The iron/tumor volume ratio ranged from 0.14 to 0.49 with a mean of 0.28 for the localized types, and from 0.26 to 0.28 with a mean of 0.27 for the diffuse types, respectively (p=0.72).

CONCLUSION

Dual-energy computed tomography is a feasible technique that allows the detection and quantification of hemosiderin deposits in patients with intra-articular knee masses. Hemosiderin volume is greater in diffuse-type PVNS compared with localized-type PVNS.

CLINICAL RELEVANCE/APPLICATION

DECT can be used as a novel imaging technique to quantify iron content in soft-tissue masses.

SSJ15-03 Detection of Myeloma Infiltration of Bone Marrow using Texture Analysis of Apparent Diffusion Coefficient Maps: A Feasibility Study

Tuesday, Nov. 29 3:20PM - 3:30PM Room: E450B

Awards
Student Travel Stipend Award

Participants
Qin Wang, MD, Beijing, China (*Presenter*) Nothing to Disclose
Huadan Xue, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Shuo Li, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Zheng Yu Jin, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the feasibility of using texture analysis of apparent diffusion coefficient maps for the detection of myeloma infiltration of bone marrow.

METHOD AND MATERIALS

17 consecutive patients with plasma disorder was recruited prospectively, including 8 clinically diagnosed multiple myeloma(MM) and 9 patients with monoclonal gammopathy of undetermined significance (MGUS). All patients received whole-body DWI MRI. A hyperintense appearence on high-b-value DWI images was considered as myeloma infiltration. Texture Analysis of ADC maps on lumber vertebral bodies in each patient were performed using TexRAD commercially available research software(TexRAD Ltd, Cambridge,UK) by manually delineating a round region of interest covering the middle cross-sectional area of each vertebra. Vertebrae with focal lesions or compression fracture were excluded from the analysis. The technique selectively filters and extracts textures at different size scales(fine, medium and coarse) followed by quantification of the histogram using 6 parameters: mean, standard-deviation(SD),kurtosis, entropy, skewness, and mean value of positive pixels(MPP). Students' t test was performed to compare the texture analysis parameters between myeloma-infiltrated vertebrae and non-infiltrated vertebrae. ROC analysis was performed to assess the diagnostic performance of these parameters to detect myelonma infiltration.

RESULTS

A total of 22 myeloma-infiltrated vertebrae and 27 non-infiltrated vertebrae were evaluated. At fine texture scale, most of the parameters (ie.mean, ,kurtosis, entropy, skewness, and MPP) except SD were significantly different between the two groups(P<0.05). ROC analysis identified three texture parameters (at fine texure scale) with highest AUCs, including mean(0.974), entropy(0.998) and MPP(0.974). The sensitivity of mean, entropy and MPP was 90.9%,100% and 90.9% respectively. The specificity of mean, entropy and MPP was equal(96.2%).

CONCLUSION

It is feasible to use texture analysis of ADC Maps for the differentiation between myeloma-infiltrated from non-infiltrated bone marrow.

CLINICAL RELEVANCE/APPLICATION

Texture analysis of ADC Maps may complement conventional DWI MRI to differentiate myeloma-infiltrated from non-infiltrated bone marrow.

SSJ15-04 Fat Fraction Map Reconstructed from Two-point Dixon Technique in Quantification of Early Fatty Infiltration in Multiple Myeloma Patients: Comparison and Correlation with Single-voxel Magnetic Resonance Spectroscopy

Tuesday, Nov. 29 3:30PM - 3:40PM Room: E450B

Participants
Xiao-Jiao Pei, MD, Beijing, China (*Presenter*) Nothing to Disclose
Zhen-Yu Pan, MD , Beijng, China (*Abstract Co-Author*) Nothing to Disclose
Yufei Lian, MA,MA, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Shurong Jin, MA,MA, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Yuchang Yan, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Kun Li, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Qinglei Shi, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Xiaoye Wang, MD,MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To test whether fat fraction map (FFM) reconstructed from two-point Dixon technique can be used to quantify fat content of vertebral bone marrow in multiple myeloma patients by comparing the results with single voxel Magnetic Resonance Spectroscopy (MRS) and to evaluate the correlation between these quantitative parameters.

METHOD AND MATERIALS

Twenty patients with different pathological patterns of multiple myeloma (MM) and twenty healthy volunteers were enrolled and underwent three volume two-point T1-Dixon and single voxel MRS imaging. The FFM were reconstructed from Dixon images using the equation FFM =Lip/In where Lip represented fat images and In represented in-phase images. The quantitative parameters were measured by placing the region of interest (ROI) in certain regions that corresponding to the MR-spectroscopy voxel. The fat fraction of MRS (MRS-FF) was calculated by using the integral area of lip peak divided by the sum of integral area of lip peak and water peak. The paired samples t test was used to compare the difference among quantitative parameters. The relationship about FF between T1-Dixon and MRS was assessed by using the Pearson correlation test. Receiver operating characteristic (ROC) analysis of discrimination between normal and MM were performed to determine the optimal cut-off value.

RESULTS

FF values were significantly correlated between T1-dixon and MRS: r = 0.775 (P =0 .001). ROC analysis demonstrated that no significance difference were found between area under the curve of T1-Dixon([0.805±0.087, (0.646 to 0.986)] (normal vs MM))and MRS ([0.768±0.119, (0.478 to 0.932)] (P = 0.478)), with optimal cutoff values of 16.627 and 10.216, respectively.

CONCLUSION

Both two-point T1-Dixon and single-voxel MRS may be reliable method to examine the bone marrow fat of vertebral bone, and good correlations are existed between two-point T1-dixon and MRS.

CLINICAL RELEVANCE/APPLICATION

Because the two-point T1-Dixon technique and MRS can be used for the detection of fat content, and bone marrow fat content is more sensitive to change in patients with multiple myeloma fat, the two technique may provide vital information for identification and diagnosis of multiple myeloma.

SSJ15-05 Quantifying and Optimizing Metal Artefact Reduction using Virtual Monochromatic Dual-Source CT in different Metal Implants

Tuesday, Nov. 29 3:40PM - 3:50PM Room: E450B

Participants
Ruud H. Wellenberg, MSc, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose
Emilie C. Donders, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Peter Kloen, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Geert J. Streekstra, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Cornelis Slump, Enschede, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Mario Maas, MD, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Martijn F. Boomsma, MD, Zwolle, New Caledonia (*Abstract Co-Author*) Nothing to Disclose
Roeland P. Kleipool, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Ludo F. Beenen, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Nick H. Lobe, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To quantify and optimize metal artifact reduction using virtual monochromatic Dual-Source CT in different metal implants compared to non-metal reference scans. Region-of-interest (ROI) measurements were used to determine fluctuations and inaccuracies in soft tissues and bone due to metal artifacts.

METHOD AND MATERIALS

A human cadaver was scanned on a Dual-Source CT scanner with 80kVp/150kVp and 100kVp/150kVp. Scans without ostheosynthetic implants, served as a reference. Thereafter scans were made after implanting a titanium plate, a stainless-steel plate and a titanium intramedullary pen in the left lower leg respectively. Scans were reconstructed with three different reconstruction filters. Virtual monochromatic images were analyzed from 70 to 190 keV, with steps of 10 keV, where 70 keV served as a reference. ROIs were placed in muscle, fat, cortical bone, implant and in the tibial medulla where CT numbers and standard deviation (SD) were measured. Optimal keVs regarding CT number accuracy and SDs were determined by searching for minimal absolute differences between the reference and implant scans.

RESULTS

Based on visual assessment, 100kVp/150kVp and the sharpest filter were chosen with less metal artifacts and sharper edges

respectively. The stainless-steel implant resulted in more severe artifacts. The titanium pen resulted in the least severe metal artifacts. CT number inaccuracies in 70keV images were decreased with 96%, 87% and 73% at optimal keVs of 130keV, 180keV and 190keV for the titanium plate, stainless-steel plate and titanium pen ($p<0.001$) respectively. SDs decreased with 73%, 66% and 35% at optimal keVs of 130keV, 150keV and 140keV for the titanium plate, stainless-steel plate and titanium pen respectively ($p<0.001$).

CONCLUSION

When optimizing metal artifact reduction by virtual monochromatic imaging a metal specific tailoring is advised in order to minimize fluctuations and inaccuracies in soft tissues and bone due to metal artifacts.

CLINICAL RELEVANCE/APPLICATION

In DECT, tailoring monochromatic energies for different metal implants is essential order to minimize fluctuations and inaccuracies in soft tissues and bone due to metal artifacts.

SSJ15-06 MRI in Forensic Medicine - A Unique Approach using 31P Magnetic Resonance Spectroscopy of the Skeletal Muscle

Tuesday, Nov. 29 3:50PM - 4:00PM Room: E450B

Participants
Jin Yamamura, MD, Hamburg, Germany (*Presenter*) Nothing to Disclose
Sarah Keller, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Tony Schmidt, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Roland Fischer Sr, DiplPhys, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim of this study was to investigate the temporal pattern of phosphor metabolites in the adductor magnus muscle post mortem and to check the value of 31P-MRS as a forensic tool especially for the determination of the time of death.

METHOD AND MATERIALS

21 corpses, died of natural cause, were examined (13 male, 8 female; age: 70.5 ± 8.7 y, weight 74 ± 18 kg). A control group of 3 male subjects (mean age: 38.7±24.5 y, range: 2 –67 y, mean body weight: 81±17 kg) was examined at a single time point as well. 31P MRS was performed on a 1.5 T MRI (TR 700 ms, TE 0.35 ms, averages 256, flip angle 90°). A standard 31P surface coil in the patient table, placed under the thigh, was employed. To measure the concentration of the phosphor metabolites scans were repeated in intervals of one hour over a period from 2 to 24 h post mortem (p.m.). The core temperature was rectally measured throughout the MRI examination.

RESULTS

The mean core temperature decreased from 36.0 °C to 25.7 °C. The comparison of ex vivo and in vivo spectra of the adductor magnus muscle showed characteristic differences. In opposite to in vivo spectra, the ex vivo spectra were dominated by the inorganic phosphate (Pi) peak which was used for further analyses. The ex vivo phosphocreatine (PCr) signal was either very small or even not detectable depending on the time post mortem. During the investigated period, the ex vivo peaks showed similar chemical shifts compared to the in vivo spectra (PCr, γ-ATP, α-ATP, β-ATP: 0.34 ± 0.11, -2.01 ± 0.12, -7.08 ± 0.16, -15.43 ± 0.37 ppm). However, the Pi peak shifted from 5.18 ± 0.13 ppm (in vivo) by about 1.0 ppm and 1.5 ppm after 5 and 10 hours p. m., respectively. The α-, β-, γ-ATP/Pi and the PCr/Pi ex vivo ratios decrease from the beginning of the measurement to the end, while the PME/β-ATP ratio is exponentially increasing with a slope of 0.39 ± 0.02 h-1 ($r2 = 0.54$). The α-ATP/Pi ratio decreased exponentially from 0.445 to 0.032 ($r2 = 0.997$, $p < 0.001$).

RESULTS

The mean core temperature decreased from 36.0 °C to 25.7 °C. The comparison of ex vivo and in vivo spectra of the adductor magnus muscle showed characteristic differences. In opposite to in vivo spectra, the ex vivo spectra were dominated by the inorganic phosphate (Pi) peak which was used for further analyses. The ex vivo phosphocreatine (PCr) signal was either very small or even not detectable depending on the time post mortem. During the investigated period, the ex vivo peaks showed similar chemical shifts compared to the in vivo spectra (PCr, γ-ATP, α-ATP, β-ATP: 0.34 ± 0.11, -2.01 ± 0.12, -7.08 ± 0.16, -15.43 ± 0.37 ppm). However, the Pi peak shifted from 5.18 ± 0.13 ppm (in vivo) by about 1.0 ppm and 1.5 ppm after 5 and 10 hours p. m., respectively. The α-, β-, γ-ATP/Pi and the PCr/Pi ex vivo ratios decrease from the beginning of the measurement to the end, while the PME/β-ATP ratio is exponentially increasing with a slope of 0.39 ± 0.02 h-1 ($r2 = 0.54$). The α-ATP/Pi ratio decreased exponentially from 0.445 to 0.032 ($r2 = 0.997$, $p < 0.001$).

CONCLUSION

There is a characteristical postmortal time pattern of the phosphor metabolites. Especially the α-ATP/Pi ratio could be useful as a forensic tool because of its significant exponential postmortal time course.

CLINICAL RELEVANCE/APPLICATION

The phosphor magnetic resonance spectroscopy (31P MRS) could be used as an important tool in the forensic medicine.

RC520

Molecular and Functional Imaging/Surrogate Markers in Radiation Oncology

Wednesday, Nov. 30 8:30AM - 10:00AM Room: S403B

BQ OI RO

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

Participants
Nina A. Mayr, MD, Seattle, WA (*Moderator*) Nothing to Disclose

Sub-Events

RC520A Imaging Surrogate Markers in Liver Cancer

Participants
Mary U. Feng, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

RC520B Imaging Surrogate Markers in Lymphoma

Participants
John P. Plastaras, MD, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how PET/CT scans after chemotherapy are used to make decisions about lymphoma treatment. 2) Describe how pre-chemotherapy PET/CT scans are used to define target volumes in involved site radiotherapy paradigm. 3) Propose prescription doses for lymphoma treatments based on PET/CT as an imaging biomarker.

ABSTRACT

RC520C Imaging Surrogate Markers in Esophageal Cancer

Participants
Steven H. Lin, MD, PhD, Houston, TX, (shlin@mdanderson.org) (*Presenter*) Research Grant, STCube Pharmaceuticals, Inc; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Elekta AB; Research Grant, Peregrine Pharmaceuticals, Inc; Research Grant, Hitachi, Ltd; Speaker, AstraZeneca PLC; Speaker, ProCure Treatment Centers, Inc; Speaker, McKesson Corporation

LEARNING OBJECTIVES

1) Assess the critical role of imaging in the diagnosis and treatment of esophageal cancer. 2) Critically appraise the utility of FDG-PET imaging as a predictive and prognostic marker in esophageal cancer. 3) Describe the novel imaging approaches for improved imaging biomarkers for preoperative therapy.

RC520D Imaging Surrogate Markers in Head and Neck Cancer

Participants
Min Yao, MD, PhD, Cleveland, OH (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Review the application of FDG PET in head and neck cancer2. Review how to use FDG PET in treatment planning3. Review new tracers PET in head and neck cancer

RC529

MR Series: The Added Value of DWI in Clinical Practice

Wednesday, Nov. 30 8:30AM - 12:00PM Room: E350

BQ MR

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.50

FDA Discussions may include off-label uses.

Participants
Caroline Reinhold, MD, MSc, Montreal, QC (*Moderator*) Consultant, GlaxoSmithKline plc
Alexander R. Guimaraes, MD, PhD, Portland, OR (*Moderator*) Speakers Bureau, Siemens AG;
Hersh Chandarana, MD, New York, NY (*Moderator*) Equipment support, Siemens AG; Software support, Siemens AG; Advisory Board, Siemens AG;

Sub-Events

RC529-01 Diffusion Weighted Imaging in the Evaluation of Inflammatory Bowel Disease

Wednesday, Nov. 30 8:30AM - 8:50AM Room: E350

Participants
Stuart A. Taylor, MBBS, London, United Kingdom, (stuart.taylor1@nhs.net) (*Presenter*) Research Consultant, Robarts Clinical Trials, Inc

LEARNING OBJECTIVES

1) Explain the histopathological changes in inflammatory bowel disease that underpin abnormalities in diffusion weighted imaging. 2) Describe the advantages and pitfalls of adding diffusion weighted imaging to standard MR enterography protocols. 3) Appraise the current role of diffusion weighted imaging in the diagnosis and staging of inflammatory bowel disease.

ABSTRACT

To be confirmed

RC529-02 Comparison of Different MRE Sequences Strategies for Detecting Activity and Severity in Crohn's Disease: A Practical Approach for Clinical Trials

Wednesday, Nov. 30 8:50AM - 9:00AM Room: E350

Participants
Jordi Rimola, MD, Barcelona, Spain (*Presenter*) Consultant, Robarts Clinical Trials
Almudena Cofino, MD , La Fresneda (Siero), Spain (*Abstract Co-Author*) Nothing to Disclose
Tamara Perez-Jeldres, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Sonia Rodriguez, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Ingrid Ordas, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Elena Ricart, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Julian Panes, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare different MR sequences strategies for grading activity in patients with Crohn's disease (CD).

METHOD AND MATERIALS

MR enterograhy (MRE)and ileocolonoscopies performed within 1 month in 43 patients with CD were reviewed. Intestinal segments involved by CD were assessed using, T2, DWI or a combination of both, classified as inactive, active mild-moderate or active severe and compared with findings using contrast enhanced gadolinium sequences. Bowel DWI intensity (b=800) was classified as inactive when no signal was detected or active (presence of bright signal intensity). Activity based on T2 sequences included the detection of at least wall thickness>3mm, high signal intensity, or detection of ulcers. Segments were classified as severely inflamed on T2 sequences if they displayed edema and/or ulcers, and based on the DWI sequence if they displayed bright signal similar to the spleen.T2 and T1 with gadolinium sequences were reviewed for calculating MaRIA score also for each individual segment. Sensitivities and specificities of each sequence(s) for correctly classifying each segment in the aforementioned categories were compared. Simplified Endoscopy Score for CD (SES-CD) was the gold standard.

RESULTS

224 segments were included in the analysis. Sensitivities and specificities of T2, DWI or combination of both for detecting activity was 0.81, 0.78, 0.80; and 0.97, 0.72, 0.96 respectively. Sensitivity for diagnosing severe disease was 0.93, 0.3, 0.93 and specificity 0.88, 0.93 and 0.85 respectively for T2, DWI or a combination. For detecting active inflammation, T2 sequence has similar ($p>0.05$) sensitivity and specificity to combined T2 and DWI findings, but has higher specificity than DWI. T2 had higher sensitivity than DWI for identifying severe disease. When comparing MaRIA index with T2, MaRIA only had higher specificity for identifying severe inflammation.

CONCLUSION

Our results support the use of a T2 sequence as a first screening step, and proceed only with a full MRE examination (including gadolinium) only when abnormal findings are identified in the initial T2 sequence. The addition of DWI does not improve the accuracy of MRE.

CLINICAL RELEVANCE/APPLICATION

MR enterography (MRE) is an accurate technique for grading activity in Crohn's disease (CD). DWI sequence has been suggested as an alternative to gadolinium for assessing CD.

RC529-03 Quantified Terminal Ileal Motility during MR Enterography as a Biomarker of Crohn's Disease Activity: A Prospective Study

Wednesday, Nov. 30 9:00AM - 9:10AM Room: E350

Participants
Alex Menys, London, United Kingdom (*Presenter*) Director, Feedback plc; Director, Motilent Ltd; Shareholder, Motilent Ltd
Carl A. Puylaert, MSc, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Charlotte J. Tutein Nolthenius, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Andrew Plumb, MBBCh, MRCP, Stockport, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Jesica Makanyanga, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Douglas A. Pendse, FRCR,MD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Gauraang Bhatnagar, FRCR, Plymouth, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Frans M. Vos, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Jaap Stoker, MD, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Research Consultant, Robarts Clinical Trials
Stuart A. Taylor, MBBS, London, United Kingdom (*Abstract Co-Author*) Research Consultant, Robarts Clinical Trials, Inc

PURPOSE

To prospectively evaluate the predictive accuracy of quantified MRI small bowel motility for Crohn's disease (CD) inflammatory activity against histopathological and endoscopic reference standards and to compare with conventional magnetic resonance index of severity (MaRIA) scoring.

METHOD AND MATERIALS

82 subjects with CD (42 male, median age 32.5 years, range 16 to 70 years) were recruited prospectively from two European centres as part of the VIGOR++ study, undergoing ileocolonoscopy & MR enterography separated by median 5 days (range 0 to 14). The CD Endoscopic Activity Index (CDEIS–endoscopic standard) was scored at the terminal ileum (TI), & a histopathological activity score (eAIS–histopathological standard) was derived from multiple biopsies from the distal terminal ileum. TI motility was quantified using a validated software algorithm based on image registration applied to a breath hold 2D "cine" acquisition (BTFE, slice thickness 1cm, temporal resolution 1.1 images/s). The TI MaRIA score was also calculated by two experienced readers blinded to the clinical & motility data. A motility cut-off score (0.30) was pre-selected from a prior, retrospective study & the sensitivity & specificity of Motility & MaRIA (≥11) for disease activity (defined as eAIS ≥1 or CDEIS ≥4) was calculated. Motility was correlated with reference standards using Spearman's rank & Receiver Operating Characteristic (ROC) area under the curves (AUC) were constructed. Diagnostic performance was compared using McNemar's test.

RESULTS

Results: Against eAIS, motility had sensitivity & specificity of 92.3% and 75.6% for activity. Sensitivity but not specificity was significantly higher than MaRIA (80.0% P=0.03 & 79.1% P=1.0, respectively). Against CDEIS, motility had sensitivity & specificity of 93.3% & 74.0%, significantly higher (sens) & lower (spec) respectively than MaRIA (82% P=0.03 & 83.7% P=0.05). Motility had moderate negative correlations with eAIS ($R=-0.61$, $p<0.001$) & CDEIS ($R=-0.59$, $p<0.001$) & demonstrated a ROC AUC of 0.87 (eAIS) & 0.86 (CDEIS), respectively.

CONCLUSION

In this dual site prospective study, quantified motility appears a valid biomarker for endoscopic and histopathological activity in Crohn's disease.

CLINICAL RELEVANCE/APPLICATION

Motility assessment is rapid (<60s per case) with previously demonstrated good inter-reader agreement. This prospective validation study suggests clinical utility over and above existing time consuming manual MRI activity scores.

RC529-04 Quantitative Assessment of Bowel Inflammatory Severity of Crohn Disease on MR Enterography Using MaRIA Score: Comparison between Enteric and Portal Phases

Wednesday, Nov. 30 9:10AM - 9:20AM Room: E350

Participants
Hye Young Jang, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jin Sil Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seong Ho Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Research Grant, DONGKOOK Pharmaceutical Co, Ltd
Jong Seok Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyun Jin Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ah Young Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The Magnetic Resonance Index of Activity (MaRIA) is a score system to quantitatively assess bowel inflammatory severity of Crohn disease (CD) on MR enterography (MRE), arguably the most widely adopted in clinical trials among MRE indices. MaRIA was originally developed for portal-phase imaging, while enteric phase is currently the primary contrast-enhanced imaging for MRE. This study was to compare MaRIA scores between enteric and portal phases.

METHOD AND MATERIALS

42 CD patients (M:F, 33:9; 27±6.2 years) prospectively underwent MRE and ileocolonoscopy within 1 week. MRE was performed after oral administration of 1500mL 2.5% sorbitol over 80 min to achieve good fluid distention of the small bowel as well as the right-sided colon. Endoscopy recorded inflammatory activity according to CD endoscopic index of severity (CDEIS). 79 segments (39 terminal ilea and 40 right-sided colons) were finally analyzed. Three independent readers assessed MaRIA score for each segment separately using enteric (MaRIA*e*) and portal (MaRIA*p*) phases. Spearman correlation of MaRIA*e* and MaRIA*p* with CDEIS was analyzed and the two correlation coefficients were compared. Agreement between MaRIA*e* and MaRIA*p* was assessed using

Bland-Altman analysis. Interobserver agreement was analyzed using repeatability coefficient and intraclass correlation coefficient (ICC).

RESULTS

Correlation coefficients between MaRIA and CDEIS were 0.714 (MaRIA*e*) vs. 0.727 (MaRIA*p*) for reader 1 (p=0.309), 0.816 vs. 0.817 for reader 2 (p=0.919), and 0.778 vs. 0.776 for reader 3 (p=0.844), consistently demonstrating no significant difference between the two phases. Bland-Altman mean difference between MaRIA*e* and MaRIA*p* and repeatability coefficient were -0.36 and 1.12 for reader 1, -0.3 and 1.4 for reader 2, -0.35 and 0.9 for reader 3, indicating consistent minute systematic underestimation on enteric phase compared with portal phase. Repeatability coefficients among the three readers were approximately 15 for both phases and ICCs were 0.74 for both phases.

CONCLUSION

MaRIA*e* and MaRIA*p* deemed practically equivalent, given their highly comparable results and the fact that systematic underestimation on enteric phase was miniscule, particularly when compared with the magnitude of interobserver variability.

CLINICAL RELEVANCE/APPLICATION

MaRIA scores can practically be assessed using both enteric and portal phases allowing for more flexible use although constant use of a single phase may be ideal.

RC529-05 Whole Body DWI for Tumor Detection and Assessment of Response

Wednesday, Nov. 30 9:20AM - 9:40AM Room: E350

Participants
Anwar R. Padhani, MD, FRCR, Northwood, United Kingdom, (anwar.padhani@stricklandscanner.org.uk) (*Presenter*) Advisory Board, Siemens AG; Speakers Bureau, Siemens AG; Researcher, Siemens AG; Speakers Bureau, Johnson & Johnson

LEARNING OBJECTIVES

To provide a rationale for the use of whole body MRI when evaluating malignant disease extent and for therapy response assessment To show how measurements are acquired distinguishing between tumour detection (core) and response assessment (comprehensive) protocols that are MET-RADS compliant To provide interpretation guidelines including how to recognise false positive and negative cases in disease detection. To highlight and review the MET-RADS response assessment guidelines To provide the scientific evidence and illustrate by case reviews the efficacy of WB-MRI comparing with PET/CT, bone and CT scans including areas of potential synergy To highlight specific clinical indications for WB-MRI use and highlight patient and clinical pathway altering benefits and limitations

LEARNING OBJECTIVES

1) To provide a rationale for the use of whole body MRI when evaluating malignant disease extent and for therapy response assessment. 2) To show how measurements are acquired in the body and to distinguish between tumour detection and response assessment protocols. 3) To provide interpretation guidelines including how to recognise false positive and negative cases in disease detection and response assessment settings. 4) To provide the scientific evidence and illustrate by case reviews the efficacy of WB-MRI comparing with PET/CT, bone and CT scans including areas of potential synergy. 5) To highlight specific clinical indications for WB-MRI use and highlight patient and clinical pathway altering benefits and limitations.

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/

Anwar R. Padhani, MD, FRCR - 2012 Honored Educator

RC529-06 Diagnostic Accuracy of Whole-body MR Imaging including Diffusion Weighted Imaging (DWI) for the Detection of Malignant Tumor Recurrence:Comparison with Whole-body PET/MRI

Wednesday, Nov. 30 9:40AM - 9:50AM Room: E350

Participants
Su Joa Ahn, 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; Grant, Bayer AG; Grant, General Electric Company; Grant, STARmed Co, Ltd; Grant, RF Medical Co, Ltd; Grant, Toshiba Corporation; Grant, Samsung Medical Healthcare
Seung Joon Choi, Incheon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Rihyeon Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jae Seok Bae, 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 compare whole-body (WB) PET/MRI with dedicated WB-MRI including DWI (WB-DW-MRI) for the detection of local recurrence or distant metastasis in patients with various primary malignant tumors.

METHOD AND MATERIALS

Whole-body PET/MRI with [18F]-fluoro-2-deoxy-glucose including dedicated WB-DW-MRI was performed in 181 consecutive patients for the detection of the tumor recurrence of various primary malignant tumors (colorectum=108, HCC=30, stomach=17, breast=7, others=19). Two radiologists reviewed the dedicated WB-DW-MRI and WB-PET/MR images with Dixon and T2WI for the

presence of malignancy in separate sessions. Presence of local recurrence, lymph node (LN) metastases and distant metastases were confirmed using histopathology or radiological/clinical follow-up within at least 6 months as the reference standard.

RESULTS

Tumor recurrence was found in 126 of 181 patients with 229 malignant foci: local recurrence (n=7) and metastases in the liver (n= 147), LNs (n=33), lung (n= 22), peritoneum (n=11), bone (n=4), and others (n=5). Overall diagnostic accuracy for WB-DW-MRI and PET/MRI were comparable: 98.3% (sensitivity 86.5%, specificity 99%) for WB-DW-MRI and 97.7% for (sensitivity 84.1%, specificity 98.5%) for PET/MR. Both modalities detected all seven local recurrences. PET/MRI detected significantly more LN metastases (sensitivity 97%, n=32/33) than WB-DW-MRI (sensitivity 72.7%, n= 24/33, p=.03). For liver metastasis, WB-DW-MRI detected more liver metastases than PET/MRI (p=.01): sensitivities of 93.8% vs. 84.83%, and specificities of 94.7% vs. 98.7%, respectively. For pulmonary metastases, both WB-DWI-MRI and PET/MRI showed relatively low sensitivity (77%,64%) with comparable high specificity (98%, 98%), and accuracy (98%, 97%). Respective values for the detection of peritoneal seeding were 58%, 99%, and 98% for WB-DW-MRI, and 58%, 98%, and 97% for PET/MRI. Kappa values for whole-body MRI and PET/MRI interpretations were moderate to good.

CONCLUSION

WB-DW-MRI and PET/MRI provided comparable overall diagnostic accuracy for the detection of not only local recurrence but also distant metastasis in underlying malignant tumor patients.

CLINICAL RELEVANCE/APPLICATION

As WB-DW-MRI appears to provide a comparable diagnostic performance to FDG PET/MR, it can be a good alternative examination for evaluation of patients with abdominal malignancies.

RC529-07 FDG PET/MRI Quantitative Discrimination between Normal and Metastatic Liver Tissue using DTI Indices and SUV

Wednesday, Nov. 30 9:50AM - 10:00AM Room: E350

Participants
Dan Stein, Tel Aviv, Israel (*Presenter*) Nothing to Disclose
David Groshar, MD, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose
Hanna Bernstine, MD, Petah Tikva, Israel (*Abstract Co-Author*) Nothing to Disclose
Meital Nidam, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose
Liran Domachevsky, MD, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose
Ifat Abadi-Korek, PhD, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose
Dorit Stern, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose
Natalia Goldberg, MD, Petah Tiqwa, Israel (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To discriminate by quantitative PET/MRI metastatic liver tissue from normal liver tissue using diffusion tensor imaging (DTI) indices (FA and ADC) and fluorine 18 fluorodeoxyglucose (FDG) standardized uptake value (SUV).

METHOD AND MATERIALS

32 patients with known malignancy were enrolled in this IRB approved study after written informed consent. Data from 11 patients (6 women, 5 men, mean age 59±12) with visible liver metastases (VLM) were evaluated. All patients were injected with FDG and Gadolinium based contrast intravenously and underwent an abdominal examination on 3.0 T PET-MRI scanner, including Dixon and DTI protocols with simultaneous PET acquisition. Two independent radiologists and nuclear medicine specialists evaluated the images. Fractional anisotropy (FA), apparent diffusion coefficient (ADC) values as well as body weight peak SUV (pSUV) in metastatic lesions and in normal liver tissue (NL) were obtained by copying the volume of interest (VOI) between the registered scans. Tissue heterogeneity was calculated via the coefficient of variance (cv) cv=sd\mean.

RESULTS

VLM\NL groups were respectively SUVp=2.18±0.49\ 8.31±2.79, FA= 0.42±0.17\0.35±0.13, ADC =1.16±0.1\1.18±0.26 and cv(ADC)=0.28±0.08\0.18±0.04; only SUVp and cv(ADC) have shown significant differentiation between metastatic and normal liver tissue ($p<0.001$).

CONCLUSION

As far as we know this is the first quantitative comparison of FDG uptake values and DTI indices in the liver. This study has effectively demonstrated the feasibility of quantitative assessment of liver tissue using PET and MRI indices to differentiate metastatic disease from normal liver tissue. Furthermore, it introduces tissue heterogeneity as an important assessment tool.

CLINICAL RELEVANCE/APPLICATION

Using PET-MR, this study has demonstrated the high correlation between quantitative data extracted via each modality and demonstrated that tissue heterogeneity calculated via DTI may be applied as a strong diagnostic tool to discriminate metastases from normal liver tissue.

RC529-08 Prediction of Therapeutic Response to Sorafenib in Patients with Advanced Stage HCC using Diffusion Weighted Imaging with Intravoxel-Incoherent Motion

Wednesday, Nov. 30 10:00AM - 10:10AM Room: E350

Participants
Jeong Hee Yoon, MD, Seoul, Korea, Republic Of (*Presenter*) Grant, Bayer AG; Speaker, General Electric Company; Speaker, Koninklijke Philips NV; Speaker, Bayer AG
Jeong Min Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Grant, Guerbet SA; Support, Siemens AG; Grant, Bayer AG; Grant, General Electric Company; Grant, STARmed Co, Ltd; Grant, RF Medical Co, Ltd; Grant, Toshiba Corporation; Grant, Samsung Medical Healthcare
In Chan Song, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Mi Hye Yu, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate diffusion weighted imaging (DWI) in prediction of response of patients with hepatocellular carcinomas (HCCs) to treatment with Sorafenib assessed by mRECIST.

METHOD AND MATERIALS

In this IRB-approved prospective study, 15 patients (M: F= 11:4) with advanced HCC were enrolled and informed consent was obtained from all patients. Patients underwent DWI using nine b-values (0-800sec/mm2) at 3T before starting Sorafenib treatment. Intrahepatic target lesion (6.3±4.9cm, range 1.5-15cm) was determined on baseline computed tomography (CT) and progression of the disease was determined on 3 months follow-up CT scan by a radiologist who was blind to DWI results. DWI was analyzed using intravoxel incoherent motion (IVIM) model and parameters (apparent diffusion coefficient (ADC), pure diffusion (D), pseudodiffusion (D*) and perfusion fraction (f)) were compared between responders (complete response, partial response) and non-responders (stable disease, progressive disease) according to mRECIST criteria on 3 moths follow-up CT scan.

RESULTS

After excluding three patients who withdrew informed consent, parameters of DWI were compared between responders (n=5) and non-responders (n=7). Initial tumor size was not significantly different between two groups (5.6±4.9cm vs. 6.9±5.2cm, P=0.67, respectively). Baseline ADC was significantly higher in responders than non-responders (1.42±0.3 mm2/sec vs. 1.09±0.08 mm2/sec, P=0.025) and D was significantly higher in responders (1.30±0.27 mm2/sec vs. 1.02±0.06 mm2/sec, P=0.024). In addition, baseline f was significantly higher in responders than non-responders (21.2±7.0% vs. 13.8±2.5%, P=0.025). However, D* showed significant overlap between two groups (37.5±11.6 mm2/sec vs. 44.3±13.6 mm2/sec, P=0.39).

CONCLUSION

Baseline DWI using IVIM may be able to characterize HCCs would be responsible for Sorafenib treatment in patients with advanced HCCs.

CLINICAL RELEVANCE/APPLICATION

Prediction of Sorafenib response on non-invasive imaging would be beneficial to avoid expensive, non-necessary treatment in advanced HCCs.

RC529-09 Can Simple DWI Signal Observation Determine Complete Response for Locally Advanced Rectal Cancer after Neoadjuvant Chemoradiotherapy?

Wednesday, Nov. 30 10:10AM - 10:20AM Room: E350

Participants
Xiao-Yan Zhang, Beijing, China (*Presenter*) Nothing to Disclose
Ying-Shi Sun, MD, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We aimed to determine if high-signal observed on DWI after neoadjuvant chemoradiotherapy (CRT) in the tumor bed can accurately predict residual tumor for locally advanced rectal cancer, and if low-or iso- signal observed on DWI after neoadjuvant CRT can accurately predict pathological complete response (PCR) for locally advanced rectal cancer.

METHOD AND MATERIALS

One hundred and ninety five patients with locally advanced rectal cancer who underwent neoadjuvant CRT and subsequent surgery were included in this study. All patients were evaluated pre- and post-CRT by standardized turbo spin echo and DW-MRI. Pre- and post-CRT tumor and normal rectal wall signal intensity (SI) (which were simply scored as high-, iso-, and low-signal) were recorded and evaluated by one radiologist who was blinded with the pathological results. Complete response patients were determined combining T2WI and DWI signal from baseline and preoperative MRI, and then compared with the pathological results.

RESULTS

There are thirty three patients with pathological complete response in totally 195 rectal cancer patients (16.9%), 162 patients with residual tumor. In PCR group, 11 patients (33.3%) with complete tumor SI loss (low- or iso- signal) on DWI and T2WI were determined with complete response accurately. Other 22 patients were misdiagnosed with residual tumor because of high- or iso-signal on DWI and T2WI. In non-PCR group, 148 patients were determined with residual tumor accurately because of high- or iso-signal on DWI and T2WI. 14 patients were misdiagnosed as complete response because of complete tumor SI loss (low- or iso-signal) on DWI and T2WI. By the simple signal observation, the sensitivity, specificity, and accuracy for PCR is 33.3%, 91.4%, and 81.5%, respectively.

CONCLUSION

Only a few of PCR showed complete tumor SI loss on DWI, most PCR showed high SI on DWI because of edema, congestion, immature fibrosis, or other reasons. We cannot unequivocally determine a complete response by using simple signal observation.

CLINICAL RELEVANCE/APPLICATION

We cannot unequivocally determine a complete response by using simple signal observation on DWI.

RC529-10 Histogram Analysis of Diffusion-Weighted MR Imaging as a Biomarker for Colorectal Cancer

Wednesday, Nov. 30 10:20AM - 10:30AM Room: E350

Participants
Koichi Hayano, MD, Chiba, Japan (*Presenter*) Nothing to Disclose
Yumiko Takahashi, MD, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose
Gaku Ohira, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose
Hisahiro Matsubara, MD, PhD, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Abnormality in the tumor structure or vasculature is a well-recognized feature of malignancy. On the other hand, diffusion-weighted MR imaging (DWI) has been reported as a tool that can reflect tumor structures such as fibrosis, cellularity, and angiogenesis. The purpose of this study is to apply histogram analysis to DWI to quantify structural abnormality of colorectal cancer, and compare the histogram parameters with survival in colorectal cancer.

METHOD AND MATERIALS

43 patients (30 M / 13 W; median age: 66.0 years) with colorectal caners were retrospectively evaluated. Median follow-up time was 65.7 months. DWI was performed before the therapy. Histogram parameters including kurtosis and skewness of the tumor were measured on DWI at b=1000, and apparent diffusion coefficient (ADC) of the tumor was also measured on ADC map generated by DWIs at b=0 and 1000. Associations of tumor parameters (kurtosis, skewness, and ADC) with pathological features were analyzed, and these parameters were also compared with recurrence free survival (RFS), and overall survival (OS) using Cox regression and Kaplan-Meier analysis.

RESULTS

Low ADC value of tumor significantly associated with lymph node metastasis and synchronous distant metastasis (both P=0.04), while low kurtosis of tumor significantly associated with lymphnode metastasis (P=0.0003). In Cox regression analysis, no parameters showed significant correlations with OS, while only kurtosis showed a significant correlation with RFS (P=0.04). In Kaplan-Meier analysis, patients with higher kurtosis tumors (kurtosis > 2.23) showed a significantly better RFS (P=0.03, Wilcoxon test).

CONCLUSION

Pre-therapeutic tumor histogram parameter measured on DWI can be a useful imaging biomarker reflecting RFS in colorectal cancer patients.

CLINICAL RELEVANCE/APPLICATION

Histogram analysis of DWI can be a widely applicable imaging biomarker for colorectal cancer reflecting survival, and it would enable personalized therapy for colorectal cancer patients.

RC529-11 DWI Beyond ADC

Wednesday, Nov. 30 10:50AM - 11:10AM Room: E350

Participants
Bachir Taouli, MD, New York, NY, (bachir.taouli@mountsinai.org) (*Presenter*) Consultant, MEDIAN Technologies ; Grant, Guerbet SA

LEARNING OBJECTIVES

1) Review the current evidence on the use of quantitative ADC outside the brain. 2) Review limitations of ADC quantification. 3) Review the potential added value of non-mono exponential processing methods, including IVIM, stretched exponential and kurtosis for diffusion quantification.

ABSTRACT

LEARNING OBJECTIVES

1) Review current methods for obtaining ADC calculation. 2) Review clinical applications of ADC quantification in the Body. 3) Review advanced diffusion quantification methods beyond ADC, including bi-expoenential and diffusion kurtosis, potential clinical applications, and limitations.

ABSTRACT

RC529-12 Comparison of Mono- and Bi-exponential Model of Diffusion-Weighted Imaging in Evaluation of Histological Differentiation of Hepatocellular Carcinoma (HCC) in Patients with Hepatitis B Virus Infection

Wednesday, Nov. 30 11:10AM - 11:20AM Room: E350

Participants
Qungang Shan, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Tianhui Zhang, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Jin Wang, MD, Guangzhou, China (*Presenter*) Nothing to Disclose
Zhong-Ping Zhang, MMedSc, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Yunhong Shu, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Bingjun He, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Zhuang Kang, Guang Zhou, China (*Abstract Co-Author*) Nothing to Disclose
Bing Wu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Zhenyu Zhou, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Jingbiao Chen, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare diagnostic value of apparent diffusion coefficient (ADC) and intravoxel incoherent motion (IVIM) derived metrics in the evaluation of histological differentiation of hepatocellular carcinoma (HCC) in patients with hepatitis B virus (HBV) infection.

METHOD AND MATERIALS

Institutional approval and consent form were obtained for this study. 79 chronic HBV patients with 82 pathologically confirmed HCCs were enrolled in our study. The lesions were classified into three groups according to pathological results as following: well-differentiated (n=24), moderately-differentiated (n=47) and poorly-differentiated (n=11). All subjects underwent conventional MRI and DWI scans using a 3.0T MR system. Respiratory-triggered diffusion-weighted imaging (DWI) were performed using eleven b values (b=0, 30, 50, 100, 150, 200, 300, 500, 800, 1000, 1500 sec/mm2) and two b values (b=0, 800 sec/mm2) successively. D

(diffusion coefficient), D* (pseudo-diffusion coefficient) and f (perfusion fraction) were calculated using bi-exponential model. ADC0,800 and ADCtotal were calculated by fitting b=0, 800 sec/mm2 and all b values into mono-exponential model, respectively. All metrics were compared among HCCs with the three histological differentiation subtypes using Kruskal-Wallis test, spearman rank correlation and receiver operating characteristic (ROC) analysis.

RESULTS

ADCtotal, ADC0,800, D and f values were significantly correlated with histological grades: r = -0.686 (*P* < .001), r = -0.423 (*P* < .001), r= -0.497 (*P* < .001) and r= -0.323 (*P* = .004), respectively. D* did not differ among three groups. The area under the ROC curve (AUC-ROC) of ADCtotal, ADC0,800, D, and f for diagnosing well-differentiated HCCs was 0.937, 0.794, 0.863 and 0.790, respectively, and the AUC-ROC of the above metrics for diagnosing poorly-differentiated HCCs was 0.867, 0.709, 0.734 and 0.616, respectively.

CONCLUSION

ADCtotal derived by mono-exponential model using multiple b-value DWI showed relatively higher diagnostic accuracy as compared with other metrics in evaluating histological differentiation of HBV-related HCCs.

CLINICAL RELEVANCE/APPLICATION

This study demonstrated that ADCtotal, ADC0,800, D and f were useful metrics in evaluating histological differentiation of HBV-related HCCs and they could be valuable in selecting the treatment strategy.

RC529-13 Intravoxel Incoherent Motion Diffusion-Weighted Magnetic Resonance Imaging Predicts Bevacizumab-Induced Transient Remodeling of the Vasculature in Colorectal Carcinoma Xenografts Model

Wednesday, Nov. 30 11:20AM - 11:30AM Room: E350

Participants
Huanhuan Liu, Shanghai, China (*Presenter*) Nothing to Disclose
Yanfen Cui, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Caiyuan Zhang, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Dengbin Wang, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Increasing evidence suggests that vascular endothelial growth factor (VEGF) inhibition could boost transient "normalization" of tumor vasculature, thus improving tumor perfusion and therapeutic effect of chemotherapy. Our study was to investigate the value of intravoxel incoherent motion diffusion-weighted imaging (IVIM DWI) in predicting bevacizumab-induced transient remodeling of the vasculature in colorectal carcinoma (CRC) xenograft.

METHOD AND MATERIALS

Forty mice bearing HCT-116 CRC xenograft underwent IVIM DWI at baseline and 1, 3 and 7 days after administration of bevacizumab(n=20) or 0.9% NaCl solution intraperitoneally(n=20). Parameters of apparent diffusion coefficient (ADC), true diffusion coefficient (D), perfusion fraction (f), and blood pseudodiffusion coefficient (D*) were compared between the two groups and within groups after treatment. Histopathological results were used as the standard reference.

RESULTS

After a single bevacizumab dose of 200 ug, the tumor microvessel density decreased to <35% of control within 7 days. Compared with the control group, the perfusion-related parameter D* value increased on day 3 (*P*=0.018) and then decreased on day 7 significantly (*P*=0.036). The ADC and D values increased significantly on day 3 (*P*=0.002, *P*=0.010, respectively) and day 7 (*P*=0.002, *P*=0.001, respectively). A sustained decrease of the f value was observed within 7 days after bevacizumab-treatment, which showed a significant difference on day 3 (*P*=0.044) and day 7 (*P*=0.012). The ADC, D, D*, and f values were constant within the control group. Endothelial cell density decreased and vessel maturity index (ratio of a-smooth muscle actin to CD31 pixels per tumor section) increased significantly on day 3 (*P*=0.001, *P*=0.003, respectively) and day 7 (*P*<0.001, *P*<0.001, respectively) in the treated group, indicating the "normalization" of the tumor vasculature.

CONCLUSION

IVIM DWI could be helpful for early prediction of the transient remodeling of vasculature in CRC non-invasively. The chemotherapy during the transient "normalization" window of tumor vasculature could increase the delivery of chemotherapeutic drugs and improve the therapeutic efficacy.

CLINICAL RELEVANCE/APPLICATION

IVIM DWI could predicts the transient remodeling of vasculature in CRC non-invasively, thus to guide application time of chemotherapeutic drugs and improve the therapeutic efficacy.

RC529-14 Two-Dimensional US Elastography for Focal Lesions in Liver Phantoms: Influencing Factors for Stiffness Measurement of Small Lesions

Wednesday, Nov. 30 11:30AM - 11:40AM Room: E350

Participants
Jeong Ah Hwang, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Woo Kyoung Jeong, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyoung Doo Song, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Tae Wook Kang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyo Keun Lim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Eun Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

US elastography (USE) has been investigated for the purpose of estimating liver fibrosis, but 2-dimensional (2-D) USE can depict a

US elastography (USE) has been investigated for the purpose of estimating liver fibrosis, but 2-dimensional (2-D) USE can depict a focal lesion with different elasticity with a color map. The purpose of this study is to determine accuracy and influencing factors of stiffness value of focal lesions in the phantoms using 2-D USE.

METHOD AND MATERIALS

Using two customized phantoms with different elasticity (4±1 kilopascal [kPa], mimicking normal liver; 15±2 kPa, mimicking liver cirrhosis [LC]) which have 9 spherical hypoechoic inclusions with same elasticity (23±3 kPa), different size (20mm, 15mm and 10mm in a raw) and different depth (3cm, 5cm and 7cm). Two radiologist investigated stiffness of inclusion bodies and background for each inclusions using in the region of interest (ROI). Mean stiffness and standard deviation (SD) in ROI were acquired, and the shape of inclusion was also assessed with a qualitative 5-graded scoring system about target visualization on color map. As possible influencing factors, the type of background phantom, depth of inclusions, size of inclusions, and observers were considered. We compared by Kruskal-Wallis test, and performed multiple regression tests to detect significant influencing factors about 2-D USE.

RESULTS

Measured mean stiffness value was significantly higher in LC phantom (10.50 kPa in normal, 13.81 kPa in LC; p=0.013), inclusions in 7cm of depth (10.94 kPa in 3cm, 11.20 kPa in 5cm and 15.59 kPa in 7cm; p=0.001). In multiple regression analysis in mean stiffness, there was significant difference of mean stiffness in type of phantom, depth and size of inclusions. Mean SD in ROI was also significantly larger in 7cm of depth (0.86 kPa in 3cm, 1.23 kPa in 5cm and 3.94 kPa in 7cm; p=0.001). In multiple regression analysis for SD in ROI, there were significant differences in type of phantom and depth of inclusions. Morphologic score was significantly different only in aspect of the size of inclusion bodies (p<0.001). Background stiffness was not different according to depth or observers (p=0.491 and 0.522, respectively).

CONCLUSION

2-D USE for focal lesion evaluation could be influenced by different background stiffness, deep position of the lesion, and small size of lesion.

CLINICAL RELEVANCE/APPLICATION

Background liver stiffness, depth and size of the target lesion should be considered for focal hepatic lesion evaluation using 2-D USE.

RC529-15 Unresectable Hepatic and Pulmonary Tumors Show Different Responses to Oxygen Challenge in Blood Oxygen Level Dependent (BOLD) MRI

Wednesday, Nov. 30 11:40AM - 11:50AM Room: E350

Participants
Xiangyu Yang, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Eric D. Miller, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Preethi Subramanian, MS, BEng, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Terence M. Williams, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (*Presenter*) Nothing to Disclose

PURPOSE

To investigate whether oxygen challenge triggers similar Blood Oxygen Level Dependent (BOLD) responses in MRI in different types of tumors.

METHOD AND MATERIALS

Ten patients (6 male/4 female, 69 ± 10 y.o.) with unresectable hepatic (n=6) or pulmonary (n=4) lesions were imaged with the BOLD MRI technique prior to stereotactic body radiation therapy (SBRT). The MRI was performed on an Ingenia CX 3T scanner using a dStream WholeBody coil. The BOLD MRI sequence is a dynamic multi-echo turbo field echo (TFE) fast T2* mapping sequence with the following sequence parameters: 350 mm FOV, 176 x 174 matrix, 10 slices with 5 mm thickness, TR 34.8 ms, 16 TEs ranging from 1.38 to 17.17 ms, 25° flip angle, 20 dynamics, scan time 10’32”. Oxygen challenge started at the 11th dynamic scan, delivered through a high flow nasal cannula at a flow rate of 15 L/min. Patients were instructed to keep a smooth, shallow breathing pattern during the scan. Regions of interest (ROIs) were defined by a radiation oncologist on target lesions. BOLD response was quantified as the percent change in R2* relaxation rate, and statistical significance was determined with the Student’s t-test. The influence of fat-water phase interference in liver was corrected for by including three fat peaks at 3.8, 3.4, and 2.6 ppm in R2* fitting.

RESULTS

Ten hepatic lesion (fat content 5-29%) and four pulmonary lesion ROIs (fat content 2-3%) were defined. During the oxygen challenge, tumor R2* decreased by -3-15% (median 7%) in hepatic lesions, and increased by -3-11% (median 2%) in pulmonary lesions. The BOLD response is statistically significant (p<0.05) in 6 of the 10 hepatic lesions but none of the 4 pulmonary lesions.

CONCLUSION

In MRI, pulmonary lesions have substantially weaker BOLD response to oxygen challenge than hepatic lesions, likely due to a more deoxygenated blood supply.

CLINICAL RELEVANCE/APPLICATION

BOLD MRI contrast appears to be tumor type dependent and such difference needs to be considered when assessing tumor perfusion and/or hypoxia.

RC529-16 Feasibility of Multi-parametric Quantitative MR Imaging for the Characterization of HCC

Wednesday, Nov. 30 11:50AM - 12:00PM Room: E350

Participants
Yong Eun Chung, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Joonseok Lim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Chansik An, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Mi-Suk Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jin-Young Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Myeong-Jin Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Research Grant, Bayer AG

PURPOSE

To investigate the feasibility of quantitative MR imaging for the characterization of HCC

METHOD AND MATERIALS

This prospective study enrolled 56 patients (56.7 ± 8.7 years old, M:F = 51:5) who were planned for surgery due to suspected HCC in the liver. Multi-parametric quantitative MR including T1, T2 and T2* relaxometry and multi-frequency (transducer frequency: 28Hz, 56Hz, 84Hz) MR elastography (MRE) were obtained before surgery. Quantitative parameters were measured both in the liver and within the tumor in possible all slices and the average value was calculated. Pathologic characteristics of HCC including intra-tumoral necrosis, hemorrhage, fatty change, Edmondson-Steiner grade were acquired after surgery. Paired t test was used for comparing MR parameters between adjacent liver and focal liver lesion. Correlation between MR parameters and pathologic characteristics were evaluated with Pearson correlation coefficient. A P value less than 0.05 was considered as statistically significant.

RESULTS

Among 56 patients, 40 patients were finally diagnosed as HCC (43.2 ± 21.0 cm) after surgery. Other 6 patients were confirmed as cholangiocarcinoma (n=4), hepatic adenoma (n=1) and dysplastic nodule (n=1). All relaxation time was significantly longer in HCC (T1, 1172.2 ms; T2, 84.9 ms; T2*, 26.1 ms) compared to that of adjacent liver (T1, 786.6 ms; T2, 49.7 ms; T2*, 13.9 ms, $P<0.001$). Storage modulus, loss modulus and shear modulus in all transducer frequencies were significantly higher in HCC than that of adjacent liver ($P<0.05$), except loss ($P=0.847$) and shear modulus ($P=0.133$) in 28Hz. There was a significant negative correlation between T2* relaxation time of HCC and proportion of intra-tumoral hemorrhage ($r=-.335$, $P=0.020$). There was no significant correlation between other relaxation times or MRE parameters and pathologic characteristics of HCC ($P>0.05$).

CONCLUSION

Although there was a significant difference of quantitative MR parameters between adjacent liver parenchyma and HCC, they did not provide additional information for the pathologic characteristics of HCC, except T2* relaxation time which represent intra-tumoral hemorrhage.

CLINICAL RELEVANCE/APPLICATION

Quantitative MR parameters may not represent pathologic characteristics of HCC, except short T2* relaxation time which suggest intra-tumoral hemorrhage.

SSK01

Breast Imaging (Intervention Path Correlation)

Wednesday, Nov. 30 10:30AM - 12:00PM Room: E450A

BR BQ IR

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

Participants
Michael A. Cohen, MD, Atlanta, GA (*Moderator*) Nothing to Disclose
Michael N. Linver, MD, Albuquerque, NM (*Moderator*) Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, Real Imaging Ltd; Scientific Advisory Board, Seno Medical Instruments, Inc
Paul R. Fisher, MD, East Setauket, NY (*Moderator*) Research Grant, Siemens AG;

Sub-Events

SSK01-01 Unwise Conventional Wisdom: Real Truths About Atypical and Malignant Solitary Papillomas of the Breast

Participants
Sheryl G. Jordan, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose
Niyati Mukherjee, MD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
Christine E. Bookhout, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
Zane S. Jordan, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
Thomas J. Lawton, MD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Radiologists continue to be taught breast atypical and malignant papillomas present with nipple discharge or palpable lump, are peripheral rather than central in locale, that symptomatic patients are at more risk for atypia/malignancy than asymptomatic patients hence require surgical excision, and that peripheral papillomas have predilection to be mammographically occult. Our clinical experience defies each of these; we hence studied characteristics of our institution's ten year experience with these diagnoses.

METHOD AND MATERIALS

IRB-approved, study retrospectively identified all patients with histologic confirmed diagnosis of solitary atypical or malignant papilloma from January 1, 2004 through September 3, 2014 in our CoPath and RadPathConf databases. Diagnoses of papillomatosis and nonsynchronous multiple intraductal papillomas excluded. Remaining cases (N=53) were reviewed multivariate manner. Then study cohort was analyzed against a comparison cohort (N=57) of all institution patients with solitary benign papillomas on core needle biopsy same time frame.

RESULTS

Study cohort solitary papilloma w/ atypia or malignancy on 53 CNB pts: median age 60, range 35-85. 39/53 screening mammo detected 11/53 palpable lump or nipple discharge 3/53 screening MRI. 0/53 solitary papilloma patients presented w/ bloody nipple discharge. 16/53 central in breast, 37/53 peripheral. Based on CNB results, malignancy was more common central (31%) vs peripheral (19%) papillomas. Both central and peripheral most commonly presented as mammo new mass or asymmetry. 14/47 cases were upstaged to malignancy on surgical excision path. 4/16 central and 10/37 peripheral, with all invasive carcinomas favorable prognosis and luminal molecular subtypes. Comparison cohort solitary benign papilloma 57 CNB pts: median age 48, range 15-78, 30/57 nipple discharge or palpable lump, 10 bloody and 6 nonbloody. 27 screen-detected. 25/57 central and 32/57 peripheral.

CONCLUSION

Study debunks conventional wisdom on patient presentation and imaging findings for at-risk papillomas. Atypia and malignancy were detected more frequently in asymptomatic patients on screening exams, and malignancy in central papillomas. Erroneous physician bias should not hamper care.

CLINICAL RELEVANCE/APPLICATION

In an era of desired turnkey patient care, this study assists radiologists in refining pre- and post-biopsy assessment and management recommendations of breast patients with solitary papillomas.

SSK01-02 Cryoablation as a Primary Treatment of Low Risk Breast Cancers in Women 65 and Older: Imaging Findings and Interim Update of the Ice 3 Trial

Wednesday, Nov. 30 10:40AM - 10:50AM Room: E450A

Participants
Kenneth R. Tomkovich, MD, Freehold, NJ (*Presenter*) Consultant, Scion Medical Technologies, LLC; Scientific Advisory Board, IceCure Medical, Inc; Speaker, Becton, Dickinson and Company; Consultant, Becton, Dickinson and Company
Alexander B. Sevrukov, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Randy D. Hicks, MD, Flint, MI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The Ice3 trial is the first of its kind large scale multi-center trial to assess cryoablation as a primary treatment for breast cancer without surgical resection. We report interim results and imaging findings of this novel approach.

METHOD AND MATERIALS

The goal of this HIPAA compliant IRB approved multi-center trial is cryoablation of approximately 150 patients with low risk invasive

The goal of this HIPAA compliant IRB approved multi-center trial is cryoablation of approximately 150 patients with low risk invasive carcinoma of the breast. The study is limited to females age 65 and older with primary, unifocal, biopsy proven cancer measuring 1.5 cm or less. Tumors must be ER+/PR+ or ER+/PR-, HER 2-, and Nottingham grade 1 or 2 with an ultrasound visible target following core needle biopsy. All patients underwent ultrasound guided cryoablation using the IceSense 3 system (IceCure Medical, Ltd.) using local anesthesia. The goal was to create a 1cm visible margin of ice around the tumor during the freeze, thaw, freeze cycles. Patients have the option of post procedure hormone therapy, chemotherapy and radiation therapy as clinically indicated. Patients do not undergo surgical lumpectomy post cryoablation. Patients will be followed by mammography at 6 months then annually for 5 years following ablation.

RESULTS

The trial began enrollment in October 2014. To date, 69 patients have been treated with cryoablation at 11 institutions throughout the United States. Tumor sizes ranged from 3 to 14 mm. Ages ranged from 65-90. There have been no serious adverse events. There has been 100% procedural success to date. 30 patients have reached the 6 month follow up mark and 4 patients have had 12 month follow up imaging. There have been no imaging or clinical findings suggestive of residual or recurrent tumor following treatment. Most common mammographic findings post cryoablation include fat necrosis and "cryo-halo". The fat necrosis is comparable to that seen post lumpectomy.

CONCLUSION

Cryoablation is safe, well tolerated and easily monitored. To date, there has been 100% initial procedural success. There has been no evidence of residual or recurrent tumor in patients with at least 6 month follow up imaging. Most common imaging findings include fat necrosis and the "cryo-halo" effect. This trial is ongoing.

CLINICAL RELEVANCE/APPLICATION

Interim results suggest that cryoablation is a safe and effective primary treatment for women with low-risk invasive breast cancer and a potential image guided alternative to surgical lumpectomy.

SSK01-03 Canceled MRI-Guided Breast Biopsies: Is Follow-Up Necessary?

Wednesday, Nov. 30 10:50AM - 11:00AM Room: E450A

Awards
Student Travel Stipend Award

Participants
Niveditha Pinnamaneni, MD, New York, NY (*Presenter*) Nothing to Disclose
Samantha L. Heller, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Ana Paula D. Leite, MD, MS, Recife, Brazil (*Abstract Co-Author*) Nothing to Disclose
Hildegard B. Toth, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to evaluate the frequency of ipsilateral breast malignancy in patients after a canceled MRI-guided breast biopsy due to nonvisualization of the original lesion.

METHOD AND MATERIALS

This retrospective study is Institutional Review Board approved. Electronic medical records from 1/2007-12/2013 were searched for patients with canceled MRI-guided breast biopsy due to lesion nonvisualization. Imaging studies and medical records were reviewed for patient demographics, MRI lesion characteristics and follow-up imaging. Patients without follow-up data were excluded.

RESULTS

We identified 1403 lesions detected at MRI and scheduled for MR biopsy. 89 (6.3%) were canceled due to nonvisualization of the lesion at biopsy. Follow up imaging was available for 85/89 patients (95.5%). Mean patient age was 47.1 years (range: 23.9-75.9 years). Average follow-up interval was 29.5 months (range: 2.8–80.2 months). In 71/85 patients (83.5%), the abnormality was not seen on follow-up exams. In 14/85 patients (16.5%), the lesion was seen on subsequent studies. For 6/14 patients (42.8%), upon reassessment, the MRI finding was felt to be secondary to background parenchymal enhancement. In 8/14 (57.1%) patients, the original MRI finding was re-identified and underwent biopsy. Six of 8 lesions (75%) were benign, 1/8(12.5%) lesions was high risk (ADH on pathology and ADH and ALH on surgical resection), and 1/8 lesions yielded DCIS with microinvasion.

CONCLUSION

Cancer detection rate was 1/85 (1.2%). The incidence of subsequent malignancy is low in patients who have had a canceled MRI biopsy due to nonvisualization, but continued follow –up imaging is warranted.

CLINICAL RELEVANCE/APPLICATION

Although cancer detection rate is low in patients with canceled MRI-guided breast biopsies due to nonvisualization, short-term follow-up MRI within 6-12 months is recommended.

SSK01-04 Management of Breast Papillomas by US-Guided Vacuum-Assisted Removal, Sonographic Follow-up and US-Guided Vacuum-Assisted Reexcision of Residual or Recurrent Lesions. Long-term Outcomes

Wednesday, Nov. 30 11:00AM - 11:10AM Room: E450A

Participants
Jose Maria Oliver-Goldaracena, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Carolina Martinez Gamarra, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Agustin Andres Mateo, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Vicenta Cordoba Chicote, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Ana Veron Sancrez, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Roca Navarro, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To review the long-term outcome of percutaneous management of breast papillomas by US-Guided Vacuum-Assisted Removal (US-VA) , Sonographic follow-up and US-VA reexcision of residual or recurrent lesions.

METHOD AND MATERIALS

Between April 2010 and June 2015,133 lesions(mean size 11mm, range 3-43mm) were remove with US-VA: 90 probably intraductal papillomas(benign intraductal mass within a dilated duct or cyst with Color-Doppler signal or correlation on ductography) and 43 benign papillomas(BP) diagnosed at US-CNB in a consecutive series of 112 patients(mean age 64, range 22-85).Pathological discharge was present in 70 patients while 42 patients were asymptomatic.Patients underwent US follow-up at 1-2 months, 6-8 months and 12-14 months after US-VA and later annual US follow-up.When a residual or recurrent suspicious papilloma(sP) was detected at US follow-up, reexcision by US-VA was performed.Clinical, US follow-up and pathologic outcomes were recorded.

RESULTS

At histology, there were 119 benign papillomas(BP),7 atypical papillomas(AP),1 papilloma with DCIS ,1 DCIS and 5 cases with no histologic lesions.US follow-up (range 10-72 months,mean 41) was performed in 99 patients with 119 BP and 6 patients with 7 AP.US showed 14 residual sP(range 1-6 months, mean 2) and 9 recurrent sP(range 8-24 months, mean 14) in 21 patients with 23 BP. Reexcision US-VA was performed in 20 sP in 18 patients. In 17 of them histology showed BP and in 3 fibrosis. In 3 sP(3 patients) reexcision US-VA were not performed:1 patient with 1 recurrent sP grew inside the nipple and underwent surgical excision that confirmed the diagnsosis of BP and 2 sP(2 patients) developed many recurrent papillomas in different locations at 14 and 24 months .Nipple discharge disappeared in all but one of the symptomatic patients (68/69). In this series of 126 papillomas(105 patients), percutaneous management by US-VA removal, US follow-up and reexcision US-VA has been effective in 123 papillomas (102 patients). None were upgraded to DCIS at long term US follow-up or in the setting of residual or recurrent lesions.

CONCLUSION

US-VA removal,US follow-up and US-VA reexcision of residual or recurrent lesions allow percutaneous long-term management in most of patients with papillomas.

CLINICAL RELEVANCE/APPLICATION

US-VA removal,US follow-up and US-VA reexcision of residual or recurrence lesions is appropiate for the percutaneous management of patients with papillomas at long term.

SSK01-05 Does Mammographic Calcification Determine Surgical Outcome in HER 2 Positive Breast Cancers rather than the response to Neo-Adjuvant Chemotherapy Itself?

Wednesday, Nov. 30 11:10AM - 11:20AM Room: E450A

Participants
Fayyaz A. Mazari, MSc,PhD, Sheffield, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Nisha Sharma, MBChB, Leeds, United Kingdom (*Presenter*) Nothing to Disclose
Kieran Horgan, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
David Dodwell, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Neo-adjuvant chemotherapy (NAC) is frequently used in treatment of HER2+ breast cancer to downstage the disease and for breast conservation. Mammographic calcification usually represents DCIS and does not resolve after NAC. We wanted to investigate whether HER2+ cancers with mammographic calcification behave differently in their response to NAC.

METHOD AND MATERIALS

This was a retrospective review of HER2+ breast cancer patients who underwent NAC from 2007-2015. Data recording included demographics, mammographic appearance, radiological response, surgery & pathological response. Subgroup analysis was performed for presence of mammographic calcification & cancer subtype.

RESULTS

89 patients were included. Median age was 49 years (IQR41-58). 60.7%(N=54) had mammographic calcification. 62.9%(N=56) were luminal B and 37.1%(N=33) were non-luminal HER2+ cancers. Significant radiological response was observed in 53.9%(N=48). 95.5% (N=85) had surgery with 29.5%(N=25) undergoing breast conservation. Pathological complete response (pCR) was observed in 27.1%(N=23) of these patients. 17.6%(N=15) showed residual DCIS only, and 54.1%(N=46) had residual invasive cancer. ***a) Subgroup analysis for mammographic calcification:*** A significantly low (P=0.033,X2) pCR rate was observed in patients with mammographic calcification (19.2%,N=10) compared to those without it (40.6%,N=13). ***b) Subgroup analysis for cancer subtype:*** pCR rates in non-luminal HER2+ cancers (46.7%,N=14) were significantly higher (P=0.003,X2) compared to luminal B cancers (16.7%,N=9). Presence of mammographic calcifications significantly reduced the pCR rates in luminal B (9.4%vs27.3%) and non-luminal (35.0%vs70.0%) cancers. Likewise, residual DCIS was three times more likely after NAC in luminal B (31.3%vs9.1%) and non-luminal HER2+ (33.3%vs10.0%) cancers with mammographic calcification.

CONCLUSION

HER2+ cancers with mammographic calcification behave differently to NAC. It is argued that all HER2+ breast cancers should be offered breast conserving surgery at the outset given its response to anti-HER2 & chemotherapy. Our study shows mammographic calcifications should drive the type of surgery rather than the response to chemotherapy.

CLINICAL RELEVANCE/APPLICATION

This paper explores the significance of mammographic calcification in treatment planning of HER2+ breast cancer. This can provide the basis for developing breast conservation algorithms in this patient group.

SSK01-06 Digital Breast Tomosynthesis Vacuum Assisted Biopsy for Tomosynthesis-Detected Sonographically Occult Lesions

Wednesday, Nov. 30 11:20AM - 11:30AM Room: E450A

Participants
Nikki S. Ariaratnam, MD, Voorhees, NJ (*Presenter*) Nothing to Disclose
Sherrill T. Little, MD, Glen Mills, PA (*Abstract Co-Author*) Nothing to Disclose
Markus Whitley, MD, Voorhees, NJ (*Abstract Co-Author*) Nothing to Disclose
Kristy Ferguson, Voorhees, NJ (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the utility of Digital Breast Tomosynthesis Vacuum-Assisted Biopsy (DBT VAB) and pathological results of DBT-detected abnormalities that are occult on 2D mammography and breast ultrasound (US).

METHOD AND MATERIALS

This is a HIPAA compliant retrospective review of a prospectively-maintained database of 1116 consecutive stereotactic biopsies performed over 27 months (12/1/13-2/29/16). Two breast radiologists independently assessed each case for the technical feasibility of sampling under DBT VAB versus standard stereotactic (prone or upright) biopsy. DBT VAB was performed in 38 consecutive patients (age range 38-76; mean age 55 years) for 38 non-calcified lesions which were solely detected using DBT and not observed on US. Imaging findings and pathology results were reviewed.

RESULTS

Technical success was achieved in 38 of 38 (100%) lesions using DBT VAB. The densities of the patients' breast tissues were: fatty (5), scattered fibroglandular densities(15), heterogeneously dense (12), and extremely dense (6). The lesion types were: masses (16), architectural distortion (16), and asymmetry (6). Pathologic findings were malignant in 8 of 38 lesions (21%; 95% confidence interval: 8.1%, 33.9%), including 6 invasive malignancies. The malignant lesions appeared on tomosynthesis as masses (5) and distortion (3). High-risk findings (radial scars, ADH, LCIS and papillomas) were found in 14 of 38 lesions, in which 3 were masses and 11 presented as distortion.

CONCLUSION

DBT VAB may be easily and successfully performed for the primary evaluation of tomosynthesis-detected lesions that are not readily visible on US or conventional 2D mammography. Furthermore, the majority of DBT VAB cases yield actionable pathologies including high-risk lesions, DCIS, or invasive carcinomas. Therefore, it is paramount to perform DBT VAB primarily when available, or proceed to breast MRI or needle localization to further pursue these tomosynthesis-detected lesions.

CLINICAL RELEVANCE/APPLICATION

Digital breast tomosynthesis vacuum-assisted biopsy reliably samples lesions seen only on tomosynthesis and occult on ultrasound and 2D mammography, with the majority of these lesions yielding malignant or high risk pathologies.

SSK01-07 Clinical, Imaging, and Intervention Factors Associated with Atypia Upgrade in the Setting of Vacuum Assisted Core Needle Biopsy

Wednesday, Nov. 30 11:30AM - 11:40AM Room: E450A

Awards
Student Travel Stipend Award

Participants
Erin Alencherry, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Rakhee H. Goel, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Sarah Gore, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Cheryl L. Thompson, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Christina Dubchuk, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (*Abstract Co-Author*) Research Grant, Hologic, Inc;

PURPOSE

To determine the upgrade rate following breast excision for atypia, including flat epithelial atypia (FEA), atypical lobular hyperplasia (ALH) and atypical ductal hyperplasia (ADH), in the setting of vacuum assisted biopsy (VAB) performed with either a 9 or 12 gauge needle.

METHOD AND MATERIALS

Between 2012-2015, 363 patients had atypia on VAB, including ultrasound, MRI and stereotactic guided. Patients were excluded if surgical excision was not completed, mastectomy was performed, or if the surgical specimen included the biopsy site for a simultaneously diagnosed malignancy on a separate VAB. An upgrade was defined as obtaining ductal carcinoma in situ (DCIS) or invasive cancer on excision. Demographic, imaging, biopsy and pathology characteristics were analyzed for association with upgrade among the 254 cases included in the final review.

RESULTS

Of the 254 atypia lesions, 34 (12%) were upgraded at resection. Upgrade rates for each atypia are: 8% (14/160) for FEA, 10% (9 of 80) for ALH, and 17% (25/123) for ADH. The 34 upgraded patients included 25 DCIS, 3 invasive cancers, and 1 mucoepidermoid cancer. 8 patients upgraded had a simultaneously diagnosed cancer in either the same or opposite breast. 11 upgraded patients had core biopsy pathology known to be associated with upgrade, including papilloma and severe ADH. After exclusion of these 19 high-risk patients, only 4 FEA upgrades remain (3%, 4/151). Imaging findings associated with upgrade included segmental distribution of calcifications (45% vs 6%, $p < 0.0001$) and the presence of a mass (38.3% vs 17.8%, p=0.006). For stereotactic biopsy of calcifications, having only 0-24% of calcifications removed during biopsy was associated with upgrade (42% vs 9.8%, p=0.0008). Patients with a personal history of breast cancer were more likely to be upgraded (20.6%), compared to those without a cancer history (11%, p=0.018).

CONCLUSION

In the absence of personal history of breast cancer, segmental calcifications, mass lesion, concurrent cancer or papilloma there is a

low FEA upgrade rate, which may allow follow-up without excision. ADH and ALH should be excised because of higher upgrade rates.

CLINICAL RELEVANCE/APPLICATION

The upgrade rate following vacuum assisted biopsy of Flat Epithelial Atypia is low. Clincal, imaging, and intervention characteristics are useful for determining which cases should be excised.

SSK01-08 What Happens After a Diagnosis of High Risk Lesion at Stereotactic Biopsy? - A Look At Breast Imaging Compliance and Outcomes

Wednesday, Nov. 30 11:40AM - 11:50AM Room: E450A

Awards
Student Travel Stipend Award

Participants
Marissa L. Albert, MD, MSc, New York, NY (*Presenter*) Nothing to Disclose
Yiming Gao, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Leng Leng Young Lin, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Alana A. Lewin, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
James S. Babb, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Hildegard B. Toth, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Samantha L. Heller, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess compliance for subsequent annual screening mammography following diagnosis of high risk lesions at stereotactic biopsy with or without surgical excision.

METHOD AND MATERIALS

This IRB-approved HIPPA compliant study included 208 patients (mean age 53, range 31-81) who underwent a stereotactic biopsy between 1/2012-12/2014, yielding high risk lesions. Subjects with upgrade to cancer at surgical excision who had mastectomies (n=5) were excluded. Post diagnosis compliance to annual mammography (defined as within 9-18 months of biopsy) was compared to date-matched baseline annual mammographic screening compliance acquired from a dataset of 34,339 studies performed during 1/2012-12/2014 at the same institution. Post biopsy clinical notes were reviewed to identify patient care by a breast surgeon. Statistical analysis was performed.

RESULTS

Of 34,339 screening mammograms, 831/34339 (2.42%) were recommended for stereotactic biopsy. 208/831 (25%) were high risk lesions at stereotactic biopsy (Table.1), 140 (67.3%) lesions underwent surgical excision with 11.4% (16/140) upgrade to cancer (12 DCIS, 4 IDC). Excluding five mastectomy patients, 135/203 (66.5%) underwent surgery and 68/203 (33.5%) did not. The overall post-high-risk-diagnosis compliance to annual mammography of 57.1% (116/203) is similar to 56.3% among control patients who had a normal screening mammogram. Of note, compliance is significantly higher (94/135; 69.6%) in the surgical group as compared to the non-surgical group (22/68; 32.4%)($p<0.001$). Among non-surgical patients, those compliant with 1 year mammogram (17/22; 77.3%) are significantly more likely to have seen a breast surgeon than the non-compliant (10/29; 34.1%) ($p=0.004$).

CONCLUSION

Diagnosis of a high risk lesion at stereotactic biopsy did not compromise subsequent annual mammographic screening overall. Patients without surgical excision who did not undergo a surgical consultation had significantly lower subsequent imaging compliance as compared to their counterparts who underwent surgery, suggesting specialist care may be important in ensuring adherence to imaging recommendations.

CLINICAL RELEVANCE/APPLICATION

Patients with high risk lesions are at increased risk for breast cancer. Educating patients and physicians is important to ensure adherence to annual mammography in those who do not undergo surgery.

SSK01-09 Non-Palpable Breast Lesion Localization and Excision Utilizing SAVI SCOUT: A Single Institution Analysis of Patient Outcomes

Wednesday, Nov. 30 11:50AM - 12:00PM Room: E450A

Participants
Victoria Mango, MD, New York, NY (*Presenter*) Nothing to Disclose
Ralph T. Wynn, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Lauren C. Friedlander, MD, White Plains, NY (*Abstract Co-Author*) Nothing to Disclose
Ameer Gomberawalla, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Sheldon Feldman, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Richard S. Ha, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate outcomes of SAVI SCOUT guided localization and excision of non-palpable breast lesions.

METHOD AND MATERIALS

An IRB approved HIPAA compliant retrospective review of 77 SAVI SCOUT (® Cianna Medical) cases was performed. A non-radioactive, infrared-activated, electromagnetic wave reflector was percutaneously inserted adjacent to/within 77 non-palpable breast targets in 68 patients utilizing image guidance 0-8 days preoperatively. Target/reflector were surgically localized utilizing an electromagnetic wave/infrared light emitting handpiece. Target/reflector removal was verified with handpiece specimen

interrogation, specimen radiography and pathology. Distance between target and reflector on mammogram and specimen radiograph was recorded in addition to reflector distance from the skin. Final specimen pathology including margins was reviewed. Re-excision rates and complications were recorded.

RESULTS

77 reflectors were placed using sonographic (22/77) or mammographic (55/77) guidance. Mean target-reflector distance on mammography was 0.3 cm. 77/77 (100%) targets/reflectors were excised. Final pathology yielded 42 malignancies (avg 0.9 cm; 25 IDC, 1 ILC, 15 DCIS, 1 papillary ca), 20 high risk lesions and 15 benign results. 67/77 (87%) specimen radiographs demonstrated a target-reflector distance compared with post-procedure mammogram within 0.5 cm. 3/77 (4%) specimens demonstrated a >1.2 cm increased target-reflector distance on specimen radiograph compared with post-procedure mammogram. Average reflector depth on post-procedure mammogram was 2.6 cm (range 0.3-6.3 cm) and 1.3 cm (range 0.5-2.8 cm) on ultrasound. No procedural complications were identified. 3 patients required re-excision for positive margins. 7 patients had 2 reflectors placed in one breast, 1 patient had 3 reflectors placed in one breast. Reflectors were placed at minimum 2.6 cm apart.

CONCLUSION

The SAVI SCOUT surgical guidance system is an accurate method to localize and excise non-palpable breast lesions with acceptable margin positivity and re-excision rates. Bracketing is possible with reflectors as close together as 2.6 cm. Reflector migration is observed in a small percentage of cases; however targets were still successfully excised.

CLINICAL RELEVANCE/APPLICATION

Wire guided excision of non-palpable breast lesions has disadvantages overcome with I-125 seed localization. SAVI SCOUT provides a non-radioactive alternative with comparable patient outcomes.

SSK06

Gastrointestinal (Quantitative Imaging)

Wednesday, Nov. 30 10:30AM - 12:00PM Room: E353A

GI BQ CT MR

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

FDA Discussions may include off-label uses.

Participants
Dushyant V. Sahani, MD, Boston, MA (*Moderator*) Research support, General Electric Company; Medical Advisory Board, Allena Pharmaceuticals, Inc
Alvin C. Silva, MD, Scottsdale, AZ (*Moderator*) Nothing to Disclose

Sub-Events

SSK06-01 Hepatic Perfusion CT Yields Early Imaging Biomarkers for Treatment Response of Sorafenib on Hepatocellular Carcinoma

Participants
Yuko Nakamura, MD, Bethesda, MD (*Presenter*) Nothing to Disclose
Toru Higaki, PhD, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Wataru Fukumoto, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Chikako Fujioka, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Masao Kiguchi, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd; Research Grant, Bayer AG; Research Grant, Eisai Co, Ltd; Medical Advisor, General Electric Company; ; ; ; ;
Akira Taniguchi, RT, Tokyo, Japan (*Abstract Co-Author*) Employee, Toshiba Corporation
Makoto Iida, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Sorafenib inhibits excessive angiogenesis of abnormal arteries seen in advanced hepatocellular carcinoma (HCC). Hepatic perfusion CT facilitates the quantitative evaluation of hepatic arterial- and portal venous perfusion. We investigated whether perfusion CT performed before- and 1 week after sorafenib administration yields imaging biomarkers for the survival of HCC patients.

METHOD AND MATERIALS

We evaluated 51 HCC patients (11 women, 40 men, mean age 68.9 years, mean survival 250 days) who underwent perfusion CT before- and 1 week after sorafenib therapy. Serum alpha-fetoprotein (sAFP) and des-γ-carboxyprothrombin were recorded before sorafenib administration. We measured arterial and portal perfusion in their hepatic tumor and liver parenchyma [(AP)(PP)tumor], [(AP)(PP)liver] before and after sorafenib administration. The perfusion ratio was calculated by dividing the post- by the pre-sorafenib value. The effect of each value on the overall survival rate was analyzed with the Cox proportional hazards model; statistically significant parameters were subjected to receiver operating characteristic (ROC) analysis based on 250-day survival after sorafenib administration to determine the overall survival rate with the Kaplan-Meier method.

RESULTS

By univariate Cox regression analysis, sAFP and pre-sorafenib APtumor were significantly associated with the overall survival rate (p=0.04 and 0.03, respectively). The APtumor ratio tended to be associated with the overall survival rate (p=0.06). The optimal cut-off value for sAFP, pre-sorafenib APtumor, and the APtumor ratio was 133ng/mL, 82.1 mL/min/100 mL, and 1.1 by ROC analysis, respectively. By the Kaplan-Meier method the overall survival rate was higher in patients with sAFP<=133 ng/mL, with pre-sorafenib APtumor >82.1 mL/min/100 mL, and with APtumor ratio<=1.1 (log rank, p=0.01, 0.03, and 0.03, respectively).

CONCLUSION

Not only sAFP, but also pre-sorafenib APtumor, and the APtumor ratio were significantly associated with the overall survival rate, suggesting that early evaluation by hepatic perfusion CT yields imaging biomarkers for predicting overall survival in HCC patients treated with sorafenib.

CLINICAL RELEVANCE/APPLICATION

On hepatic perfusion CT scans, pre-sorafenib APtumor and the APtumor ratio are promising imaging biomarkers for predicting the overall survival rate in sorafenib-treated HCC patients.

SSK06-02 Early Treatment Response Evaluation after Yttrium-90 Radioembolization of Hepatocellular Carcinoma with Quantitative CT Analysis

Wednesday, Nov. 30 10:40AM - 10:50AM Room: E353A

Participants
Sungwon Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jin-Young Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Do-Young Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jong Yun Won, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Myeong-Jin Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Research Grant, Bayer AG

PURPOSE

To evaluate quantitative computed tomography (CT) perfusion analysis for assessment of early treatment response after Yttrium-

90 transarterial radioembolization (TARE) in patients with hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

Dynamic contrast-enhanced CT was performed before and 4 weeks after transarterial radioembolization in 45 patients (35 men and 10 women; mean age, 61 years) with HCC. Enhancement maps of the liver were made by subtracting precontrast images from delayed phase images before and after the TARE. The portion of the liver which enhances less than the mean enhancement plus one standard deviation of the normal liver parenchyma was segmented out. The difference between remaining over-threshold areas of the tumoral and peritumoral enhancement before and after TARE was divided by the initial tumor area (the increased area of delayed enhancement per tumor size; IDEPT). The difference between nonenhancing areas within tumors (INPT) before and after TARE per tumor size was also computed. All processes were performed in a quantitative method by in-house programming written by Matlab. Kaplan-Meier curves were plotted to illustrate tumor recurrence rates.

RESULTS

Post-treated HCCs with IDEPT over 25% showed significantly longer recurrence-free periods than those with IDEPT less than 25% (P = .0184). The hazard ratio of the tumor recurrence was 8.42 (P = .045) for IDEPT <25% group versus IDEPT >25% group. HCCs with high INPT had a tendency to have longer recurrence-free periods but, did not reach statistically significant difference.

CONCLUSION

Quantitative analysis of the tumor and peritumoral delayed enhancement difference before and 4 weeks after TARE seems to predict tumor recurrence-free periods in patients with HCCs. In early follow up, the increased necrotic area may not predict the potential for recurrence.

CLINICAL RELEVANCE/APPLICATION

Early treatment response evaluation after Yttrium-90 radioembolization can help physicians to determine whether the patients need an early additional treatment or not.

SSK06-03 The Role of Volume Perfusion Computed Tomography (VPCT) for Evaluation of HCC Response to Sorafenib

Wednesday, Nov. 30 10:50AM - 11:00AM Room: E353A

Participants
Wolfgang M. Thaiss, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Sascha Kaufmann, Tuebingen, Germany (*Presenter*) Nothing to Disclose
Christopher Kloth, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Sven Schneeweiss, MD, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael Bitzer, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Ulrich Lauer, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Marius Horger, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the impact of sorafenib on perfusion parameters of tumors and uninvolved liver parenchyma by volume perfusion computed tomography (VPCT) and to assess interim therapy response in patients with advanced Hepatocellular Carcinoma (HCC).

METHOD AND MATERIALS

VPCT was performed in 29 HCC patients (70.6y, SD 10) before initiation of sorafenib therapy and after therapy. Changes in tumor and liver parenchyma perfusion measurements were assessed between baseline (BL) and follow-up (FU, mean 3 months, range 2-4) and compared to mRECIST response criteria. Response to sorafenib was classified by FU as response (R, time to progression >6 months) or non-response (nonR, time to progression <6 months).VPCT was performed for 40-sec using 80 kV, 100/120 mAs, 64x0.6 mm collimation, 26 consecutive measurements, i.v. injection (50 ml iodinated contrast), flow rate (5 ml/s). Blood flow (BF), blood volume (BV), arterial liver perfusion (ALP), portal-venous perfusion (PVP) and the hepatic perfusion index (HPI) were registered both in tumor and non-involved liver parenchyma. Permeability was additionally assessed for HCCs.Paired t-test was used for FU and unpaired t-test for group comparisons, p-values were adjusted for multiple testing.

RESULTS

One patient was lost in FU. 14 were R and 14 were nonR according to mRECIST. Time to progression was 114.1d (SD 40.2) in the nonR group and 295.4d (SD 108, p<0.0001) for the R group (one complete remission).Perfusion parameters did not vary between groups at BL. Significant differences existed for all perfusion parameters between nonR and R at FU (e.g. BF mean nonR: 44.6 mL/100mL/min (SD 10.3), FU 48.7 (SD 17.8); BF mean R: 47.6 mL/100mL/min (SD 25.8), FU 29.4 (13.6); n.s. at BL, p=0.00013 at FU) and for R between BL and FU (p=0.0035 for BF). Permeability decreased in R (36.4 mL/min (SD 28), FU 26.6 (SD 12.6), p=0.011) and varied significantly to nonR (p=0.00013).No significant differences existed for normal liver parenchyma neither for time or group factor.

CONCLUSION

Perfusion parameters were significantly different in HCC patients that responded (mRECIST) to sorafenib treatment both between baseline and follow-up as well as compared to non-responders at follow-up.

CLINICAL RELEVANCE/APPLICATION

VPCT perfusion parameters accurately assess the impact of sorafenib therapy on HCCs and may predict progression after initial follow-up after 3 months. Lager studies are needed for confirmation.

SSK06-04 CT Perfusion of Colorectal Cancer: Impact of 4D Volume Coverage on Quantitative Analysis

Wednesday, Nov. 30 11:00AM - 11:10AM Room: E353A

Awards
Student Travel Stipend Award

Participants
Hongliang Sun, MD, Beijing, China (*Presenter*) Nothing to Disclose
Yanyan Xu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Wu Wang, MD, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
ying hou, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the feasibility of CT perfusion imaging in adaptive 4-dimensional(4D)-volume mode in patients with colorectal cancer (CRC), and to compare quantitative measurements between 2-dimensional regions of interest (2D-ROI) and 3-dimensional volumes of interest (3D-VOI).

METHOD AND MATERIALS

Sixty patients with biopsy-proven CRCs were enrolled in this study. They underwent CT perfusion imaging in a 4D-volume mode with 320-slice CT. Quantitative perfusion analysis (artery flow [AF], blood volume [BV], flow extraction product [KTrans]) were performed by using modified Patlak mode in 2D-ROI and 3D-VOI, respectively. The differences of perfusion quantitative parameters in 2D-ROIs and 3D-VOIs were analyzed by using paired samples t test or Wilcoxon signed ranks test. Intra- and inter-observer agreement for 2D-ROIs and 3D-VOIs analysis was evaluated using the intraclass correlation coefficient (ICC) and Bland-Altman analysis.

RESULTS

No significant differences were found between the values of perfusion quantitative parameters based on 2D-ROIs and 3D-VOIs analysis. Intra- and inter-observer reproducibility in 2D-ROIs and 3D-VOIs were relatively good to excellent, respectively. The intra-observer 95% limits of consistency of perfusion parameters(AF, BV, KTrans) were (-33.9～13.5)%、(-62.8～77)%、(-87.1～73.3)% with 2D-ROIs, respectively; (-33.5～11.8)%、(-44.7～50.6)%、(-64.5～48.5)% with 3D-VOIs, respectively; The inter-observer 95% limits of consistency of perfusion parameters(AF, BV, Ktrans) were (-49.2～13.9)%、(-57.6～48.4)%、(-71.9～72.3)% with 2D-ROIs, respectively; (-39.6～11.3)%、(-42.6～37.1)%、(-64.7～61.9)% with 3D-VOIs, respectively.

CONCLUSION

There were no statistically differences between 2D-ROI and 3D-VOI analysis of colorectal cancer CT perfusion parameters. However, the 3D-VOI analysis appropriately improves intra- and inter-observer consistency, reflecting perfusion parameters more accurately and repeatedly.

CLINICAL RELEVANCE/APPLICATION

Considerable colorectal cancer heterogeneity was found in both qualitative and quantitative analysis with the use of 4D volume perfusion techniques for both imaging and perfusion parameters analysis.

SSK06-05 Study of Intra-Patient Variability and Reproducibility of Quantitative Tumor Perfusion Parameters Evaluated with Dynamic Contrast-enhanced Ultrasonography

Wednesday, Nov. 30 11:10AM - 11:20AM Room: E353A

Participants
Nathalie B. Lassau, MD, PhD, Villejuif, France (*Presenter*) Speaker, Toshiba Corporation; Speaker, Bracco Group
Benedicte Coiffier, Vilejuif, France (*Abstract Co-Author*) Nothing to Disclose
Laura Faivre, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose
Bernard Asselain, MD, Paris, France (*Abstract Co-Author*) Nothing to Disclose
Stephanie Pitre-Champagnat, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose
Serge Koscielny, Villejuif, France (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Dynamic Contrast Enhanced Ultrasonography (DCE-US) is a functional imaging technique enabling quantitative assessment of solid tumor perfusion in metastatic patients treated with antiangiogenic therapies. A multicentric study including 539 patients validated the area under the curve parameter (AUC) as correlated to freedom from progression and overall survival.The objective of this prospective monocentric study was to evaluate the intra-patient variability and reproducibility of DCE-US criteria by comparing the two perfusion curves obtained for a same patient on the same metastasis during 2 visits performed the same day, before and after lunch.

METHOD AND MATERIALS

For each patient, two DCE-US examinations were performed at baseline, day 15 and day 30, one before and one after lunch. A 3-minute perfusion curve was recorded just after injection of Sonovue to determine seven perfusion criteria. DCE-US examinations were analyzed by pairs: pre and post prandial. Log transformed values were used to determine the variability of the two measures (coefficient of variation CV) and their reproducibility (Spearman correlation coefficient).

RESULTS

Sixty patients with cancer (23 colon, 36 kidney and 1 breast), treated by Axitinib (26), Sunitinib (27) and other anti-angiogenic treatments (7) were included. Thirty had hepatic and 30 extra-hepatic metastatic target lesions. A total of 312 DCE-US were performed. Data with a quality from 1 to 5 were available for 128 pairs of DCE-US examinations: 45 at baseline, 45 at day 15 and 38 at day 30. Pre and post prandial values were not significantly different. Three parameters were associated with a correlation coefficient above 0.8 ($p<0.0001$): AUC ($r=0.88$), area under the wash-out AUWO ($r=0.88$) and area under the wash-in AUWI ($r=0.82$). For AUC and AUWO, the range of individual variations (value after/value before lunch) was less than 2 log with parameter

values ranging over about 4 logs (CV=61% and 64% respectively). Variability was independent of the site of metastases.

CONCLUSION

This study showed that AUC and AUWO are the two most reproducible and reliable DCE-US parameters.

CLINICAL RELEVANCE/APPLICATION

AUC and AUWO are two reliable and reproducible DCE-US parameters, and relevant for the evaluation of the response to TKI treatments.

SSK06-06 Reproducibility of mRECIST in Measurement and Response Assessment for Hepatocellular Carcinoma with Transarterial Chemoembolization: Intraobserver and Interobserver Reproducibility among Multiple Readers

Wednesday, Nov. 30 11:20AM - 11:30AM Room: E353A

Participants
Ga-Eun Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ga Ram Kang, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Joon-Il Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Moon Hyung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Eun Rha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Soon Nam Oh, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Michael Y. Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seung Eun Jung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jae Young Byun, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this retrospective study was to evaluate the reproducibility of Modified Response Evaluation Criteria in Solid Tumors (mRECIST) for hepatocellular carcinoma (HCC) in patients who underwent transarterial chemoemobolization (TACE) as a first-line treatment.

METHOD AND MATERIALS

97 patients who underwent TACE (60 conventional TACE and 37 drug-eluting beads embolization) as a first-line treatment for HCC from January 2010 to December 2014 were enrolled. Four readers (two experts in mRECIST and two non-experts) with varying degree of experience underwent the education for mRECIST first, and then evaluated the pair of contrast enhanced dynamic CT of the liver scanned within one or two months before and after TACE. They independently measured the longest diameter of target lesions (up to three hepatic lesions). and categorized the responses of target lesion by comparing sum of longest diameters (SLD) on pre- and post-TACE. They also categorized the response of non-target lesions, assessed the presence of new lesions and decided overall responses according to mRECIST. Repeated image review and size measurement were performed two or more weeks later after first review by all four readers. To assess the intra- and interobserver reproducibility of SLD, Lin's concordance correlation coefficients (ρc) were used. The kappa statistics (κ) were used to compare the agreement of response categorization of target lesions and overall responses.

RESULTS

Results For concordance correlation coefficient of SLD, intraobserver reproducibilities were very good (ρc > 0.9) and interobserver reproducibilities were acceptable to very good (ρc = 0.8756 - 0.9756) in all four readers. In kappa statistics, intraobserever agreements of response categorization were moderate to very good (κ = 0.564-0.656) for non-experts and very good (κ = 0.853 - 0.989) for experts for both target lesions and overall responses. Most of interobserver agreements for response categorization between any two readers were within good range (κ = 0.6-0.8).

CONCLUSION

mRECIST demonstrates acceptable intra- and interobserver reproducibilities for HCC patients treated with TACE. Intraobserver reproducibilities were better for experts in mRECIST than non-experts, even though satisfactory level in both cases.

CLINICAL RELEVANCE/APPLICATION

Response evaluation for HCC after TACE by mRECIST is robust and can be used in daily practice and multicenter studies involved by multiple radiologists..

SSK06-07 Differentiation of Malignant Thrombus from Bland Thrombus of the Portal Vein in Patient with Cirrhosis: Application of Intravoxel Incoherent Motion Diffusion-Weighted MR Imaging

Wednesday, Nov. 30 11:30AM - 11:40AM Room: E353A

Participants
Jeong Min Choi, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Eun-Suk Cho, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Junyoung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yun Jung Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Malignant thrombus of the portal vein (PV) shows internal blood flow. On the other hand, bland thrombus does not have intra-thrombus blood flow. Our purpose of this study was to demonstrate the presence of blood flow within the malignant thrombus using intravoxel incoherent motion (IVIM) diffusion-weighted (DW) MR imaging and investigate the utility of IVIM in distinguishing bland thrombus from malignant thrombus of the PV in patients with cirrhosis or hepatocellular carcinoma.

METHOD AND MATERIALS

Forty three patients with PV thrombosis (malignant thrombus n = 29 and bland thrombus n = 14) examined with gadoxetic acid-

enhanced MR imaging including IVIM were enrolled. IVIM DW imaging was acquired with free-breathing axial single-shot echo-planar two-dimensional imaging sequence and the following eight b values: 0, 25, 50, 75, 100, 200, 500 and 800 sec/mm2. Diffusion coefficient (*D*), pseudo-diffusion coefficient (*D**), and perfusion fraction (*f*) were calculated with bi-exponential model using Matlab software and were compared between malignant and bland thrombi using unpaired t-test.

RESULTS

*D** of malignant thrombus (mean = 67.51 x 10-3mm2/sec) was significantly higher than that of bland thrombus (9.31 x 10-3mm2/sec, $p < 0.001$). However, there was no significant difference in *f* between malignant (18.47 %) and bland thrombi (18.46 %). *D* of bland thrombus (1.35 x 10-3mm2/sec) was significantly higher than that of malignant thrombus (1.03 x 10-3mm2/sec, p = 0.014). However, the mean *D* difference between the two thrombi was relatively small.

CONCLUSION

Increased pseudo-diffusion coefficient (*D**) of malignant thrombus suggests higher intra-thrombus micro-perfusion, which might be due to blood flow by arterial neovascularization within the malignant thrombus. Therefore, IVIM DW imaging appears to be a promising method for the discrimination between bland and malignant PV thrombi.

CLINICAL RELEVANCE/APPLICATION

Malignant thrombus had higher pseudo-diffusion coefficient, which might be due to increased intra-thrombus blood flow by neovascularization. IVIM imaging can discriminate bland thrombus from malignant thrombus.

SSK06-08 Functional Imaging of Small Bowel: Quantitative Perfusion Analysis with Dynamic Contrast Enhanced MRI in Vascular Assessment of Chrohn's Localizations to Distinguish Fibrotic from Active Disease

Wednesday, Nov. 30 11:40AM - 11:50AM Room: E353A

Participants
Sophie Lombardi, Vimercate, Italy (*Presenter*) Nothing to Disclose
Davide Ippolito, MD, Monza, Italy (*Abstract Co-Author*) Nothing to Disclose
Cammillo R. Talei Franzesi, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Pietro A. Bonaffini, MD, Monza, Italy (*Abstract Co-Author*) Nothing to Disclose
Chiara Trattenero, MD, Sirone, Italy (*Abstract Co-Author*) Nothing to Disclose
Sandro Sironi, MD, Monza, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To differentiate Crohn's disease small bowel activity (fibrotic from acitve disease) by measurement of quantitative perfusion kinetics parameters obtained from dynamic contrast-enhanced magnetic resonance imaging.

METHOD AND MATERIALS

We analyzed 43 patients with known biopsy proven CD,who underwent MR-enterography, performed on 1.5T MRI system (Achieva, Philips), using a phased array sense body multi-coil, after oral administration of 1,5-2 of PEG solution. MRE protocol included T1 weighted, sSShT2, sBTFE and gadolinium enhanced THRIVE sequences acquired on coronal and axial planes. Dedicated workstation was used to generate colour permeability maps, and after the placing of Region of Interest (ROI) on bowel site involved by CD localization the following parameters were calculated and statistically analyzed: Relative Arterial, Venous and Late enhancement (RAE, RVE, RLE), Maximum Enhancement (ME) and Time To Peak (TTP).

RESULTS

Quantitative perfusion analysis showed a good correlation with local degree of Crohn’s inflammation activity, showing significant differences ($p < 0.001$) between inflamed and fibrotic bowel wall vascularity for all the evalueted parameters, obtaining higher values in active Crohn’s disease bowel site. Twenty-nine out of 43 patients showed active disease (reference standard disease activity on morphologic sequences: wall bowel thickness, hyper-enhancement and layered enhancement)
with following perfusion parameters: RAE (%) 116.1, RVE (%) 125.3, RLE (%)127.1, ME (%) 1054.7, TTP (sec) 157; the same parameters calculated in patients with mural fibrosis were: REA 56.4, RVE 81.2, RLE 85.4, ME 809.6, TTP 203.4.

CONCLUSION

Evaluation of perfusion kinetics parameters of small bowel CD lesions, by dynamic contrast perfusion-MR analysis, represents a feasible and routinely appliable complementary diagnostic tool that enables quantitative evaluation of local inflammation activity in CD patients.

CLINICAL RELEVANCE/APPLICATION

MRI sequences combined with quantitative dynamic contrast enhanced analysis can add functional information, related to bowel vascularity, useful to differentiate active from chronic lesion in CD.

SSK06-09 Texture Analysis on MRI of Low Rectal Cancer Improves Evaluation of Tumor Response and Outcome after Combined Chemoradiation Therapy

Wednesday, Nov. 30 11:50AM - 12:00PM Room: E353A

Awards
Student Travel Stipend Award

Participants
Anthony Dohan, MD, Montreal, QC (*Presenter*) Nothing to Disclose
Vipul Bist, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Stephanie Nougaret, MD, Montpellier, France (*Abstract Co-Author*) Nothing to Disclose
Marc Ychou, MD,PhD, Montpellier, France (*Abstract Co-Author*) Nothing to Disclose
Philippe Rouanet, Montpellier, France (*Abstract Co-Author*) Nothing to Disclose
Christophe Cassinotto, MD, Pessac, France (*Abstract Co-Author*) Nothing to Disclose
Frederic Bibeau, Montpellier, France (*Abstract Co-Author*) Nothing to Disclose

Caroline Reinhold, MD, MSc, Montreal, QC (*Abstract Co-Author*) Consultant, GlaxoSmithKline plc
Benoit P. Gallix, MD, PhD, Montpellier, France (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate texture analysis (TA) on magnetic resonance images for predicting pathological tumor response grade (TRG) and disease-free survival (DFS) in patients with locally advanced rectal tumors who underwent combined chemoradiation therapy (CRT) before mesorectal excision.

METHOD AND MATERIALS

Institutional review board approval was obtained for this observational retrospective study. Fifty-two patients were included. TA was performed using TexRAD® software on single-slices T2-weighted-images before and after CRT. The tumor volume reduction ratio, TA parameters and their changes were compared with the TRG and DFS. Receiver operating characteristic (ROC) curve analyses were performed and the 3 strongest parameters were incorporated into a multivariate regression model to identify predictive factors for response and their odds-ratios (OR). A score combining these 3 factors was built and optimal cutoff value for predicting response was assessed with ROC curve analysis. DFS was estimated with the Kaplan-Meier statistic and compared between groups with the log-rank test.

RESULTS

The strongest independent predictive factors for TRG were the decrease in volume (AUC=.84;.72-.96), the decrease in mean value(ssf=0) (AUC=.82;.69-.94) and the post-CRT entropy(ssf=4) (AUC=.80;.66-.93). In multivariate analysis, the predictive factors of TRG=3 or 4 were a decrease in volume>70%(OR=9.5,P=.033), decrease in mean value(ssf=0)>15%(OR=7.2,P=.037) and a post-CRT entropy(ssf=4)<5.74(OR=21.62,P=.002). A score ranging from 0 to 6 was built. AUC of the score for predicting good response was .92(.84-.99) with a sensitivity of 84% and a specificity of 80% for a cutoff value of 3. The mean follow-up of survivors at the time of analysis was 76 months±48(SD). Patients with a score>3 had a higher DFS (P=.005).

CONCLUSION

A score combining changes in signal intensity, entropy and volumes offer the best performances to predict TRG and outcome in rectal cancer.

CLINICAL RELEVANCE/APPLICATION

MRI Texture analysis performed on rectal cancer before and after CRT allows prediction of tumor response and patients DFS.

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/

Stephanie Nougaret, MD - 2013 Honored Educator
Caroline Reinhold, MD, MSc - 2013 Honored Educator
Caroline Reinhold, MD, MSc - 2014 Honored Educator

SSK15

Neuroradiology (Image Analysis and Quantitative Neuroradiology)

Wednesday, Nov. 30 10:30AM - 12:00PM Room: N229

NR BQ CT MR

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

FDA Discussions may include off-label uses.

Participants
Greg Zaharchuk, MD, PhD, Stanford, CA (*Moderator*) Research Grant, General Electric Company; Consultant, General Electric Company;
Amy L. Kotsenas, MD, Rochester, MN (*Moderator*) Nothing to Disclose

Sub-Events

SSK15-01 White Matter and Gray Matter Segmentation in 4D CT Images of Acute Ischemic Stroke Patients: A Feasibility Study

Participants
Rashindra Manniesing, PhD, Nijmegen, Netherlands (*Presenter*) Research funded, Toshiba Corporation
Sil Van de Leemput, MSc, Nijmegen, Netherlands (*Abstract Co-Author*) Research funded, Toshiba Corporation
Mathias Prokop, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG Speakers Bureau, Bracco Group Speakers Bureau, Toshiba Corporation Speakers Bureau, Koninklijke Philips NV Research Grant, Toshiba Corporation
Bram Van Ginneken, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Stockholder, Thirona BV; Co-founder, Thirona BV; Research Grant, MeVis Medical Solutions AG; Research Grant, Delft Imaging Systems; Research Grant, Toshiba Corporation;

PURPOSE

White matter (WM) and gray matter (GM) respond differently to ischemia and thrombolytic treatment. Being able to differentiate WM/GM in CT enables tissue dependent perfusion analysis and automated detection of stroke related pathology. In this work we show the feasibility of segmenting WM/GM in 4DCT images of acute ischemic stroke patients.

METHOD AND MATERIALS

In total 18 stroke patients who received both a 4DCT and follow-up MR scan were included in this retrospective study. CT imaging was done on a 320-row scanner with 19 or 24 volumetric acquisitions after contrast injection resulting in 512x512x320 isotropic voxels of 0.5 mm. T1w imaging was done on a 1.5T MR scanner resulting in approximately 384x318x26 voxels of 0.6x0.6x5.5 mm. The MR image was segmented with FSL tools and served as reference standard to train and evaluate the method. The method starts with brain segmentation by atlas registration followed by a refinement using a geodesic active contour with dominating advection term steered by a gradient based speed function. Within the segmented brain, three groups of features are then extracted: intensity, contextual and temporal, including a multi-scale representation of the temporal average image weighted according to the exposures of the individual time points to maximize the signal-to-noise ratios. In total 120 features were then fed into a non-linear support vector machine with Gaussian radial basis kernel. A leave-one-patient out cross validation was carried out. Segmentation results were visually inspected for overall quality. Dice coefficient (DC) and 95th percentile Hausdorff distance (HD) were reported.

RESULTS

The segmentations were evaluated as good with the separation of WM/GM at the cortex good to excellent. GM segmentation at the cortex had generally less thickness variations compared to the reference standard. DC were 0.79±0.06 and 0.77±0.06, 95% HD were 8.71±3.22 and 7.11±3.93 mm, for WM and GM, respectively.

CONCLUSION

WM and GM segmentation in 4DCT is feasible.

CLINICAL RELEVANCE/APPLICATION

WM and GM segmentation in 4DCT enables tissue dependent perfusion analysis and may increase sensitivity of detecting core and penumbra. Volume measurements of WM and GM normalized with the contralateral side may yield an important diagnostic parameter in the acute phase of ischemia.

SSK15-02 Human-Machine Performance Comparison Study in Distinguishing Radiation Necrosis from Brain Tumor Recurrence on Routine MRI

Wednesday, Nov. 30 10:40AM - 10:50AM Room: N229

Participants
Prateek Prasanna, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Ameya Nayate, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Amit Gupta, MD, MBBS, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Lisa Rogers, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose
Leo J. Wolansky, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Gagandeep Singh, MBBS, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Marco C. Pinho, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Kimmo Hatanpaa, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Anant Madabhushi, PhD, Piscataway, NJ (*Abstract Co-Author*) Nothing to Disclose
Pallavi Tiwari, PhD, Cleveland, OH (*Presenter*) Nothing to Disclose

PURPOSE

An extremely challenging problem in neuro-oncology is distinguishing radiation necrosis (RN), a radiation related injury, from tumor recurrence (RT) on routine follow up MRI. To date no radiographic features have been reliably identified that can distinguish RN from RT. The purpose of this study is to investigate if computer extracted texture descriptors (CETDs) can mine subtle morphologic attributes on routine MRI (T1w, T2w, FLAIR), that may not be visually appreciable to trained experts, and help distinguish between RT and RN.

METHOD AND MATERIALS

3T MRI studies with T1w, T2w , FLAIR protocols in N=47 patients (18 RN, 29 RT) obtained 9-months post-surgery were analyzed. A set of 135 CETDs (i.e. Haralick, Laws energy, histogram of gradients) within lesion for each MRI protocol was extracted. CETDs were trained on N=32, and tested on N=15 using a random forest classifier. Independently, two board-certified neuro-radiologists with 2- and 4-years of experience, read the same MRI scans (T1w, T2w , FLAIR) to diagnose the presence of RN or RT on N=47 studies. For every study, the readers assigned a confidence score between 0.5 and 1 (in increments of 0.1), based on their confidence in making the diagnosis of RN or RT, with 0.5 = unclear and 1 = completely confident. The readers were blinded to the pathology reports at the time of MRI interpretation.

RESULTS

Analysis from CETDs and the interpretations of the brain MRI by the two neuroradiologists were compared to the pathologic findings which served as the gold standard. On the training set (N=32), the CETD classifier accuracy was 75%, as compared to 62% and 55% for experts 1 and 2. Similarly, on the test set (N = 15), the CETD classifier demonstrated an accuracy of 91% in identifying tumor recurrence cases, while the accuracies of experts 1 and 2 were 42% and 50%. Consensus with correct classification between the 2 experts was only seen in 18 of 47 studies.

CONCLUSION

Our results demonstrate that CETDs may capture subtle morphometric differences between RT and RN on routine MRI that are not readily appreciable to neuroradiologists. A multi-institutional, multi-reader study is warranted to validate the findings.

CLINICAL RELEVANCE/APPLICATION

Reliably distinguishing RT from RN using CETDs on routine MRI could allow for immediate and appropriate patient management, as well as prevent unnecessary antineoplastic interventions in patients with RN.

SSK15-03 Detectability of Restenosis after Carotid Artery Stenting Using Full Iterative Reconstruction at 320-detector CT Angiography

Wednesday, Nov. 30 10:50AM - 11:00AM Room: N229

Participants
Kazushi Yokomachi, RT, Hiroshima, Japan (*Presenter*) Nothing to Disclose
Fuminari Tatsugami, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Toru Higaki, PhD, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Chikako Fujioka, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Masao Kiguchi, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuo Awai, MD, Hiroshima, Japan (*Abstract Co-Author*) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd; Research Grant, Bayer AG; Research Grant, Eisai Co, Ltd; Medical Advisor, General Electric Company; ; ; ; ;
Eiji Nishimaru, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoshinori Funama, PhD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

While restenosis after carotid artery stenting (CAS) for carotid artery stenosis can be assessed on CT angiograms (CTA), when images are reconstructed with conventional filtered back projection (FBP) or hybrid IR (AIDR 3D, Toshiba), blooming artifacts from the stent structure hamper their detection. The forward projected model-based iterative reconstruction solution (FIRST) is an algorithm that repeats both back and forward projections in the image-reconstruction process. It yields higher spatial resolution, lower image noise, and fewer artifacts. We studied the effect of FIRST on the image quality of CTA scans acquired after CAS and compared the detectability of restenosis on FIRST-, FBP-, and AIDR 3D images.

METHOD AND MATERIALS

We scanned a neck phantom created on a 3D printer using a 320-detector CT scanner (Aquilion One, Toshiba). We placed carotid WALLSTENT (8 * 21 mm, Boston Scientific, USA) or PRECISE stent (8 * 21 mm, Johnson&Johnson, USA) in the carotid artery part of the phantom and filled the carotid arteries with diluted contrast medium (approximately 450 HU). We created 0.4-, 0.6-, 0.8-, and 1.0 mm-thick restenosis along the stents (Figure). CT studies were repeated 5 times; the images were reconstructed with FBP, AIDR 3D (strength level: standard) and FIRST. Each image was reformatted cross-sectionally and the restenosis thickness was measured on all images.

RESULTS

With the carotid WALLSTENT, the size of the 0.8-mm restenosis model was 0.11 mm with FBP and significantly smaller than with AIDR 3D (0.53 mm) or FIRST (0.64 mm) ($p<0.001$). No 0.6- or 0.4-mm restenosis were detected on FBP- and AIDR 3D images. With FIRST, the size of model restenosis measuring 0.6- or 0.4 mm was 0.54 ± 0.09- and 0.40 ± 0.11 mm, respectively. With the PRECISE stent, the size of model restenosis measuring 0.6 mm was significantly smaller on AIDR 3D- than FIRST images (0.32 mm vs 0.55 mm; $p=0.02$). Neither FBP nor AIDR 3D detected the 0.4 mm restenosis model; on FIRST images it was 0.3±0.1 mm.

CONCLUSION

The detectability of restenosis after carotid artery stenting was better on FIRST- than FBP- or AIDR 3D images.

CLINICAL RELEVANCE/APPLICATION

FIRST is recommended for the precise evaluation of restenosis after carotid artery stenting.

SSK15-04 Awards

Texture Analysis on Contrast-Enhanced CT Images Helps Predict Local Failure to Chemoradiotherapy in Head and Neck Squamous Cell Carcinoma

Wednesday, Nov. 30 11:00AM - 11:10AM Room: N229

Trainee Research Prize - Fellow

Participants
Hirofumi Kuno, MD, PhD, boston, MA (*Presenter*) Nothing to Disclose
Muhammad M. Qureshi, MBBS,MPH, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Baojun Li, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Margaret N. Chapman, MD, Boston , MA (*Abstract Co-Author*) Nothing to Disclose
Vanesa C. Andreu, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Minh T. Truong, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Osamu Sakai, MD, PhD, Boston, MA (*Abstract Co-Author*) Consultant, Guerbet SA

PURPOSE

The accurate prediction of prognosis and failure is crucial for optimizing treatment strategies for cancer patients. The purpose of this study is to assess the performance of texture analysis for the prediction of treatment failure in primary head and neck squamous cell carcinoma (HNSCC) treated with chemoradiotherapy.

METHOD AND MATERIALS

This IRB approved retrospective study included 66 patients (56men, 10 women; 31–80 years; median age, 59 years) diagnosed with primary HNSCC (32 oropharynx, 10 hypopharynx, 20 larynx and 4 oral cavity, including 25 HPV-positive and 25 HPV- negative) who underwent contrast-enhanced CT for staging between 2/2008-2/2015 followed by chemoradiotherapy. CT texture of the whole primary tumor was measured by using an in-house developed MATLAB-based texture analysis program. Receiver operating characteristic (ROC) analysis with the area under the ROC curve was used to identify the optimal threshold of any significant texture parameter. Multivariate cox proportional hazards models were used to examine the association between CT texture parameter and local failure adjusting for age, sex, primary tumor stage, primary tumor volume and HPV status.

RESULTS

Twenty-three patients developed local failure (follow-up periods; 2 to 28 months), and the remaining 43 showed local control (7 to 87 months). Multivariate analysis revealed that 2 histogram features (geometric mean [HR=7.76; *P*=.006], harmonic mean (HR=7.19; *P*=.009)) and 6 gray-level run-length features (SRE [HR=4.82; *P*=.014], LRE [HR=5.99; *P*=.007], GLN [HR=4.81; *P*=.021], RLN [HR=4.08; *P*=.025], HGRE [HR=3.96; *P*=.049], SRLGE [HR=4.23; *P*=.044]) remained significant predictor of outcome after adjusting for clinical variables. T-stage, tumor volume and HPV were not independent predictors in this model.

CONCLUSION

Independent of primary tumor CT texture analysis parameters are associated with local failure in patients with HNSCC who were treated with chemoradiotherapy. The results suggest that the CT texture analysis may serve as independent indicator of local failure regardless of HPV status. Further testing including larger sample size is needed to validate the performance of the predictive model.

CLINICAL RELEVANCE/APPLICATION

CT texture analysis could serve as a widely applicable pretreatment noninvasive biomarker for predicting local failure that could be used to help make treatment decisions in patients with HNSCC.

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/

Osamu Sakai, MD, PhD - 2013 Honored Educator
Osamu Sakai, MD, PhD - 2014 Honored Educator
Osamu Sakai, MD, PhD - 2015 Honored Educator

SSK15-05 Detecting Tumor Features of Head and Neck Cancers on CT Using Computerized Analysis

Wednesday, Nov. 30 11:10AM - 11:20AM Room: N229

Awards
Student Travel Stipend Award

Participants
Sean A. Woolen, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Lubomir M. Hadjiiski, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Kenny H. Cha, MSc, 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
Francis P. Worden, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Paul Swiecicki, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Benjamin Wasserman, BA, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Ashok Srinivasan, MD, Canton, MI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

AT-101 is an oral chemotherapeutic agent that inhibits antiapoptotic Bcl proteins, induces pro-apoptotic proteins noxa and puma, and may be beneficial in laryngeal cancer patients treated with organ preservation therapy. The objective of our study was to investigate the feasibility of computer segmentation for determining pre-therapy tumor features that can be used as predictors of tumor response to AT-101.

METHOD AND MATERIALS

Retrospective analysis of pre-therapy CT neck scans was performed in 18 patients diagnosed with laryngeal cancer in this IRB approved study. Contouring of the tumors was performed by one board certified neuroradiologist, and tumor features were generated on an internally developed/validated computer aided detection (CAD) system. The system performs 3D segmentation on the basis of a level-set model using an approximate bounding box for the lesion of interest. Twenty seven radiomic features, including morphological and gray-level features, were extracted from the computer and hand-segmented lesions. Post-treatment responses were obtained after one cycle of AT-101 chemotherapy from laryngoscopic exam. A positive response was recorded when there was at least 50% reduction in tumor volume. Pearson correlations were done between the radiomic features versus lesion response and hand versus computer segmentation.

RESULTS

All 18 lesions examined were primary laryngeal cancers. Out of the 18 patients, there were 6 non-responders (33%) and 12 responders (67%). The computer-estimated tumor volume between the pre-treatment scans achieved a very strong correlation (intraclass correlation coefficient [ICC] = 0.97) with the estimates from manual segmentation. The automatic and manual estimate ICC for tumor features were very strong for contrast enhancement (ICC=0.91) and strong for tumor eccentricity, moment ratio, and axis ratio (ICC=0.76, 0.71, and 0.77). Out of all of the features, the contrast features showed the highest correlation to treatment response.

CONCLUSION

Our results indicate that the computerized segmentation system can reliably estimate tumor features and tumor size on CT scans relative to radiologists. Our next step is the utilization of this CAD system to evaluate potential predictors from the pre-therapy scan.

CLINICAL RELEVANCE/APPLICATION

The CAD system has the potential to aid radiologist in calculating treatment response and guide clinical decision making by identifying treatment response predictors.

SSK15-06 Multiple sclerosis Plaques Searched by Synthetic MRI

Wednesday, Nov. 30 11:20AM - 11:30AM Room: N229

Awards
Student Travel Stipend Award

Participants
Akifumi Hagiwara, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose
Masaaki Hori, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Christina Andica, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Mariko Yoshida, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Koji Kamagata, Tyuuouku, Japan (*Abstract Co-Author*) Nothing to Disclose
Michimasa Suzuki, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Kanako K. Kumamaru, MD, PhD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Misaki Nakazawa, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Shigeki Aoki, MD, PhD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Synthetic MRI enables creation of almost any contrast-weighted image from a single MRI quantification scan. Double inversion recovery (DIR) and phase-sensitive inversion recovery (PSIR) images, which are known to be better than T2-weighted or fluid-attenuated inversion recovery (FLAIR) images for detecting MS plaques, can also be created. The aim of this study was to assess whether synthetic MRI is suitable for detecting MS plaques.

METHOD AND MATERIALS

Twelve MS patients who underwent quantitative and conventional MRI were retrospectively analyzed in this study. Quantitative MRI was performed by using the two-dimensional axial QRAPMASTER pulse sequence. This pulse sequence is a multi-slice, multi-echo, multi-saturation delay method of saturation recovery acquisition by turbo spin-echo readout, with which images are obtained by different combinations of echo time and saturation delay time for quantifying T1, T2, and PD, Synthetic T2-weighted, FLAIR, DIR, and PSIR images were produced after parameter quantification on SyMRI software (v. 8.0, SyntheticMR AB, Linköping, Sweden). The numbers of visible plaques were determined by a radiologist for a set of these four kinds of synthetic MR images and a set of conventional T1-weighted inversion recovery, T2-weighted, and FLAIR images. Acquisition time of synthetic MRI was 7 minutes and 12 seconds and that of conventional MRI was 6 minutes and 29 seconds in total. Lesion-to-white matter contrast and contrast-to-noise ratio (CNR) were calculated and compared between synthetic and conventional DIR images. Acquisition time was 6 minutes and 15 seconds for conventional 3D DIR images. For statistical analysis, we used the Wilcoxon signed-rank test to compare the numbers of lesions detected in the synthetic and conventional images and the contrast and CNR of synthetic and conventional DIR images.

RESULTS

Detected numbers of plaques were 157 in total by synthetic MR images and 139 in total by conventional MR images (P=0.014). Lesion-to-white matter contrast and CNR were better on synthetic DIR images than on conventional DIR images (P=0.001 and <0.001, respectively).

CONCLUSION

Synthetic MRI is better than conventional MRI for detecting and delineating MS plaques.

CLINICAL RELEVANCE/APPLICATION

Synthetic MRI, which creates almost any contrast-weighted image after a single quantification scan, enables detection of more MS plaques than conventional MRI in a comparable acquisition time.

SSK15-07 Segmentation of Small Cerebral Vessels on CT Perfusion Images of Patients with Suspected Acute Stroke

Wednesday, Nov. 30 11:30AM - 11:40AM Room: N229

Participants
Midas Meijs, MSc, Nijmegen, Netherlands (*Presenter*) Research funded, Toshiba Corporation
Mathias Prokop, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG Speakers Bureau, Bracco Group Speakers Bureau, Toshiba Corporation Speakers Bureau, Koninklijke Philips NV Research Grant, Toshiba Corporation
Frederick J. Meijer, MD,PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Bram Van Ginneken, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Stockholder, Thirona BV; Co-founder, Thirona BV; Research Grant, MeVis Medical Solutions AG; Research Grant, Delft Imaging Systems; Research Grant, Toshiba Corporation;
Rashindra Manniesing, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Research funded, Toshiba Corporation

PURPOSE

Due to partial volume effects, accurate segmentation of small cerebral vessels on CT is a challenge. We present a novel technique that incorporates local intensity histogram information to segment the cerebral vasculature on CT perfusion (CTP) scans for suspected ischemic stroke.

METHOD AND MATERIALS

A pattern recognition approach based on global and local image features followed by a random forest classifier is proposed. The features consist of an automatically computed brain mask denoting intracranial tissue, the first volume of the CTP scan, the CTP scan temporal average weighted according to the individual exposures to maximize signal-to-noise ratio, the weighted temporal variance (WTV), and local histogram features of the WTV calculated in a neighborhood of 9x9x9 voxels around a centered voxel. The mean, standard deviation, entropy and mode of the histogram are extracted as local feature values. In total 26 patients that underwent CTP were included. The CTP was acquired on a 320-detector row scanner. Image size was 512x512x320 voxels by 19 time points with voxel sizes of approximately 0.5 mm. Training was done on 8 patients with manually annotated data. The remaining 18 patients were used as testing set. Segmentations were visually inspected for completeness and overall quality. 3D-patches including the M2/M3 segments of the middle cerebral artery were manually annotated for quantitative evaluation. The modified Hausdorff distance (MHD) (maximum of the median HDs) and the accuracy (true positive + true negative voxels divided by amount of voxels in a patch) of the segmentation were reported for the annotated patches.

RESULTS

Overall the method was capable of segmenting the complete cerebral vasculature with inclusion of very small distal vessels. Parts of one internal carotid were missed in one patient because of clipping artefacts. In 3 patients false positive voxels were observed in the skull base region near the internal carotid artery and cavernous sinus. The MHD was 0.51±0.28 mm, which is similar to the voxel spacing, and the accuracy was 0.97±0.01.

CONCLUSION

Our approach provides high-quality segmentation of small cerebral vessels from CTP data.

CLINICAL RELEVANCE/APPLICATION

The high quality segmentation provided by our approach is an important step towards the automated localization and evaluation of vascular pathology in acute stroke patients.

SSK15-08 A Semi-automated Method for Expert Detection and Quantification of Carotid Artery Intraplaque Hemorrhage with 3D-MRI

Wednesday, Nov. 30 11:40AM - 11:50AM Room: N229

Participants
Tishan Maraj, MBBS,MSc, Toronto, ON (*Presenter*) Nothing to Disclose
Alan R. Moody, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Navneet Singh, MD,MPH, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Tina Binesh Marvasti, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
General Leung, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Pascal N. Tyrrell, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Mariam Afshin, PhD,MENG, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Carotid artery intraplaque hemorrhage (IPH) is identified by high intensity areas within the vessel wall compared with the sternocleidomastoid muscle (SCM) on 3-dimensional (3D) magnetic resonance imaging (MRI). Expert readers identify IPH as intensities >1.5 times the SCM, but detection may be subject to inter-reader variability, particularly when areas are small. We aimed to create a semi-automated image processing protocol that would consistently identify and quantify IPH on 3D MRI with the accuracy of an expert reader.

METHOD AND MATERIALS

3D-T1 weighted (T1w) gradient recalled echo (GRE) sequences from 15 carotid arteries with MRI-detected IPH were used in this REB approved retrospective study. Each sequence was used to create 16, 2mm thick axial reformats. Two expert readers independently rated the randomized images from 10 carotid arteries (n=160) for presence of IPH with a consensus decision for conflicting images. This was compared with the semi-automated detection of vessel wall high signal >/=1mm2 using thresholds from 1.2 to 2.2 times the SCM intensity, measured from a 20mm2 region of interest (ROI) at the level of the carotid artery bifurcation. The optimal threshold was derived from a receiver operating characteristic (ROC) curve by the Youden Index (YI). For the remaining 5 carotid arteries, the semi-automated method used the optimal threshold to measure IPH area per axial image (n=80), which was compared with the manual measurements of an expert using intraclass correlation coefficient (ICC) statistics.

RESULTS

There was strong agreement between expert readers for the initial independent assessment ($\kappa = 0.90$, $p<0.01$). The ROC curve

produced an area under the curve of 0.94 suggesting excellent diagnostic accuracy. The highest YI was 0.80, obtained at the 1.5 intensity ratio on the ROC curve. This corresponded to a sensitivity, specificity, positive predictive value, and negative predictive value of 80%, 100%, 100% and 83% respectively for regions of IPH >/=1mm2. The manual area measurements produced an ICC of 0.99 (95%CI 0.99 to 1.00) when compared with the 1.5 intensity ratio of the semi-automated method.

CONCLUSION

This semi-automated method for carotid artery IPH quantification has high accuracy compared with expert readers for areas >/=1mm2 on 3D-MRI.

CLINICAL RELEVANCE/APPLICATION

This semi-automated method can lead to improved consistency in detection and quantification of high signal intensity representing IPH.

SSK15-09 Performance of CAD system for Diagnosing Indeterminate Thyroid Nodules

Wednesday, Nov. 30 11:50AM - 12:00PM Room: N229

Participants
Jungmin Bae, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Soo Yeon Hahn, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung Hee Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seung Hee Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
So Yoon Park, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the capability of a breast ultrasound (US)-dedicated computer-assisted diagnosis (CAD) system as a supplemental tool for diagnosing indeterminate thyroid nodules.

METHOD AND MATERIALS

One hundred thirty-four patients with 139 nodules were enrolled in this prospective study between November 2015 and February 2016. US features and results of elastography were recorded according to the Korean Thyroid Imaging Reporting and Data System (K-TIRADS) in terms of size, composition, orientation, shape, margin, echogenicity, calcifications along with final assessment. After finishing the US examination, CAD system (breast US-dedicated CAD) was applied to the representative US images and the results were obtained as "benign" or "malignant". We evaluated the overall performance of CAD, and analyzed the performance of CAD system in diagnosing the thyroid nodules which were categorized as "indeterminate" (n=59) by radiologists. We also evaluated other US parameters and tools that can improve the performance of CAD system.

RESULTS

Among the 139 nodules, 91 nodules were benign and 48 nodules were malignant. Radiologists categorized the nodules as "benign" (n=37), "indeterminate" (n=59) and "malignant" (n=43). In diagnosing the indeterminate nodules (n = 59), CAD system showed high sensitivity (87.5%) and negative predictive value (95.5%), while specificity and positive predictive value were low (41.2%, 18.9%). By adding the results of elastography and the presence of calcification, specificity increased up to 94.1% and positive predictive value increased up to 57.1%, whereas sensitivity decreased to 50%.

CONCLUSION

CAD designed for breast mass showed high sensitivity and negative predictive value, but low specificity and positive predictive value in diagnosing the indeterminate thyroid nodules. Considering the presence of calcifications as well as applying the results of elastography could improve the specificity and positive predictive value of the CAD system.

CLINICAL RELEVANCE/APPLICATION

Development of thyroid-specific CAD system analyzing the US features including calcifications, and having elastography as one of the analyzing parameters is recommended for better performance.

SSM14

Science Session with Keynote: Musculoskeletal (Cartilage)

Wednesday, Nov. 30 3:00PM - 4:00PM Room: E353C

MK BQ MR

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

Participants
Michael P. Recht, MD, New York, NY (*Moderator*) Nothing to Disclose
Michael J. Tuite, MD, Madison, WI (*Moderator*) Nothing to Disclose

Sub-Events

SSM14-01 Musculoskeletal Keynote Speaker: Cartilage Imaging-One View of the Future

Wednesday, Nov. 30 3:00PM - 3:20PM Room: E353C

Participants
Michael P. Recht, MD, New York, NY (*Presenter*) Nothing to Disclose

SSM14-03 Does Cartilage Composition Change after Joint Preserving Hip Surgery for FAI - Preliminary Data of a Prospective Comparative Longitudinal Study Using Delayed Gadolinium Enhanced MRI of Cartilage (dGMERIC) at 3 T

Wednesday, Nov. 30 3:20PM - 3:30PM Room: E353C

Participants
Florian Schmaranzer, Bern, Switzerland (*Presenter*) Nothing to Disclose
Pascal Haefeli, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Markus Hanke, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Stefan Werlen, MD, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Moritz Tannast, MD, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Klaus A. Siebenrock, MD, PhD, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Delayed gadolinium enhanced MRI of cartilage (dGEMRIC) allows a 'monitoring' of glycosaminoglycan depletion of cartilage and can be used as biomarker for osteoarthritis. Longitudinal data on the change in hip cartilage composition in patients with femoroacetabular impingement (FAI) is lacking. We aimed to assess whether changes in T1 values occur 1 year after FAI surgery compared to patients with non-operative treatment and if changes correlate with clinical short-term outcome.

METHOD AND MATERIALS

IRB-approved prospective, comparative, longitudinal study of two groups (61 hips, 55 patients). After exclusion 17, 18 hips were assigned to the `operative` (open/arthroscopic correction) respectively to the `non-operative` (conservative treatment) group. At baseline, groups were comparable regarding radiographic osteoarthritis (Tönnis score), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and T1 values. Patients had baseline and 1-year follow-up i.v. dGEMRIC scans with the same 3 T magnet (0.4 ml/kg, 0.2 mmol gadopentate dimenglumine /kg). Radial T1 maps were reformatted from a 3D dual flip-angle volume interpolated breathold examination (VIBE). Central, peripheral femoral (12 `hour´ positions) and acetabular (10 `hour` positions) T1 values were manually measured separately from each other with the help of 2D radial high-resolution PD-w images. Baseline and 1-year follow-up WOMAC scores were obtained. Statistical analysis included paired/unpaired Student's t-Tests ($p<0.05$).

RESULTS

Acetabular T1 values decreased significantly ($p<0.05$) in 17/20 (85%) zones and in 21/24 (88%) of femoral zones in the operated group. In the non-operative group, no acetabular zone and 2/24 (8%) femoral zones presented with a significant drop. After 1 year the WOMAC significantly improved (58±42 to 33±42; $p= 0.007$) for the operative group, while there was no significant change (55±45 to 48±50; $p= 0.825$) for the non-operative group.

CONCLUSION

FAI surgery led to a decline in cartilage composition on MRI after 1 year despite significant clinical improvement. This decline may result from postoperative inflammation and/or may reflect altered biomechanic stress within the cartilage and requires longer follow-up.

CLINICAL RELEVANCE/APPLICATION

DGEMRIC may improve our understanding of hip osteoarthritis and has great potential to improve surgical treatment planning for FAI.

SSM14-04 Quantitative Measurement of Medial Femoral Knee Cartilage Volume - Analysis of The OA Biomarkers Consortium FNIH Project Cohort

Wednesday, Nov. 30 3:30PM - 3:40PM Room: E353C

Participants
Lena Schaefer, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Ming Yin, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Meera Sury, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Scott Jamieson, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

John A. Lynch, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Michael C. Nevitt, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Jeffrey W. Duryea, PhD, Boston, MA (*Presenter*) Nothing to Disclose
Stacy E. Smith, MD, Weston, MA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Objective and efficient methods to determine knee cartilage volume are useful for large osteoarthritis (OA) trials. We previously developed and validated a fast and responsive quantitative software tool to measure cartilage volume on MRI scans. The purpose of the present study is to further validate this method in a larger patient cohort and to assess predictive validity in a case-control study.

METHOD AND MATERIALS

The OA Biomarkers Consortium FNIH Project is a case-control study of knee OA progression nested within the Osteoarthritis Initiative (OAI), including 600 subjects in four subgroups based on radiographic and pain progression over 48 months in knees with OA. We used logistic regression to assess the association of change in cartilage volume with progression status. Our software tool measured cartilage volume in the central weight-bearing portion of the medial femur. We evaluated different sized areas of cartilage segmentation and their ability to differentiate the case control status of the cohort. The readings were performed on sagittal double echo steady state (DESS) MRI scans at the baseline and 24-month visits.

RESULTS

Change in medial femoral cartilage volume was associated with radiographic progression (OR=4.47; 95% CI=2.75-7.25). This correlation was significant but less prominent with combined radiographic and pain progression (OR=1.84; 95% CI=1.50-2.25). Smaller areas of cartilage segmentation were also able to predict the case-control status with similar results. The average reader time for the largest area was less than 20 minutes per scan. Smaller areas could be assessed with substantially less reader time, since smaller regions require fewer slices to be segmented.

CONCLUSION

We demonstrated that our software tool to measure cartilage volume in focal regions of the medial femur is ideal for existing and future large studies of knee OA and showed its clinical validity in a case-control setting. Smaller areas of segmented cartilage deliver the same associations with similar ORs as larger regions. This implies that comparable performance can be achieved with substantially less reader time, and that the method could be used for studies requiring assessment of several thousand MRI scans.

CLINICAL RELEVANCE/APPLICATION

By showing its clinical validity in a case-control setting we demonstrated that our tool to measure cartilage volume is fast and responsive and useful for future clinical studies of OA therapies.

SSM14-05 Presence and Severity of Type 2 Diabetes Mellitus are Associated With Cartilage Matrix Degeneration Measured With 3T MRI T2 Relaxation Time: Data from the Osteoarthritis Initiative

Wednesday, Nov. 30 3:40PM - 3:50PM Room: E353C

Awards
Student Travel Stipend Award

Participants
Alexandra S. Gersing, MD, Munich, Germany (*Presenter*) Nothing to Disclose
Nattagan Chancheck, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Benedikt J. Schwaiger, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Gabby B. Joseph, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Michael C. Nevitt, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Charles E. McCulloch, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Thomas M. Link, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Consultant, General Electric Company; Research Consultant, InSightec, Ltd; Research Grant, InSightec Ltd; Royalties, Springer Science+Business Media Deutschland GmbH; Consultant, Springer Science+Business Media Deutschland GmbH; Research Consultant, Pfizer Inc;

PURPOSE

To assess the cross-sectional association of presence and severity of type 2 diabetes mellitus (DM) with cartilage degeneration, measured using 3T MRI-based T2-values.

METHOD AND MATERIALS

In this study, 100 subjects with DM (age 60.6±8.5y; 57 females) and risk factors for osteoarthritis (OA) or mild radiographic OA (Kellgren-Lawrence (KL) score ≤2) were frequency-matched to 200 subjects without DM (age 60.9±8.1y; 114 females) on age, sex, BMI and KL score. For a subgroup analysis, DM subjects with severe disease were defined as subjects with present diabetes-related renal and ophthalmological complications at any time point until 48 months (N=28). Knee MRI examinations were assessed for structural joint abnormalities using the Whole-Organ Magnetic Resonance Imaging Score (WORMS). Our outcomes at baseline were cartilage composition as assessed with T2-maps averaged over all compartments, as well as in the patella and medial tibia and in the bone layer of the laminar analysis in these regions. Multivariable linear regression models adjusting for age, sex, baseline BMI and KL score were used to calculate associations with DM status.

RESULTS

Cartilage T2 values of the patella were significantly higher in subjects with DM in comparison to subjects without DM (mean diff. 1.1msec [95% confidence interval (CI) 0.6, 1.5]; P=0.023) and cartilage T2 of the bone layer of the medial tibia and patella (mean diff. 1.2msec [95% CI 0.5, 1.9], P=0.003 and mean diff. 1.1msec [95% CI 0.2, 2.0], P=0.022, respectively). Subjects with more severe DM overall showed significantly higher T2 values compared to controls (bone layer averaged: over all compartments, mean diff. 2.2 [95% CI 0.3, 3.4], P=0.044; medial tibia, mean diff. 1.4msec [95% CI 0.3, 2.6], P=0.001). However, no significant differences in structural knee abnormalities (WORMS of cartilage, meniscus and bone marrow) were found between controls and DM subjects with various disease severity (P>0.05 in all cases).

CONCLUSION

Compared to controls, subjects with DM showed significantly higher cartilage T2 values with even higher T2 values in subjects with more severe disease. These results suggest more advanced biochemical cartilage degradation in DM patients.

CLINICAL RELEVANCE/APPLICATION

MR-based knee cartilage T2 measurements allow monitoring of the effect of DM on joint health and underline the need for preventative treatment of patients with DM in order to slow or prevent cartilage deterioration.

SSM14-06 T1-rho MRI Detects Cartilage Improvement Following Surgical Treatment for Cam-Type FAI

Wednesday, Nov. 30 3:50PM - 4:00PM Room: E353C

Participants
Kawan S. Rakhra, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Helen Anwander, MD, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Gerd Melkus, PhD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Paul E. Beaule, MD, Ottawa, ON (*Abstract Co-Author*) Consultant, Wright Medical Technology, Inc Consultant, Getinge AB Consultant, MEDACTA International SA Consultant, MicroPort Scientific Corporation

PURPOSE

The goal of this study was to determine if the T1-rho MRI profile of hip hyaline cartilage improves in patients with cam-type femoroacetabular impingement following surgical osteochondroplasty.

METHOD AND MATERIALS

The study included 17 subjects with cam-type FAI diagnosed clinically and radiologically by MRI. T1-rho MRI(1.5T) of the symptomatic hip, pre- and post-operatively(2 years), was performed. Each subject underwent arthroscopic osteochondroplasty. The superior hip hyaline cartilage was segmented as a bilayer. The cartilage was subsequently divided into 2 zones(anterosuperior, posterosuperior) and further into equal thirds(medial, middle, lateral) zones in the transverse plane, generating 6 sub zones.The mean T1-rho relaxation value for the entire bilayer, and for the anterosuperior and posterosuperior zones, with and without further division into thirds, was performed and compared between the pre- and post-operative scans using a paired t-test.

RESULTS

The global mean T1-rho relaxation value(msec) postoperatively(30.62 ± 3.77) was significantly lower than pre-operatively(33.04 ± 2.99), p=0.0467.For the anterosuperior zone, the mean T1-rho relaxation value(msec) postoperatively(29.62)was significantly lower than pre-operatively(34.01), p=0.008.For the posterosuperior zone, the mean T1-rho relaxation value(msec) postoperatively(32.47)was not significantly different from pre-operatively(32.80), p=0.823.Further subdivision of the anterosuperior zone into thirds, found that the T1-rho relaxation values(msec) were significantly lower post-operatively than pre-operatively in both the lateral(27.61 vs 31.57, p=0.006) and middle(29.41 vs 33.46, p=0.021) subzones. None of the subzones posterosuperiorly demonstrated any significant difference between pre- and post-operative states.

CONCLUSION

There is significant reduction in the T1-rho relaxation values following osteochondroplasty, namely in the anterosuperior zone where cam-FAI is known to preferentially cause chondral disease. The change in T1-rho suggests an increase in proteoglycan content, equating with improved cartilage health.

CLINICAL RELEVANCE/APPLICATION

T1-rho MRI cartilage mapping can monitor biochemical changes in hyaline cartilage and be used to evaluate the impact of joint preserving surgical treatments.

RC607

Genitourinary Series: Prostate MRI in the PI-RADS Era: Detection, Diagnosis and MRI Guided/Targeted Interventions

Thursday, Dec. 1 8:30AM - 12:00PM Room: E450B

GU BQ MR

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

Participants

Clare M. Tempany-Afdhal, MD, Boston, MA (*Moderator*) Research Grant, InSightec Ltd; Consultant, Profound Medical Inc; Advisory Board, Profound Medical Inc; Spouse, Employee, Spring Bank Pharmaceuticals, Inc; Spouse, Consultant, AbbVie Inc; Spouse, Consultant, Bristol-Myers Squibb Company; Spouse, Consultant, Gilead Sciences, Inc; Spouse, Consultant, Merck & Co, Inc; Spouse, Consultant, Vertex Pharmaceuticals Incorporated; Spouse, Consultant, Echosens SA; Spouse, Consultant, GlaxoSmithKline plc; Spouse, Consultant, Novartis AG; Spouse, Consultant, Boehringer Ingelheim GmbH; Spouse, Consultant, Ligand Pharmaceuticals, Inc; Spouse, Consultant, Medgenics, Inc; Spouse, Consultant, Kadmon Corporation, LLC; Spouse, Consultant, Johnson & Johnson; Spouse, Consultant, Achillion Pharmaceuticals, Inc; Spouse, Stock options, Spring Bank Pharmaceuticals, Inc; Spouse, Stock options, Medgenics, Inc; Spouse, Editor, John Wiley & Sons, Inc

LEARNING OBJECTIVES

1) Prostate MRI in the PI-RADS era: Detection, diagnosis and MRI guided/targeted interventions Overview- Current issues in Prostate cancer care MpMRI Interpretation and Reporting using PI-RADS v2 MR assessment and reporting will be reviewed and attendee will learn how to apply PI-RADS v2 MpMRI quantitative metrics- added value to PI-RADS? 2) To understand the complementary nature of quantitiative metrics MpMR and prostate biopsy: when to biopsy and how Cognitive, fusion and In boreapproaches will be outlined Impact of PI-RADS on outcomes of prostate biopsy and treatment. Meta-analytic and otherreviews of population studies will be presented

ABSTRACT

Sub-Events

RC607-01 Overview - Current Issues in Prostate Cancer Care

Thursday, Dec. 1 8:30AM - 8:55AM Room: E450B

Participants
Clare M. Tempany-Afdhal, MD, Boston, MA, (ctempany@bwh.harvard.edu) (*Coordinator*) Research Grant, InSightec Ltd; Consultant, Profound Medical Inc; Advisory Board, Profound Medical Inc; Spouse, Employee, Spring Bank Pharmaceuticals, Inc; Spouse, Consultant, AbbVie Inc; Spouse, Consultant, Bristol-Myers Squibb Company; Spouse, Consultant, Gilead Sciences, Inc; Spouse, Consultant, Merck & Co, Inc; Spouse, Consultant, Vertex Pharmaceuticals Incorporated; Spouse, Consultant, Echosens SA; Spouse, Consultant, GlaxoSmithKline plc; Spouse, Consultant, Novartis AG; Spouse, Consultant, Boehringer Ingelheim GmbH; Spouse, Consultant, Ligand Pharmaceuticals, Inc; Spouse, Consultant, Medgenics, Inc; Spouse, Consultant, Kadmon Corporation, LLC; Spouse, Consultant, Johnson & Johnson; Spouse, Consultant, Achillion Pharmaceuticals, Inc; Spouse, Stock options, Spring Bank Pharmaceuticals, Inc; Spouse, Stock options, Medgenics, Inc; Spouse, Editor, John Wiley & Sons, Inc

LEARNING OBJECTIVES

1) To understand the clinical issues and current concerns in Prostate Cancer care. 2) To learn and understand how to apply mpMRI PIRADSv2 in clinical practice. 3) To understand the potential of quantitative metrics from mpMRI which may help in interpretation. 4) To learn the role of mpMRI in prostate biopsy and understand the different approaches. 5) To Understand the role of MRI in prostate cancer therapy.

ABSTRACT

RC607-02 Mp MRI and PIRADS 2016 Update

Thursday, Dec. 1 8:55AM - 9:20AM Room: E450B

Participants
Katarzyna J. Macura, MD, PhD, Baltimore, MD, (kmacura@jhmi.edu) (*Presenter*) Author with royalties, Reed Elsevier

LEARNING OBJECTIVES

View learning objectives under the main course title.

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/

Katarzyna J. Macura, MD, PhD - 2012 Honored Educator
Katarzyna J. Macura, MD, PhD - 2014 Honored Educator

RC607-03 The PI-RADS Version 2 Lexicon: Application by Radiologists Inexperienced in Prostate MRI Interpretation

Thursday, Dec. 1 9:20AM - 9:30AM Room: E450B

Awards

Student Travel Stipend Award

Participants
Laura M. Leonards, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Nisha Alle, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Taylor J. Choy, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Daniel J. Margolis, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Patrick J. Pan, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Andrew B. Rosenkrantz, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Hyung J. Kim, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

PI-RADS version 2 (v2) includes a detailed lexicon to guide scoring a lesion's level of suspicion. While the lexicon has been evaluated among experienced radiologists, a key intended benefit of PI-RADS v2 is to assist interpretation by radiologists without prostate MRI expertise. Thus, our aim was to evaluate the performance of radiologists inexperienced in prostate MRI interpretation in applying the PI-RADS v2 lexicon.

METHOD AND MATERIALS

Four radiology residents without prior prostate MRI training evaluated 40 prostate MRI exams. Readers were provided screen captures indicating the location of one specific lesion per case (20 in PZ; 20 in TZ), along with the PI-RADS v2 document. Readers scored the specified lesion for a wide array of lexicon components. These exams had previously been evaluated by six expert prostate MRI radiologists as part of a national multi-center reproducibility study; experts' consensus readings served as reference. Reader-averaged percent agreement with the reference was computed for the lexicon features (considered excellent when >80%).

RESULTS

In PZ, novice radiologists' agreement with the expert-derived reference was excellent (84%-90%) for features related to DWI (focal shape; marked high b-value hyperintensity; marked ADC hypointensity; DWI >3), though moderate (75%) for DCE (+). In TZ, agreement was excellent for T2 encapsulation (86%), though moderate (61%-78%) for other T2WI features (circumscribed shape; lenticular shape; heterogeneity; moderate hypointensity; T2 >3) and moderate (74%-81%) for DWI features. Agreement for PI-RADS >3 was 89% in PZ and 75% in TZ. Kappa values were also generally better for PZ than for TZ features (average kappa 0.57 and 0.32 respectively), with moderate to substantial agreement for all PZ features except DCE (fair), but nonsignificant slight agreement for heterogeneity, intensity, and invasiveness, and negative kappa for lenticular, in the PZ. For overall PI-RADS >3, kappa was 0.61 in PZ and 0.40 in TZ.

CONCLUSION

Novice radiologists performed reasonably well using the PI-RADS v2 lexicon, achieving excellent agreement with expert readers in PZ for DWI and overall PI-RADS >3. However, performance was weaker for DCE in PZ and for numerous TZ features.

CLINICAL RELEVANCE/APPLICATION

The results are encouraging regarding novice radiologists' ability to apply PI-RADS v2 lexicon in practice. Further education should target DCE in the PZ and textural T2-related features in the TZ.

RC607-04 Cancer Detection Rates of Category "4" Lesions for PI-RADSv2 on Prostate mpMRI

Thursday, Dec. 1 9:30AM - 9:40AM Room: E450B

Participants
Matthew Greer, BS, Cleveland Heights, OH (*Presenter*) Nothing to Disclose
Joanna Shih, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Nathan S. Lay, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Tristan Barrett, MBBS, BSc, Guildford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Leonardo K. Bittencourt, MD, PhD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Samuel Borofsky, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Ismail M. Kabakus, MD, PhD, Ankara, Turkey (*Abstract Co-Author*) Nothing to Disclose
Yan Mee Law, MBBS, Singapore, Singapore (*Abstract Co-Author*) Nothing to Disclose
Jamie Marko, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Haytham M. Shebel, MD, Mansoura, Egypt (*Abstract Co-Author*) Nothing to Disclose
Francesca Mertan, BS, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Maria Merino, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Peter Pinto, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
Peter L. Choyke, MD, Rockville, MD (*Abstract Co-Author*) Researcher, Koninklijke Philips NV; Researcher, General Electric Company; Researcher, Siemens AG; Researcher, iCAD, Inc; Researcher, Aspyrian Therapeutics, Inc; Researcher, ImaginAb, Inc; Researcher, Aura Biosciences, Inc
Ronald M. Summers, MD, PhD, Bethesda, MD (*Abstract Co-Author*) Royalties, iCAD, Inc; ;
Baris Turkbey, MD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

PIRADSv2 was proposed to standardize the interpretation of multi-parametric MRI (mpMRI) for prostate cancer. PIRADS=4 lesions have been disputed as this category contains diverse definitions. From data collected from a multi-reader study, we sought to characterize PIRADS=4 lesions based on T2W or DWI imaging alone and PIRADS=4 based on PIRADS =3 with DCE positivity.

METHOD AND MATERIALS

9 radiologists from 8 institutions participated in a multi-reader study. Patients were consecutive treatment-naïve patients who had ERC 3T MRI (T2W, ADC, b2000, and DCE). 163 patients were evaluated; 110 cases with prostatectomy after mpMRI, 53 controls with no lesions on MRI or positive biopsies. Readers were blinded to all outcomes. Lesions were prospectively detected and scored with PI-RADSv2 on mpMRI. Readers were instructed to detect lesions that would be included in a clinical report. Screen shots of detected lesions, and PIRADS scoring for T2W, DWI, and DCE sequences were recorded. All lesions were correlated between readers and to whole mount prostatectomy. Cancer detection rate (CDR) was determined as the proportion of true positive lesions

detected. Clinically significant (CS) cancers were defined as lesions Gleason≥3+4.

RESULTS

Among all readers a total of 654 lesions were detected. There were 3, 70, 115, 212, 305, and 161 lesions at PIRADS =1, 2, 3, 4, and 5, respectively. Of the 305 PIRADS=4 lesions, 79.7% were in the peripheral zone (PZ) and 20.3% were in the transition zone (TZ). Of the PZ lesions, 89 lesions were scored PIRADS=3 on DWI and positive in DCE (3+1) to be overall PIRADS=4. Of the TZ lesions, 4 were graded PIRADS=3 on T2W and PIRADS=5 on DWI. The CDR for PIRADS=3 was 33.3% for CS lesions. For all PIRADS=4 lesions the CDR was 80.1% and 72.9% for all and CS lesions. PIRADS=3+1 had a CDR of 67.1% for all tumors and 56.9% for CS tumors. With the PIRADS=3+1 lesions removed, the CDR for PIRADS=4 improved to 87.7% and 82.2% for all and CS lesions. This was similar to the CDR for PIRADS=5 of 90.4% and 89.7% for all and CS lesions.

CONCLUSION

On PI-RADSv2 the category of PIRADS=4 represents a diverse subset of lesions. PIRADS=3+1 lesions decrease the CDR of PIRADS=4 and may be better represented as a separate category.

CLINICAL RELEVANCE/APPLICATION

PIRADSv2 characterizes prostate cancer on MRI. Further refinement to optimize its utility as a reporting tool, especially for PIRADS=4 lesions, may improve cancer detection rates on MRI.

RC607-05 Evaluating the Additional Utility of ADC Values to PI-RADS v2

Thursday, Dec. 1 9:40AM - 9:50AM Room: E450B

Awards
Student Travel Stipend Award

Participants
Eric J. Jordan, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Charles E. Fiske, MD, Moraga, CA (*Abstract Co-Author*) Nothing to Disclose
Ronald J. Zagoria, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Antonio C. Westphalen, MD, Mill Valley, CA (*Abstract Co-Author*) Scientific Advisory Board, 3DBiopsy LLC ; Research Grant, Verily Life Sciences LLC

PURPOSE

To evaluate the combination of ADC values with PI-RADS v2 for the diagnosis of clinically significant prostate cancer (CS-PCa).

METHOD AND MATERIALS

This retrospective IRB approved study included 170 men whom underwent 3-Tesla prostate MRI and subsequent MR/US fusion biopsies at a single non-academic center from 11/2014 to 3/2016. All scans were performed with a surface coil and included T2, diffusion-weighted (b-values of 10, 400, 800 and 1200) and dynamic contrast enhanced sequences. Suspicious findings were classified using Prostate Imaging Reporting and Data System (PI-RADS) v2, and all were targeted using MR/US fusion biopsies. Mixed effect logistic regression analyses were used to determine the ability of PIRADS v2 alone and combined with ADC values to predict CS-PCa (Gleason score ≥7). Performances of PIRADS v2 alone and combined with ADC values were compared utilizing he area under receiver-operating characteristic curves (Az ROC) derived from the logistic models. As categories are more practical in clinical situations than numeric values, an additional model with ADC categories of ≤800, 800-1000 and ≥1000 was performed.

RESULTS

A total of 282 suspicious lesions were detected, 71 of which were CS-PCa, 33 were Gleason score 3+3 PCa, and 168 were negative. The overall PIRADS v2 score is a statistically significant predictor of CS-PCa ($p<0.001$). The area under the ROC curve for PI-RADS v2 to discriminate between patients with and without CS-PCa was 0.69 (95% CI=0.63-0.76). ADC values and ADC categories were both independent predictors on univariate models ($P<0.001$), Az ROC curve=0.77, 95% CI=0.71-0.83, and 0.74, 95% CI=0.68-0.79, respectively). Both PIRADS v2 and ADC value categories are significant predictors of CS-PCa in a multivariate analysis ($P< 0.05$, Az ROC = 0.76, 95% CI=0.69-0.82). The Az ROC of PIRADS v2 alone and PIRADS v2 with ADC categories are significantly different ($P=0.005$). Further analysis of the ROC curves also shows the main benefit of utilizing ADC values is better discrimination of PI-RADS 4 lesions.

CONCLUSION

ADC values improve the PI-RADS v2 prediction of clinical significant prostate cancer.

CLINICAL RELEVANCE/APPLICATION

Our study suggests that a PI-RADS v2 4 lesion should perhaps be upgraded to PI-RADS v2 5 when associated with an ADC value ≤ 800.

RC607-06 Comparison of Subjective and Quantitative Imaging features of Extra-prostatic Extension in Prostatic Carcinoma Using Multi-parametric (mp) MRI

Thursday, Dec. 1 9:50AM - 10:00AM Room: E450B

Awards
Student Travel Stipend Award

Participants
Satheesh Krishna, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Nicola Schieda, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Christopher Lim, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Robert Lim, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Trevor A. Flood, MD, FRCPC, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Robert K. Moreland, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose

Matthew D. McInnes, MD, FRCPC, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose
Wael M. Shabana, MD, Ottawa, ON (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Extraprostatic extesion (EPE) of prostatic carcinoma is a critical prognostic outcome; however, pre-operative diagnosis of EPE remains challenging.This study compares previoulsy described subjective and quantitative imaging features of EPE using mp-MRI.

METHOD AND MATERIALS

With IRB approval, 115 men underwent mp-MRI and radical prostatectomy (RP) between 2012-2015. Gleason scores were: 3+3=6 (N=3), 3+4=7 (48), 4+3=7 (49), 4+4=8 (N=5) and 4+5=9 (N=10). Two blinded radiologists evaluated mp-MRI for: 1) EPE (using the PI-RADS v1.0 scoring sysem) and 2) length of capsular contact. Dominant tumor foci were co-registered from RP to ADC map and 1) mean, 50th, 25th and 10th centile ADC histogram values and 2) first order ADC texture features (Skewness, Kurtosis, Entropy) were calculated. Outcomes were studied using chi-square, logistic regressioin and ROC analysis.

RESULTS

Mean age and PSA were 63.4 ± 4.8 years and 8.0 ± 11.7 ng/mL with no difference between groups (p>0.05). At histopathology, 71.3% (82/115) of patients had EPE.PI-RADS version 1.0 score of ≥3 yielded ROC-AUC of 0.62 (CI 0.47-0.79) with sensitivity/specificity (SENS/SPEC) of 71.4%/53.8% for diagnosis of EPE. Length of capsular contact was greater with EPE (22.4 ± 15.2 vs 14.2 ± 7.0 mm), although the difference was not significant (p=0.06). ROC-AUC was 0.69 (CI 0.54-0.86) with ≥ 19 mm yielding SENS/SPEC of 57.1%/76.9% for EPE.There was no difference in mean ADC, 10th, 25th or 50th centile ADC values between groups (p>0.05).ADC kurtosis and skewness did not differ between groups (p>0.05); however, ADC entropy was larger with EPE (7.67 ± 1.26 vs 6.48 ± 1.10), (p=0.01). ADC Entropy yielded an ROC-AUC of 0.78 (CI 0.64-0.91) with SENS/SPEC of 57.1%/92.3% for diagnosis of EPE using a threshold of ≥7.83.There was no difference comparing ROC-AUC between subjective and quantitative metrics, (p=0.20).

CONCLUSION

ADC entropy was the most useful quantitative metric for evaluation of EPE. Length of capsular contact also showed some value; however, skewness, kurtosis and ADC histogram values were not useful. Compared to subjective assessment, quantitative metrics had higher specificity but lower sensitivity for diagnosis of EPE, although the difference in accuracy was not significant.

CLINICAL RELEVANCE/APPLICATION

Diagnosis of EPE in prostate cancer using mp-MRI is challenging, ADC Entropy and length of capsular contact may improve specificity compared to subjective analysis alone.

RC607-07 Mp MRI Quantitative Metrics - Added Value to PIRADS?

Thursday, Dec. 1 10:00AM - 10:25AM Room: E450B

Participants
Andrew B. Rosenkrantz, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC607-08 Mp MR and Prostate Biopsy: When to Biopsy and How

Thursday, Dec. 1 10:40AM - 11:05AM Room: E450B

Participants
Clare M. Allen, MBBCh, London, United Kingdom (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

RC607-09 Is Standard Systematic Prostate Biopsy Necessary in Patients with Elevated PSA, Negative mp-MRI and no Prior Prostate Biopsy?

Thursday, Dec. 1 11:05AM - 11:15AM Room: E450B

Participants
Jinxing Yu, MD, Richmond, VA (*Presenter*) Nothing to Disclose
Ann S. Fulcher, MD, Midlothian, VA (*Abstract Co-Author*) Nothing to Disclose
Mary A. Turner, MD, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
William C. Behl, MS, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Sarah G. Winks, MD, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Anna L. Ware, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Meagan Sok, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Baruch Grob, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose
Lance Hampton, Richmond, VA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Purpose: To determine the detection rate of prostate cancer by TRUS guided biopsy in patients with elevated PSA, negative mp-MRI and no prior prostate biopsy and to determine the necessity of performing a baseline standard systematic prostate biopsy if mp-MRI is negative.

METHOD AND MATERIALS

Materials and Methods: A total of 102 consecutive men with elevated PSA, negative mp-MRI, and no prior TRUS guided prostate biopsy underwent standard systematic prostate biopsy (12 cores). Histopathology results including presence of prostate cancer

(PCa), Gleason score (GS), and percentage of positive core, as well as patients' clinical information including age, PSA, PSA density (PSAD), and prostate volume were recorded. Two experienced GU radiologists retrospectively reviewed all mp-MRI studies in consensus without knowledge of the TRUS biopsy results. Cancer suspicious regions (CSR) by mp-MRI were assigned PI-RADS scores based on PI-RADS v2. The imaging findings were correlated with the histopathology findings.

RESULTS

Results: On 12-core TRUS guided prostate biopsy, 9 of 102 patients had biopsy-proven PCa with GS ≥ 7 (9%). Among them, 7 patients had PCa GS 7 with a mean positive specimen of 20% and cores per patient of 1.3, and 2 had PCa GS 8 with positive specimen of 15%. Retrospective review of the mp-MRI studies detected 3 corresponding CSRs with PI-RADS score 3 (3/9, 33%). There was no corresponding abnormality identified in the remaining 6 patients with PCa GS 7. Prostate cancer GS 6 was detected in 22 of 102 patients (22%) with a mean positive specimen of 15% and a mean number of positive cores per patient of 2.3.

CONCLUSION

Conclusions: A baseline TRUS guided prostate biopsy may be necessary in order to avoid missing PCa GS ≥7 (9% in our study) in patients with elevated PSA, negative mp-MRI and no prior prostate biopsy.

CLINICAL RELEVANCE/APPLICATION

A baseline TRUS prostate biopsy may be necessary because some significant prostate cancers may be sparsely distributed in the gland, resulting in negative mp-MRI study in patients with elevated PSA.

RC607-10 In-Bore Magnetic Resonance-Guided Transrectal Biopsy for the Detection of Clinically Significant Prostate Cancer

Thursday, Dec. 1 11:15AM - 11:25AM Room: E450B

Participants
Ely R. Felker, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Stephanie A. Lee-Felker, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
John F. Feller, MD, Indian Wells, CA (*Abstract Co-Author*) Consultant, Koninklijke Philips NV; Consultant, Visualase, Inc ; Consultant, Hitachi, Ltd; Speaker, Hitachi, Ltd
Daniel J. Margolis, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
David S. Lu, MD, Los Angeles, CA (*Abstract Co-Author*) Consultant, Medtronic, Inc Speaker, Medtronic, Inc Consultant, Johnson & Johnson Research Grant, Johnson & Johnson Consultant, Bayer AG Research Grant, Bayer AG Speaker, Bayer AG
Robert A. Princenthal, MD, Thousand Oaks, CA (*Abstract Co-Author*) Employee, Koninklijke Philips NV
Stuart T. May Sr, MD, Indian Wells, CA (*Abstract Co-Author*) Nothing to Disclose
Martin I. Cohen, MD, Thousand Oaks, CA (*Abstract Co-Author*) Nothing to Disclose
Jiaoti Huang, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Bernadette M. Greenwood, BS, RT, Indian Wells, CA (*Abstract Co-Author*) Speakers Bureau, GenomeDx Biosciences Inc
Jeffrey Yoshida, Newport Beach, CA (*Abstract Co-Author*) Nothing to Disclose
Hyung J. Kim, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine the safety and efficacy of in-bore magnetic resonance-guided prostate biopsy (MRGB) for detection of clinically significant disease (CSD) in untreated men with known or suspected prostate cancer (PCa), and to compare MRGB results by Mp-MRI assessment grade.

METHOD AND MATERIALS

512 patients underwent multiparametric magnetic resonance imaging (Mp-MRI) followed by MRGB at one of three centers in this IRB-approved, HIPAA-compliant, retrospective study. Exclusion criteria were prior prostate cancer therapy and incomplete Mp-MRI (n = 51). Patients (n = 461) were analyzed in two subcohorts: no prior PCa (NP) (n = 381) and active surveillance (AS) (n = 80). Detection rates of PCa and CSD (Gleason Score at least 3 + 4) were calculated and compared among subcohorts and by Mp-MRI assessment grade (PI-RADS v1 or previously published modified PI-RADS score). Logistic regression was performed to identify predictors for detection of PCa and CSD.

RESULTS

Mean patient age was 66 years, median prostate-specific antigen (PSA) was 7.5 ng/mL, and median prostate volume was 54 cc. A mean of 1.7 targets was sampled per gland. Significant adverse events (urosepsis and hematuria with obstruction) occurred in 1% (5/461). Overall PCa detection rates were 51% per patient (233/461) and 37% per lesion (282/757). 65% (151/233) of men with detected PCa had CSD. Per patient PCa detection rates in the NP and AS subcohorts were: 47% (178/381) and 69% (55/80), respectively, significantly higher in the AS group ($p < 0.001$). CSD was detected in 10% (47/451), 43% (96/225) and 84% (68/81) of lesions with Mp-MRI assessment grades of 3, 4 and 5, respectively. Older age, higher PSA, and lower prostate volume predicted MRGB detection of CSD (OR=1.07 and $p = 0.003$, OR=1.1 and p=0.014, and OR=0.98 and p=0.032, respectively).

CONCLUSION

In-bore MRGB is safe and high-yield for detection of CSD among men with high and very high suspicion targets (grades 4 and 5). The yield of MRGB for CSD among men with intermediate suspicion targets (grade 3) is lower, such that it may be reasonable to defer biopsy in select cases.

CLINICAL RELEVANCE/APPLICATION

MRGB is a safe and high-yield technique for detecting clinically significant PCa and may be useful in men with suspected PCa but no prior definitive diagnosis and those on AS.

RC607-11 The Predictive Value of Significant Cancer for Prostate Imaging Reporting and Data System version 2 (PI-RADS v2)

Thursday, Dec. 1 11:25AM - 11:35AM Room: E450B

Awards
Student Travel Stipend Award

Participants
Huihui Wang, MD, Beijing, China (*Presenter*) Nothing to Disclose
Xiaoying Wang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To retrospectively evaluate whether Prostate Imaging Reporting and Data System version 2 (PI-RADS v2) is helpful for the detection of clinically significant prostate cancer.

METHOD AND MATERIALS

Consecutive patients whose PSA level elevated underwent mpMRI (T2WI, DWI and DCE, at 1.5 or 3 Tesla scanner) and transrectal US-guided biopsy between January 2014 and December 2015. An experienced radiologist blinded to any clinical information was assigned to score each patient according PI-RADS v2. Six to 14 biopsy cores were sampled per patient depending on MR detection and operator. Significant prostate cancer was defined as no less than grade 2 according to 2014 International Society of Urological Pathology (ISUP) grading system. The Cochran-Armitage trend test was used to analyze the association between PI-RADS score and significant cancer at biopsy.

RESULTS

A total of 529 patients were included in the analysis. Patients' mean (±sd) age, prostate-specific antigen were 67.2 (±8.9) years and 51.32 (±194.22) ng/mL, respectively. Overall, biopsies were negative, clinically insignificant and clinically significant in 224 (42.3%), 71 (13.4%) and 234 (44.2%) patients, respectively. Twelve of 173 (6.9%) men with PI-RADS scores of 1 and 2 had significant prostate cancer. The negative predictive value of PI-RADS scores of 1 and 2 for clinically significant prostate cancer was 93.1%. PI-RADS scores of 3 to 5 gave a sensitivity of 94.9% and a specificity of 54.8%. Receiver-operator curve analysis gave an area under the curve of 0.850.

CONCLUSION

PI-RADS v2 is helpful in predicting significant prostate cancer and can be used in the decision-making process for prostate biopsy. However, a small amount of significant cancer is misdiagnosed among PI-RADS score of 1 and 2.

CLINICAL RELEVANCE/APPLICATION

MpMRI provides extensive anatomical and functional imaging of the prostate. PI-RADS is useful in predicting clinically significant prostate cancer which would be important for guiding biopsy and treatment.

RC607-12 Impact of PIRADS on Outcomes of Prostate Biopsy and Treatment

Thursday, Dec. 1 11:35AM - 12:00PM Room: E450B

Participants
Jurgen J. Futterer, MD, PhD, Nijmegen, Netherlands (*Presenter*) Research Grant, Medtronic, Inc; Research Grant, Siemens AG

LEARNING OBJECTIVES

View learning objectives under the main course title.

ABSTRACT

RCC51

Imaging Integration with Cancer Genomics/Proteomics: Methodologies Leveraging the Cancer Imaging Archive

Thursday, Dec. 1 8:30AM - 10:00AM Room: S501ABC

BQ IN

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

Participants

John B. Freymann, BS, Rockville, MD, (freymannj@mail.nih.gov) (*Presenter*) Nothing to Disclose
Justin Kirby, Bethesda, MD (*Presenter*) Stockholder, Myriad Genetics, Inc
C. Carl Jaffe, MD, Boston, MA (*Presenter*) Nothing to Disclose
Brenda Fevrier-Sullivan, BA, Bethesda, MD (*Presenter*) Nothing to Disclose
Evis Sala, MD, PhD, New York, NY, (salae@mskcc.org) (*Presenter*) Nothing to Disclose
Sandy Napel, PhD, Stanford, CA (*Presenter*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc; Scientific Advisor, RADLogics, Inc
Erich Huang, PhD, Bethesda, MD (*Presenter*) Nothing to Disclose
Juan J. Ibarra-Rovira, MD, Houston, TX (*Presenter*) Nothing to Disclose
Maryellen L. Giger, PhD, Chicago, IL (*Presenter*) Stockholder, Hologic, Inc; Stockholder, Quantitative Insights, Inc; Co-founder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Corporation;

LEARNING OBJECTIVES

1) Learn the processes needed to develop reproducible image-genetic features from local or publicly available archives through presentations made by tumor specific clinical image-genetic clinician teams. 2) Learn from successful teams how clinical radiologists can use public archives to jump start integrative investigative efforts. 3) Learn from other radiology teams how to avoid missteps during development of image-genetic and radiomic research.

ABSTRACT

Diagnostic images analyzed by expert radiologists can offer reproducible data that connect them to tumor tissue genetics, proteomics and pathology images. But the methodology developed by clinician-based teams, and its potential pitfalls, are best demonstrated by presentations made by successful clinical image research teams. This didactic session will teach attendees a formal approach to the basic skills needed to navigate and utilize public image-genetic paired archives - for example NCI's The Cancer Imaging Archive of diagnostic radiology that also links genetic and pathology images on same patients. After a formal methodology overview, panelists will present lessons learned and best practices developed by volunteer clinician researcher teams who've already contributed much to the genetic-clinical imaging literature on breast, brain tumor, lung, renal, head-neck and bladder, illustrated with examples of completed analysis, findings and planned activities.

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/

Evis Sala, MD, PhD - 2013 Honored Educator

SSQ18

Physics (CT-Quantitative)

Thursday, Dec. 1 10:30AM - 12:00PM Room: S403B

BQ CT PH

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

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 ;
Hiroyuki Yoshida, PhD, Boston, MA (*Moderator*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

Sub-Events

SSQ18-01 Deep-Learning Bladder Cancer Treatment Response Assessment in CT Urography

Thursday, Dec. 1 10:30AM - 10:40AM Room: S403B

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*) Nothing to Disclose
Elaine M. Caoili, MD, MS, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Alon 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

PURPOSE

To estimate bladder cancer treatment response in CT urography (CTU) by training a Deep-Learning Convolution Neural Network (DL-CNN) to recognize the patterns of bladder lesions indicative of treatment response.

METHOD AND MATERIALS

With IRB approval, pre- and post-neoadjuvant chemotherapy CTU scans of 82 patients (87 lesions) were collected retrospectively. Cystectomy was performed at the end of treatment, and the cancer stage after treatment was used as the reference standard to determine if a patient responded to treatment. 27% of the patients had T0 cancer stage after chemotherapy, which corresponds to a complete response to treatment. Bladder lesions in the CTU scans were segmented using our Auto-Initialized Cascaded Level Sets (AI-CALS) system. Regions of interests (ROIs) were extracted from within the segmented lesions from corresponding pre- and post-treatment scans of a patient and were paired together in multiple combinations to generate pre-post-treatment paired ROIs. A total of 104 temporal lesion pairs were generated from the 87 lesions, resulting in 6,700 pre-post-treatment paired ROIs. We trained a DL-CNN to distinguish between bladder lesions that were diagnosed as stage T0 post-treatment and those that were greater than stage T0. Leave-one-case-out cross-validation was performed for training and testing the DL-CNN. In each partition the trained DL-CNN outputted a likelihood of stage T0 score for the left-out test case. An observer performance study with two experienced radiologists was also performed independently, in which the radiologist estimated the likelihood of stage T0 after viewing each pre-post-treatment CTU pair. Receiver operating characteristic (ROC) analysis was performed and the area under the curve (AUC) was calculated for the DL-CNN and radiologists' estimates.

RESULTS

The AUC for prediction of T0 disease after treatment was 0.75 ± 0.05 for the DL-CNN, and 0.75 ± 0.05 and 0.70 ± 0.06 for the two radiologists. The differences in the AUC values among the DL-CNN and the two radiologists did not reach statistical significance.

CONCLUSION

Our study demonstrated the feasibility of using DL-CNN for the estimation of bladder cancer treatment response in CTU

CLINICAL RELEVANCE/APPLICATION

Deep learning CNN may be useful as decision support for bladder cancer treatment response assessment, vital for identifying non-responders and stopping treatment to preserve their physical condition.

SSQ18-02 K-Means Clustering Guided Bilateral Filter for Dynamic CT Perfusion at Lower Dose Levels

Thursday, Dec. 1 10:40AM - 10:50AM Room: S403B

Participants
Francesco Pisana, Heidelberg, Germany (*Presenter*) Doctoral student, Siemens AG
Thomas Henzler, MD, Mannheim, Germany (*Abstract Co-Author*) Research support, Siemens AG; Speaker, Siemens AG
Stefan O. Schoenberg, MD, PhD, Mannheim , Germany (*Abstract Co-Author*) Institutional research agreement, Siemens AG
Ernst Klotz, DiplPhys, Forchheim, Germany (*Abstract Co-Author*) Employee, Siemens AG
Bernhard Schmidt, PhD, Forchheim, Germany (*Abstract Co-Author*) Employee, Siemens AG
Marc Kachelriess, PhD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To develop a practical filter for functional maps quality improvement in dynamic CT perfusion (CTP), exploiting the temporal redundancy of data.

METHOD AND MATERIALS

CTP acquisitions are normally performed with low kVp and mAs values, to keep the radiation dose in acceptable levels. Functional maps are derived by non-linear algorithms and normally result in enhanced noise. We developed a new image filter exploiting data redundancy in two ways: first, voxels belonging to vessels and small anatomical structures were automatically segmented from noise using the temporal autocorrelation function of the high spatial frequencies and an optimal guiding image was created (G). In a second step, all voxels were iteratively classified in K clusters, based on their temporal CT values, via k-means clustering (K); this information was used to avoid mixing distinct functional classes. Based on that, we implemented a k-means clustering guided bilateral filter (KG) and compared its performances to the time-intensity profile similarity filter (TIPS) and to the partial temporal non local means filter (PATEN). The study was conducted on an in-house developed phantom and on clinical cases. The dose reduction potential of KG compared to TIPS was also estimated by adding noise to the raw-data.

RESULTS

For a better comparison, all filters were implemented with the same sizes. Blood flow maps obtained from the KG filtered CT images showed the highest contrast-to-noise ratio improvements (6.96), followed by the TIPS (5.81) and the PATEN (2.09) ones. The KG filter was able to better preserve the original spatial resolution of the CT images. Finally, computational times were significantly shorter with the KG filter. Our results suggest that with the KG filter, dose could be reduced potentially by c.ca 40 % at same CNR levels when compared to the TIPS filter.

CONCLUSION

The proposed KG filter seems to provide better results when compared to state-of-the-art filters for quality improvement of CTP functional maps, and in much shorter times. To our knowledge, this is the first approach using the k-means clustering and the temporal autocorrelation function in a denoising strategy for CTP.

CLINICAL RELEVANCE/APPLICATION

We believe the potential of the proposed algorithm can be further exploited and optimized, to allow for lower dose CTP protocols that still provide high diagnostic quality in clinically acceptable times.

SSQ18-03 Building Towards a QIBA Challenge: Establishing Exchangeability between Clinical and Virtual Databases for Quantitative CT Volumetry

Thursday, Dec. 1 10:50AM - 11:00AM Room: S403B

Participants
Marthony Robins, BSc, Durham, NC (*Presenter*) Nothing to Disclose
Justin B. Solomon, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Andrew J. Buckler, MS, Wenham, MA (*Abstract Co-Author*) Stockholder, vascuVis Inc President, vascuVis Inc CEO, vascuVis Inc Stockholder, Elucid Bioimaging Inc President, Elucid Bioimaging Inc CEO, Elucid Bioimaging Inc
Ehsan Samei, PhD, Durham, NC (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Siemens AG

PURPOSE

To devise and pilot test a Challenge through Quantitative Imaging Biomarkers Alliance (QIBA) to establish statistical exchangeability between virtually inserted and native lesions.

METHOD AND MATERIALS

Computational lung lesion models (based on pathologically confirmed malignant tumors) were virtually inserted into 16 phantom datasets and 30 chest CT cases using a validated image-domain insertion program. The study is designed as a public challenge to academic researchers and commercial software developers to apply their segmentation and volume estimation algorithms on simulated and corresponding real lung lesions. Initial data were analyzed in terms of bias (in phantom data only), location reproducibility, and algorithm reproducibility (variance between measurements by different algorithms on the same lesion) in volume estimation between the virtual and real lesions to assess non-inferiority of virtually inserted lesions.

RESULTS

Pilot results from three segmentation algorithms (iNtutition, Tera Recon Inc., Syngo.via, Siemens Healthcare, and IntelliSpace, Philips Healthcare) yielded <2% difference in mean bias for real and virtual lesions, respectively for one algorithm, while others yielded 5-6%, and 5-8%, respectively. Lesion complexity and insertion location (juxta-pleura and mediastinum) affected volume estimation for both virtual and real lesions similarly with no statistically significant difference ($p > .05$). Algorithm reproducibility was consistent between virtual and real lesions for all lesion types (solitary or attached), noise levels, pitch, and slice thickness.

CONCLUSION

Patient images provide anatomical detail but often lack ground truth. Standardized databases of virtually inserted lesions can address this obstacle. These pilot results pave the way for a broad QIBA challenge to enable generalization for statistical similarity of hybrid (virtual lesions inserted in clinical patient data) datasets to clinical datasets across a wider set of volumetry algorithms.

CLINICAL RELEVANCE/APPLICATION

Standardized databases of virtually inserted lesions will help to develop and validate better lesion segmentation tools for quantitative CT towards enacting precision medicine.

SSQ18-04 Measuring Head Movement in 3D During CT-Perfusion Analysis - A Pilot Study

Thursday, Dec. 1 11:00AM - 11:10AM Room: S403B

Participants
Mette C. Marklund, MD, PhD, Roskilde, Denmark (*Presenter*) Nothing to Disclose
Anders O. Baandrup, BSC, Roskilde, Denmark (*Abstract Co-Author*) Nothing to Disclose
Troels Wienecke, MD,PhD, Roskilde, Denmark (*Abstract Co-Author*) Nothing to Disclose
Carsten Thomsen, Copenhagen, Denmark (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

A robust, very accurate and low tech marker can be used for measuring head movement in the X-, Y and Z-direction and rotation during a CTP.

Background

The purpose of this pilot study is to test a simple, non-anatomical dependent method to calculate head motion in the X-, Y- and Z-dimensions and rotation. Most CT-scanners have inbuilt options for movement correction based on landmarks. Some of the algorithms operate in 3D others in 2D. Only very few studies have examined, how much the patient actually moves during a CT perfusion (CTP) study since no external, non-anatomic dependent marker for objective measurement in all 3 dimensions exists.

Evaluation

To determine the motion in patients instructed to lying still, we developed a marker designed to be placed on the patients forehead. The marker was drawn in Autocad® and 3D printed. It contains 4 air filled cones in 2 planes pointing in 2 directions in each plane. It was tested in a phantom set-up with a micrometer (Mitutoyo 164-163 Digimatic Micrometer) enabling the marker moving as little as 0.001 mm. Raw data were calculated by an external radiologist with no knowledge on the applied movement parameters. By applying an advanced mathematical algorithm, measuring the size and elliptical deformation of the black holes during the scan, a very accurate value (δ) for movement in the X-, Y- and Z-direction could be calculated. The marker was placed on the forehead of 5 consecutive patients suspected for Ischemic Stroke (IS) undergoing CTP. The patients were all well-cooperating. Movement parameters (fig. 4) are given for our most restless patient nr. 3: δ(X): -3.6 to 4.4 mm, δ(Y): -1.3 to 1.9 mm,δ(Z): -1.4 to 2.0 mm and rotation -2.0 to 3.2 degrees.

Discussion

Movement artifacts lower the signal/noise ratio and increase the risk of diagnostically insufficient images. Even though the movement errors can be reduced by post processing, the S/N-ratio will remain lower than if the patient had not moved at all. Determining the extent of true motion is fundamental for setting up future projects aiming to optimize head stabilization and developing advanced post processing algorithms.

SSQ18-05 Initial Validation of a View-Sharing Acquisition Using a Physical Perfusion Phantom

Thursday, Dec. 1 11:10AM - 11:20AM Room: S403B

Participants
Jacob Johnson, Madison, WI (*Presenter*) Institutional research support, General Electric Company
Leah Henze Bancroft, PhD, Madison, WI (*Abstract Co-Author*) Institutional research support, General Electric Company
Edward F. Jackson, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Jorge E. Jimenez, MS, Madison, WI (*Abstract Co-Author*) Institutional research support, General Electric Company
Frank R. Korosec, PhD, Madison, WI (*Abstract Co-Author*) Research support, General Electric Company
Courtney K. Morrison, Madison, WI (*Abstract Co-Author*) Research support, General Electric Company
Roberta M. Strigel, MD, MS, Madison, WI (*Abstract Co-Author*) Research support, General Electric Company
Ryan Bosca, PhD, Madison, WI (*Abstract Co-Author*) Research support, General Electric Company

PURPOSE

Dynamic contrast-enhanced (DCE) MRI is a clinical research tool that can provide quantitative imaging biomarkers (QIBs) of perfusion. As new commercially-available and research MR acquisition strategies utilize view sharing and sparse sampling techniques to achieve high spatial and temporal resolution images, validating the ability of these methods to reproduce QIBs is critically important. We used a perfusion phantom to evaluate the reproducibility of gamma-variate (GV) fits using a commercial view-sharing sequence (DISCO) compared with a conventional fast spoiled gradient echo sequence (FSPGR).

METHOD AND MATERIALS

The phantom (Shelly Medical Imaging Technologies) consists of a peristaltic pump that provides a single input to a custom shell-contained perfusion cylinder. Within the cylinder, the input is coiled and perforated which allows flowing water to traverse the length of the input to the "tube" output or flow into the bulk of the cylinder to the "cylinder" output. Adjustable valves control the flow ratio, r, of the tube/cylinder output. The flow was set to 4mL/s and r was set to 0.5. Images were acquired on a 3.0T GE MR750 scanner using a 32-channel head coil (NOVA) with the FSPGR (FOV=24x12x7.2 cm^3, matrix=256x128x24, 9.7s/volume) and DISCO (FOV=24x12x28.8 cm^3, matrix=256x128x96, 9.6s/volume) sequences. The FSPGR data were acquired twice during two different scanning sessions to assess reproducibility. For each method, a power injector was used to inject 5mL of Gd-DOTA followed by a 10mL saline flush at a rate of 2mL/s after acquiring images for 60s. The GV parameters (alpha and beta) were estimated for all contrast concentration time curves. The mean, 95% confidence intervals (CI), and coefficients of variation (CV) were calculated for each parameter.

RESULTS

For the conventional DCE-MRI acquisition, the mean, 95%CI, and CV for alpha was 2.66, (2.32, 3.00), and 6.53%, respectively, while that of beta was 25.13, (21.60, 28.65), and 7.17%, respectively. The alpha and beta parameters for the DISCO acquisition were 2.98 and 23.13, respectively.

CONCLUSION

For comparable temporal resolutions, DISCO reproduced the GV parameters within the 95% CI of the conventional DCE-MRI acquired parameters.

CLINICAL RELEVANCE/APPLICATION

For a conventional temporal resolution, DCE-MRI GV reproducibility of a commercial view-sharing technique was established. This methodology can be used to validate other research techniques.

SSQ18-06 Quantitative CT Perfusion Imaging of the Liver in Sparse-view Setting

Thursday, Dec. 1 11:20AM - 11:30AM Room: S403B

Participants
Esmaeil Enjilela, PhD, London, ON (*Abstract Co-Author*) Nothing to Disclose
Ting-Yim Lee, MSc, PhD, London, ON (*Abstract Co-Author*) License agreement, General Electric Company
Jiang Hsieh, PhD, Waukesha, WI (*Abstract Co-Author*) Employee, General Electric Company
Errol E. Stewart, PhD, London, ON (*Abstract Co-Author*) Nothing to Disclose
Mark Dekaban, London, ON (*Abstract Co-Author*) Nothing to Disclose
Aaron So, PhD, London, ON (*Presenter*) Nothing to Disclose
Feng Su, PhD, London, ON (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We investigated the effect of projection undersampling on quantitative CT liver perfusion imaging.

METHOD AND MATERIALS

Dynamic contrast enhanced (DCE) liver images were acquired from a 68 kg patient with hepatocellular carcinoma (HCC) after intravenous contrast injection, with a 64-slice GE HD750 CT scanner at 120 kVp, 70 mA and 0.4 s gantry period using an axial shuttle mode for 42 times, during which the patient was free-breathing throughout. DCE liver images were reconstructed from full projections (984) using filtered backprojection (FBP), and 1/3 (328) and 1/4 (246) of full projections, evenly distributed over 360° with FBP and compressed sensing (CS). Each set of DCE liver images were registered and analyzed with CT Perfusion (GE) to generate hepatic arterial blood flow (HABF) maps. HABF measurements from the sparse-view FBP and CS protocols were compared to those from the full-view FBP method.

RESULTS

Mean HABF measured from full (984) view FBP were comparable to those from 328-view FBP and 328-view CS: 60.6 vs. 63.1 and 62.2 mL/min/100g in liver tumor, and 27.7 vs. 25.6 and 23.4 in normal liver tissue, respectively. In the 246-view setting, FBP failed to minimize streaks in DCE images, leading to a larger discrepancy in HABF measurement from full-view FBP: 37.0 vs. 27.7 mL/min/100g in tumor (-25% difference), and 70.5 vs. 60.6 (16.3% difference) in normal tissue, respectively. By contrast, DCE images generated from the same number of projections (246) with CS was without streaks and the resulting HABF values were in better agreements with those of full-view FBP: 29.8 vs. 27.7 mL/min/100g (-7.6% difference) in tumor, and 55.1 vs. 60.6 (-9.1% difference) in normal tissue, respectively. Projected effective doses of the full and ¼ view DCE acquisition protocols for 8 cm coverage were 11.3 and 3.8 mSv respectively.

CONCLUSION

Only 1/3 of full projections were needed in CT liver perfusion measurement, regardless of the choice of image reconstruction algorithm (FBP or CS). Under extremely sparse condition (< 1/3 of full projections), CS may be more reliable than FBP in preserving image quality and accuracy of liver perfusion measurement.

CLINICAL RELEVANCE/APPLICATION

It is feasible to achieve low dose (<4 mSv) CT perfusion imaging of the whole liver for HCC treatment planning and follow-up by reducing the number of projection measurement in DCE acquisition.

SSQ18-07 Identifying Quantitative Image Features that Correlate with Radiologists' Image Quality Preferences on Breast CT

Thursday, Dec. 1 11:30AM - 11:40AM Room: S403B

Participants
Juhun Lee, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Robert M. Nishikawa, PhD, Pittsburgh, PA (*Presenter*) Royalties, Hologic, Inc; Research Consultant, iCAD, Inc;
Ingrid Reiser, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
John M. Boone, PhD, Sacramento, CA (*Abstract Co-Author*) Research Grant, Siemens AG; Royalties, Wolters Kluwer nv;

PURPOSE

To evaluate which quantitative image features on breast computed tomography (CT) images correlate with radiologists' subjective image quality preferences.

METHOD AND MATERIALS

A total of 102 pathology-proven breast lesions in 92 dedicated breast CT images were collected under an IRB-approved protocol. An iterative image reconstruction (IIR) algorithm was used to obtain CT images with 28 different image qualities. Through image feature analysis from breast lesions (developing classifiers on 23 image features extracted from the lesion), three IIRs and one clinical reconstruction with a wide range of image quality (from smooth to sharp quality) were selected for an IRB-approved reader study. A subset of breast lesions was selected (N = 30, 17 malignant) with corresponding trained classifier AUCs of 0.68 – 0.95 for the selected reconstructions. For each lesion, six experienced MQSA radiologists ranked the four image data sets in regards to their impression of best diagnostic information. In addition, each feature value was ranked for the four reconstructions. The correlation between computer feature and radiologists' rankings was evaluated to identify computer features that correlate with radiologists' preferences. The correlation analysis was repeated for benign and malignant lesions separately, as the characteristics of benign and malignant lesions are different.

RESULTS

Five image features were identified. The radiologists' image quality preferences increased as the lesion shape became more spherical (p-value = 0.02), as the lesion surface flattened (p-value = 0.01), and as the lesion texture increased (p-value = 0.02) for benign lesions. Radiologists' preferences increased as more lesion margin was visible (p-value = 0.02) and as lesion contrast at the margin increased (p-value = 0.03) for malignant lesions. For all lesions, radiologists' preferences increased as the lesion texture increased (p-value = 0.02).

CONCLUSION

There exists a set of quantitative image features that correlate with radiologists' image quality preferences, potentially allowing subjective impression to be quantified. More cases and readers are required to generalize these results.

CLINICAL RELEVANCE/APPLICATION

We identified quantitative image features that correlate with radiologists' perceptions of image quality for breast CT images. These features may be useful for optimizing reconstruction algorithms and evaluating dose reduction techniques.

SSQ18-08 Modeling of Human Lungs: An Anatomically Based Prototyping of Airways, Arteries, and Veins from Initially Segmented Branches to the Terminal Branches and Interstitium

Thursday, Dec. 1 11:40AM - 11:50AM Room: S403B

Participants
Ehsan Abadi, Durham, NC (*Presenter*) Nothing to Disclose
Gregory M. Sturgeon, MS, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
William P. Segars, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Justus E. Roos, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Carl E. Ravin, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Ehsan Samei, PhD, Durham, NC (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Siemens AG

PURPOSE

To mathematically model and grow airway, artery, and vein trees toward simulation of comprehensive lung architecture facilitating virtual clinical trials (VCTs).

METHOD AND MATERIALS

Lung lobes and initial branches of airways, arteries, and veins were segmented separately inside each lobe using CT data of 58 adult patients. Airway trees were grown, within the boundary of each lobe, from the endpoints of the segmentations based on a volume-filling method. The growth model for the arteries was spatially constrained to neighboring and corresponding airways according to the anatomical understanding of bronchial arterial units. In contrast, pulmonary veins and venules were grown independently according to the anatomical known interstitial meshwork. At each bifurcation, diameters of the daughter branches were assigned using morphometry equations in the literature. The algorithm was assigned to stop growing if a branch length was less than 1.2 mm. Co-incidental intersections were identified automatically and subsequently avoided. Simulated CT images were obtained from the virtual lung phantoms using an analytical algorithm developed in our lab and reconstructed using filtered backprojection.

RESULTS

A database of 58 adult patient-specific lung phantoms was created. Airways and vessels were generated up to 16 and 15 bifurcations, respectively. For airways and arteries, the diameters in the first branches were on the order of 10, 6, 8, 5, and 8 mm for the upper left lobes, lower left lobes, upper right lobes, middle right lobes, and lower right lobes, respectively. For veins, the first branch diameters were 16, 8, 10, 9, and 12 mm. Terminal generated branches diameters were approximately 0.2, 0.3, and 0.3 mm for airways, arteries, and veins, respectively.

CONCLUSION

We present an algorithm to create anatomically-informed lung phantoms. For the first time, we 1) incorporated airway, artery, and vein tree structures from initially segmented branches to the terminal branches; and 2) simulated CT images based on these models. The outcome will be used to perform VCTs such as patient-based optimization and comparison of imaging techniques that would not be practical using simplistic phantoms or real human datasets.

CLINICAL RELEVANCE/APPLICATION

Modeling anatomically-informed lung airways and vessels to the level of interstitial structures makes the virtual phantoms more representative of clinical realities which lead to more realistic VCTs.

SSQ18-09 Application of Compressed Sensing for Low-intensity Sparse-view CT Myocardial Perfusion Imaging

Thursday, Dec. 1 11:50AM - 12:00PM Room: S403B

Participants
Esmaeil Enjilela, PhD, London, ON (*Abstract Co-Author*) Nothing to Disclose
Ting-Yim Lee, MSc, PhD, London, ON (*Abstract Co-Author*) License agreement, General Electric Company
Jiang Hsieh, PhD, Waukesha, WI (*Abstract Co-Author*) Employee, General Electric Company
Aaron So, PhD, London, ON (*Presenter*) Nothing to Disclose

PURPOSE

We investigated the effectiveness of compressed sensing (CS) for reconstructing dynamic contrast-enhanced (DCE) CT heart images from sparsely sampled x-ray projections at different noise levels in CT myocardial perfusion (MP) imaging.

METHOD AND MATERIALS

Prospectively ECG gated CT MP imaging was acquired on three normal pigs (40-60kg) over 22-25 heart beats after contrast injection with a 64-slice GE HD750 CT scanner using 140kV/80mA/350ms. Reference DCE heart images were reconstructed from the full set of beam-hardening (BH) corrected projections (984) with filtered backprojection (FBP). Synthetic noise that incorporated the effects of energy-integrating detector and bowtie beam filtering was added to the BH corrected projections to simulate image noise corresponds to 50, 40, 30 and 20 mA at 140 kV and 350 ms gantry period. From each set of simulated low mA projections, one-third (328) evenly distributed over 360º was used to reconstruct DCE heart images with CS. MP maps generated from each set of FBP and CS DCE images with CT Perfusion (GE) were compared in the lateral, apical and septal wall of the myocardium over 8 consecutive 5 mm slices (144 myocardial segments total).

RESULTS

328-view CS DCE images at all low mA settings were able to resolve the same anatomical features as 80 mA 984-view FBP. MP maps derived from each low mA CS DCE image set were also comparable to those from 80 mA full-view FBP. Bland-Altman analysis revealed subtle mean bias in CT MP measurement for all low mA sparse-view CS protocols compared to 80 mA full-view FBP: 2.67 mL/min/100g (95% CI: 18.37 – 13.04 ml/min/100g), 5.35 (21.51 – 10.81), 6.02 (24.34 – 12.29) and 8.77 (30.15 – 12.62) for 50, 40, 30 and 20 mA respectively. Projected effective dose of the 20 mA 328-view CS protocol for MP imaging was 0.66 mSv and 12 times lower than that of the standard 80 mA full-view FBP protocol (8 mSv) for 8 cm axial coverage.

CONCLUSION

Compared to FBP, CS was effective in reconstructing DCE heart images from 1/3 of full projections at four times reduced mA without affecting the anatomical and functional CT assessment.

CLINICAL RELEVANCE/APPLICATION

Low mA and sparse view dynamic acquisition coupled with CS reconstruction can minimize radiation dose of CT MP imaging, which would facilitate its use for assessing high-risk coronary artery disease.

SPSH53

Hot Topic Session: Radiation and Immune Therapies: Challenges in Evaluation of Treatment Response

Thursday, Dec. 1 3:00PM - 4:00PM Room: E353B

BQ RO

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

FDA Discussions may include off-label uses.

Participants

Sub-Events

SPSH53A Radiation and Immune Therapy

Participants
Marka R. Crittenden, MD, PhD, Portland, OR, (marka.crittenden@providence.org) (*Presenter*) Advisory Board, Regeneron Pharmaceuticals, Inc; Advisory Board, AstraZeneca PLC; Advisory Board, Pfizer Inc; Researcher, Jounce Therapeutics, Inc; Researcher, Rigel Pharmaceuticals, Inc; Researcher, Bristol-Myers Squibb Company

LEARNING OBJECTIVES

1) Describe the mechansims of synergy between radiation and the immune system. 2) Develop an understanding of how to combine radiation and immune therapy to enhance both local and sytemic responses.

ABSTRACT

That radiation therapy has the capacity to prime immune responses has gained traction in recent years. Various mechanisms of synergy between radiation and adaptive immune responses have been identified in preclinical studies. There are now multiple clinical studies attempting to integrate immunotherapy with RT to extend the effects beyond the primary tumor. However, in addition to these positive stimuli on immunity, RT also initiates suppressive mechanisms in the tumor, which relate to intrinsic processes associated with repair of damaged tissues. A greater understanding of the positive role which radiation plays on adaptive immunity and the negative feedback on inflammation that shuts down these immune responses is needed by radiation oncologists. This input from preclinical models is particularly relevant as we begin to integrate immunologic agents into clinical practice. This educational session will provide an introduction to radiation and immunotherapy broken down into radiation's impact on adaptive immunity and the negative feedback that radiation can cause in the tumor environment and on innate immune cells that may limit the efficacy of radiation combined with immunotherapy. In the process we will identify promising targets for clinical translation and extend the audiences understanding through checkpoint inhibitors and beyond.

URL

SPSH53B Radiation and Immune Therapy in CNS Tumors

Participants
Lia M. Halasz, MD, Seattle, WA, (lhalasz@uw.edu) (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the existing data on immunotherapy for treatment of primary and secondary brain tumors. 2) Learn about new areas of study and clinical trials. 3) Recognize challenges for response evaluation.

ABSTRACT

Response of primary and secondary brain tumors to immunotherapy has brought into question the dogma of the central nervous system as an immuno-priveleged site. In this educational session, we will review the clinical data for immunotherapy in the treatment of primary and secondary brain tumors, as well as existing clinical trials. We will also discuss the challenges in determining response and possible toxicities from combined immunotherapy and brain irradiation.

URL

SPSH53C Radiographic Imaging and Cancer Immune Therapy

Participants
Annick D. Van den Abbeele, MD, Boston, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

ABSTRACT

URL

RCA55

The Cancer Imaging Archive: Using 'Big Data' for the study of Cancer Radiomics, Proteomics, Genetics and Pathology (Hands-on)

Thursday, Dec. 1 4:30PM - 6:00PM Room: S401AB

BQ IN

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

Participants
Justin Kirby, Bethesda, MD (*Moderator*) Stockholder, Myriad Genetics, Inc
Justin Kirby, Bethesda, MD (*Presenter*) Stockholder, Myriad Genetics, Inc
Lawrence R. Tarbox, PhD, Little Rock, AR (*Presenter*) Nothing to Disclose
C. Carl Jaffe, MD, Boston, MA (*Presenter*) Nothing to Disclose
Brenda Fevrier-Sullivan, BA, Bethesda, MD (*Presenter*) Nothing to Disclose
Fred W. Prior, PhD, Little Rock, AR (*Presenter*) Stockholder, Siemens AG
John B. Freymann, BS, Rockville, MD (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Learn what data sets are available in The Cancer Imaging Archive (TCIA). 2) Identify and download existing TCIA data sets which match your research interests. 3) Collaborate with other researchers using Shared Lists and Digital Object Identifiers. 4) Identify metadata and support resources that include the TCIA helpdesk, FAQs, and system documentation.

ABSTRACT

Access to large, high quality data is essential for researchers to understand disease and precision medicine pathways, especially in cancer. However HIPAA constraints make sharing diagnostic clinical images outside an individual institution a complex process. The NCI's Cancer Imaging Archive (TCIA) addresses this challenge by providing hosting and de-identification services which take the burden of data sharing off researchers. TCIA now contains over 59 unique data collections of more than 28 million images. Recognizing that images alone are not enough to conduct meaningful research, most collections are linked to rich supporting data including patient outcomes, treatment information, genomic / proteomic analyses, and expert image analyses (segmentations, annotations, and radiomic / radiogenomic features). This hands-on session will teach the skills needed to fully access TCIA's existing data as well as learn how to submit new data for potential inclusion in TCIA.

SST02

Cardiac (Quantitative Imaging)

Friday, Dec. 2 10:30AM - 12:00PM Room: E450A

CA BQ CT MR

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

FDA Discussions may include off-label uses.

Participants
Seth J. Kligerman, MD, Denver, CO (*Moderator*) Nothing to Disclose
Bernd J. Wintersperger, MD, Toronto, ON (*Moderator*) Speakers Bureau, Siemens AG; Research support, Siemens AG

Sub-Events

SST02-01 Native T1 Variations after Repeated Measurements: Implication for Defining Regional Myocardial Changes Using MRI

Friday, Dec. 2 10:30AM - 10:40AM Room: E450A

Participants
Kai Lin, MD, MSc, Chicago, IL (*Presenter*) Nothing to Disclose
Jeremy D. Collins, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Kenichiro Suwa, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Zhanming Fan, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (*Abstract Co-Author*) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;
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

Changes of native T1 values may reflect the progression of cardiovascular diseases (CVDs). However, It can be difficult to determine whether a local change in native T1 values in the left ventricle (LV) is caused by measurement inaccuracies due to reproducibility and/or observer variability or by real changes in tissue structure as a result of improvement or deterioration of cardiovascular diseases. The aim of the present study was to establish normal T1 variation (T1v) thresholds for repeated measurements of regional T1 values using magnetic resonance imaging (MRI).

METHOD AND MATERIALS

This HIPAA compliant study was approved by the institutional review board (IRB). Eighteen healthy volunteers (38.5 ± 15.4 years [mean ± SD]; age range: 23 - 70 years; 12 male and 6 female) recruited to undergo 2 consecutive cardiac MRI scans using modified Look-Locker Inversion recovery (MOLLI) with two basal resolutions on different days to repeat T1 measurements on LV (at base, mid-ventricular and apex levels). The absolute differences (d) and standard deviations (SDs) of regional T1 values were acquired with the two scans (with basal resolutions 256 and 384) and two readers. T1v threshold (mean difference + 2SD), intra-class correlation coefficient (ICC) and coefficient of variation (CoV) were calculated on LV slices and segments.

RESULTS

T1 mapping using the MOLLI sequence was successfully performed in all 18 volunteers twice. For all participants, there was no significant difference of heart rates and blood pressure between two scans. Thre were totally 54 LV slices and 288 myocardial segments eligible for analysis. On a per-slice basis (n = 54), ICCs for intra-observer, inter-observer, inter-resolution, inter-study T1v were 0.988, 0.899, 0.763 and 0.6. CoVs were 0.72%, 2.39%, 3.90% and 4.28%. T1v thresholds were 22 ms, 66 ms, 118 ms and 120 ms. On a per-segment basis (n = 288), ICCs for T1v were 0.974, 0.859, 0.711 and 0.594. CoVs were 1.09%, 3.36%, 4.69% and 5.01%. T1v thresholds were 33 ms, 94 ms, 140 ms and 144 ms. See figure 1 and 2.

CONCLUSION

The regional T1v thresholds from repeated measurements found in our study demonstrate the underlying variability of the MOLLI techniques which is commonly used for myocardial native T1 quantification.

CLINICAL RELEVANCE/APPLICATION

Based on our data, we suggest not considering a regional T1v from an individual patinet that is inside of T1v thresholds, as an indication of the progression of CVDs.

SST02-02 Evaluation of Radiation-induced Cardiac Injury based on Native T1 and Extracellar Volume

Friday, Dec. 2 10:40AM - 10:50AM Room: E450A

Awards
Student Travel Stipend Award

Participants
Hidenobu Takagi, MD, PhD, Morioka, Japan (*Presenter*) Nothing to Disclose
Hideki Ota, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Rei Umezawa, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Tomoyoshi Kimura, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Keiichi Jingu, MD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Kei Takase, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate radiation-induced cardiac injury after chemoradiotherapy (CRT) for esophageal cancer using myocardial T1 and extracellar volume (ECV) fraction.

METHOD AND MATERIALS

This institutional review board-approved prospective study enrolled 26 patients (15 men, 11 women) with esophageal cancer scheduled for CRT between January 2013 and April 2015. No subjects had known cardiovascular comorbidity. Patients underwent serial cardiac MR examinations using a 3T whole body scanner before (n = 26), 0.5 years after (n = 21) and 1.5 years after (n = 15) CRT. Scan protocol included cine MR imaging, T1 mapping using modified Look-Locker inversion recovery before and after gadolinium-contrast administration and late gadolinium enhanced MR imaging. Mean T1 time in the left ventricular myocardium and blood pool were measured on both T1 maps in 4-chamber plane images (T1myo pre, T1myo post, T1blood pre and T1blood post). Regions of interest were placed on midwall of basal interventricular septum (IVS) as an irradiated area and that of the apical lateral wall as a non-irradiated area. ECV fraction was calculated using the following formula: (1 - hematocrit)(1/T1myo post - 1/T1myo pre)/(1/T1blood post - 1/T1blood pre). Ejection fraction (EF) derived from cine MR imaging, myocardial native T1 (T1myo pre) and ECV values after CRT were compared with those at the baseline as the reference using repeated measures ANOVA with Turkey's honestly significant difference test. $P < 0.05$ indicated statistical significance.

RESULTS

All patients completed CRT with median total radiation dose of 60 Gy (range, 50.4–66 Gy). EF was not significantly changed after CRT. On basal IVS, native T1 of 0.5 (1256 ± 33 ms) and 1.5 years (1223 ± 59 ms) after CRT were significantly higher than that of baseline (1179 ± 41 ms, $p < 0.01$ for both); ECV of 0.5 (32 ± 3%) and 1.5 years (28 ± 4%) after CRT were significantly higher than that of baseline (26 ± 3%, $p < 0.05$ for both). On apical lateral wall, no significant change was found in native T1 nor ECV after CRT.

CONCLUSION

Myocardial native T1 and ECV in basal IVS were increased after CRT. These results indicate radiation-induced subclinical myocardial injury with preserved left ventricular function.

CLINICAL RELEVANCE/APPLICATION

Native T1 and ECV can demonstrate radiation-induced subclinical myocaridial toxiy in patients with esophageal cancer treated with chemoradiotherapy.

SST02-03 Effects of 24-Hour-Shift Related Short Term Sleep Deprivation on Cardiac Function: A CMR Based Study

Friday, Dec. 2 10:50AM - 11:00AM Room: E450A

Participants
Daniel Kuetting, MD, Bonn, Germany (*Presenter*) Nothing to Disclose
Andreas Feisst, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Rami Homsi, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Julian A. Luetkens, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Daniel K. Thomas, MD, PhD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Hans H. Schild, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose
Darius Dabir, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Sleep deprivation is known to increase blood pressure, inflammatory processes, and stress hormone secretion. This study sought to investigate the immediate effects of 24 hour shift associated sleep deprivation on radiologists.

METHOD AND MATERIALS

15 subjects (1, female, mean age 31.6 ± 2.1 years; mean EF 60.5 %) were scanned on a clinical 1.5 T CMR scanner (Philips Ingenia) before and following a 24 hour shift with an average of 3 hours of sleep. In addition venous blood and urine samples were collected from all subjects and blood pressure (BP) as well as heart rate (HR) were measured. Short axis slices as well as horizontal long axis views were acquired using standard SSFP-sequences. Standard CMR parameters for left ventricular volumes, ejection fraction and wall thickness as well as Feature Tracking derived circumferential and longitudinal strain parameters were measured.

RESULTS

Following short term sleep deprivation (average sleep duration: 182 min) significant increases in systolic (pre: 112.6 ± 12.9 mm Hg; post: 118.5 ± 14.3 mm Hg; p= 0.017) and diastolic BP (pre: 63.9 ± 12.3 mm Hg; post: 71.5 ± 7.7 mm Hg, p= 0.021) , HR (pre: 66 ± 9.8 min-1; post: 71.4 ± 11.6 min-1; p= 0.002) as well as peak systolic circumferential strain (PSCS; pre: –22.3 ± 2.4 %; post: –23.9 ± 2.4%, p = 0.011) and peak systolic longitudinal strain (PSLS; pre: -21.4± 1.9 %*s-1; post: -23.1 ± 1.9 %*s-1, p = 0.005) were revealed. Additionally significant increases in cortisol (pre: 10.0 ± 4.4 µg/dl; post: 14.7 ± 5.7 µg/dl; p= 0.023), TSH (pre: 1.6 ± 0.5 µU/ml, post: 2.7 ± 1.0 µU/ml; p=0.002) FT3 (pre: 3.1 ± 0.98 pg/ml, post: 3.4 ± 0.5 pg/ml; p=0.039) and FT4 (pre: 0.9± 0.1 ng/dl, post: 1.0 ± 0.1 ng/dl; p=0.039) levels were found. In contrast, left ventricular ejection fraction, noradrenalin, glucose and insulin levels were unchanged (p = ns).

CONCLUSION

For the first time it could be shown that 24 hour shift related short term sleep deprivation leads to a significant increase in cardiac contractility, blood pressure, heart rate and stress hormone secretion.

CLINICAL RELEVANCE/APPLICATION

The clinical relevance is not yet well understood, since these effects may only be short lived and should be further studied in a larger cohort.

SST02-04 Quantitative Assessment of Left Ventricular Three-dimensional Maximum Principal Strain Using

Cardiac Computed Tomography: Identification of Myocardial Infarction Assessed by Cardiac Magnetic Resonance Imaging

Friday, Dec. 2 11:00AM - 11:10AM Room: E450A

Participants
Takahiro Yokoi, Toon, Japan (*Presenter*) Nothing to Disclose
Yuki Tanabe, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
Teruhito Kido, MD, PhD, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
Naoki Fukuyama, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
Akira Kurata, PhD, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
Ryo Ogawa, MD, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
Masashi Nakamura, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
Tomoyuki Kido, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
Masao Miyagawa, MD, PhD, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
Teruhito Mochizuki, MD, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Myocardial strains have a potential for accurate and objective assessment of regional cardiac dysfunction. The purpose of this study was to investigate the feasibility of three-dimensional (3D) maximum principal strain (MP-strain) of left ventricle (LV) for detecting myocardial infarction (MI) assessed by late gadolinium enhancement-magnetic resonance imaging (LGE-MRI).

METHOD AND MATERIALS

This study population consisted of 59 patients (mean age: 65.7±9.2 years), who underwent coronary CT angiography (CTA) with retrospective ECG gated mode and LGE-MRI for evaluation of coronary artery disease. Short axial images of LV were reconstructed every 10% (0-90%) of the RR interval of the ECG signal. The MP-strain value was analyzed in the endocardium based on the 16-segment model by using prototype software algorithm (Ziostation 2, Ziosoft Inc., Tokyo, Japan). All myocardial segments were defined as normal or infarcted segments [subendocardial (LGE<50%) and transmural infarction (LGE≧50%)] by LGE-MRI. The peak endocardial MP-strain values were analyzed at a segment level, and compared between normal and infarcted segments. Diagnostic performance [sensitivity, specificity, positive and negative predictive value (PPV and NPV)] of endocardial MP-strain for detecting MI was evaluated by receiver operating characteristic (ROC) analysis.

RESULTS

A total of 913 segments (97%) could be assessed for MP-strain analysis. Of 913 segments, 112 segments (12%) were diagnosed as infarcted segments. The peak endocardial MP-strain at infarcted segments were significantly lower than normal segments (median: 0.28 vs. 0.64, p <0.05), and significantly decreased in order to normal, subendocardial and transmural infarction (median: 0.64 vs. 0.34 vs. 0.23, P<0.05). The peak endocardial MP-strain had the area under the curve of 0.92 (95% confidence interval (CI): 0.89-0.94). Sensitivity, specificity, and PPV and NPV (95% CI) were 86% (80-92), 85% (82-87), 44% (38-51), and 97% (96-98) using a cut-off value of 0.40.

CONCLUSION

Quantitative assessment of CT MP-strain is feasible for detecting myocardial infarction assessed by LGE-MRI with high diagnostic performance.

CLINICAL RELEVANCE/APPLICATION

The MP-strain is available for the quantitative assessment of regional cardiac dysfunction by post-processing of coronary CTA data sets without additional radiation exposure and contrast medium.

SST02-05 Characteristics of Myocardial Scar Assessed by T1 Mapping in MI Patients: A Preliminary CMR Study

Friday, Dec. 2 11:10AM - 11:20AM Room: E450A

Participants
Chen Cui, MSc, Beijing, China (*Presenter*) Nothing to Disclose
Shihua Zhao, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

LGE cannot separate fat from fibrosis in scar tissue, for both of them manifest as high signals in LGE image. The main aim of present study is to investigate if T1 mapping by MRI is able to distinguish the difference between fat deposition, fibrosis and intact myocardium

METHOD AND MATERIALS

Twenty four Patients with myocardial infarction and ten healthy volunteers were studied after written informed consent was obtained. The MRI scan protocols included a series of short axis cine imaging of LV for function analysis, water-fat separation imaging, LGE imaging and T1 maps acquired by MOLLI sequence. The patients were divided into two groups depended on the presence or absence of fat in water-fat separation image. The scar tissue characteristics was determined by the results of water-fat separation and LGE image. The T1 values of the different scar areas represent fat, fibrosis and normal myocardium were compared.

RESULTS

The fat deposition was found in half of the patients (12 of 24). In patient with fat deposition, the distribution of fat deposition segments are identical with the LGE area. There are significant different between the T1 value of the scar area in patient with fat disposition, without fat disposition and the normal (remote) area of the patients (521±76 vs 1001.9±50.2 vs 1171.1±109 msec).In penitent without fat disposition, we used the remote myocardium of LGE as the standard true negative for fibrosis. The area under the ROC curve is 0.917±0.062; the best cut-off value for T1 value to detect fibrosis is 1095 msec (sensitivity of 83.3%, specificity of 91.7%).

CONCLUSION

Native T1 value can be used to identify the tissue characteristics of myocardium scar in patient with MI without the need of contrast agents. The fat disposition areas are lower and the fibrosis is higher than intact myocardium in T1 value.

CLINICAL RELEVANCE/APPLICATION

The fat deposition in myocardial scars is presence in more than half of the MI patients and is associated with different kinds of cardiac events.Present study provides new insights for further prognostic study

SST02-06 The Influence of Adaptive Iterative Dose Reduction 3D and Temporal Averaging on Contour Sharpness of Dynamic Myocardial CT Perfusion

Friday, Dec. 2 11:20AM - 11:30AM Room: E450A

Participants
Sarah Feger, Berlin, Germany (*Presenter*) Nothing to Disclose
Ahmed Shaban, MSc, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Steffen Lukas, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Bjorn Bokelmann, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Elke Zimmermann, MD, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Matthias Rief, MD, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Marc Dewey, MD, Berlin, Germany (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Bracco Group; Research Grant, Guerbet SA; Research Grant, Toshiba Corporation; 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; ; ; ; ; ; ; ; ;

PURPOSE

Myocardial computed tomography perfusion (CTP) allows the assessment of the functional relevance of a coronary stenosis. Dynamic CTP may be used to quantitatively analyze the absolute myocardial blood flow, but image quality is limited due to motion artefacts. Temporal averaging and iterative reconstructions were introduced to improve image quality. However, they are supposed to deteriorate image sharpness. Thus, the aim of this study was to investigate the influence of temporal averaging and adaptive iterative dose reduction 3D (AIDR 3D) on the contour sharpness of dynamic myocardial CTP.

METHOD AND MATERIALS

The dynamic myocardial CT perfusion datasets of 29 patients acquired at 9.5±2.0 mSv were reconstructed with filtered back projection (FBP) and strong levels of AIDR 3D. Temporal averaging without motion correction was performed as postprocessing step by combining two, three, four, six, and eight original 3D datasets. We compared the contour sharpness based on two different parameters including 4 edges of the myocardium: the distance between 25% and 75% of the maximal grey value (d) and the maximal slope between two contiguous voxels (m).

RESULTS

Both objective contour sharpness parameters showed the tendency to be deteriorated for strong levels of AIDR 3D compared with FBP (d=2.50 mm versus 2.27 mm; m=121.31 versus 145.24 summarized for all 4 edges; for d $p=0.02$ at edge 1, p n.s.at edges 2-4 and for m $p<0.04$ for all edges, respectively). With increasing levels of temporal averaging contour sharpness was slightly deteriorated. Best values for contour sharpness were acquired without temporal averaging (d=2.08 mm, m=167.34). Contour sharpness was worst for strongest levels of temporal averaging (d=2.52 mm, m=117.68; comparison between lowest and highest temporal averaging level: for d $p>0.17$ at all edges and for m $p<0.019$ at edges 1,3,4 and p n.s. at edge 2).

CONCLUSION

The usage of higher levels of temporal averaging without motion correction and strong levels of AIDR 3D slightly deteriorated objective contour sharpness parameters of dynamic myocardial CTP.

CLINICAL RELEVANCE/APPLICATION

In dynamic myocardial CTP the implementation of AIDR 3D and temporal averaging might reduce contour sharpness.

SST02-07 Fibrosis Quantification in Hypertensive Heart Disease with LVH and Non-LVH: Findings from T1 mapping and Contrast-free Cardiac Diffusion weighted Imaging

Friday, Dec. 2 11:30AM - 11:40AM Room: E450A

Participants
Lian-Ming Wu, Shanghai, China (*Presenter*) Nothing to Disclose

PURPOSE

To assess the extent of fibrosis and relationship between ADC value and systolic strain in hypertensive patients with left ventricular hypertrophy (HTN LVH), hypertensive patients without LVH using cardiac Diffusion weighted imaging and T1 mapping.

METHOD AND MATERIALS

T1 mapping was underwent in 13 HTN LVH (mean age, 56.23+3.30 years), 17 HTN non-LVH (mean age, 56.41+2.78 years), and 12 normal control subjects (mean age, 55.67+3.08 years) at 3.0T MRI using cardiac Diffusion weighted imaging and previously validated modified look-locker inversion-recovery pulse sequence and the mean ADC ECV and native T1 were determined for each subject.

RESULTS

HTN LVH subjects had higher native T1 (1233.12+79.01) compared with controls (1133.88+27.40) ($p<0.05$). HTN LVH subjects had higher ECV (0.28+0.03) compared with HTN non-LVH subjects (0.26+0.02) and controls (0.24+0.03), ($p<0.05$). HTN LVH subjects had higher ADC (2.23+0.34) compared with HTN non-LVH subjects (1.88+0.27) and controls (1.61+0.38),($p<0.05$). A positive association was noted between LVMI and ADC (Spearman=0.450, $p<0.05$). However, ADC was not linearly related to an increase in

LVMI. Increased levels of ADC were associated with reduced peak systolic and early diastolic circumferential strain rate across all subjects.

CONCLUSION

Contrast-free non-invasive quantitative DWI is a feasible alternative to the native T1 value and established contrast-enhanced ECV-CMR for the identification of diffuse myocardial fibrosis in HTN patients. HTN LVH patients have greater diffuse fibrosis and reduced circumferential strain and circumferential strain rate compared with HTN non-LVH and control subjects. Although diffuse fibrosis is linearly related to worsening circumferential strain, variations in ADC among patients with LVH may provide insight into the differential expression of fibrosis and myocyte hypertrophy among patients with HTN. ADC Measurement may serve as a useful novel target to monitor the efficacy of therapies for HTN patients.

CLINICAL RELEVANCE/APPLICATION

HTN LVH subject had greater ADC value and associated reduction in peak systolic circumferential strain, and early diastolic strain rate compared with HTN non-LVH and normal control subjects. Contrast-free DW-CMR is an alternative sequence to ECV in the evaluation of extent of fibrosis in HTN LVH and HTN Non-LVH while native T1 has its limited value.

SST02-08 Demonstration of Subclinical Myocardial Fibrosis in Patients with Primary Aldosteronism by Native T1 Time and Extracellar Volume Fraction

Friday, Dec. 2 11:40AM - 11:50AM Room: E450A

Participants
Hidenobu Takagi, MD, PhD, Morioka, Japan (*Presenter*) Nothing to Disclose
Hideki Ota, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Ryo Morimoto, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoshikiyo Ono, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Kentaro Takanami, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Kei Takase, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To evaluate the degree of myocardial fibrosis in patients with primary aldosteronism (PA) based on native T1 and extracellar volume (ECV).

METHOD AND MATERIALS

This retrospective study included 36 PA patients (20 men, 16 women) diagnosed by experienced endocrinologists and 15 control patients (9 men, 6 women) with essential hypertension. No subjects had known cardiovascular comorbidity nor severe renal dysfunction. All patients underwent cardiac MR examinations using a 3T whole body scanner between January 2013 and March 2016. Scan protocol included cine MR imaging, T1 mapping using modified Look-Locker inversion recovery before and after gadolinium-contrast administration and late gadolinium enhanced MR imaging. Mean T1 time on left ventricular myocardium and blood pool were measured on 4-chamber plane images before and after gadolinium-contrast injection. Regions of interest were placed on the midwall of basal interventricular septum (IVS) and apical lateral wall and left ventricular chamber. ECV fraction was calculated using hematocrit and individual T1 values. Presence of late gadolinium enhancement (LGE) was evaluated. The mean values of native T1 and ECV fraction as well as the presence of LGE were compared between PA and control groups. $P<0.05$ indicated statistical significance.

RESULTS

The prevalence of LGE, native T1 and ECV in PA group were significantly higher than that of control group (prevalence of LGE, 44.1% vs. 6.7%, $p=0.02$, native T1, basal IVS, 1240±8ms vs. 1183±15ms, apical lateral, 1185±9ms vs. 1124±16 ms, $p<0.01$ for both, ECV, basal IVS, 29±1% vs. 26±1%, apical lateral, 30±1% vs. 26±1%, $p<0.05$ for both). A similar tendency was found in 19 PA patients and 14 controls who had no LGE (native T1, basal IVS, 1236±13ms vs. 1189±17ms, apical lateral, 1189±14ms vs. 1126±17ms, $p<0.05$ for both, ECV, basal IVS, 29±1% vs. 26±1%, apical lateral, 30±1% vs. 26±1%, $p<0.05$ for both).

CONCLUSION

Myocardial native T1 and ECV in PA group were significantly higher than that of control hypertensive patients. These results indicate increased myocardial fibrosis in PA patients who has no history of cardiovascular disease.

CLINICAL RELEVANCE/APPLICATION

Native T1 and ECV can assess subclinical myocardial damage in PA patients.

SST02-09 CT-Derived Coronary Functional Flow Reserve: Computational Fluid Dynamics versus Machine Learning

Friday, Dec. 2 11:50AM - 12:00PM Room: E450A

Participants
Moritz H. Albrecht, MD, Charleston, SC (*Presenter*) Nothing to Disclose
Christian Tesche, MD , Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; ; ;
Matthias Renker, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Lucian Itu, Brasov, Romania (*Abstract Co-Author*) Employee, Siemens AG
Stefan Baumann, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Richard Bayer, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Christian Canstein, Charleston, SC (*Abstract Co-Author*) Employee, Siemens AG
Chris Schwemmer, Erlangen, Germany (*Abstract Co-Author*) Employee, Siemens AG
Max Schoebinger, Heidelberg, Germany (*Abstract Co-Author*) Employee, Siemens AG
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Consultant, Guerbet SA
Carlo N. De Cecco, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare two technical approaches for CT-derived coronary functional flow reserve (cFFR) determination: a method based on computational fluid dynamics (cFFRCFD) and a machine learning algorithm (cFFRML).

METHOD AND MATERIALS

Sixty-seven coronary lesions in 58 patients (61±12 years, 64% male) who had undergone CT angiography (CTA) followed by invasive FFR were included in this single-center retrospective study. cFFR values were derived from CTA datasets on-site on a local workstation using both cFFRCFD and cFFRML based on coronary artery anatomy and ventricular mass integrated with hemodynamic parameters. Diagnostic performance of both cFFR techniques was compared and evaluated for detection of lesion-specific ischemia against visual stenosis grading on CCTA, quantitative coronary angiography (QCA), and invasive FFR as the reference standard.

RESULTS

On a per-lesion and per-patient level, cFFRML showed a sensitivity of 77% and 87%, and a specificity of 96% and 89% for detecting lesion-specific ischemia, respectively. Furthermore, cFFRCFD resulted in a sensitivity of 77% and 85% and a specificity of 91% and 88% on a per lesion and per-patient basis (p=0.89 and p=0.95, respectively). At receiver operating characteristics analysis on a per-lesion level, cFFRML (AUC 0.85) and cFFRCFD (AUC 0.84) showed significantly higher discriminatory power for detecting lesion-specific ischemia compared to CCTA (AUC 0.62) and QCA (AUC 0.69) (cFFRML, p=0.001 and p=0.03; cFFRCFD, p=0.003 and p=0.04). Also on a per-patient level, cFFRML (AUC 0.88) and cFFRCFD (AUC 0.88) performed significantly better (cFFRML p=0.003 and p=0.04; cFFRCFD p=0.003 and p=0.04) than CCTA (AUC 0.62) and QCA (AUC 0.69). Mean total processing time per-patient for cFFRML and cFFRCFD determination was 40.4±6.8 minutes and 43.7±7.2 minutes (p=0.086), respectively.

CONCLUSION

The cFFRML algorithm shows a higher specificity, with no significant difference in diagnostic accuracy for detecting lesion-specific ischemia compared to the cFFRCFD approach. Both methods outperform CCTA and QCA accuracy in the detection of flow limiting stenosis.

CLINICAL RELEVANCE/APPLICATION

While both methods provide high diagnostic accuracy in the detection of flow limiting stenosis, our data suggests that the cFFRML algorithm may be preferable over the cFFRCFD technique due to higher specificity in the objective quantification of lesion-specific ischemia.

SST04

Gastrointestinal (Oncology Imaging and Response)

Friday, Dec. 2 10:30AM - 12:00PM Room: E353B

GI BQ CT OI

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
Janio Szklaruk, MD, PhD, Bala Cynwyd, PA (*Moderator*) Nothing to Disclose

Sub-Events

SST04-01 Personalized 3D-printed Transparent Liver Model Using the Hepatobiliary Phase MR Imaging: Usefulness in the Lesion-by-lesion Imaging-pathologic Matching of Focal Liver Lesions - Preliminary Results

Friday, Dec. 2 10:30AM - 10:40AM Room: E353B

Participants
Ijin Joo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jung Hoon Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sang Joon Park, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyung Bun Lee, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Nam-Joon Yi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the usefulness of personalized three-dimensional (3D)-printed transparent liver model using MR imaging for focal liver lesions (FLLs) in the lesion-by-lesion imaging-pathologic matching.

METHOD AND MATERIALS

This preliminary prospective study was approved by our institutional review board and written informed consents were obtained. Eleven patients with multiple FLLs who underwent gadoxetic acid-enhanced MRI for the preoperative workup of colorectal liver metastases (CRLM) or hepatocellular carcinoma (HCC) were included. A total of 51 indeterminate or malignant FLLs (13.5±14.0 mm; range, 2~80 mm) were detected on MRI. After the digital segmentation of hepatobiliary phase MR images, a transparent 3D-printed liver model with colored anatomical structures and FLLs at a 50% scale (except for too small FLLs at 100 or 150% scales) was produced. During gross sectioning of formalin-fixed liver specimen, a lesion-by-lesion matching between FLLs on liver model and on gross specimen was performed, and if needed, additional cross-section of the specimen was made.

RESULTS

Imaging-pathologic matching was successfully performed in 98.0% (50/51) of MRI-detected FLLs. On gross pathology analysis, 80.4% (41/51) of FLLs (14.8±15.1 mm) including histologically confirmed 36 CRLM, 4 HCC, and 1 no viable tumor were found on initial assessment; and 17.6% (9/51) of FLLs (7.3±3.3 mm) including 6 CRLM, 2 HCC, and 1 focal nodular hyperplasia were additionally found by second review of the specimen with an aid of 3D-printed transparent liver model with or without additional cross section (5.9%, 3/51 and 11.8%, 6/51, respectively). One FLL (2.0%, 1/51) of 2 mm was not found even after additional cross section of the specimen.

CONCLUSION

3D-printed liver model with FLLs enhances the lesion detection in the resected specimen and imaging-pathologic matching which may be helpful for making an accurate assessment of tumor burden as well as obtaining a reliable reference for imaging-detected FLLs.

CLINICAL RELEVANCE/APPLICATION

1. 3D-printed liver model with focal liver lesions (FLLs) might be helpful in the pathologic tumor staging by avoiding missed diagnosis of small FLLs.
2. A lesion-by-lesion imaging-pathologic matching using 3D-printed liver model may provide a reliable reference of standard for each FLL which is essential in the evaluation of diagnostic performance of imaging studies.

SST04-02 Automated Computed Tomography Volumetry to Predict Hemihepatectomy Specimens' Volumes in Patients with Primary or Secondary Hepatic Malignancy: Correlation with Intraoperative Volumes

Friday, Dec. 2 10:40AM - 10:50AM Room: E353B

Participants
Philipp Mayer, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose
Martin Groezinger, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Peter Schemmer, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Hans-Ulrich Kauczor, MD, Heidelberg, Germany (*Abstract Co-Author*) Research Grant, Siemens AG Research Grant, Bayer AG Speakers Bureau, Boehringer Ingelheim GmbH Speakers Bureau, Siemens AG Speakers Bureau, Novartis AG Speakers Bureau, GlaxoSmithKline plc Speakers Bureau, Almirall SA
Miriam Klauss, MD, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

One of the major causes of perioperative mortality of patients undergoing major hepatic resections is post-hepatectomy liver failure (*PHLF*). For surgical planning and preoperative appraisal of the risk of *PHLF* it is important to accurately predict the resectate

volume and the volume of the future liver remnant.

METHOD AND MATERIALS

The objective of our study is to prospectively evaluate the accuracy of hemihepatectomy resectate volumes determined by computed tomography volumetry (*CTV*) using an automated Liver Analysis Module (***S***) (syngo.CT, Siemens, Erlangen Germany) when compared with intraoperatively measured volumes and weights as gold standard in patients undergoing hemihepatectomy. Between January 2014 and November 2015, 24 patients (13 women, 11 men) scheduled for hemihepatectomy due to histologically proven primary or secondary hepatic malignancies were included in our study. Conversion factors between CT volumes one the one side and intraoperative volumes and weights on the other side were calculated using the method of least squares. Absolute and relative disagreements between CT volumes (with and without conversion factors) and intraoperative volumes were determined.

RESULTS

A conversion factor of c = 0.9057 most precisely predicted intraoperative volumes of exsanguinated hemihepatectomy specimens from CT volumes in all patients with mean absolute and relative disagreements between CT volumes and intraoperative volumes of 56.80 ml and 6.25 %. The use of operation-specific conversion factors yielded even better results.

CONCLUSION

CTV performed with ***S*** accurately predicts intraoperative volumes of hemihepatectomy specimens when applying conversion factors.

CLINICAL RELEVANCE/APPLICATION

Precise preoperative estimation of the resectate volume and the volume of the future liver remnant can help to minimize the risk of PHLF in patients undergoing major hepatic resections.

SST04-03 Differentiation of Intrahepatic Mass-forming Cholangiocarcinoma from Liver Abscess by Dual Source Dual-energy Spectral CT Quantitative Parameters

Friday, Dec. 2 10:50AM - 11:00AM Room: E353B

Participants
Ji Eun Kim, MD, Jinju, Korea, Republic Of (*Presenter*) Nothing to Disclose
Kyungsoo Bae, MD, Changwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jae Min Cho, MD, Jinju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hocheol Choi, Jinju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Dae Seob Choi, BA, Jinju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyunok Kim, Jinju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To investigate the use of dual source dual-energy spectral CT quantitative parameters compared with the use of conventional CT imaging features for differentiating intrahepatic mass-forming cholangiocarcinoma (IMCC) from liver abscess (LA).

METHOD AND MATERIALS

In this institutional review board-approved, retrospective study, 64 patients with IMCC and 52 patients with LA who were imaged in the portal venous phase (PVP) using dual energy-mode were included. Regions of interest were placed within each lesion to measure the mean CT value and its standard deviation (SD), normalized iodine concentration (NIC), and slope (k) of the spectral curve on virtual monochromatic spectral (VMS) images. Two observers qualitatively evaluated lesion types on the basis of conventional CT features. Independent samples t-test was used to compare quantitative parameters between IMCC sand LA. Parameters were fitted to logistic regression models. Sensitivity and specificity analyses were performed by using receiver operating characteristic curves and were compared with data from the qualitative analysis.

RESULTS

The CT value on VMS images at 50-130 keV (20 keV-interval), NIC, and k value were significantly higher in IMCCs than in LAs ($P < .0001$). The best single parameter for differentiating IMCC from LA was CT value at 90 keV, with sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of 89.1%, 86.5%, 87.9%, 89.1%, and 86.5%, respectively. The best combinations of parameters were CT value at 70-130 keV and NIC, with values of 87.5-90.6%, 75.0-78.9%, 83.6%, 81.7-83.6%, and 83.7-86.7%, respectively. Compared with qualitative analysis, the CT value at 90 keV showed higher accuracy (87.9% vs 74.1%, $P = .0113$) and sensitivity (89.1% vs 71.9%, $P = .0433$) and similar specificity (86.5% vs 76.9%, $P > .05$), and the combined CT value at 110-130 keV and NIC showed higher sensitivity (90.6% vs 71.9%, $P = .0118$) and similar specificity (75.0% vs 76.9%, $P > .05$) and accuracy (83.6% vs 74.1%, $P > .05$).

CONCLUSION

Quantitative analysis of dual source dual-energy spectral CT quantitative parameters showed higher sensitivity than qualitative analysis of conventional CT imaging features for differentiating IMCC from LA.

CLINICAL RELEVANCE/APPLICATION

The results of this study suggest that quantitative parameters of dual-sorce dual energy spectral CT imaging can be complementary to conventional CT imaging for differentiating IMCC from LA.

SST04-04 Dynamic Enhancement Pattern of Insulinomas on Volume Perfusion CT

Friday, Dec. 2 11:00AM - 11:10AM Room: E353B

Participants
Liang Zhu, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Huadan Xue, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Wei Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Hao Sun, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Gu Mu Yang Zhang, MD, Beijing, China (*Presenter*) Nothing to Disclose

PURPOSE

To assess the enhancement pattern of insulinomas on volume perfusion CT (VPCT), and to select phases for optimal tumor-parenchyma contrast.

METHOD AND MATERIALS

From August 2014 to December 2015, consecutive patients who underwent VPCT of the pancreas (80kV) with clinically suspected insulinomas were identified. Patients who received surgery and had pathological diagnosis of insulinomas were included, and patients with known multiple endocrine syndrome were excluded. Two experienced radiologists retrospectively evaluated tumor enhancement patterns on VPCT and analyzed the time-attenuation curve of the tumor and pancreatic parenchyma in consensus. The tumors were identified on CT with reference to surgical reports. Tumor-parenchyma contrast at each time point was measured and phases for optimal tumor-parenchyma contrast were selected.

RESULTS

Sixty-three patients were included,with 63 tumors.Five tumors were isoattenuating (tumor-parenchyma contrast <20HU in all 25 dynamic phases), 19 tumors had transient hyperenhancement (tumor-parenchyma contrast >20HU, duration < 10s), and 39 tumors had persistent hyperenhancement. Optimal tumor-parenchyma contrast was observed 9 s after abdominal aorta arriving at threshold of 200HU (AAT), with mean tumor-parenchyma attenuation difference of 77.6±57.2HU. At 9 s after AAT, 14 tumors were isoattenuating, including 5 tumors with intrinsic low contrast and 9 tumors with missed transient hyperenhancement. Complementary phases could be 12 s after AAT (detects another 4 tumors), 4 s after AAT and 1s after AAT (both detect another 3 tumors).

CONCLUSION

VPCT enables detection of insulinomas even if the hyperenhancement is transient. Optimal tumor-parenchyma contrast occurs 9 s after AAT. Tumors that are inconspicous on single- or biphasic contrast enhanced CT are mainly due to missed transient hyperenhancement.

CLINICAL RELEVANCE/APPLICATION

By analyzing dynamic enhancement of insulinomas, a single opitmal phase was selected, which yeilded the maximum tumor-parenchyma contrast and facilitates detection of insulinomas with low radiation dose. It was also found that transient hyperenhancement was the main reason that some insulinomas were inconspicuous on single- or biphasic enhanced CT.VPCT could detect insulinomas even if the hyperenhancement was transient.

SST04-05 Early Evaluation of Sunitinib for the Treatment of Advanced Gastroenteropancreatic Neuroendocrine Neoplasms via CT Imaging: RECIST or Choi Criteria?

Friday, Dec. 2 11:10AM - 11:20AM Room: E353B

Participants
Yanji Luo, Guangzhou, China (*Presenter*) Nothing to Disclose
Shiting Feng, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Zi-Ping Li, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Jie Chen, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The aim of this study was to assess and compare the Response Evaluation Criteria in Solid Tumors (RECIST) and the Choi criteria for evaluating the early response of advanced gastroenteropancreatic neuroendocrine neoplasms (GEP-NENs) treated with sunitinib.

METHOD AND MATERIALS

Eighteen patients with pathologically proven advanced GEP-NENs treated with sunitinib were enrolled in the study. Pre- and post-treatment CT scans (plain, biphasic enhanced CT scan) were performed on all patients. Changes in the target tumor size and density from pre-treatment to 1.4-3.1 months after treatment were measured and recorded for each patient. Tumor responses were identified using RECIST and the Choi criteria. The time to tumor progression (TTP) for each patient was measured and compared between groups using the Kaplan-Meier method. The expression of vascular endothelial growth factor receptor 2 (VEGFR 2) was detected in 10 GEP-NEN tissues via immunohistochemical(IHC) staining.

RESULTS

Among the 18 patients, 4 (22%) exhibited a partial response (PR), 9 (50%) exhibited stable disease (SD), and 5 (28%) experienced progressive disease (PD), according to RECIST. However, based on the Choi criteria, 8 (44%) patients exhibited a PR, 4 (22%) exhibited SD, and 6 (33%) experienced PD. According to RECIST, the TTP of the PR group was significantly longer than that of the PD group (P=0.007) but not the SD group (P=0.131). According to the Choi criteria, the TTP of the PR group was significantly longer than that of the SD (P=0.026) and PD groups (P<0.001). Among the 10 patients showing IHC staining for VEGFR 2, seven (70%) tissues showed positive results, among which 3 (42.9%) and 4 (57.1%) exhibited PR, according to RECIST and the Choi criteria at early evaluation, respectively.

CONCLUSION

The Choi criteria appear to be more sensitive and more precise than RECIST for assessing the early response of advanced GEP-NENs treated with sunitinib.

CLINICAL RELEVANCE/APPLICATION

Choi criteria might be considered as an alternative to RECIST to evaluate the effects of sunitinib in patients with advanced GEP-NENs.

SST04-06 Agreement of Six- and Composite Three-echo Magnitude PDFF-Estimation MRI Sequences in a Multi-center Clinical Trial

Friday, Dec. 2 11:20AM - 11:30AM Room: E353B

Participants
Michael S. Middleton, MD, PhD, San Diego, CA (*Presenter*) Consultant, Allergan plc Institutional research contract, Bayer AG Institutional research contract, sanofi-aventis Group Institutional research contract, Isis Pharmaceuticals, Inc Institutional research contract, Johnson & Johnson Institutional research contract, Synageva BioPharma Corporation Institutional research contract, Takeda Pharmaceutical Company Limited Stockholder, General Electric Company Stockholder, Pfizer Inc Institutional research contract, Pfizer Inc
Mary Kosinski, PhD, Nashville, TN (*Abstract Co-Author*) Employee, NuSirt Biopharma, Inc
Omar Flores, PhD,MBA, Nashville, TN (*Abstract Co-Author*) Employee, NuSirt Biopharma, Inc
Michael Zemel, PhD, Nashville, TN (*Abstract Co-Author*) Employee, NuSirt Biopharma, Inc
Claude B. Sirlin, MD, San Diego, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Guerbet SA; ;

PURPOSE

Most MR scanners can acquire 6-echo and/or composite 3-echo magnitude MRI sequences to estimate proton density fat fraction (PDFF). PDFF estimated from the first 3 echos of a 6-echo sequence is nearly equivalent to that estimated from all 6-echos. However, to pool data in clinical trials, we need to show that PDFF derived from 6-echo sequences is essentially equivalent to that derived from separately-acquired composite 3-echo sequences. Hence, the purpose of this study was to calculate the agreement of baseline 6- and composite 3-echo sequences using regression and Bland-Altman analysis in a multi-center clinical trial.

METHOD AND MATERIALS

Anonymized baseline MRIs were analyzed to estimate PDFF for 64 subjects from 7 sites in an ongoing multi-center clinical trial. A multi-echo (ME) magnitude spoiled gradient-recalled-echo (6-echos) MRI sequence, and a pair of double-echo sequences were acquired for each subject. A composite 3-echo dataset was created from the double-double-echo (DDE) sequences. Two additional composite three-echo datasets (one from 1st, 2nd, an 4th echoes; one from first 3 echoes) were created directly from the ME sequence. Three co-localized regions of interest were placed in the right lobe of the liver for all sequences. PDFF was calculated for each dataset using a custom MatLab algorithm. Regression and Bland-Altman analysis was performed to evaluate agreement between PDFF derived from the three composite DDE datasets, and the ME sequence.

RESULTS

ME sequence-derived PDFF ranged from 2.11 to 35.07%. PDFFs from separately- acquired ME and composite DDE sequences showed strong agreement (slope near 1, intercept near 0), but were slightly different (mean difference 0.46%; difference range -2.01 to 1.96%; $p < 0.0001$). Agreement was even stronger for the composite DDE sequences derived directly from the ME sequence, with best agreement for the composite DDE sequence derived from the first 3 echos of the ME sequence (mean difference 0.14%; difference range -0.86 to 0.69%).

CONCLUSION

PDFFs derived from ME sequences showed strong agreement with those derived from separately-acquired and derived composite DDE sequences, with small differences that are likely to be considered negligible in clinical trials.

CLINICAL RELEVANCE/APPLICATION

Our data support that PDFFs from 6-echo and separately-acquired composite 3-echo magnitude MRI sequences may be pooled, given their strong agreement in a multi-center clinical trial.

SST04-07 Diagnostic Value of Low Dose CT-protocol with 4th Generation Iterative Reconstruction Algorithm in Assessment of Mesorectal Fascia Invasion in Rectal Cancer: Comparison with Magnetic Resonance

Friday, Dec. 2 11:30AM - 11:40AM Room: E353B

Participants
Silvia Girolama Drago, Monza, Italy (*Presenter*) Nothing to Disclose
Davide Ippolito, MD, Monza, Italy (*Abstract Co-Author*) Nothing to Disclose
Cammillo R. Talei Franzesi, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandra S. Casiraghi, Casatenovo, Italy (*Abstract Co-Author*) Nothing to Disclose
Sandro Sironi, MD, Monza, Italy (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine the diagnostic efficacy in terms of radiation dose and image quality of low dose CT protocol combined with iterative reconstruction algorithm (iDose4) in the assessment of mesorectal fascia (MRF) invasion in rectal cancer patients in comparison with standard dose CT, using MRI as reference standard.

METHOD AND MATERIALS

Ninety-one patients with biopsy proven primary rectal adenocarcinoma underwent CT whole-body staging: 42 of them underwent low-dose CT while 49 underwent standard CT protocol. Low dose contrast-enhanced MDCT scans were performed on a 256 (ICT, Philips) scanner with tube voltage 120 KV, automated mAs modulation and slice thickness 2 mm, using iDose4 iterative reconstruction algorithm. The control group of 49 patients underwent standard dose (120 KV, 200-300mAs) contrast-enhanced MDCT examination on the same scanner. All patients were also evaluated with standard lower abdomen MR study, performed on 1.5 T magnet, including standard multiplanar sequences, considered as reference standard. Diagnostic accuracy in terms of MRF assessment was determined on CT images in portal venous phase for both CT protocol and compared with MRI imaging finding. Dose length product (DLP) calculated for both groups was compared and statistically analyzed.

RESULTS

Low-dose protocol combined with iDose4 showed high diagnostic quality in assessment of MRF involvement, also in comparison with standard MR studies. Total DLP was significantly ($p<0.0081$) lower for low dose protocol studies (2453.4 mGy*cm), as compared to standard dose examinations (3194.3 mGy*cm), allowing an overall dose reduction of 23 %. Image noise was slightly higher in low dose images but the difference was not statistically significant.

CONCLUSION

Low-dose CT-protocol combined with iDose4 reconstruction algorithm offers high quality images with significant reduction of

Low-dose CT protocol combined with iDose4 reconstruction algorithm offers high quality images with significant reduction of radiation dose, being a useful tool in the evaluation of MRF involvement in rectal cancer patients.

CLINICAL RELEVANCE/APPLICATION

MDCT with low dose protocol, due to radiation dose reduction and high image quality, should be considered a reliable tool in rectal cancer staging, especially in patient with MRI contraindications.

SST04-08 Quantitative Functional Evaluation of Advanced Hepatocellular Carcinoma: Correlation between Dual-energy Iodine Maps and Perfusion CT Parameters

Friday, Dec. 2 11:40AM - 11:50AM Room: E353B

Participants
Sebastien Mule, MBBS, Reims, France (*Abstract Co-Author*) Nothing to Disclose
Frederic Pigneur, MD, Creteil, France (*Abstract Co-Author*) Nothing to Disclose
Ronan Quelever, BUC, France (*Abstract Co-Author*) Employee, General Electric Company
Laurence Baranes, MD, Creteil, France (*Abstract Co-Author*) Nothing to Disclose
Philippe Richard, Velizy Cedex, France (*Abstract Co-Author*) Employee, General Electric Company
Alain Rahmouni, MD, Nogent Sur Marne, France (*Abstract Co-Author*) Nothing to Disclose
Valerie Vilgrain, MD, Clichy, France (*Abstract Co-Author*) Nothing to Disclose
Alain Luciani, MD,PhD, Creteil, France (*Presenter*) Nothing to Disclose

PURPOSE

To determine whether dual-energy CT (DECT) iodine concentrations correlate with perfusion CT parameters in patients with advanced hepatocellular carcinomas (HCC).

METHOD AND MATERIALS

Sixteen patients with advanced HCC who underwent dynamic perfusion CT and multiphase DECT using a single source DECT (GE HD750) were retrospectively included. Iodine maps and blood flow (BF), blood volume (BV), hepatic arterial BF (artBF), and hepatic portal BF (portBF) maps were calculated. Circular regions of interest were manually drawn in HCC and tumor-free liver parenchyma and copied to all perfusion and iodine maps. Correlation between arterial and portal iodine maps and perfusion maps was calculated (Pearson correlation coefficient). An adjusted P value (Holm's method) < 0.05 was considered significant.

RESULTS

Mean HCC and liver-free parenchyma iodine concentrations were 22.7 mg/ml and 17.1 mg/ml at arterial phase ($p=0.02$), and 18.7 mg/ml and 24.5 mg/ml at portal phase ($p=0.07$), respectively. A significant correlation was found between BF and arterial iodine concentration ($r=0.73$, $p<0.0001$), BF and portal iodine concentration ($r=0.72$, $p<0.0001$), artBF and arterial iodine concentration ($r=0.74$, $p<0.0001$), BV and arterial iodine concentration ($r=0.56$, $p=0.0027$), BV and portal iodine concentration ($r=0.53$, $p=0.0094$).

CONCLUSION

DECT derived iodine maps correlate with perfusion parameters and may therefore allow accurate tumor functional evaluation in patients with advanced HCC.

CLINICAL RELEVANCE/APPLICATION

DECT derived iodine concentration significantly correlate with perfusion parameters and may therefore allow accurate longitudinal tumor functional evaluation in patients with advanced HCC.

SST04-09 Value of Pelvis CT during Follow-up of Patients with Pancreatic Adenocarcinoma

Friday, Dec. 2 11:50AM - 12:00PM Room: E353B

Awards
Student Travel Stipend Award

Participants
Jason J. Bailey, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
James H. Ellis, MD, Ann Arbor, MI (*Abstract Co-Author*) Consultant, General Electric Company
Matthew S. Davenport, MD, Cincinnati, OH (*Abstract Co-Author*) Royalties, Wolters Kluwer nv; ;
Richard H. Cohan, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Bin Nan, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Aishwarya Parameswaran, MS, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Lin Hsu, MD, Ann Arbor , MI (*Abstract Co-Author*) Nothing to Disclose
Vaibhav Sahai, MBBS, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Isaac R. Francis, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To determine the frequency in which the pelvis component of an abdominopelvic CT provides information that would influence clinical management in patients with previously resected or locally advanced pancreatic ductal adenocarcinoma (PDA).

METHOD AND MATERIALS

This institutional review-board approved retrospective study with waived informed consent included 247 subjects with histologically proven PDA, including 153 post-pancreaticoduodenectomy and 94 with locally advanced unresectable disease who had imaging interpreted at our cancer center between January 2005 and December 2013. Imaging reports were obtained from our institution’s Radiology Information System, reports were searched for the words “whipple” and “unresectable” to create two cohorts, and the radiology report associated with the first examination intended for oncologic treatment guidance was chosen for review. Separate abdomen and pelvis CT findings were reviewed and graded for their likelihood of representing metastatic disease. Probability of finding isolated metastatic disease on pelvic CT was determined using 95% binomial proportion confidence intervals.

RESULTS

No subjects who had undergone pancreaticoduodenectomy had an isolated pelvic metastasis on follow-up imaging (0%; 95% CI 0-2.38, p = 0.0004); 33 had metastatic disease in the abdomen, and 120 had no or equivocal evidence of abdominopelvic metastatic disease. One subject with locally advanced unresectable PDA had a possible isolated pelvic metastasis on follow-up imaging (1.1%; 95% CI 0.03-5.79, p = 0.048); 20 had metastatic disease in the abdomen, and 73 had no or equivocal evidence of abdominopelvic metastatic disease.

CONCLUSION

Isolated pelvic metastatic disease rarely occurs in patients with PDA who have had prior pancreaticoduodenectomy or have a locally advanced unresectable primary tumor, suggesting that routine pelvic CT follow-up imaging of these patients is unnecessary.

CLINICAL RELEVANCE/APPLICATION

Routine pelvic CT may not be necessary in follow-up of patients with pancreatic adenocarcinoma who have had prior pancreaticoduodenectomy or have a locally advanced unresectable primary tumor.