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Explore Invent Transform

CAS-MOA

Cardiac Monday Poster Discussions

Monday, Nov. 27 12:15PM - 12:45PM Room: CA Community, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

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Sub-Events

CA210-SD-MOA1 A Novel Contrast Injection Protocol of Variable Two-Phase Injection Method for Cardiac CT

Station #1

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PURPOSE

This study was focused on evaluating a novel contrast injection protocol of variable two-phase injection method (VTIM) to maintain the TEC (Time Enhancement Curve) and the target CT number. Using Flat Single-Phase Injection Method (FSIM), it is difficult to achieve the target peak CT number at the same time. This problem causes under and nonuniform-enhancement of coronary arteries, which causes difficulty of automatic coronary artery tracking of workstation or difficulty of distal coronary stenosis assessment. To overcome the problem, we evaluated Variable Two-Phase Injection Method (VTIM) in comparison to FSIM.

METHOD AND MATERIALS

We targeted to maintain 400HU for more than 5 seconds in the descending aorta. The same amount of contrast medium and injection duration of 13 seconds were used. In FSIM, contrast injection was kept on 3.6mL/sec. In VTIM, contrast injection rate was decreased from 5.1 to 4.0mL/sec in 5 seconds in the first phase, then from 4.6 to 2.2mL/sec for 8 seconds in the second phase. 1) A digital and blood flow phantom were used to compare the TEC characteristics of the two methods. 2) The CT value of proximal (0mm) and distal (170mm) LAD and RCA were assessed in the clinical setting. The difference in CT value on the proximal coronary points was calculated between LAD and RCA. Enhancement slope was calculated as the ratio of proximal to distal coronary CT value to assess the distal enhancement.

RESULTS

In the digital and blood flow phantom, the rise time of TEC was shorter and the target CT value was obtained earlier in VTIM compared with FSIM. In both VTIM and FSIM, the target CT value of 400HU for more than 5 seconds were achieved, while the time over 400HU was longer in VTIM (Fig1,2). In the clinical evaluation, the CT value difference between LAD and RCA was smaller (Fig3), and the correlation was better in VTIM (Fig4).The enhancement slope was smaller in VTIM than FSIM (Fig5), which meant better distal coronary enhancement.

CONCLUSION

VTIM demonstrated earlier and more effective contrast enhancement in cardiac CT. VTIM has the potential to improve contrast enhancement in the coronary arteries, which may enhance diagnostic performance in cardiac CT.

CLINICAL RELEVANCE/APPLICATION

A novel injection protocol, VTIM, achieves better contrast distribution and distal coronary enhancement than FSIM in cardiac CT. It may contribute to better automatic coronary tracking and distal coronary stenosis assessment.

CA211-SD-MOA2 Non-Contrast Compressed Sensing Whole-Heart Coronary MRA at 3T: First Results in Twenty Healthy Volunteers

Station #2

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PURPOSE

Whole-heart coronary magnetic resonance angiography (WHC-MRA) is a promising non-contrast and radiation-free technique for the assessment of coronary artery. However, one of the main problematic factors includes relatively long acquisition times. Compressed sensing (CS) techniques are known to be able to reduce scan time considerably, and this technique was recently applied to the cardiovascular field around cine MRI (Kido T et al. J Cardiovasc Magn Reson 2016). However, almost no studies of CS MR have been reported in the field of coronary artery. The purpose of this study was to evaluate the diagnostic quality of CS WHC-MRA compared with conventional WHC-MRA.

METHOD AND MATERIALS

Twenty healthy volunteers underwent both conventional navigator gated WHC-MRA and navigator gated WHC-MRA with a prototype sequence using CS on a clinical 3T MRI scanner (MAGNETOM Skyra, Siemens Healthcare). The spatial resolution of CS protocol is almost same as conventional protocol. We respectively assessed acquisition times, scores of image quality on a 4-point scale (1-4) of coronary artery (RCA: proximal, middle and distal, LAD: main, proximal, middle and distal, LCX: proximal and distal) and the visualized vessel lengths of RCA, LAD and LCX.

RESULTS

With a mean acceptance rate of 46.8% for both methods (no significant difference), the mean effective scan time was 3 min 45 sec for CS WHC-MRA and 15 min 06 sec for conventional WHC-MRA ($p<0.001$). Conventional WHC-MRA received mean image scores above 3.4 in all segments. CS WHC-MRA received scores above 3 (good quality for diagnosis) in almost all segments, and only the distal RCA segment was graded slightly below 3 (2.9 on average). The average visible vessel lengths were 12.5 ± 4.8 cm (conventional) and 11.5 ± 4.4 cm (CS) for RCA ($p < 0.05$, 95 % CI; -3.5 cm to 1.5 cm), 11.1 ± 2.9 cm (conventional) and 10.6 ± 3.0 cm (CS) for LAD ($p=0.15$, 95 % CI; -4.0 cm to 2.8 cm), 8.2 ± 2.5 cm (conventional) and 7.1 ± 2.2 cm (CS) for LCx ($p < 0.05$, 95 % CI; -4.0 cm to 1.7 cm), respectively.

CONCLUSION

CS WHC-MRA could shorten the scan time considerably while maintaining diagnostic image quality compared with conventional WHC-MRA. Further study is needed to evaluate the clinical benefit of this technique.

CLINICAL RELEVANCE/APPLICATION

CS WHC-MRA is short enough to be acquired in the waiting time between contrast injection and Late Gadolinium Enhancement imaging.

CA212-SD-MOA3 Coronary Artery Stent Evaluation Using a Vascular Model at Ultra-High Resolution CT with 0.25-mm Slice Thickness

Station #3

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PURPOSE

The purpose of this study was to evaluate improvement of measurement accuracy of in-stent lumen using coronary stent phantoms on Ultra-High Resolution CT (U-HRCT : 0.25mm×160 detector-rows) compared with conventional 80 detector-rows CT (MDCT : 0.5mm×80 detector-rows).

METHOD AND MATERIALS

As for a vascular model of the coronary artery, Acrylonitrile-butadiene-styrene resin material with a CT value of 40 HU that is similar to that of a vessel wall was chosen to simulate the coronary artery. All the vessel models had an inner diameter of 2.25mm,2.5mm and 3.0 mm. As for stents, three different sizes (2.25mm, 2.5mm, 3.0mm) of stents (XIENCE Xpedition : Abbott) were inserted into vascular model. All the stent phantoms had filled with contrast material diluted to 300 HU. Those phantoms in water-filled tank were scanned on both U-HRCT and MDCT. The diameter of the stent lumen was measured by using ImageJ software (National Institutes of Health). The measurements were repeated 5 times in each stents. The underestimate ratio (UR) was defined using the following equation: UR = [TD - Dct]/TD. The true diameter (TD) of stent is measured on the IVUS image, Dct is the inner diameter of the stent as measured on the CT image. All of the statistical analysis were performed on Mann-Whitney test.

RESULTS

The underestimate ratio (U-HRCT vs. MDCT) were (31% vs. 71%, $p < 0.05$) for 3.0mm stent, (37% vs. 88%, $p < 0.05$) for 2.5mm stent, and (46% vs 92%, $p < 0.05$) for 2.25mm stent. The underestimate ratio of U-HRCT were significantly smaller than that of MDCT.

CONCLUSION

Ultra-High Resolution CT offers improved measurement accuracy for imaging coronary stents compared to conventional MDCT.

CLINICAL RELEVANCE/APPLICATION

Superior spatial resolution of Ultra-High Resolution CT could be promising for more accurate measurement of in-stent diameter.

CA213-SD-MOA4 The Impact of Forward-projected Model-based Iterative Reconstruction SoluTion (FIRST) on Diagnostic Performance of Coronary CT Angiography with Lower Radiation Dose

Station #4

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PURPOSE

To evaluate the impact of Forward-projected model-based Iterative Reconstruction SoluTion (FIRST) on diagnostic performance for detection of coronary artery disease (CAD) of coronary CT angiography (CCTA) with lower radiation dose.

METHOD AND MATERIALS

This retrospective study included 26 consecutive patients (6 women, mean age, 66±10 years) suspected stable CAD who underwent CCTA followed by invasive coronary angiography (ICA). We excluded patients with known CAD. All CCTA examinations were performed with a 320-row CT scanner. Prospective ECG gating with acquisition window of just diastolic or systolic to diastolic phase were used for patients with heart rate of <70 or >=70bpm. The CT images were reconstructed with both filtered back projection (FBP) with smooth kernel and FIRST. Per-segment diameter stenosis was independetly mesured on each CCTA with FBP and FIRST, and ICA based on SCCT 18 segment. The obstrcutive CAD was defined as >=50% diameter stenosis. Image noise of CCTA was defined as standard deviation of attenuation values of region of interest at the ascending aorta. Per- patient, vessel and segment diagnostic performance of CCTA with the refferrence standard of ICA, differences from ICA in diameter stenosis and the image noise were compared between FIRST and FBP.

RESULTS

Obstructive CAD was found in 30(9%) segments among 26(33%) vessels in 19(73%) patients. There were no significant difference in per-patient diagnostic performance between FIRST and FBP (sensitivity, 95%vs.100%, p=0.32; specificity, 71%vs.57%, p=0.56 and accuracy, 88%vs.88%, p=1.00). Per- vessel and segment specificity and accuracy of FIRST were significantly higher than those of FBP (vessel, 90%vs.71% and 91%vs.81%; segment, 98%vs.92% and 98%vs.93%, p<0.05 for all). Mean difference between CCTA with FIRST and ICA in diameter stenosis was significantly lower than FBP (3±9%vs.7±9%, p<0.01). Mean effective radiation dose of CCTA was 1.7±0.7mSv. Image noise of FIRST was significantly lower than FBP (20±2vs.36±6, p<0.01).

CONCLUSION

CCTA with FIRST showed not only lower image noise but also better diagnostic performance, and enables more accurate quantification of coronary artery stenosis in comparison with FBP at lower radiation dose.

CLINICAL RELEVANCE/APPLICATION

The use of FIRST reduces the image noise and improves diagnostic performance of CCTA with lower radiation dose.

CA214-SD-MOA5 Influence of Myocardial Mass on Accuracy of Machine-Learning Coronary CTA-Derived Fractional Flow Reserve Compared to Invasive Measurement: Results from the MACHINE-Registry

Station #5

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PURPOSE

To investigate the impact of myocardial mass on the accuracy of on-site machine-learning coronary CTA-derived fractional flow reserve (CT-FFRml) estimations for the determination of lesion-specific ischemia using invasive FFR as the reference standard.

METHOD AND MATERIALS

Three-hundred and one patients from the MACHINE registry (Machine leArning based CT angiograpHy derIved FFR: a multi-ceNtEr registry; NCT02805621) who had undergone coronary CTA followed by invasive FFR measurement in four centers in the US, Europe, and Asia were included in the analysis. All datasets were analyzed using an on-site machine-learning CT-FFR algorithm (Siemens Frontier). In a per-vessel analysis, the coronary arteries (n = 458) were separated into two groups based on myocardial mass; specifically, <= 162 g (n = 231) and > 163 g (n = 227). The correlation between myocardial mass and the discrepancy of CT-FFRml and invasive FFR was assessed. Per-vessel diagnostic accuracy of CT-FFRml for the detection of lesion-specific ischemia (invasive FFR<0.8) was analyzed for both groups and compared to subjective coronary CT angiography (CCTA) evaluation.

RESULTS

Higher myocardial mass was associated with an underestimation of CT-FFRml values (mean deviation in FFR measurements, 0.02 [3.0%], r = 0.307, P < 0.001). The incremental value of CT-FFRml for the accurate prediction of lesion-specifc ischemia compared to visual CCTA assessment alone was greater (P = 0.04) in the high-myocardial mass group (increase in accuracy, 18.0 %) compared to the low-myocardial mass cohort (increase in accuracy, 16.8 %).

CONCLUSION

The incremental value of CT-FFRml for the detection of lesion-specific ischemia compared to CCTA evaluation alone increases with higher myocardial mass values. Simultaneously, higher myocardial mass is correlated with a slight underestimation of CT-FFRml values.

CLINICAL RELEVANCE/APPLICATION

The incremental value of CT-FFRml analysis compared to standard CCTA evaluation alone to predict stenosis-related hypoperfusion increases with higher myocardial mass values. This finding may shed new light on the relationship between functional CT approaches such as fractional myocardial mass and CT-FFRml for the prediction of lesion-specific ischemia. In addition, our data may hold potential for optimized training of the deep-learning CT-FFRml algorithm by including CCTA data with higher myocardial mass values, which showed a slight underestimation of FFR values.

CA215-SD-MOA6 Initial Experience with Contrast-Enhanced Whole-Heart 3D Cine Cardiac MRI within a Single Breath-Hold at 3T

Station #6

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PURPOSE

Bright-blood anatomical imaging can be challenging using balanced SSFP at 3T with increased susceptibility to banding artifacts. SPGR-weighted 4D Flow has shown potential for comprehensive imaging of cardiac flow and function with blood pool contrast. However, visualization of function and wall motion is suboptimal with conventional gadolinium agents due to transient blood enhancement. We share our initial experience with single breath-hold SPGR 3D Cine as an option to evaluate cardiac function at 3T, to overcome limitations of 4D Flow and potentially reduce scan time.

METHOD AND MATERIALS

With HIPAA-compliance and IRB approval, 17 patients underwent cardiac MRI on a 3 Tesla magnet at our institution between November 2016 and April 2017, including multiplanar cine SSFP, single breath-hold volumetric SPGR 3D Cine, and SPGR 4D Flow. We compared blood pool-to-myocardial contrast between bolus-timed 3D Cine, blood-pool 4D Flow after intravenous administration of gadobutrol or gadobenate dimeglumine and conventional SSFP. Near-isotropic 3D Cine acquisitions were reformatted into short-axis and 2-, 3-, and 4-chamber planes using proprietary software. Left ventricular function was visually graded using 3D Cine by two interpreters (8 years and 1 year cardiac MRI experience) and compared against quantitative measurements from SSFP as the clinical gold standard. Statistical analysis included two-tailed paired t-tests and assessment of intraclass correlation coefficient (ICC).

RESULTS

Left ventricular first-pass bolus-timing was adequately performed for 3D Cine in all acquisitions. 3D Cine showed superior blood pool-to-myocardial signal ratios (3.54 ± 0.82), followed by SSFP (2.48 ± 0.52) and 4D Flow (1.69 ± 0.17). Each of these comparisons was statistically significant (p<0.001). Visual grading of left ventricular function using 3D Cine showed good inter-reader reliability (ICC=0.776) between two readers and correlated well using quantitative functional measurements from conventional SSFP (ICC=0.798 for reader A, 0.614 for reader B).

CONCLUSION

SPGR-weighted 3D Cine provides excellent blood-pool to myocardial contrast compared against both 4D flow and conventional SSFP and shows promise for evaluating systolic function in a single breath hold.

CLINICAL RELEVANCE/APPLICATION

Along with 4D Flow MRI, single-breath hold 3D Cine has potential to reduce the time and technical skill required for evaluation of structural heart disease using cardiac MRI.

CA216-SD-MOA7 Cardiac Sympathetic Denervation in Anderson-Fabry Disease Precedes Myocardial Fibrosis: A 123I - Metaiodobenzylguanidine Myocardial Scintigraphy and Magnetic Resonance Imaging Study

Station #7

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PURPOSE

Cardiac sympathetic denervation is detectable by myocardial 123I-metaiodobenzylguanidine (MIBG) imaging in patients with Anderson-Fabry disease (AFD), suggesting its usefulness for early detection of the disease. We aimed to correlate MIBG findings with the presence of myocardial fibrosis on cardiac magnetic resonance (MR).

METHOD AND MATERIALS

Twenty-five patients (13 men, mean age 45±13 years) with genetically proved AFD and preserved left ventricular (LV) systolic function and 10 age and gender-matched control subjects underwent 123I-MIBG single-photon emission computed tomography (SPECT) imaging. Within one month, all patients also underwent contrast enhanced MR. Eleven patients (44%) were on enzyme replacement therapy. MIBG early and late heart to mediastinum (H/M) ratios, myocardial washout rate and SPECT total (TDS) and regional (RDS) defect score were calculated. Twelve patients (48%) exhibited troponin I values above the normal range (0-0.063 ng/ml). Sixteen (64%) patients were in New York Heart Association (NYHA) class 1 and 9 (36%) in NYHA class 2.

RESULTS

Early and late H/M ratios and washout rate were comparable in AFD patients and controls. TDS was 9±13 in AFD patients, while no evidence of regional reduced MIBG uptake was observed in the controls. The TDS was significantly higher in the infero-lateral myocardial region, compared to the antero-septal region (7±9 vs. 2±4, P<0.01). Patients were further divided in 3 groups according to cardiac MIBG and MR findings: (group 1), 10 patients with normal MIBG and MR findings; (group 2), 5 patients with unmatched reduced MIBG uptake and normal MR findings and (group 3), 10 patients with matched reduced MIBG uptake and evidence of myocardial fibrosis on MR. In group 3, mean RDS in the infero-lateral region was significantly higher compared to patients of group 2 (15±10 vs. 7±5, P<0.01).

CONCLUSION

This study demonstrates that regional cardiac sympathetic denervation is frequent in AFD patients with preserved LV systolic function and it may precede signs of myocardial damage, such as fibrosis. Thus, MIBG imaging can be considered a challenging technique for early detection of cardiac involvement in AFD.

CLINICAL RELEVANCE/APPLICATION

123I-MIBG scintigraphy is a powerful and non invasive tool that can be used in the diagnostic work up of patients with AFD, allowing to identify cardiac sympathetic derangement before the onset of myocardial fibrosis.

CA110-ED-MOA8 Cardiac MRI in Patients with Pacemakers/ICDs: Challenges and Solutions with a Practical Guide

Station #8

Awards

Identified for RadioGraphics

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TEACHING POINTS

1. To review the safety aspects of MRI in patients with devices such as pacemakers/ICDs 2. To present a flow-chart on management of these complex cases. 3. To discuss the challenges and artifacts encountered in cardiac MRI with these devices 4. To illustrate solutions for these challenges and artifacts.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Safety issues with pacemakers -Static magnetic field- Movement/vibration; Activation of reed switch -Gradient and RF fields- Heating, tissue damage, cardiac stimulation, interference with pacemaker function 3. Design changes in MRI-conditional pacemakers/ICDs 4. Currently available FDA approved MR conditional pacemakers/ICDs 5. Steps for ensuring safe performance of MRI in these patients 6. Performing MRI in MR unsafe devices. 7. Description of specific MR conditions for the different devices 8. Management of artifacts during scanning - Reduce inhomogeneity near heart (Move generator; optimize shimming) - Technical adjustments (Lower voxel , shorter TE, higher bandwidth, parallel imaging, PROPELLER) - Sequences with lower artifacts (Spin echo; Gradient echo instead of SSFP for cine; Frequency scouting; Wideband sequences)

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator