SSA02-01 • Diagnostic Accuracy of 320-detector Computed Tomography Angiography in Evaluating In-stent Restenosis of Coronary Artery

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PURPOSE
To study the sensitivity (SN), specificity (SP), accuracy, positive predictive value (PPV) and negative predictive value (NPV) of 320-detector CT angiography (CTA) in diagnosing in-stent restenosis (ISR) on the bases of invasive coronary angiography (ICA) as a golden standard.

METHOD AND MATERIALS
In a 27 months period from Aug. 2010 to October 2012, 189 patients (aged 35-79, mean 56.6 years, 169 males) with 318 stents subsequently underwent ICA after CTA on the same day in 182 (96.3%) patients, on the second day in 6 (3.2%), and on the 4th day in one patient (0.5%). The interval time between the last stents implantation and CTA was 3.6 to 61.6 (mean 11.2) months. Significant ISR was defined as 50% luminal diameter narrowing. The 318 stents comprised 230 drug eluting stents and 73 bare metal stents. Data was not available for 15 stents. Drug-eluting stents included Endeaver Resolute (n = 75), Taxus Liberte (n = 62), Cypher (n = 43), Xience V (n = 32), Biomatrix (n=8), Nobori (n=2) and Promus (n=8). While the bare metal stents were Driver (n = 31), Vision (n=27), and Multi-Link Zeta (n = 15). Stents were placed in LAD (n = 156), RCA (n = 110), LCX (n = 51) and LM (n = 1). A stent placed in diagonal branch and obtuse marginal branch in one case each was classified to LAD and LCX, respectively.

RESULTS
ISR was found in 18 (9.5%) of 189 patents and in 25 (7.9%) of 318 stents. On stent level, the SN, SP, accuracy, PPV, and NPV of CTA in detecting ISR were 92%, 96%, 96%, 66% and 99%, respectively. On patient level, the corresponding figures were 94%, 96%, 96%, 74%, and 99%, respectively. The number of implanted stents in patients with ISR was significantly higher than that in those without ISR (2.56 ± 1.38 vs. 1.59 ± 0.92, p = 0.009). ISR was significantly more frequently found in 12.7% (14/96) of RCA stents, 10% (5/45) of LCX stents, and in 3.8% (6/149) of LAD stents (p = 0.027).

CONCLUSION
On both stent and patient levels, the SN, SP and accuracy of 320-detector CTA in diagnosing ISR is high, ranging from 92% to 96%. However, the PPV is is 66% on stent level, and 77% on patient level.

CLINICAL RELEVANCE/APPLICATION
The advanced technique 320-detector CTA plays a potential and promising role in assessing ISR of coronary arteries, it is especially useful in excluding ISR with a high NPV of 99%.
SSA02-02 • Value of Super-resolution Technique in Detection of Coronary Artery Stenoses on Whole-heart Coronary MRA

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PURPOSE
Coronary MRA provides noninvasive detection of coronary artery disease without exposing the patient to radiation. However, the image resolution of coronary MRA is limited. In the conventional coronary MR images, resolution enhancement is usually performed with bicubic interpolation. Recently, Super-Resolution (SR) technique has been proposed to increase resolution of brain MRI. The purpose of this study was to demonstrate the value of SR technique for the detection of coronary artery stenoses on whole-heart coronary MRA as compared with conventional bicubic interpolation.

METHOD AND MATERIALS
Whole-heart coronary MRA was acquired with 32-channel cardiac coils in 36 patients at 1.5 T (n=16) and 3.0T (n=19). We have newly developed a SR technique optimized for whole-heart coronary MRA by modifying the existing SR method. Receiver operating characteristic (ROC) analysis was performed to evaluate the diagnostic performance of SR technique and conventional bicubic interpolation to detect coronary stenoses of >50% on coronary angiography. In the observation study, the cases were displayed in a random order with a custom-made viewer, and three observers independently rated the likelihood of the presence of coronary artery stenoses using a continuous scale from 0 to 1. Two reading sessions were conducted with 3-day interval.

RESULTS
For all observers, the areas under the ROC curves (AUCs) were improved by using SR technique. The mean AUC was 0.861 for SR technique, being significantly higher than that for conventional bicubic interpolation (0.797, P = .024). Interobserver variability was reduced from 0.170 to 0.164 by using SR technique instead of conventional bicubic interpolation. Interclass correlation coefficient was 0.855 by SR technique and 0.812 by conventional bicubic interpolation, respectively.

CONCLUSION
High-resolution whole-heart coronary MRA using a Super-Resolution technique permits noninvasive detection of coronary artery stenoses with significantly improved image quality as compared to conventional bicubic interpolation method.

CLINICAL RELEVANCE/APPLICATION
High-resolution coronary MRA generated by Super-Resolution technique allows for more accurate detection of coronary stenoses with higher confidence level as compared to conventional bicubic methods.

SSA02-03 • Mechanical Deformity of Coronary Stent Detected by Cardiac CT: Morphological Predictors and Clinical Implication

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PURPOSE
To evaluate the features and morphologic predictors of mechanical deformities of coronary stents and the effect of mechanical deformities on in-stent restenosis (ISR) using cardiac CT.

METHOD AND MATERIALS
We retrospectively reviewed coronary CT angiography to evaluate mechanical deformities of coronary stents. A total of 864 coronary stents from 584 patients (mean age, 62.8 years; male:female=447:137) were enrolled consecutively in our hospital. The presence of mechanical deformities of coronary stent (partial or complete fracture, longitudinal compression [LC; distortion or shortening of a stent in the longitudinal axis], and radial
compression ([RC; focal decrease of stent diameter in radial axis]), ISR (>50% stenosis of stent on cross-sectional image) and aneurysm were evaluated. Morphologic predictors of mechanical deformity included stent location, stent length, stent overlap by two or more stents, bifurcation lesion stent, excessive tortuosity, and side branch ballooning procedure. Multiple logistic regression analyses were performed to find predictors of mechanical deformity, ISR, and aneurysm.

RESULTS
Of 864 stents, proportions of any fracture, complete fracture, LC, and RC were 12.3%, 3.9%, 2.8% and 7.2%, respectively. Stent fracture and RC of stent were significantly higher in stent with excessive tortuosity (fracture 27.1% vs. 11.2%, p

CONCLUSION
Mechanical deformities of coronary stent can be effectively evaluated with cardiac CT. Excessive tortuosity and ostial stent are independent predictors of stent fracture and LC, respectively. The presence of ISR and aneurysm are significantly associated with stent fracture.

CLINICAL RELEVANCE/APPLICATION
Cardiac CT may be an effective modality to evaluate mechanical deformities and their complications of coronary stent.

SSA02-04 • Evaluation of Hemodynamic Significance of Coronary Stenosis by Vessel Attenuation Measurement on CT: Comparison with Adenosine Perfusion MRI

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PURPOSE
Correlation between CT-detected coronary stenosis and myocardial ischemia is poor. Corrected contrast opacification (CCO) calculation is a new technique based on coronary CT angiography (cCTA) data, that estimates the effect of stenosis on coronary flow. The purpose of this study is to evaluate the association between CT-derived CCO and ischemia by adenosine perfusion magnetic resonance imaging (APMRI) as reference standard.

METHOD AND MATERIALS
Sixty vascular patients without cardiac complaints (mean age 64.4±7.7 years; 78% male) underwent cCTA and APMRI for cardiac risk assessment. The study was approved by the local medical ethical committee. cCTA was performed using a first-generation dual-source CT scanner. On cCTA, coronary luminal attenuation values (in Hounsfield units) were measured at 4 locations from proximal to distal coronary artery; 4 extra measurements were performed in vessels with >50% lumen stenosis. CCO was calculated by dividing coronary CT attenuation by descending aorta CT attenuation at equal level. A 1.5T MRI scanner was used for APMRI, with an inducible perfusion defect under adenosine considered indicative of myocardial ischemia. Decreases in CCO across the coronary artery and across stenosis were calculated, and compared with presence of ischemia on APMRI.

RESULTS
In total, 166 stenoses were found in 96 coronary arteries. Seven patients with 17 stenoses in 11 coronary arteries showed myocardial ischemia on APMRI. Baseline characteristics did not differ between patients with and without myocardial ischemia. For anatomical stenoses, there was no significant difference in the decrease in CCO across the coronary artery between vessels with or without stenosis (0.064±0.121 vs. 0.049±0.103; P=0.50). Difference in CCO across a coronary stenosis was significantly larger in patients with myocardial ischemia than in those without (0.101±0.097 vs. 0.048±0.110, respectively; P

CONCLUSION
In cardiac asymptomatic patients, there is a significant correlation between the decrease in CCO across CT-detected coronary stenosis and ischemia on APMRI.

CLINICAL RELEVANCE/APPLICATION
Corrected contrast opacification, based on common cCTA data, is a promising non-invasive method to assess the functional significance of CT-detected stenosis.

SSA02-05 • Iterative Image Reconstruction Improves Accuracy of Automated Plaque Burden Assessment in Coronary CT Angiography: A Comparison to Intravascular Ultrasound

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PURPOSE
To determine whether iterative image reconstruction algorithms improve the accuracy of coronary CT angiography (CCTA) for (semi-)automated plaque burden assessment as compared to intravascular ultrasound (IVUS).

METHOD AND MATERIALS
CCTA and IVUS data were acquired from seven coronary arteries in an ex-vivo setting. CT images were reconstructed by using filtered-back projection (FBPR), adaptive-statistical (ASIR) and model-based (MBIR) iterative reconstruction algorithms. Cross-sectional images of the arteries were co-registered between CCTA and IVUS in 1-mm increments. In CCTA, a fully-automated (without manual corrections) and a semi-automated (allowing manual corrections of vessel-wall boundaries) plaque burden assessment were performed for each of the reconstruction algorithms using commercially available software. In IVUS, plaque burden was measured manually. Agreement between CCTA and IVUS was determined with Pearson correlation coefficients.

RESULTS
A total of 173 corresponding cross-sections were included. The average plaque burden by IVUS was 63.39±10.63%. By CCTA, it was 54.9±11.7/53.3±13.1/55.4±12.2% for FBPR/ASIR/MBIR using fully-automated and 54.9±11.8/53.4±12.9/57.1±11.1% using semi-automated assessment, respectively. Manual corrections in the semi-automated assessment were performed in 39% of all cross-sections and improved the plaque burden correlation with IVUS, independent of the reconstruction algorithm (p

CONCLUSION
Using MBIR algorithm in CCTA with a semi-automated assessment enables more accurate measurement of plaque burden as compared to ASIR and FBPR using IVUS as the reference standard.

CLINICAL RELEVANCE/APPLICATION
Model-based reconstruction algorithm could further enhance the role of coronary CT angiography as a non invasive risk stratification tool for patients with coronary artery disease

SSA02-06 • Diagnostic Accuracy of Computed Tomography Coronary Angiography for Evaluation of Coronary Artery Disease: A Comparison between High Definition versus Standard Definition Scanner

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PURPOSE
A high-definition computed tomography coronary angiography (HDCTCA) scanner, with improved in-plane spatial resolution of 230 μm, has recently been developed. The aim of this study is to compare the diagnostic accuracy by HDCTCA with standard definition 64-slice scanner (SDCTCA) by using ICA as the reference method.

METHOD AND MATERIALS
One-hundred-forty consecutive patients (mean age 65±8 years, male 105) scheduled for ICA were randomized to SDCTCA (n= 70, group 1) or HDCTCA-scan protocol (n= 70, group 2) (Discovery CT 750 HD scanner, GE
Healthcare, Milwaukee, WI) before ICA. The scanning parameters were: slice acquisition 64x0.625 mm, gantry rotation time 330 msec and prospective ECG-triggering. We evaluated the Likert image quality (score 1: non-diagnostic to score 4: excellent), overall feasibility (Fe), the sensitivity (Se), specificity (Sp), negative predictive value (NPV), positive predictive value (PPV) and accuracy (Ac) versus ICA in a segment-based model and comparing the diagnostic performance between group 1 and group 2.

RESULTS
The 2 groups were homogeneous in terms of baseline characteristics. Group 2 showed a higher mean image quality score (3.8 vs 3.1, p

CONCLUSION
The present study showed an improved overall feasibility, positive predictive value and accuracy mainly in calcified coronary artery lesions in HDCTCA in comparison with SDCTCA due to the better spatial resolution and the consequent reduced blooming effect.

CLINICAL RELEVANCE/APPLICATION
HDCTCA offers a possible and alternative solution to the problem of heavily calcified coronary arteries reducing the overestimation of calcium volume by nearly half.

SSA02-07 • Impact of Different Levels of Iterative Reconstruction on Quantitative and Qualitative Image Quality in CCTA

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PURPOSE
To evaluate the ability of a new iterative reconstruction algorithm (IR) to improve quantitative and qualitative image quality (IQ) in coronary computed tomography angiography (CCTA) in patients with suspected coronary artery disease (CAD) and to investigate feasibility of radiation dose reduction.

METHOD AND MATERIALS
ECG-gated 256-slice MDCT CCTA scans were performed in 30 patients at 120 kVp and 200 mAs, with data reconstructed using the conventional standard filtered back projection (FBP) and seven different levels of IR (L1 - L7). Image noise, contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR) were evaluated for all data. Further qualitative IQ was analyzed by dint of a 5-point grading scale (5: excellent to 1: nondiagnostic) concerning detail resolution and oversmoothing, not CNR.

RESULTS
IR improves SNR (6.6 ± 3.1 with FBP) up to 10.6 ± 6.4 (IR Level 7). Likewise, CNR improved from 4.6 ± 2.5 (FBP) to 7.2 ± 5.1 (IR Level 7). Simultanously noise was reduced from 45.2 ± 11.6 (FBP) to 29.3 ± 9.7 (IR Level 7). Qualitative image quality was similar for all reconstruction methods (mean values 3.9 to 4.2, no significance difference, p > 0.05)

CONCLUSION
IR (iDose) improves SNR and CNR compared to FBP without loss of detail resolutions. Thus a reduction of 30% radiation dose seems feasible.

CLINICAL RELEVANCE/APPLICATION
The iterative reconstruction algorithm is promising for future reduction of radiation dose in CCTA.

SSA02-08 • Iterative Reconstruction Algorithms in Coronary CT Angiography for the Characterization of Coronary Atherosclerotic Plaque—A Comparison with Histology

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PURPOSE
To evaluate whether iterative reconstruction algorithms improve the accuracy of coronary CT angiography (CCTA) for coronary plaque characterization as compared to histology.

METHOD AND MATERIALS
CCTA and histological data were acquired from coronary arteries of 3 ex-vivo hearts. CT images were reconstructed using filtered-back projection (FBPR), adaptive-statistical iterative (ASIR) and model-based iterative (MBIR) reconstruction algorithms. First, cross-sectional CCTA images were co-registered between all three reconstruction algorithms and second CCTA triplets were co-registered with histology. Plaque area 200?m and circumference >60°, as well a cap thickness

RESULTS
In total, 173 FBPR/ASIR/MBIR triplets by CCTA were co-registered with histological cross-sections, where lipid-core plaque (LCP) was presence in 26 locations based on histology. Plaque area

CONCLUSION
Model-based reconstruction algorithm further enhances the accuracy of coronary CT angiography as a non-invasive tool for the detection and characterization of vulnerable plaque

CLINICAL RELEVANCE/APPLICATION
Model-based reconstruction algorithm further enhances the accuracy of coronary CT angiography as a non-invasive tool for the detection and characterization of vulnerable plaque

SSA02-09 • CT Coronary Artery Opacification Gradients Using Different Iodinated Contrast Injection Protocols

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PURPOSE
To evaluate differences in coronary contrast opacification gradients, also known as TAG or Transluminal Attenuation Gradients, between biphasic and triphasic coronary CTA injection protocols.

METHOD AND MATERIALS
Contrast opacification gradients from 320 x 0.5 mm detector row CT were computed for two populations: 32 patients with normal coronary arteries plus 12 patients with left anterior descending (LAD) coronary artery stenosis (>50%) scanned with biphasic injection protocol, and 11 normal patients scanned at a separate institution with a triphasic injection protocol. Linear regression determined correlation between mean Hounsfield Unit and distance from the coronary ostium, lumen cross-sectional area, and lumen short axis diameter. For each gradient (regression slope), multivariate regression model adjusting for BMI analyzed differences found between the two patient cohorts.

RESULTS
While gradients showed strong to excellent linear-fit (Pearson r values = 0.64 - 0.91) for each injection protocol, the different protocols introduced variability in normal coronary artery gradients. However, the gradients computed from biphasic injection protocol in LAD arteries with >50% stenosis were significantly (p-values: from

CONCLUSION
Coronary contrast opacification gradients vary with respect to a biphasic versus triphasic injection protocols, with both showing differences between normal and abnormal coronary arteries.

CLINICAL RELEVANCE/APPLICATION
To date, gradients have been validated using only biphasic protocols; these data suggest that both biphasic and triphasic injections can be used to differentiate normal and abnormal coronary arteries.