2013 RSNA (Filtered Schedule)

Sunday, December 01, 2013
10:45-12:15 PM • SSA02 • Room: S502AB • Cardiac (Coronary CT/MR I)
10:45-12:15 PM • SSA03 • Room: S504AB • Cardiac (Radiation Dose Reduction)
12:30-01:00 PM • LL-CAS-SUA • Room: Lakeside Learning Center • Cardiac - Sunday Posters and Exhibits (12:30pm - 1:00pm)
01:00-01:30 PM • LL-CAS-SUB • Room: Lakeside Learning Center • Cardiac - Sunday Posters and Exhibits (1:00pm - 1:30pm)
02:00-03:30 PM • RC103 • Room: N227 • Cardiovascular Risk Assessment: The Role for the Radiologist
02:00-03:30 PM • RC151 • Room: E261 • Introduction to Cardiac MR: Infarcts, Cardiomyopathies and Masses (How-to Workshop)

Monday, December 02, 2013
08:30-10:00 AM • MSMC21 • Room: S406A • Cardiac CT Mentored Case Review: Part I (In Conjunction with the North American Society for Cardiac Imaging) (...
08:30-10:00 AM • RC203 • Room: E351 • Imaging for Electrophysiology
10:30-12:15 PM • MSMC22 • Room: S406A • Cardiac CT Mentored Case Review: Part II (In Conjunction with the North American Society for Cardiac Imaging) ...
10:30-12:00 PM • SSC01 • Room: S405AB • Cardiac (Coronary CT/MR II)
10:30-12:00 PM • SSC02 • Room: S502AB • Cardiac (Anatomy and Function I)
10:30-12:00 PM • SSC03 • Room: S504AB • Cardiac (Quantitative Imaging)
12:15-12:45 PM • LL-CAS-MOA • Room: Lakeside Learning Center • Cardiac - Monday Posters and Exhibits (12:15pm - 12:45pm)
12:45-01:15 PM • LL-CAS-MOB • Room: Lakeside Learning Center • Cardiac - Monday Posters and Exhibits (12:45pm - 1:15pm)
01:30-03:05 PM • MSMC23 • Room: S406A • Cardiac CT Mentored Case Review: Part III (In Conjunction with the North American Society for Cardiac Imaging)...
03:00-04:00 PM • SSE03 • Room: S502AB • Cardiac (Valve Disease)
03:00-04:00 PM • SSE04 • Room: S504AB • Cardiac (Nonischemic Cardiomyopathy)
03:30-06:00 PM • MSMC24 • Room: S406A • Cardiac CT Mentored Case Review: Part IV (In Conjunction with the North American Society for Cardiac Imaging) ...

Tuesday, December 03, 2013
08:30-10:00 AM • MSES31 • Room: S100AB • Essentials of Cardiac Imaging
08:30-10:00 AM • RC303 • Room: N226 • Cardiac Perfusion Imaging
08:30-10:00 AM • RC324 • Room: S402AB • Mentored Case Approach to Pediatric Cardiovascular Disease 2: Cardiac Disease (An Interactive Session)
08:30-10:00 AM • RC350 • Room: E260 • Cardiac CT Angiography (A Practical Guide) (How-to Workshop)
08:30-12:00 PM • VSPD31 • Room: S102AB • Pediatric Radiology Series: Chest/Cardiovascular Imaging I
10:30-12:00 PM • SSG03 • Room: S504AB • Cardiac (Coronary CT/MR III)
12:15-12:45 PM • LL-CAS-TUA • Room: Lakeside Learning Center • Cardiac - Tuesday Posters and Exhibits (12:15pm - 12:45pm)
12:45-01:15 PM • LL-CAS-TUB • Room: Lakeside Learning Center • Cardiac - Tuesday Posters and Exhibits (12:45pm - 1:15pm)
03:00-04:00 PM • SSJ03 • Room: E350 • Cardiac (Contrast II)
03:00-04:00 PM • SSJ04 • Room: S502AB • Cardiac (Contrast I)
03:00-04:00 PM • SSJ05 • Room: S504AB • Cardiac (CV Outcomes and Risk Assessment)
04:30-06:00 PM • RC403 • Room: N228 • Cardiac PET/CT and PET/MR
04:30-06:00 PM • RC423 • Room: S403B • Minicourse: Current Topics in Medical Physics-Nuclear Cardiac Imaging for Physicists

Wednesday, December 04, 2013
07:15-08:15 AM • SPSH40 • Room: E353A • Hot Topic Session: Indications for MRI versus Low Dose CT in Congenital Heart Disease
08:30-10:00 AM • RC516 • Room: S104A • Women and Cardiovascular Disease (In Conjunction with the American Association for Women Radiologists)
08:30-12:00 PM • VSCA41 • Room: S502AB • Cardiac Radiology Series: Transcatheter Aortic Valve Replacement (TAVR)
10:30-12:00 PM • SSK03 • Room: S504AB • Cardiac (Coronary CT/MR IV)
12:15-12:45 PM • LL-CAS-WEA • Room: Lakeside Learning Center • Cardiac - Wednesday Posters and Exhibits (12:15pm - 12:45pm)
12:45-01:15 PM • LL-CAS-WEB • Room: Lakeside Learning Center • Cardiac - Wednesday Posters and Exhibits (12:45pm - 1:15pm)
03:00-04:00 PM • SSM03 • Room: S502AB • Cardiac (Experimental and Animal)
03:00-04:00 PM • SSM04 • Room: S504AB • ISP: Cardiac (Clinical Trials and Population Studies)
04:30-06:00 PM • SPSC45 • Room: S404CD • Controversy Session: The Heart of the Matter: Nuclear Stress Test vs CTA for Low to Intermediate Risk Cardiac ...

Thursday, December 05, 2013
08:30-10:00 AM • RC611 • Room: S505AB • Advances in Cardiac Nuclear Imaging: SPECT/CT and PET/CT
08:30-12:00 PM • VSCA51 • Room: S404CD • Cardiac Radiology Series: Cardiac Dual Energy CT
10:30-12:00 PM • SSQ03 • Room: S504AB • Cardiac (Myocardial Ischemia and Viability)
12:15-12:45 PM • LL-CAE1176-THA • • Imaging the Tips of the Ventricles: A Systematic Approach to Apical Pathology
12:15-12:45 PM • LL-CAS-THA • Room: Lakeside Learning Center • Cardiac - Thursday Posters and Exhibits (12:15pm - 12:45pm)
12:45-01:15 PM • LL-CAS-THB • Room: Lakeside Learning Center • Cardiac - Thursday Posters and Exhibits (12:45pm - 1:15pm)
04:30-06:00 PM • RC703 • Room: N227 • Cardiomyopathy

Friday, December 06, 2013
08:30-10:00 AM • RC803 • Room: E353A • Interactive Game: Read with the Experts (Cardiac Radiology)
10:30-12:00 PM • SST02 • Room: S502AB • Cardiac (Coronary CT/MR V)
10:30-12:00 PM • SST03 • Room: S504AB • Cardiac (Anatomy and Function II)

FFRCT - The New Kid on the Block

LL-CAE1171
Gilat Grunau , PhD
James Min , MD *
Giang Nguyen , MD
Rekha Raju
Tae-Hyun Yang
Cameron J Hague , MD
Jonathan A Leipsic , MD *

PURPOSE/AIM
Recent technological innovations through the integration of computational fluid dynamics have enabled the non-invasive calculation of fractional flow reserve (FFR) and lesion specific ischemia from a resting coronary CT angiogram. The purpose of this exhibit is: 1.To review the data supporting FFR guided revascularization. 2. To review the science behind FFRCT 3. To present the current evidence evaluating the

diagnostic performance of FFRCT as compared to measured FFR.
CONTENT ORGANIZATION
1. Review the limitations of cCTA in evaluation of individuals with stable angina, specifically the discrepancy between stenosis and ischemia and discuss the current evidence supporting ischemia and in particular FFR guided revascularization.
2. To discuss computational fluid dynamics and how it is applied to FFRCT
3. To discuss the diagnostic performance of FFRCT as compared to measured FFR.
SUMMARY
FFRCT represents a novel non-invasive method for the calculation of FFR from typically-acquired resting cCTA. The recently published evidence has shown a high diagnostic accuracy of FFRCT to identify lesion specific ischemia as compared to measured FFR. FFRCT has also been shown to have great promise in the assessment of intermediate stenosis which are commonly difficult lesions to manage with anatomical imaging alone.

Myocardial Perfusion Assessment with Multi-Imaging Modalities

LL-CAE1172
Sung Min Ko

PURPOSE/AIM
We aimed to directly compare multi-imaging modalities (SPECT, CMR, and CTP) and to understand benefits and drawbacks of each modality for detecting myocardial perfusion defects.
CONTENT ORGANIZATION
Detection of ischemia is an important part of the diagnostic strategy of coronary artery disease (CAD) in current guidelines. Noninvasive functional imaging modalities such as single photon emission computed tomography (SPECT), cardiac magnetic resonance (CMR), and positron emission tomography (PET) perfusion imaging are increasingly being performed for the detection and risk stratification of obstructive CAD. SPECT imaging is widely available and most extensively evaluated. Both CMR and PET have a significantly higher diagnostic accuracy than SPECT. CMR perfusion imaging can provide an alternative at a similar diagnostic accuracy as PET. CT perfusion (CTP) images are obtained using a static (single-phase first-pass myocardial enhancement imaging with single-or dual- energy mode) or dynamic acquisition (quantitative time resolved myocardial perfusion imaging). Stress CTP imaging has shown good accuracy for the detection of ischemic myocardium and allowed for incremental value of coronary CT angiography on the detection of functionally significant CAD.
SUMMARY
Radiologists need to understand benefits and drawbacks of multi-imaging modalities for myocardial perfusion.

Endocardial Cushion Defect: The Shamrock Sign

LL-CAE1173
Pardeep Athwal , MD
Electra V Kaloudis , MD, MPH

PURPOSE/AIM
To introduce a new radiological sign, the Shamrock Sign, which refers to the appearance of endocardial cushion defects on imaging. We hope this novel association will allow for more rapid and consistent identification and diagnosis of endocardial cushion defects on imaging.
CONTENT ORGANIZATION
We will first summarize the pathophysiology and its relationship to the appearance of endocardial cushion defects on imaging. Additionally, we will review several cases of endocardial cushion defects on imaging obtained from our institutions and highlight the consistent appearance seen in several different patients. Finally, we will tie in the above discussion with the resemblance of endocardial cushion defects to a Shamrock, and propose a novel new sign, The Shamrock Sign.
SUMMARY
We hope to introduce a new radiological sign, The Shamrock Sign, which will provide for more rapid and consistent identification/ diagnosis of endocardial cushion defects on imaging. We will achieve this by 1. Review of the pathophysiology and its relationship to imaging findings of endocardial cushion defects 2. Reviewing several cases of endocardial cushion defects obtained from our institutions and illustrate the consistent appearance 3. Propose our radiological sign, based on the above discussion and resemblance of endocardial cushion defects to shamrocks on imaging.

Dual-Source CT: How to Bring Out Its High Potential for Pediatric Patients with Complex Congenital Heart Disease

LL-CAE1174
Suzu Kanzaki
Masahiro Higashi , MD
Hiroaki Naito , MD, PhD

PURPOSE/AIM
To review the usefulness of Dual-Source CT for pediatric patients with complex congenital heart disease, focusing on scan protocol, scan technique and images for presentation.
CONTENT ORGANIZATION
Scanning pediatric patients with complex congenital heart disease as daily routine examination is challenging because of the patients' high heart rate and their difficulty to control their breath. Dual source CT offers high temporal resolution, therefore images with less motion artifacts can be acquired even without general anesthesia or intubation of the patients. Furthermore, the amount of contrast media can be reduced and radiation dose can be lowered. The images allow confident diagnoses in particularly for vascular anomaly cases such as MAPCA (Major Aortopulmonary Collateral Arteries). We explain how to select the scan mode, how to optimize scan protocols as well as contrast injection protocols and how to present images effectively to optimize diagnosis.
SUMMARY
The usefulness of Dual-Source CT for routine scans of pediatric patients with complex congenital heart disease is presented. Teaching points are: 1) selection of proper scan protocol and its optimization, 2) optimization of injection protocol, 3) how to scan the patients without sedation or intubation, and 4) how to present images for optimizing the diagnosis.

The A to Z of T1 Mapping for Tissue Characterization of Myocardium: Focused on Minimizing Mistakes While Setting Up Protocols

LL-CAE1177
Yon Mi Sung , MD
Hye Y Oh , MD
Junhyung Ann
Yoon Kyung Kim , MD
Hye-Young Choi , MD, PhD

PURPOSE/AIM
1. To review the infrastructure required to perform T1 mapping on MR for tissue characterization of myocardium
2. To discuss the factors affecting T1 values to avoid errors in setting up protocols
3. To explain the utility of T1 mapping in clinical cases

CONTENT ORGANIZATION
Introduction
- Merits of T1 mapping
- Potential clinical application of T1 mapping Scanners and Sequences
- 1.5T scanner versus 3T scanner
- Various sequences (MOLLI, shMOLLI, and SASHA) Contrast Agents Related Factors Affecting T1 Values
- To use or not to use contrast agents
- Types of contrast agents
- Contrast injection methods
- Time delay following contrast administration Other Factors Affecting T1 Values
- Cardiac cycle (systole and diastole)
- Breathhold versus free-breathing
- Heart rate Clinical Cases Using T1 mapping
- Ischemic heart diseases (acute and chronic)
- Myocarditis and myocardial diseases
- Tumors
SUMMARY
The major teaching points of this exhibit are to understand the basic knowledge about T1 mapping including various factors affecting T1 values and to apply it to see microscopic changes in the myocardium.

Multimodality Imaging of the Cardiac Complications of Radiation Therapy

LL-CAE2508
Kentaro Takanami , MD, PhD
Rei Umezawa
Akira Arai
Tomohiro Kaneta
Shoki Takahashi , MD

PURPOSE/AIM
1. To review the imaging findings of cardiac effect of radiation therapy (RT) on morphological imaging, including ultrasonography (US), CT, and MRI, and functional imaging, including SPECT and PET.
2. To discuss the clinical role of the multimodality imaging in the prevention of a fatal outcome of cardiac complications of RT.
CONTENT ORGANIZATION
1. Pathophysiology of the RT-induced changes in the heart.
2. Multimodality imaging findings of cardiac complications of RT.
3. Clinical role of the multimodality imaging in the prevention of a fatal outcome of cardiac complications of RT.
SUMMARY
RT for thoracic malignancies may give raise mild to severe cardiac complications including pericarditis, cardiomyopathy, coronary artery disease, valvular disease, and conduction abnormalities. For the evaluation of these complications, the morphological imaging are initial diagnostic tests. Meanwhile, the functional imaging have an advantage in the detection of the early cardiac effect of RT, because a functional change precedes a morphological change. In this exhibition, we demonstrate the multimodality imaging findings of cardiac complications of RT. An early detection and a close observation of the subclinical cardiac complications of RT by the multimodality imaging or intervention, if necessary, will prevent a fatal outcome.

C-arm CT versus Multidetector CT for Transcatheter Aortic Valve Replacement (TAVR): Side by Side Comparison

LL-CAE2509
Suhny Abbara , MD *
Lorenzo Azzalini
Brian B Ghoshhajra , MD

PURPOSE/AIM
Using the fluoroscopic C-arm, CT images (CACT) can be acquired intraprocedurally to assist TAVR procedures. This exhibit provides a description of the technical foundations of CACT, the acquisition, and how data are reconstructed and analyzed. The similarities and differences with multidetector CT (MDCT) are reviewed.
CONTENT ORGANIZATION
First, the technical difference between CACT and MDCT are reviewed: 2-D flat-panel detector vs. multiple rows of one-dimensional detectors; spatial resolution of 300μm vs. 600μm; low temporal resolution of CACT requiring ~5000ms (200°) acquisition vs. 75-210ms (90°-180°) acquisitions. Second, the differences in acquisition of CACT vs. MDCT are reviewed: ventilator pause vs. breath hold; rapid ventricular pacing vs. beta-blocking; intraaortic contrast injection vs. peripheral venous injection; absence vs. presence of contrast in the heart. Third, CACT and MDCT data reconstruction and analysis for TAVR planning are reviewed, including determination of optimal projection angle for valve deployment and of key metrics for valve sizing (annulus diameters, area and circumference, distance from annulus to coronary ostia, sinus height and diameters).
SUMMARY
This exhibit compares the technical aspects, acquisition and data analysis of C-arm based CT with MDCT for guidance of TAVR.

Emerging Quantitative Measures of Diffuse Myocardial Fibrosis Using Magnetic Resonance Imaging

LL-CAE2510
James Goldfarb
Dana C Peters , PhD

PURPOSE/AIM
To review the theory and methods of novel quantitative of myocardial fibrosis measures and identify future clinical indications and methodological pitfalls.
CONTENT ORGANIZATION
A. Motivation for a Quantitative Measure of Myocardial Fibrosis B. Tissue and Pharmacokinetic Models C. Measures of Diffuse Fibrosis: From T1 Values to Partition Coefficients to Extracellular Volumes D. T1 Measurement Techniques: Pixel based, ROI based E. Equations for the Calculations F. On the use of Pre-contrast T1 and Hematocrit Measurements G. Factors affecting Accuracy and Precision H. Review of Indications
SUMMARY
There are a number of emerging quantitative measures of diffuse myocardial fibrosis. This exhibit reviews
a. Theory, models and calculations b. T1 measurement techniques including advantages and pitfalls c. Recent findings with diffuse fibrosis imaging in patient populations. d. Future applications for patient care and drug development.

Intra-Thoracic, Extra-Cardiac Findings on Myocardial Perfusion SPECT Imaging and Gated Cardiac Blood Pool Imaging

LL-CAE2511
   Xiaoqin J Wang , MD
   John J Krol , MD
   M. Elizabeth Oates , MD

PURPOSE/AIM
Cinematic review of SPECT projection data from myocardial perfusion imaging (MPI) and planar data from multigated blood pool imaging (MUGA) can reveal important extra-cardiac pathology and potentially misleading artifacts. Awareness of such incidental findings can optimize interpretation.
CONTENT ORGANIZATION
Using an interactive quiz format, we will present cinematic displays of projection data from Tc-99m sestamibi MPI SPECT scans and from Tc-99m red blood cell MUGA scans. These cases will illustrate a variety of extra-cardiac findings in the thorax. Pathologic conditions will include: gynecomastia, lung cancer, pleural effusions, and transplanted lung. Artifacts related to foreign bodies (breast expanders, pacemaker), adjacent structures (left arm), radiopharmaceutical issues (damaged RBCs, extravasation), and patient factors (hiccups, lactation, pectus excavatum) will be demonstrated.
SUMMARY
The cinematic display format often yields important extra-cardiac information evident on MPI projection data and MUGA images. By reviewing these twelve illustrative cases, learners will achieve two benefits: 1) gain knowledge of extra-cardiac findings in the thorax on MPI and MUGA scans and 2) recognize clinically significant extra-cardiac pathology and avoid misdiagnosis due to artifacts.

Pulmonary Artery Abnormalities and Hemodynamics-Pressure versus Flow Phenomena

LL-CAE2512
   Jonathan Malone , MD
   Kathleen E Carey , MD
   Brian Shapiro , MD
   Patricia J Mergo , MD

PURPOSE/AIM
1. Briefly review the physiology of pulmonary arterial hemodynamics
2. Review imaging manifestations of pulmonary hypertension and abnormal flow dynamics affecting the pulmonary artery
CONTENT ORGANIZATION
Review of pulmonary artery physiology.
- Hemodynamics of pulmonary arterial circulation
- Effects of abnormal pressure or flow on the central pulmonary arteries
- Effects of the activation of pulmonary vascular endothelium and the inflammatory response Imaging manifestations of pulmonary hypertension
- Findings in primary peripheral pulmonary hypertension, chronic pulmonary thromboembolic disease, portopulmonary hypertension
- Quantification of PA pulsatility as a surrogate for compliance
- PA and RV size
- Signs of RV strain Imaging manifestations of abnormal flow phenomena affecting the pulmonary artery
- Left to right shunt: ASD, VSD, PDA, anomalous pulmonary venous return
- Pulmonary stenosis or regurgitation
- Quantification of shunt or regurgitant fraction
SUMMARY
The major teaching points of this exhibit are:
1. Pulmonary hypertension can be evaluated and quantified noninvasively with both CT and MR imaging.
2. Abnormal flow dynamics affecting the pulmonary artery such as shunting, valvular stenosis, and regurgitation can be demonstrated and also often quantified noninvasively.

Cardiovascular Magnetic Resonance at 3 Tesla- Opportunities, Challenges and Solutions

LL-CAE2513
   Prabhakar Rajiah , MD, FRCR
   Michael A Bolen , MD

PURPOSE/AIM
There has been recent increase in the use of 3T MRI scan in cardiovascular imaging. The purpose of this exhibit is 1. To review the benefits of using 3T MRI in cardiovascular imaging 2. To illustrate the challenges and artifacts that are specific to cardiac MRI at 3T. 3. To discuss and illustrate the solutions to commonly encountered challenges and artifacts at 3T cardiac MRI.
CONTENT ORGANIZATION
1. Physics of 3T MRI 2. Benefits of 3T MRI (Higher signal, spectral resolution, high T1) 3. Challenges inherent in cardiac MRI at 3T (higher RF deposition,inhomogeneties, susceptibility arifacts) 4. Safety considerations 5. Parallel imaging 6. Review and illustration with sample cases of advantages, challenges, artifacts and solutions in the following sequences

- Cine steady state free precession
- Black blood , T1, T2, fat satuation
- Flow quantification
- First pass perfusion
- Delayed enhancement
- Coronary artery imaging
- Myocardial tagging
- T1 mapping
- MR angiography

SUMMARY
1. 3T MRI is useful in cardiac imaging, particularly for perfusion, angiography, delayed enhancement and tagging. 2. Artifacts may be seen in multiple sequences, mostly due to magnetic field and RF inhomogeneities. 3. Knowledge of the physics is essential to deal with challenging artifacts and avoid misdiagnosis.

Utility of Cardiac MRI in the Evaluation of Left Ventricular Thickening

LL-CAE2514
   Prabhakar Rajiah , MD, FRCR

PURPOSE/AIM
The purpose of this exhibit is 1. To review the common and uncommon causes of LV thickening. 2. To understand the role of MRI in the evaluation of LV thickening. 3. To discuss optimal protocols in evaluation of LV thickening. 4. To illustrate a flow chart of management of LV thickening.
CONTENT ORGANIZATION
1. Definition of LV thickening. 2. Causes 3. Protocols for LV thickening- Cine, black blood, tagging, perfusion, delayed enhancement, T1

mapping, T2* 4. Sample cases of the common and uncommon causes of LV thickening

- Hypertension
- Athletes heart
- Aortic stenosis
- Subaortic membrane
- Hypertrophic cardiomyopathy- Typical, apical (Yamaguchi), spiral, mid ventricular
- infiltrative disorders- Amyloidosis, hemochromatosis
- Storage disorders- Fabry's, glycogen storage disorder

5. Understand the clinical management of patients with different causes of LV thickening.
SUMMARY
The major teaching points of this exhibit are 1. LV thickening is caused by several disorders. 2. Several sequences are available to optimally evaluate LV thickening based on etiology. 3. Athletes heart can present with hypertrophy and dilated ventricles. 4. Amyloidosis results in abnormal T1 dynamics 5. Delayed enhancement is associated with worse prognosis. 6. T2 * imaging is used in iron overload.

Eponymous Cardiovascular Surgeries for Congenital Heart Diseases-Imaging Review and Historical Perspectives

LL-CAE2515
Ji Y Buethe , MD
Ravi Ashwath , MD
Prabhakar Rajiah , MD, FRCR

PURPOSE/AIM
There are several eponymous surgeries performed for congenital heart diseases, most of which have been named after eminent surgeons. The purpose of this exhibit is
1. To illustrate complex cardiovascular surgical techniques.
2. To demonstrate cross sectional post-surgical imaging appearances and common complications.
3. To briefly describe the biography of the surgeons who pioneered these surgeries.
CONTENT ORGANIZATION
The following surgical procedures are illustrated in detail along with sample cases showing the cross sectional imaging appearances, particularly with regards to cardiac MRI. Imaging appearances of common complications are also described and demonstrated with sample cases. A short biography of the surgeons associated with these eponymous surgeries and their other important scientific contributions are also described.
1) Taussig- Blalock 2) Waterson 3) Potts 4) Peterson 5) Glenn 6) Fontan 7) Norwood 8) Damus Kaye Stansel 9) Rastelli 10) Ross 11) Mustard 12) Senning 13) Jatene 14) Konno-Rastan
SUMMARY
Surgeries for the treatment of congenital cardiac defects are complex and a thorough understanding of the procedure and hemodynamics is essential to distinguish normal post-surgical appearances from complications.

Three-dimensional Cardiac MR Imaging: Techniques and Clinical Applications

LL-CAE2516
Minako Takeda
Yasuo Amano , MD
Masaki Tachi , MD, PhD
Tetsuro Sekine
Hitomi Tani
Yasuhiro Kobayashi
Ryo Takagi , MD
Shinichiro Kumita , MD

PURPOSE/AIM
The purpose of this exhibit is to review the techniques applied to 3D cardiac MR imaging and to define its clinical applications. Radiologists will be able to use 3D cardiac MR imaging appropriate for solving each clinical problem.
CONTENT ORGANIZATION
1. MR techniques applied to 3D cardiac MR imaging: i) ECG and respiratory gating, ii) background signal suppression, iii) fast data acquisition, iv) postprocessing
2. 3D cardiac MR imaging sequences: i) cine steady-state free precession (SSFP), ii) non-cine SSFP, iii) tagging, iv) delayed enhancement, v) phase contrast
3. Clinical applications of 3D cardiac MR imaging: i) small infarction or scar, ii) arrhythmogenic scar, iii) cardiomyopathies with conduction disturbance, iv) valvular regurgitation, v) coronary artery diseases, vi) ablation mapping, vii) patients who are difficult to hold their breath
4. Merits and demerits of 3D cardiac MR imaging compared to standard 2D imaging
5. Summary
SUMMARY
The major teaching points of this exhibit are: 1. 3D cardiac MR imaging is acquired by combining several MR techniques and 2. 3D cardiac MR imaging visualizes small cardiac structures and pathologies and 4D flow patterns owing to its high high spatial and contrast resolution and no need of breath-holding.

Endoluminal View of the Heart: More than a Beautiful Picture

LL-CAE2517
Marta Tomas Mallebrera , MD
Angeles Franco Lopez
Miguel Orejas , MD
Gonzalo Aldamiz-Echevarria

PURPOSE/AIM
The purpose of this study is to demonstrate the advantages and diagnostic possibilities of endoluminal vision, a less extensive postprocessing technique, that allows to explore the inner surfaces of the heart from a unique perspective and provides images close to the surgical view.
CONTENT ORGANIZATION
Endoluminal view simulates surgical imaging and allows multidirectional viewing. Although it can be used to define the anatomy of any part of the heart, we find it especially useful in 5 clinical applications: before radio-frequency catheter ablation of pulmonary veins for atrial fibrillation and pre and post-treatment assessment of: abnormalities in the origin of the coronary arteries, atrial and ventricular septal defects, valvular disease and thoracic aortic disease. This work includes a brief description of each entity , recommended acquisition technique and potential benefits of endoluminal vision over other postprocessing techniques.
SUMMARY
Endoluminal view is an attractive new radiologic method to explore the heart and a competitive alternative diagnosis modality in many clinical applications. Our refferring physicians have found that these images are useful to assess the treatment procedure with images close to the surgical view in an easily understandable format.

Heart to Heart: A Review of Cardiac CT Angiography with Conventional Coronary Angiography Correlation

LL-CAE2518
Abigail V Berniker , MD
Justin E Mackey , MD
Oleg Teytelboym , MD

PURPOSE/AIM
This exhibit aims to:
-Review coronary artery anatomy on cardiac computed tomography angiography (CCTA) alongside catheterization images
-Demonstrate coronary artery findings through a case-based pictorial illustration with CCTA-catheterization correlation
-Enhance interpretation of CCTA through direct correlation with cardiac catheterization, the current gold standard for coronary evaluation

CONTENT ORGANIZATION
-Overview/purpose
-Practical coronary artery anatomy review with CCTA alongside catheterization images

- Normal anatomy, including dominance
- Anomalies

-Case-based illustration of coronary artery findings with CCTA-catheterization correlation

- Positive and negative remodeling
- Vessel stenosis and occlusion
- Bridging
- Stents and grafts

-CCTA artifacts and mishaps

- Examples of challenging cases

-Summary/future directions
SUMMARY
-CCTA is an important imaging tool that can provide quick, accurate, non-invasive and cost-effective assessment of coronary artery disease
-This exhibit reviews coronary artery anatomy on CCTA and catheterization imaging and illustrates the range of coronary artery disease on the two modalities
-Viewing CCTA alongside catheterization images provides the radiologist with direct feedback from the gold standard modality and enhances interpretation of CCTA

Left Ventricular Assisted Device (LVAD): Normal Findings and Appearance of Complications on Multi-detector Computed Tomography (MDCT)

LL-CAE2519
Keyur Parekh , MD *
Lewis C Sommerville , MD
Vistasp Daruwalla
Robert A Gordon
Jeremy D Collins , MD *
James C Carr , MD *

PURPOSE/AIM
Aims are 1. To explain scanning protocol for MDCT in patients with LVAD 2. To review normal findings on a MDCT with LVAD 3. To describe complications arising from LVAD
CONTENT ORGANIZATION
SUMMARY
Key learning points 1. Retrospective ECG gated MDCT chest and upper abdomen with analysis of cine images should be done 2. Inflow cannula should be in central left ventricular apex. Improper positioning leads to myocardial suck-down 3. Lack of in-plane parallelism between snap ring and underlying graft is seen with bend relief disconnect. Tear of aorta at site of insertion of outflow cannula is a rare complication 4. Abscess at site of pump is a common occurrence 5. MDCT can be used to look for thrombus, aortic valve analysis, right ventricular dysfunction and surgical complications 6. Peripheral hypodensity in cannula mimics thrombus

Pathologic Conditions of the Heart on Routine Computed Tomography of the Chest: Imaging Findings and Pitfalls

LL-CAE2520
Takayuki Kurinobu , MD
Ai Masukawa , MD
Yasuyuki Sonoyama
Hitoshi Takeuchi , MD
Junko Araki
Shichiro Katase
Yukari Takada , MD

PURPOSE/AIM
The purposes of this exhibit are:
1) To review findings of cardiac disease on routine (non-ECG-gated) computed tomography (CT) of the chest
2) To discuss imaging pitfalls
CONTENT ORGANIZATION
1) Imaging findings of cardiac disease on routine CT of the chest
(a) with symptoms of:
- chest pain and/or shock, e. g., coronary artery thrombosis, cardiac rupture, ventricular septal perforation, cardiac tamponade, tumor
- cardiac failure, e. g., old myocardial infarction, ventricular aneurysm, cardiomyopathy
(b) without symptoms, e. g., coronary aneurysm, old myocardial infarction, thrombus in cardiac chambers, tumor
2) Imaging pitfalls according to each cause
- due to cardiac cycle
- due to inhomogeneous contrast material
- due to motion artifact
SUMMARY
Although ultrasonography, magnetic resonance imaging, and ECG-gated cardiac CT are the imaging modalities of choice for evaluating known cardiac disease, evaluation of the heart is an integral part of interpreting a chest CT study. Progress in CT has enabled discovery of a lot of cardiac disease even in non-ECG-gated routine chest CT. However, cardiac diseases that are asymptomatic can be overlooked.

Familiarity with these diseases allows appropriate patient management. In addition, knowledge of CT features of pseudo-lesions in routine chest CT helps accurate evaluation.

Pearls and Pitfalls for Radiographic and Computed Tomographic Interpretation of the Syncardia Temporary Total Artificial Heart

LL-CAE2521
Sanjay K Paidisetty , MD
Rahul N Sawlani , MD
Kaushik S Shahir , MD
Richard H Christenson , MD
Jennifer Beckman , RN
Nunzio Gaglianello , MD
Michael E Mitchell , MD
Parag P Tolat , MD
Claudius Mahr , DO

PURPOSE/AIM
Heart transplantation is the definitive therapy for patients with refractory end stage heart failure (HF). Even if a HF patient is a candidate for transplantation, they are subject to donor heart shortages and thus potential death while awaiting transplantation. There are several mechanical devices providing circulatory support to bridge patients to transplantation. In 2004, the FDA approved the use of the Syncardia temporary Total Artificial Heart (t-TAH) for biventricular mechanical circulatory support. As of December 2012, 1100 devices have been implanted and the numbers continue to rise. Despite its increased use, there is a paucity of radiographic literature providing key information to help interpret t-TAH post implantation imaging.
CONTENT ORGANIZATION
SUMMARY
This exhibit will provide key information to facilitate accurate radiographic and computed tomographic imaging interpretation of the t-TAH device after implantation.

'The Myocarditis-Pericarditis Complex' A Sign of Cardiac Tuberculosis Identified on Cardiac MRI

LL-CAE2522
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PURPOSE/AIM
To review the pathophysiology of cardiac tuberculosis To discuss the spectrum of findings in cardiac TB and bring awareness of the complex imaging features including formation of complex pericardial and myocardial inflammatory masses To describe a new sign of 'pericarditis-myocarditis complex' that would point towards cardiac TB in patients presenting with myocardial mass lesions.
CONTENT ORGANIZATION
Pathophysiology of Cardiac Tuberculosis Review of the spectrum of imaging findings of Tuberculosis of the heart starting with simple pericardial disease, complex-pericardial disease, the myo-pericardial complex, dilated cardiomyopathies to complex myocardial disease including mass lesions affecting the myocardium Review the utility of the 'myocarditis-pericarditis' sign for identifying cardiac Tuberculosis on MRI
SUMMARY
The major teaching points of this exhibit are:
1. Cardiac TB has a spectrum of varied appearance on Cardiac MRI from simple pericarditis to complex pancarditis
2. Cardiac TB can present as complex and large myocardial mass lesion
3. Presence of pericarditis along with an infiltrating cardiac mass lesion in the appropriate clinical scenario is a good pointer to the mass representing Cardiac TB rather than a malignant tumour.

Cardiac Imaging with the LARIAT Procedure: A Primer for Radiologists

LL-CAE2523
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John J Green , MD, MS
Joseph Vavricek , MD
Matthew J DeVries , MD

PURPOSE/AIM
To discuss findings on imaging used for the LARIAT procedure. We will review the relevant preoperative anatomy, postoperative appearance and potential complications of the procedure including technical failures as available.
CONTENT ORGANIZATION
This educational abstract will discuss the LARIAT procedure in the following format: A. Imaging Modalities: Technical considerations relating to CT angiography, echocardiography
B. Anatomy: Relevant preoperative measurements a Radiologist should know and potential surgical contraindications identified by imaging
C. Follow-up: Imaging appearance by CT angiography and echocardiography (factors dictating surgical success)
D. Complications: Imaging appearance by CT angiography and echocardiography (including definitions of surgical failure)
SUMMARY
The LARIAT procedure is a newly employed surgical treatment used to reduce thromboembolic events in patients with atrial fibrillation and contraindication to oral anticoagulation by percutaneous and transeptal closure of the left atrial appendage. Cardiac imaging is relied upon during the preoperative work up of the left atrial appendage and used to confirm adequate exclusion. Imaging is also used to diagnose complications. This education exhibits serves as a primer, highlighting information the Radiologist should know.

Cardiac MRI Features of Myocarditis with Pathologic Correlation

LL-CAE2524
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Conor Murray
Cecily Metcalf
Jeanne Louw , MBBS, FRANZCR

PURPOSE/AIM
CONTENT ORGANIZATION
We retrospectively reviewed the cardiac MRI examinations performed at our institution from 2004 to 2012 for those patients with a discharge clinical diagnosis of myocarditis. Both typical and atypical patterns were observed. Typical findings of left ventricular lateral wall

subepicardial T2-prolongation (presumed oedema) and 10-minute post gadolinium delayed myocardial hyperenhancment on T1-weighted gradient echo and inversion recovery sequences are presented. In addition, less frequent patterns of delayed gadolinium hyper enhancement were observed and are presented. Images of the etiological subtypes of myocarditis and examples of potential mimics are also presented.

SUMMARY

Cardiac MRI yields characteristic findings on T2-weighted images and delayed post contrast T1 weighted images in all phases of myocarditis. These findings are moderately specific, though potential mimics of myocarditis are recognised.

Understanding the ECG: How to Trouble Shoot ECG Related CMR Artifacts and Correlate CMR and ECG Findings to Make a Diagnosis!

LL-CAE2525

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PURPOSE/AIM
1. To describe the fundamentals of ECG gating in cardiac magnetic resonance (CMR)
2. To list ECG related CMR artifacts and to offer practical solutions
3. To give examples of CMR findings in common cardiac diseases with ECG correlation

CONTENT ORGANIZATION
1. Electrophysiological activity of the cardiac conduction system as a predictor of cardiac mechanical activity

2. Gating methods in CMR: prospective and retrospective

3. Optimization of CMR acquisition techniques: temporal resolution, time of acquisition and segmented reconstruction

4. Illustrative examples of CMR artifacts due to an abnormal ECG such as arrhythmia and shallow R waves and practical solutions to improve imaging results

5. Examples of common cardiac diseases with suggestive CMR and ECG findings such as

- Myocardial infarction
- Acute myocarditis
- Hypertrophic cardiomyopathy
- Restrictive cardiomyopathy
- Constrictive pericarditis
- Conduction abnormalities and abnormal interventricular septal motion

SUMMARY
1. An understanding of the normal and abnormal ECG is an essential tool to obtain adequate Cardiac MR
2. There are common ECG related abnormalities that can influence image acquisition and reconstruction and practical solutions can improve image quality
3. Various cardiac diseases can present with typical MR and ECG findings

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Multidetector CT (MDCT) in the Assessment of Complications of Catheter Ablation of Pulmonary Veins

LL-CAE2526

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PURPOSE/AIM
Understand and describe the anatomy of Pulmonary veins by MDCT.
Review secondary complications in catheter ablation of pulmonary veins through the description and analysis of multiple cases collected in our service and show the usefulness of the MDCT in their diagnosis and treatment planning.

CONTENT ORGANIZATION
MDCT allows the identification of the number and morphology of Pulmonary veins. It also possible to integrate images with atrial electrophysiological mapping programs, facilitating the planning of procedures. The main complications of catheter ablation of pulmonary veins include post-surgery strictures and thrombosis, which can even produce important pulmonary infarcts. Less frequently, major complications such as dissection of the pulmonary veins, myocardial infarction, cardiac perforation and sudden death, can develop. MDCT allows us to assess properly most of the complications of the procedure. We present cases seen in our service of stenosis, dissection and thrombosis of pulmonary veins with pulmonary infarcts.

SUMMARY
Due to the increasing realization of the ablation of Pulmonary veins, it is very important for the radiologist to properly know their anatomy and variants. MDCT allows us to assess properly most of the complications of the procedure, being a very important technique in postsurgical follow-up.

Cardiac Complications of Ankylosing Spondylitis

LL-CAE2527

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Kiat Tan , MD

PURPOSE/AIM
Ankylosing spondylitis (AS) has long been known to be associated with aortic valve disease. However, AS is now known to cause a whole range of cardiac complications, which are increasingly being found on imaging. Indeed, AS associated dilated cardiomyopathy can sometimes respond well to immunosuppression. After going through the presentation, the reader should be able to list the various cardiac complications of ankylosing spondylitis and their imaging findings.

CONTENT ORGANIZATION

1. The cardiac complications of ankylosing spondylitis, (including aortitis, aortic regurgitation, coronary heart disease, cardiomyopathy and cor pulmonale) and their imaging manifestations
2. The cardiac complications of the treatment of AS
SUMMARY
Cardiovascular disease is the most common cause of death in ankylosing spondylitis. This presentation reviews the common and uncommon cardiac complications of ankylosing spondylitis, with a particular emphasis on the imaging findings of these.

Where Is the Coronary? - Pictorial Review of Variant Coronary Anatomy in Tetralogy of Fallot (TOF)

LL-CAE2528
Sangita Kapur , MD
Gunjan Aeron , MBBS, MD

PURPOSE/AIM

1. Review variant coronary anatomy in Tetralogy of Fallot (TOF)
2. To discuss significance of variant coronary anatomy
3. To illustrate multi-detector CT Imaging appearance of variant coronary anatomy
4. To explain the utility of pre-operative evaluation of coronary anatomy in patients with TOF

CONTENT ORGANIZATION
1. Coronary anomalies in TOF
- Anomaly of origin
- Anomaly of course
- Anomaly of termination
2. Significance of variant coronary anatomy
3. Review of Multi-detector CT imaging appearance
4. Sample cases
SUMMARY
The major teaching points of this exhibit are:
1. There is an increased incidence of coronary anomalies in patients with TOF
2. Evaluation of coronary anatomy is significant especially if a coronary artery courses anterior to the right ventricular outflow tract .
3. The anatomic details of associated coronary anomalies provided by coronary CTA are important for surgical decisions, particularly for revision repair of TOF.

Mapping the Future of Cardiac MRI-A Case-Based Review of T1 and T2 Mapping Techniques

LL-CAE2529
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Brent Little , MD
Neil D Amin , MD
Arthur E Stillman , MD, PhD

PURPOSE/AIM
Traditional T1- and T2-weighted cardiac sequences provide qualitative information about myocardial tissue characteristic, with arbitrary values/scales that result in inter-patient and inter-study variability of values. T1 and T2 mapping are recent MRI techniques that provide quantitative assessment of myocardial tissue – values that are standardized and can be repeated. The purpose of this exhibit is to review how these sequences are generated, provide
normal examples and show a wide variety of pathologic conditions.
CONTENT ORGANIZATION
How T1- and T2-mapping sequences are generated (including brief physics review). Physiology of abnormal T1 and T2 myocardial signal. Normal appearance/values for T1- and T2-mapping. Case review of abnormal T1- and T2 mapping: Ischemic heart diseases:

- Ischemia
- Myocardial Infarction

Non-ischemic heart diseases (including but not limited to):

- Dilated cardiomyopathy
- Hypertrophic cardiomyopathy
- Amyloid
- Tako tsubo (Stress cardiomyopathy)
- Myocarditis
- Sarcoid
- Siderotic cardiomyopathy

Conclusions
SUMMARY
T1- and T2-mapping are techniques for quantitative assessment of myocardium. This exhibit reviews the physics and physiology of these techniques, and provides examples of a wide variety of ischemic and non-ischemic heart
diseases.

Radiologists Often Miss Infective Endocarditis (IE), a Possible Etiologic Factor for Fever of Unknown Origin and Abscess

LL-CAE2530
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Masaki Urashima
Kenji Kajiwara
Yukiko Honda , MD
Shuji Date
Kazuo Awai , MD *

PURPOSE/AIM
The purpose of this exhibit is to:
1. Alert radiologists to infective endocarditis (IE) as a possible etiology for fever of unknown origin and abscess
2. Demonstrate extra-cardiac imaging findings associated with IE
3. Suggest clinical and radiological clues for IE
CONTENT ORGANIZATION
1. Pathogenesis of IE
2. Extra-cardiac imaging findings associated with IE
-Septic pulmonary emboli

-Abscess in the liver, kidneys, and brain
-Brain infarction and hemorrhage
-Infectious aneurysm
-Pyogenic spondylitis
3. Diagnostic clues for IE at radiological examinations
4. Definitive diagnosis of IE
5. Current radiological approach to primary cardiac lesions of IE
-Cardiac CT
-Cardiac MRI
-18F-FDG PET/CT
SUMMARY
Infective endocarditis (IE) is an uncommon, life-threatening infection; without adequate antimicrobial therapy almost all patients die. Radiologist often miss IE because CT and MRI can fail to demonstrate the cardiac lesions of IE. Fever of unknown origin and multiple abscesses alert to IE as a possible etiologic factor. We present imaging findings of extra-cardiac lesions associated with IE and suggest diagnostic clues.

The Heart of the Matter: Unexpected Cardiovascular Findings during CT Thorax

LL-CAE2531

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Helen Cliffe , MBBChir, BA
Dilip Oswal , MSc, FRCR

PURPOSE/AIM
1. To increase awareness and improve recognition of unexpected cardiovascular findings on CT Thorax.
2. To provide an approach to evaluating their significance and planning appropriate further investigation.
3. To help minimise errors resulting from the oversight of such findings.
CONTENT ORGANIZATION
A pictorial review will provide a logical approach to cardiovascular findings of varying significance within the following categories: 1. Findings requiring immediate assessment: coronary artery graft aneurysm, atrial clot, atrial septal defect, atrial myxoma. 2. Findings which may require non-urgent assessment depending on the clinical context: cardiomegaly, aortic arch aneurysm, partial anomalous pulmonary venous drainage. 3. Findings which may have implications for future intervention: left sided SVC, double aortic arch. 4. Findings unlikely to be of clinical significance: aberrant right subclavian artery, bovine aortic arch, interatrial septal lipoma.
SUMMARY
For general diagnostic radiologists, training in cardiac imaging is limited. Consequently, cardiovascular findings on routine CT Thorax may be under or misdiagnosed due to their subtlety and ability to mimic other lesions. We aim to highlight important and interesting cardiovascular findings, guiding management depending on clinical significance.

Prognosis Prediction of Heart Failure with Global Cardiac Function Analysis Using Routine Cardiac Magnetic Resonance Imaging: A Guide for Beginners

LL-CAE2532

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Hitoshi Takeuchi , MD
Junko Araki
Shichiro Katase
Yukari Takada , MD

PURPOSE/AIM
The purposes of this exhibit are:
1) To illustrate the principles and methods for assessing parameters to estimate prognosis of heart failure based on pathophysiology
2) To review routine scanning techniques used to measure each parameter
3) To describe the limitations and pitfalls of each parameter
CONTENT ORGANIZATION
1) Principle and assessment method of each parameter
- left ventricular (LV) systolic function, e. g., ejection fraction, stroke volume, cardiac index, myocardial mass
- LV diastolic function, e. g., LV filling curve, left atrial size, transmitral flow, pulmonary venous flow, myocardial tissue velocities
- comprehensive index measured from left ventricular systolic and diastolic function (Tei index)
2) Routine scanning techniques used to measure each parameter
3) Limitations and pitfalls of each parameter
SUMMARY
Because scanner software automatically determines many parameters for estimating the prognosis of heart failure, radiologists are often unfamiliar with the assessment of each parameter. Knowledge of the pathophysiology, clinical significance, and limitations of each parameter aids evaluation of global cardiac function to allow appropriate patient management.

Multimodality Imaging of Cardiac Sarcoidosis: MRI and FDG PET/CT

LL-CAE2533

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Abdel K Tahari , MD, PhD
Mahadevan Rajaram
Rathan M Subramaniam , MD, PhD *

PURPOSE/AIM
CONTENT ORGANIZATION
1) Histopathology and clinical features of cardiac sarcoidosis.
2) MRI and FDG PET/CT in cardiac sarcoidosis with illustrative cases
a. Role in diagnosis
b. Monitoring treatment response
c. Prognostication
d. Pitfalls
SUMMARY
Cardiac sarcoidosis remains a challenging dilemma, relying on a combination of clinical findings and imaging abnormalities. More recently, FDG PET/CT and MRI are emerging to be very useful methods in diagnosis, identification of occult sites, assessment of disease activity, staging and in monitoring treatment response in patients with cardiac sarcoidosis.

At the Heart of the Syndrome: Genetic Syndromes with Cardiovascular Manifestations

LL-CAE2534
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Carlos S Restrepo , MD
Daniel Ocazionez , MD
Cylen Javidan-Nejad , MD

PURPOSE/AIM
1. Review the most common genetic syndromes that present with associated congenital cardiovascular anomalies.
2. Discuss the role of imaging in the initial evaluation and follow up of these patients.
3. Familiarize the radiologist with the most common management strategies and complications.
CONTENT ORGANIZATION

a. Down Syndrome
b. Turner Syndrome
c. Chromosome 22q11.2 deletion
d. Williams-Beuren Syndrome
e. Marfan Syndrome
f. TGF-b Receptor Disorders (Loeys-Dietz, etc)
g. Hereditary Hemorrhagic Telangiectasia
h. Holt-Oram Syndrome
i. Noonan Syndrome
j. Others
SUMMARY
The prevalence of patients with genetic syndromes who have a coexisting congenital cardiovascular abnormality has increased steadily over the last decades and will continue to do so allowing for improvements in their medical and surgical care. Imaging plays a key role in the initial diagnosis and long term care of these patients. The radiologist must be familiar with these genetic syndromes and the associated spectrum of cardiovascular anomalies. In similar fashion, as a large number of these patients undergo surgical repair, the radiologist should be aware of these surgical procedures as well as their most common complications.

Deductive Research of Clinical Effectiveness of Removing Calcified Plaques Using Quadratic Differential Filter for Agatoston High Score Coronary CTA

LL-CAE2535
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Shigeo Sugawara , MD
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Hiromi Nanba , RT
Koki Koki , MD

PURPOSE/AIM
The purpose of this exhibits: 1.To descrive a technique for removing calcified plaques using the quadratic differential filter and zero cross method. 2.To reconstruct calcified plaques removal MIP image and compare with CAG. 3.To assess the stenosis accuracy using direct cross-section images. 4.To visualize the true lumen and calcified plaques.
CONTENT ORGANIZATION
Imaging technique:Non Helical scanning syncronized with the electcardiogram using 320 detector raw CT scanner. Quadratic differential image sharpening filter and zero cross method. Materials:Aquilion One CT scanner(Toshiba Medical Systems Inc.),Zio Station2 Image Processing Work Station(ZIO Inc.) Evaluation items:Calcified plaques removal and stenosis were compared with the accuracy CAG.Made a visualize of true lumen and calcified plaques using Virtual Endoscopy method of clinical study.
SUMMARY
1.A technique for removing calcified plaques is descrived, with the stenosis accuracy of coronary CTA assessed using direct cross-section images and visualized of true lumen and calcified plaques using VE. 2.Calcified plaques removal MIP image showed a good correlation with CAG. 3.Stenosis using direct cross-section images showed a good correlation with CAG. 4.VE clearly indicated the position relationship between the true lumen of coronary artery and calcified plaques.

â€œCriticalï¿½? Arrhythmia: Spectrum of Imaging Findings on CMR

LL-CAE2536
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Anneline S. J. M. Te Riele , MD
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Crystal Tichnell , MSc
Hugh Calkins
Harikrishna Tandri
David A Bluemke , MD, PhD *
Ihab R Kamel , MD, PhD *

PURPOSE/AIM
Cardiac MR (CMR) is often requested to evaluate a patient with critical arrhythmia of uncertain etiology. CMR findings can help differentiate between a number of diagnostic possibilities, including coronary artery disease, myocarditis, cardiac sarcoidosis, cardiomyopathies (dilated, infiltrative and hypertrophic) and arrhythmogenic right ventricular cardiomyopathy. Since the clinical presentation may overlap, identification of characteristic patterns of myocardial involvement on CMR can suggest the correct diagnosis.
CONTENT ORGANIZATION
1) Discuss the incidence and most frequent causes of critical arrhythmia 2) Describe indications for CMR in the setting of critical arrhythmia or sudden cardiac death. 3) Provide a detailed approach to assessment of functional and structural CMR findings and provide an algorithm that leads to an accurate diagnosis. 4) Case examples with CMR: a. Ischemic cardiomyopathy b. Sarcoidosis c. Idiopathic dilated cardiomyopathy d. Amyloidosis e. Hypertrophic cardiomyopathy f. Arrhythmogenic right ventricular cardiomyopathy
SUMMARY
Evaluation for critical arrhythmia is a common indication for CMR. Familiarity with characteristic patterns of imaging findings associated with commonly encountered diseases will increase the radiologist's confidence in making an accurate diagnosis.

Cardiac CTA Survival Guide: How to Build a Cardiac CTA Program in the Community Hospital Setting

LL-CAE2537
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David P Mayer , MD
Oleg Teytelboym , MD

PURPOSE/AIM
This exhibit aims to: -Outline the clinical and financial utility of cardiac computed tomography angiography (CCTA) for community hospitals
-Address the barriers radiology departments face with regards to creating a CCTA service
-Propose practical solutions to overcome these challenges
CONTENT ORGANIZATION
CCTA background, strengths and limitations

- Clinical indications
- Financial considerations

Negotiating with administrators and acquiring referrals

- Marketing
- CT hardware/software essentials
- Tackling turf wars, establishing clinical alliances
- Extending hours of coverage

Education

- Technologist training
- Radiologist credentialing

Patient preparation logistics

- Heart rate control
- IV access
- Order set development
- Nitroglycerin

Quality control

- Image quality
- Obtaining feedback from conventional angiography studies and referring clinicians

Summary
SUMMARY
CCTA is an important imaging tool that can provide fast, accurate, non-invasive and cost-effective assessment of coronary artery disease. Despite the clinical and financial benefits, it is difficult to build a successful CCTA program due to a host of challenges, particularly in the community hospital setting. This presentation methodically outlines these barriers and provides practical solutions.

Cardiac Physiology for Radiologists: A Review of Relevant Physiology for Interpretation of Cardiac MRI and CT

LL-CAE2538
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Gary H Danton , MD, PhD
Joel E Fishman , MD, PhD
Richard Kardon , DO

PURPOSE/AIM
The purpose of this exhibit is to review relevant aspects of cardiac physiology as it relates to interpreting cardiac CT and MRI
CONTENT ORGANIZATION
Evaluation of cardiac function

- LVEF
- Pulmonary venous flow analysis

Cardiac shunts

- Qp:Qs

Valvular physiology

- Pressure gradients
- Regurgitant fractions

SUMMARY
Cardiac CT and MRI can provide clinicians with useful insights into cardiac physiology and pathology. However, the language and concepts of cardiac physiology used daily by cardiologists are not often understood by radiologists. This educational exhibit will review cardiac physiology as it relates to cardiac CT and MRI. Topics include evaluation of cardiac function with understanding of left ventricular ejection fraction and pulmonary venous flow analysis. The hemodynamics of cardiac shunts will be discussed with an emphasis on the ratio of pulmonary flow to systemic flow (Qp:Qs) and effects on pulmonary pressures. Additionally, valvular physiology will be reviewed focusing on understanding pressure gradients and changes with valvular pathology including measurement of regurgitant fractions in valvular insufficiency. Understanding these basic concepts will help radiologists tailor reporting of cardiac studies to clinically relevant information.

Spectrum of Disease on Cardiac MR in Proven Arrhythmogenic Right Ventricular Cardiomyopathy Cases: A Comprehensive Review with Illustrative Case Examples

LL-CAE2539
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Ihab R Kamel , MD, PhD *

PURPOSE/AIM
Arrhythmogenic right ventricular cardiomyopathy (ARVD/C) is a rare disease; therefore many radiologists may not be familiar with typical imaging findings. Our objective is to present proven cases that belong to a large registry, ranging from mild to severe, and familiarize the practicing radiologist with the spectrum of morphologic and functional findings of ARVD/C seen on state of the art cardiac MR (CMR).
CONTENT ORGANIZATION
1. Genetics and Pathology of ARVD/C. 2. Using the diagnostic 2010 Task Force Criteria (TFC) 3. Illustrative case examples: a. Structural

abnormalities i. Ventricular dilation ii. Delayed enhancement iii. Fatty infiltration b. Functional abnormalities i. Global ventricular dysfunction ii. Regional wall motion abnormalities
SUMMARY
CMR is commonly utilized in screening subjects with ARVD/C. This review provides a systematic and detailed approach to ARVD/C assessment that can assist the practicing radiologists in making the correct diagnosis.

Building a Bridge to Save a Failing Ventricle: Radiologic Evaluation of Short-term and Long-term Cardiac Support Devices

LL-CAE2540
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Ahmed El-Sherief , MD
Joseph T Azok , MD
Michael A Bolen , MD
Charles T Lau , MD
Rahul D Renapurkar , MD

PURPOSE/AIM
The purpose of this exhibit is to:
- Review the basics of short-term and long-term cardiac support therapies.
- Review the various short-term and long-term cardiac support devices (implanted by surgical and minimally invasive techniques).
- Review normal and abnormal post-implantation imaging appearances.
CONTENT ORGANIZATION
Introduction *Short term devices* 1) Indications 2) Devices a) Counterpulsation devices-intraaortic balloon pump
b) Centrifugal pumps
c) Extracorporeal pumps
d) Axial flow pumps- Impella device
e) Percutaneous left atrial-to-femoral-arterial ventricular assist device (VAD)- TandemHeart
f) Cardiopulmonary assist devices-extracorporeal membrane oxygenation 3) Imaging appearances 4) Imaging of complications
Intermediate and long term devices 1) Indications 2) Devices a) Ventricular assist devices

- First generation
- Second generation
- Third generation

b) Total artificial heart 3) Imaging appearances 4) Imaging of complications.
SUMMARY
With this exhibit, the viewers will be able to: 1. Understand the basics of short-term and long-term cardiac support therapy
2. Recognize the various short-term and long-term cardiac support devices.
3. Identify the normal and abnormal post-implantation imaging appearances of these devices.

Characterization of Left Atrial Appendage Anatomy Using Cardiac Computed Tomography

LL-CAE2541
William J Reed , MD
Patricia J Mergo , MD
Brian Shapiro , MD
Andrew Bowman , MD, PhD

PURPOSE/AIM
An understanding of the anatomy of the left atrial appendage (LAA) is becoming increasingly important as it is recognized as a significant site for thrombus. Advanced techniques for LAA closure (including the Larait and Watchman procedures, as well as surgical closure) require precise anatomic localization and description of the LAA and its anatomic relationships prior to intervention. To date, this is not well described in the literature.
CONTENT ORGANIZATION
This scientific exhibit describes the anatomy of the LAA, as imaged with CTA, including parameters for normal size and positioning of the LAA relative to the heart. Additionally, the anatomic relationships are discussed in context of their impact on pre-procedural planning for LAA closure, including a detailed discussion of the Lariat, Watchman and surgical techniques. Specific teaching points are made emphasizing the relevant findings on CTA as they relate to pre-procedural planning. Finally, imaging techniques are discussed for optimal imaging of the LAA with CTA for assessment of LAA thrombus, with a discussion of the diagnostic criteria for identification of LAA thrombus.
SUMMARY
CTA with multi-planar 3D reconstructions provides exquisite anatomic detail of the LAA, as well as assessment for thrombus using conventional ECG-gated, contrast-enhanced CTA with 2nd phase delayed imaging through the LAA.

The Elephant in the Room: State-of-the-Art Imaging of the Elephant Trunk Procedure

LL-CAE2542
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Anna Knobel , MD
Mostafa Sadek
Konstadinos Plestis
Stephen C Machnicki , MD

PURPOSE/AIM

1. Provide an overview of stage I and stage II of the elephant trunk technique.
2. Present pre-operative and normal post-operative CTA images following both stage I and stage II procedures.
3. Discuss post-surgical complications.

CONTENT ORGANIZATION

1. Overview of stage I and stage II of the elephant trunk technique with the help of illustrations. Outline the indications, purpose, benefits and risks of the procedure.
2. Present pre-operative and successful post-operative CTA images obtained after each stage. Also review findings that may mimic complications.
3. Discuss post surgical complications which include: pseudoaneurysm, graft occlusion, graft kinking, clot formation and thromboembolism.

SUMMARY

1. The elephant trunk procedure is a relatively new technique carried out in two stages, which is used to treat thoracic aortic aneurysms and dissections.
2. This exhibit will familiarize the reader with expected post-operative CTA imaging and findings that may mimic complications.

3. It is important to look for complications that are also commonly found in other aortic surgeries, as well as those that are unique to this procedure.

Alternatives to Traditional Surgical Aortic Valve Replacement in High Risk Patients: A Pictorial Review

LL-CAE2543
Rebecca Zener , MD
Robert Kiaii , MD
David J Peck , MD

PURPOSE/AIM

- To review minimally invasive surgical interventions as alternatives to traditional surgical aortic valve replacement (AVR).
- To discuss the clinical indications/contraindications of the various options to traditional AVR.
- To provide a pictorial review of the different devices' imaging appearances on chest radiography.

CONTENT ORGANIZATION
Transcatheter Aortic Valve Replacement (TAVR): procedure overview, indications

- Transfemoral
- Direct aortic
- Transapical
- Transaxillary

Aortic Valve Bypass with Correx device (AVB): procedure overview, indications Sutureless AVR: procedure overview, indications Review of device appearance on chest radiography

- Transfemoral, direct aortic, transaxillary TAVR
- Transapical TAVR
- AVB
- Sutureless AVR

SUMMARY

1. Multiple minimally invasive surgical interventions exist as alternatives to traditional AVR. Transfemoral TAVR is the least invasive and preferred route.
2. AVB is indicated in patients with a small aortic annulus and severe peripheral vascular disease or porcelain aorta or previous cardiac surgery.
3. Sutureless AVR provides the best effective valve area in patients with a calcified or small annulus who are able to undergo traditional surgical AVR.
4. Recognition of these devices' radiographic appearance is important for the radiologist.

Go with the Flow! Cardiovascular MR Flow Quantification for Dummies

LL-CAE2544
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Daniel Ocazionez , MD
Carlos S Restrepo , MD

PURPOSE/AIM
1. Explain the basic principles underlying phase contrast sequences for MR flow quantification. 2. Apply flow quantification to commonly encountered cardiovascular conditions. 3. Post-process and interpret flow quantification sequences with emphasis on clinically significant data and recognition of potential errors in measurement.
CONTENT ORGANIZATION
1. Introduction 2. Physics of MR flow quantification 3. Sequence acquisition and post processing 4. Clinical Applications
a. Vascular flow evaluation
b. Cardiac function evaluation
c. Shunt evaluation
d. Valvular disease 5. Pitfalls and troubleshooting
SUMMARY
Flow quantification sequences are widely used in cardiovascular MR. Therefore, it is crucial that radiologists understand the fundamentals of the sequence and how it can be used to provide clinically relevant information and aid in diagnosis. Understanding which cardiovascular conditions call for the use of flow quantification as well as the ability to avoid common pitfalls encountered with its use will allow the radiologist to provide the highest quality of care for cardiovascular patients.

Imaging Biomarkers in Cardiac Radiology

LL-CAE2545
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Keisuke Kida
Yukihisa Ogawa
Yoshihiro Akashi
Kengo Suzuki
Yasuo Nakajima , MD

PURPOSE/AIM
1. To understand the definition of imaging biomarker in cardiac radiology
2. To understand the methodology, clinical benefits and limits of imaging biomarker in cardiac radiology
3. To realize the future use of imaging biomarker in personalized radiology
CONTENT ORGANIZATION
Definition of Imaging Biomarker
Methodology based on Modalities;
- CT
- MRI
- Echocardiography
- RI/PET
Use;
- Detection / Screening: Disease Assessment
- Prediction: Risk Stratification and Prognostic Evaluation

- Monitoring: Clinical Surrogate and Response to Treatment
Clinical Benefits;
- Coronary Stenosis and Plaque
- Myocardial Function
- Myocardial Viability
- Myocardial Ischemia
- Imaging Biomarker of Cardiac Toxicity caused by Chemotherapy in Oncology
Problems and Limits;
- Is it ready in Clinical Practice or Only in Research?
- Standardization and Validation
Future of imaging biomarker in Personalized Radiology
SUMMARY
The major teaching points of this exhibit are:
1. Biomarkers are increasingly important in clinical practice and research. Quantification is of increasing importance for imaging biomarkers to exploit the morphological and/or functional information in cardiac imaging.
2. In near future, imaging biomarker will become necessary in personalized medicine, though it is still the research tool at present.

Application of 270 Concentration of Contrast Agents and Low Tube Voltage Combined with Iterative Reconstruction in DSCT Coronary Angiography

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LL-CAE2546
Yan Liangliang

PURPOSE/AIM
To investigate the value of low concentrations of contrast agents and low tube voltage combined with sinogram-affirmed iterative reconstruction(SAFIRE) to improve image quality and reduce radiation dose in DSCT Sequence scan mode of coronary artery imaging.
CONTENT ORGANIZATION
SUMMARY
In Sequence scan mode, the low concentration of contrast agent and low tube voltage combined with SAFIRE technology can get better image quality and low radiation dose.

Role of CT and MR in the Evaluation of Tricuspid Valve and Associated Structures

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LL-CAE2547
Kristen Nagata , MD
Cameron Hassani , MD
Manuel Salguero-Villadiego , MD
Damian Sanchez-Quintana , MD, PhD
Farhood Saremi , MD

PURPOSE/AIM
• To demonstrate detailed anatomy of the tricuspid valve (TrV) and its anatomical variants using cadaveric samples with CT and MR correlation • To discuss the spectrum of diagnostic information CT and MR can provide in regards to pathological processes • To compare the strengths and limitations of CT and MR with currently established methods of TrV evaluation
CONTENT ORGANIZATION
• TrV apparatus morphogenesis, anatomy, and variants • Related structures: membranous septum, atrial vestibule, central fibrous body • CT and MR techniques for TrV imaging • Strengths and limitations of CT and MR compared with echo • CT and MR evaluation of TrV pathology: pulmonary hypertension, vegetations/mass, valve malformations, acquired disease, and congenital heart disease as it pertains to the TrV, post operative findings. • Imaging-based percutaneous interventions
SUMMARY
The major teaching points of this exhibit are: • Reviewing the anatomy and anatomic variants of the TrV • Learning the utility of the newest CT and MR techniques for assessing the TrV • Understanding the spectrum of pathology associated with valvular abnormalities seen on CT and MR

Cardiac CT in Diagnosis of Valvular Heart Disease: What Is the Real Incremental Value over Echocardiography?

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LL-CAE2548
Mi Sun Chung , MD
Dong Hyun Yang , MD
Joon-Won Kang , MD
Tae-Hwan Lim , MD, PhD

PURPOSE/AIM
To describe incremental values of cardiac computed tomography (CT) over echocardiography (ECHO) in diagnosis of valvular heart disease (VHD) with representative cases in clinical practice
CONTENT ORGANIZATION
1. Current roles of ECHO and cardiac CT in diagnosis of VHD (current guideline) 2. Incremental value of cardiac CT over ECHO in clinical practice
1) Overcoming weak points of ECHO
A. Evaluation restricted anatomical structures on ECHO
- Volume and function of RV and LA
- Pulmonary valve / tricuspid valve
B. Evaluation of prosthetic valve
- Morphologic and functional information of prosthetic valve
1. Pannus formation 2. Paravalvualr dehiscence
- Periprocedural evaluation of transcatheter aortic valve replacement
2) Procedure-oriented reconstruction for VHD by using variable 3D technique (How to)
- Surgeon's view vs. Interventionalist's view
3) Comprehensive evaluation of coexisting cardiac and extracardiac disease
- Extracardiac disease and coronary artery **3. Technical issue and remedy of cardiac CT for VHD**
- Radiation dose issue
- Tip for good image quality
SUMMARY
We described clinical situations to maximize advantages of cardiac CT over ECHO for accurate periprocedural evaluation of VHD. Cardiac CT can be increasingly used as a complementary modality for ECHO to provide optimal practice in VHD.

Understanding Dose Reduction Techniques at Cardiac CT for Daily Clinical Practice

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LL-CAE2549

Hidetaka Yasuda
Fuminari Tatsugami
Yutaka Misezaki
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Yukiko Honda , MD
Kazuo Awai , MD *
Masao Kiguchi , RT
Chikako Fujioka , RT

PURPOSE/AIM
The purpose of this education exhibit is to:
1. Understand different radiation dose reduction techniques at cardiac CT for the daily clinical practice
2. Present our newly developed method for radiation dose reduction at cardiac CT
CONTENT ORGANIZATION
1. Radiation exposure at current cardiac CT
- from 64- to 320-detector CT
2. Patient factors
- setting of kV, tube current, and field length based on the patient physique
- ?-blockers for heart rate control
3. Technical factors
- optimal setting of the ECG-controlled tube current modulation
- low tube voltage for specific patients
- prospective gating: step and shoot scanning
- cardiac image filter sand iterative reconstruction
4. A novel method for radiation dose reduction at cardiac CT
SUMMARY
As cardiac CT involves one of the highest radiation doses among CT studies, techniques that reduce the radiation exposure must be applied. This includes the careful selection of appropriate scanning protocols based on the patient's physique and heart rate and rhythm. Furthermore, we present our new dose reduction method that applies multi-phase data-averaging and non-rigid image registration.

Cardiac Involvement in Muscular Dystrophy: Patterns on Cardiac MRI

LL-CAE2550
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    Masoud Shariat , MD
    Vikram M Raju , MBBS, FRCR
    Bernd J Wintersperger , MD *
    Andrew M Crean , MD
    Elsie Nguyen , MD

PURPOSE/AIM
To demonstrate cardiac MR imaging features of cardiomyopathy secondary to muscular dystrophy and illustrate specific patterns for differential diagnosis.
CONTENT ORGANIZATION
1. A brief introduction outlining the various types of muscular dystrophy (such as Becker's, Duchenne, limb girdle muscular dystrophy), their pathophysiology, their epidemiology and potential involvement of the heart. 2. MR imaging features of cardiomyopathy in muscular dystrophy patients including functional imaging and late gadolinium enhancement patterns with case examples. 3. To assess and showcase potential distinguishing features from other cardiomyopathies based on the patterns of late gadolinium enhancement
SUMMARY
The aim of this exhibit is to highlight features of cardiac involvement and heart failure in individuals with various types of muscular dystrophy. The cardiac involvement in these individuals can lead to clinical complications such as heart failure requiring transplant, arrhythmia and even sudden death. MR imaging plays an important role in the general assessment of cardiomyopathy in muscular dystrophies. This exhibit aims to describe the MRI imaging features, emphasizing the late gadolinium enhancement pattern which can be used to distinguish them from other cardiomyopathies.

The Scimitar Spectrum

LL-CAE2551
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    Edward Nicol , MBBS
    Ilaria Bo , MD
    Michael Rigby , MD, MRCP
    Michael B Rubens , MBBS

PURPOSE/AIM
This presentation originates from a study of 55 patients with Scimitar Syndrome over a 21 year period at our institution. The aim of this exhibit is to:

- Define Scimitar syndrome and review the embryology.
- Using CT imaging demonstrate the morphological heterogeneity of Scimitar Syndrome including systemic collaterals, pulmonary venous and bronchial anomalies.
- Demonstrate unusual variants including left sided Scimitar syndrome, horseshoe lung and the spectrum of assiocicated congenital anomalies including aortic atresia, coarctation and anomalous coronary origin.

CONTENT ORGANIZATION

- Anatomy and Embryology of Scimitar Syndrome
- CT and catheter angiographic findings in classical Scimitar Syndrome including;

1. Pulmonary venous return
2. Systemic arterial pulmonary collaterals
3. Tracheobronchial anomalies
4. Parenchymal lung

- Atypical Scimitar Syndrome

1. Anomalous coronary origin
2. Co-arctation
3. Hypoplastic left ventricle
4. SVC anomalies

SUMMARY
The major teaching points of this exhibit are;

- Scimitar syndrome is a rare condition with classical and unusual associations.

- CT enables the radiologist to diagnose not only the vascular anomalies but parenchymal, bronchial and synchronous cardiac abnormalities.
- The benefits of a non-invasive and relatively low radiation dose imaging.

Take It to Heart: CT Imaging Is the Key to Unlocking Heart Transplantation Therapy

LL-CAE2552
Valerie D'Aurora , MD
Michael A Sadler , MD
Vadim Spektor , MD
Bita Ameri , MD
Rahul Patel , MD

PURPOSE/AIM
This exhibit will demonstrate the utility of CT imaging in pre-, peri-, and post-cardiac transplantation recipients by presenting both typical and unusual imaging findings, and illustrating early and late post-operative complications.
CONTENT ORGANIZATION
Pre-operative CT is critical in assessing surgical anatomy and confirming placement of life-extending devices. Peri-operatively, CT is used to diagnose immediate complications including pneumonia, mediastinitis, sternal osteomyelitis, and cerebral infections and infarctions. Late post-operative CT provides surveillance of the sequelae of long-term immunosuppressive therapy, such as lymphoproliferative disease and visceral malignancies, which are significant causes of morbidity and mortality in transplant recipients.
SUMMARY
The key learning points of this exhibit are:

- CT is critical in the early diagnosis of peri-operative complications and identifying the consequence of long-term immunosuppressive therapy.
- Understanding the typical pre- and post-operative CT findings in heart transplantation recipients is essential for accurate diagnosis and appropriate management.
- Optimizing treatment of cardiac transplantation recipients involves an integrative approach, in which radiologists have a responsibility to recognize diseases and complications affecting morbidity and mortality.

The Many Faces of Hypertrophic Cardiomyopathy

LL-CAE2553
Samer Dabbo , MD
Elsie Nguyen , MD

PURPOSE/AIM
Hypertrophic cardiomyopathy (HCM) is a genetic cardiac disease that is the most common cause of sudden cardiac death in young people. While inheritance is autosomal dominant in nature, there is a diverse phenotypic expression . Commonly, the inter-ventricular septum is involved; however, HCM can affect any portion of the left ventricle. Clinically it is important to identify the various forms of the disease in order to tailor treatment. To this end, the purpose of this presentation is to provide an overview of the various phenotypes of HCM with a focus on unusual manifestations (and common mimics) and their management implications.
CONTENT ORGANIZATION
A brief overview of HCM will initially be discussed, including definition, etiology and pathophysiology, hemodynamic classification, signs and symptoms. Case based format will be used to highlight the various phenotypes and mimics of HCM.
SUMMARY
1. Be able to identify the typical and atypical phenotypes of HCM. 2. Be able to identify the common mimics of HCM. 3. Be able to identify HCM features that increase risk for sudden cardiac death. 4. Discuss advantages and limitations of the various diagnostic modalities (i.e. echocardiogram, MRI, and CT) in assessing HCM.

Cracking Septal Knuckles: A Review of Subvalvular Aortic Outflow Obstruction with MR and Sonographic Correlation

LL-CAE2554
Jenanan Vairavamurthy , MD
Reshma Mathews
Tatyana Danilov
Alan C Legasto , MD

PURPOSE/AIM
1. To review the pathophysiology and causes of subvalvular left ventricular outflow tract obstruction. 2. To educate the reader on the appearance of a normal left ventricular outflow tract with correlation to cardiac MR images and echocardiography. 3. To review the MR and sonographic appearance of the main causes of subvalvular left ventricular outflow tract obstruction with an emphasis on their subtle differences.
CONTENT ORGANIZATION
1. Review of outflow tract obstruction. 2. Review of subvalvular left ventricular outflow tract obstruction. a. Causes. b. Pathophysiology 3. Normal left ventricular outflow tract anatomy with MR and sonographic correlation a. Classic appearance b. Variable morphologies 4. Causes of subvalvular outflow tract obstruction with radiologic correlation. a. Hypertrophic cardiomyopathy. b. Fixed subaortic stenosis ("Septal Knuckles").
SUMMARY
Left ventricular outflow tract obstruction has many etiologies that may be difficult to distinguish via conventional echocardiography. Cardiac MR has become increasingly relied upon in these clinical situations. Careful review of the main causes of subvalvular stenosis presented in this education exhibit will allow the reader to better distinguish between congenital and acquired conditions. This could potentially increase accuracy of MR interpretation and improve patient care.

The Prevalence and Types of Coronary Artery Fistula Detected on Coronary Computed Tomography Angiography

LL-CAE2555
Jae Jung Lim , MD
Jung Im Jung , MD, PhD
Bae Young Lee
Hae Gyu Lee

PURPOSE/AIM
Coronary artery fistulas are unusual coronary anomaly that abnormal communication between the coronary artery and the cardiac chamber or great vessel. Coronary angiography has been known to be the diagnostic method for identifying coronary anomalies. Known prevalence of coronary artery fistula has been obtained from the coronary angiography. However, incidentally found coronary artery fistula is

increasing as coronary computed tomography has become popular.
Here we determine the prevalence of coronary artery fistula and present the various types of coronary artery fistula detected on coronary computed tomography angiography.
CONTENT ORGANIZATION
1. We demonstrate the prevalence of coronary artery fistula.

2. We demonstrate the various types of coronary artery fistula detected on coronary computed tomography angiography.
1) Coronary to pulmonary artery fistula
2) Coronary to bronchial artery fistula
3) Coronary to cardiac chamber fistula
4) Coronary bronchial pulmonary artery fistula
5) Coronary to superior vena caval fistula
SUMMARY
Major teaching points of this exhibit is to determine the prevalence of coronary artery fistula and introduce the various type of coronary artery fistula detected on coronary computed tomography angiography.

Clinico-radiological Features of Intra-aortic Balloon Pumps. What the Radiologist Needs to Know and Report

LL-CAE2556
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Joseph Mullineux , MBBCh
Mini Pakkal
Vikas Shah , MBBS

PURPOSE/AIM
1. To present the normal multi-modal imaging findings of intra-aortic balloon pumps (IABP) inserted to augment coronary perfusion. 2. To describe the potentially catastrophic radiologically discernable complications associated with IABP placement. 3. Review other associated complications and the role of imaging in detection and evaluation.
CONTENT ORGANIZATION
1. Role and function of IABPs in the intensive care unit (ICU) and cardiac catheter lab. 2. Pictorial review of insertion techniques and the IABP form and mechanics including the role of CT in anticipating technical problems with its insertion. 3. Radiological examples of normal IABP positioning and findings on CXR, AXR and MDCT, including pearls and pitfalls. 4. Description, pictorial review and radiological examples of common and rare but serious associated complications of IABP placement. 5. Lessons learnt from our high volume tertiary cardio-respiratory centre
SUMMARY
The major teaching points of this exhibit are: 1. IABPs are safe and have a vital role in the ICU, however following insertion the Radiologist must be aware to the pitfalls of image interpretation. 2. Complications are rare but potentially disastrous. The radiologist must be alert to the imaging features, as early identification may allow prompt manipulation of the device to reduce the risk of these.

State of the Art Multi-modality Imaging of Left Ventricular Assist Devices (LVADs)

LL-CAE2557
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Todd R Hazelton , MD

PURPOSE/AIM
Left ventricular assist devices (LVADs) are commonly used circulatory devices in severe heart failure patients. LVADs can be used for short-term therapy as bridge to heart transplantation or long term as destination therapy for patients who are not candidates for heart transplantation.
We describe various types of LVADs used in different clinical settings and briefly describe their anatomy and function. We will discuss CTA and echocardiographic imaging protocols, normal LVAD anatomy, and post-operative complications including LVAD thrombus, graft and driveline fractures, graft dehiscence, pericardial tamponade, and others. We will review the strengths and limitations of different imaging modalities.

CONTENT ORGANIZATION
1. Review the types of LVADs, their clinical indications, and how they function.
2. Describe the normal imaging appearance of different types LVADs on CTA, X-ray, catheter angiography, and echocardiography.
3. Review LVAD-CTA and echocardiogram imaging protocols.
4. Discuss imaging findings of early and late post-operative LVAD complications.
SUMMARY
At the end of presentation the reader will:
1. Understand the various types of LVADs and function.
2. Identify the normal appearance of different types on LVADs on X-ray and CT imaging.
3. Understand the role of CTA and echocardiograms in identifying post-operative complications.

CT Findings and Complications of Eisenmenger's Syndrome in Adult Patients: A Pictorial Review

LL-CAE2558
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Maurizio Zompatori , MD
Nazzareno Galie
Fabio Niro , MD
Cecilia Modolon
Federica Ciccarese , MD
Barbara Leone
Marica Giannotta

PURPOSE/AIM
To describe the radiological features of pulmonary arterial hypertension (PAH) associated with congenital heart disease (CHD) and the complications due to the most advanced form, which is the Eisenmenger's syndrome (ES).
CONTENT ORGANIZATION
Most pediatric patients with PAH secondary to CHD survive to adulthood. The development of a bidirectional or a reversed shunt lead to the ES.
In our experience of more than 200 adult patients, the radiological appearance of PAH-CHD results into pulmonary circulation, cardiac and lung parenchymal findings, easily assessed by MDTC-angiography study.

Patients with ES are subject both to the possibility of bleeding, due to damaged capillaries and high pressure, and in-situ pulmonary thrombosis, related to hyperviscosity and slow blood flow in aneurysmal pulmonary arteries.

Moreover, a generally disregarded aspect is that the enlarged main pulmonary arteries and cardiac chambers may determine displacement or extrinsic compression on airways, pulmonary veins and mediastinal structures.

SUMMARY

MDCT-angiography study is useful to describe vascular changes and pulmonary diseases associated with PAH-CHD. It also allows to identify thoracic complications due to ES. The radiologists must be aware of the imaging features of this disease to be able to provide the correct information in the monitoring of these patients.

Computed Tomographic Imaging of Transcatheter Aortic Valve Replacement for Prediction and Prevention of Procedural Complications

LL-CAE2559

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Philipp Blanke , MD
Cameron J Hague , MD
Giang Nguyen , MD
Jennifer D Ellis , MD
Adrian Reagan , MD
Rekha Raju

PURPOSE/AIM

The purpose of this review is to provide an overview of the significant complications encountered at the time of TAVR and to discuss how CT may help mitigate their occurrence.

CONTENT ORGANIZATION

TAVR complications include post-procedural paravalvular aortic regurgitation (PAR), aortoiliofemoral vascular injury, cardiac conduction disturbances, aortic root injury, and coronary artery obstruction. Integration of advanced imaging tools such as CT have been shown historically to allow for the reduction of vascular complications through 3D assessment of vessel parameters. More recently, 3D CT measures of the annulus have allowed for the discrimination of those patients that experience moderate PAR and allow for the reduction of its frequency. Evolving data suggests that pre-procedural CT may allow identification of those who are at higher risk of annular injury by assessing the distribution of aortic valvular and LVOT calcification. Recent advances in fusion technology have uncovered significant promise for CT Fluoroscopic guidance tools to reduce the rate of perioperative conduction disturbances.

SUMMARY

The major teaching points of this review include learning TAVR complications and how the application of CT may minimize their occurrence.

ECG-gated Cardiac CT of Hypertrophic Cardiomyopathy: A Review of Findings in Primary and Secondary Hypertrophic Cardiomyopathies, and Comparison with Transthoracic Echocardiography

LL-CAE2560

Ethan J Halpern , MD

PURPOSE/AIM

1. To review findings associated with left ventricular hypertrophic cardiomyopathy. To distinguish primary hypertrophic cardiomyopathy from secondary cardiomyopathy. 2. To review the findings of obstruction within the left ventricular cavity and left ventricular outflow tract secondary to hypertrophic cardiomyopathy. 3. To illustrate advantages of ECG-gated CTA as an adjunct to echocardiography for diagnosis of hypertrophic cardiomyopathy .

CONTENT ORGANIZATION

Diagnosis of hypertrophic cardiomyopathy - based upon teaching cases from Thomas Jefferson University Hospital Primary versus secondary hypertrophic cardiomyopathy Concentric LVH versus asymmetric LVH Left ventricular non-compaction Intracardiac obstruction: - Asymmetric septal hypertrophy and left ventricular outflow tract obstruction - Systolic anterior motion of the mitral valve / chordal structures - Intracavitary obstruction

SUMMARY

ECG-gated CT can be a useful adjunct to echocardiography for the diagnosis of hypertrophic cardiomyopathy and associated structural anomalies. CT demonstrates morphologic and functional findings of hypertrophic cardiomyopathy that are visible with echocardiography. Additional associated findings such as outflow tract obstruction, apical obstruction, and ventricular non-compaction are sometimes more clearly visible on CT.

Coronary Artery Bypass Graft 256-slice MDCT Coronary Angiography: Current Surgical Techniques and Postoperative Imaging

LL-CAE2561

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Philipp R Rau , MD
Anne S Chin , MD
Yves Provost , MD
Nicolas Noiseux , MD, MSc
Carl Chartrand-Lefebvre , MD *

PURPOSE/AIM

Coronary artery bypass graft (CABG) surgery is an essential treatment option in patients with symptomatic ischemic heart disease. Noninvasive CT angiography is a readily available technique for assessing the preoperative status, the postoperative graft anatomy, as well as early and late graft complications.

CONTENT ORGANIZATION

We will depict arterial, venous, sequential and composite graft design anatomy, as well as anastomosis types used to reach distal coronary artery targets. On- and off-pump surgery techniques will be illustrated with their imaging correlates. We will discuss and show early and late graft complications (stenosis, thrombosis, aneurysm), using different 3D visualization techniques such as 3D volume rendering, maximum intensity projection and curved multiplanar reformats. We will discuss the increasing role of MDCT in preoperative staging and before re-intervention. Finally, quantitative morphometric analysis in graft imaging will be introduced, with case correlations.

SUMMARY

By means of different 3D visualization techniques, current MDCT systems allow accurate depiction of arterial and venous complex CABG anatomy including assessment of conduit patency, evaluation of distal anastomoses, and diagnosis of short and long-term complications.

Imaging before and after Catheter Ablation of Atrial Fibrillation: Doing It Like a Boss!

LL-CAE2562

Mickael Ohana , MD, MSc
Mi-Young Jeung , MD
Soraya El Ghannudi-Abdo , MD
Babe Bakouboula
Catherine Roy , MD

PURPOSE/AIM
Become familiar with acquisition protocols and post-processing used for pulmonary venous CT or MR angiography.
Provide the interventional cardiologist with all the necessary morphological and prognostic information needed when planning a procedure.
Ensure appropriate postprocedural monitoring and advise the most suitable imaging examination when complications are suspected.
CONTENT ORGANIZATION
1. Catheter ablation of atrial fibrillation: how to do it?
1.1 Pathophysiology of atrial fibrillation
1.2 Basic principles of catheter ablation
1.3 Pulmonary veins and left atrium anatomy
2. Preprocedural planning
2.1 Utility and objectives
2.2 CT pulmonary venous angiography
2.3 MR pulmonary venous angiography
2.4 Prognostic factors
3. Postprocedural monitoring
3.1 Acute complications
3.2 Delayed complications
SUMMARY
Catheter ablation is a valid therapeutic option for patients with resistant atrial fibrillation. Imaging plays a central role in preprocedural planning by assessing exact left atrium and pulmonary veins morphology, ruling out a left atrial thrombus and establishing prognostic factors such as left atrium surface/volume or atrial fibrosis. Radiologists must provide interventional cardiologist with all relevant anatomical information and be aware of principal postprocedural complications such as pulmonary vein stenosis.

Artificial Intelligence: Understanding the Radiology of Artificial Circulations

LL-CAE2563
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Cylen Javidan-Nejad , MD
Vincent M Mellnick , MD
Sunil Prasad , MD
Sanjeev Bhalla , MD

PURPOSE/AIM
As the prevalence of heart failure has increased in recent years, so has the demand for artificial assistance of circulation. Numerous devices have been developed to assist in cardiovascular circulation. The radiologist must understand how these devices operate, where they are positioned, and how they impact physiology. Additionally, the radiologist must be able to recognize complications associated with such devices.
CONTENT ORGANIZATION
1. Indications for implantable total artificial hearts (TAHs), right ventricular assist devices (RVADs), left ventricular assist devices (LVADs), biventricular assist devices (BiVADs), percutaneous ventricular assist devices (pVADs), and extracorporeal circulatory support (to include venoarterial extracorporeal membrane oxygenation (ECMO)).
2. Frequently encountered types of the previously listed devices, with discussion regarding their radiographic appearance, placement, function, and hemodynamic effects.
3. Complications related to these devices.
SUMMARY
This exhibit should give the viewer a better understanding of how devices can be used to artificially assist cardiovascular circulation, indications for use of these devices, and how they function and modify hemodynamics. The viewer will also be educated in the proper placement and radiographic appearance of these devices as well as the recognition of complications.

Imaging of Intertrial Septal Defects in the Adult Population

LL-CAE2564
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Teresa Liang , MD, BSc
Hee-Jun Kang
Collette L English , BMBS, MRCP
Savvas Nicolaou , MD

PURPOSE/AIM
1. Review the embryology and pathophysiology of atrial septal defects (ASD) and patent foramen ovale (PFO) 2. Discuss the imaging modalities used for diagnosis of ASD and PFO 2. Describe the spectrum of imaging findings of ASD and PFO
CONTENT ORGANIZATION
-Review the development of the interatrial septum, pathophysiology, epidemiology, clinical presentation, and potential complications of ASD and PFO -Review the utility and limitations of imaging modalities such as radiographs, CT, MRI, ECHO, angiography and nuclear imaging for assessment of ASD and PFO -Demonstrate the spectrum of imaging examples of ASD including ostium secondum, ostium primum, sinus venosus, and unroofed coronary sinus, and PFO -Discuss an imaging-based management algorithm for evaluation of ASD and PFO -Review imaging examples of pitfalls and mimics -Discuss the indications and imaging of ASD repairs
SUMMARY
1. Diagnosis of ASD and PFD requires an understanding of embryologic development and recognition of key morphological and imaging features of the malformation 2. Although ECHO is the main modality for diagnosis, the advancement of cardiac CT technology allows it to play an increasing role for investigating ASD when ECHO evaluation is limited 3. The 4 types of ASD can be differentially detected and diagnosed using a combination of ECHO and CT

Dual Energy CT in the Evaluation of Myocardial Perfusion

LL-CAE2565
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Carlos Capunay , MD
Roxana Campisi
Javier Vallejos , MD
Maria Munain
Jorge M Carrascosa , MD

PURPOSE/AIM

1. To demonstrate the value of myocardial perfusion CT as a potential tool to evaluate the functional repercussion of an anatomical stenosis.

2. To be familiar with beam-hardening (BH) artifact that can mimic myocardial perfusion defects.
3. To show the advantages of dual energy myocardial CT perfusion in the assessment of segments that usually can present BH artifacts on single energy CT scans.

CONTENT ORGANIZATION

1. Description of normal and abnormal (ischemia; necrosis) myocardial CT perfusion findings.
2. CT scan protocol for dual energy CT myocardial perfusion.
3. Use of iterative reconstruction algorithm to reduce radiation dose and improve image quality (noise reduction).
4. Importance of scan data reprocessing using monochromatic images with different keV levels.
5. Material decomposition (iodine-water) for measurement of iodine concentration in myocardial segments.
6. Recognize false positive findings that can mimic pathology.
7. Show normal and pathologic cases.

SUMMARY

1. Dual-energy CT myocardial perfusion for assessment of functional repercussion of an anatomical coronary stenosis can reduce the BH artifacts present on single-energy CT scanning.
2. Dual energy CT is a new modality that allows evaluation of myocardial perfusion based on the amount of iodine that reaches a myocardial segment using material decomposition.

Simultaneous Cardiac PET-MRI Perfusion Imaging Techniques: An Overview

LL-CAE2566
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Richard Laforest , PhD
Jie Zheng , PhD
Agus Priatna , PhD *
Pamela K Woodard , MD *
Robert J Gropler , MD *

PURPOSE/AIM
The purpose of this exhibit is to demonstrate potential myocardial perfusion imaging techniques on new simultaneous acquisition PET-MRI systems. Currently both PET and MRI are used for myocardial perfusion imaging. While PET provides whole heart coverage it suffers from exposure to ionizing radiation that will likely increase with the potential future availability of F-18 flow agents. Conversely, MRI does not use ionizing radiation but whole-heart coverage is not always possible because of the dependency on patient heart rate for the number of 2-dimensional first-pass slices acquired. Delayed contrast enhanced (DCE) MRI for infarction detection, on the other hand, can easily provide whole-heart coverage.
CONTENT ORGANIZATION
In this exhibit, we will demonstrate protocols for the performance of simultaneous PET-MRI using and how the combination of acquisition of DCE MRI with stress only PET may permit time-efficient whole-heart ischemia detection at a lower radiation burden. Techniques for simultaneous acquisition of stress PET and MRI perfusion data will be described and patient examples will be presented.
SUMMARY
Simultaneous PET-MRI data acquisition has the potential to provide whole-heart, high resolution myocardial imaging in clinical practice with shortened PET examination time and decreased radiation dose.

Cardiac Calcifications beyond Coronaries: Clinical Implication of MDCT Findings

LL-CAE2567
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Eric T Kimura-Hayama , MD
Francisco Castillo-Castellon , MD
Julian Ramirez Arango , MD
Rodolfo Gutierrez Quiroga , MD
Euler F Herrera Jurado , MD
Sergio A Criales Vera , MD

PURPOSE/AIM
Review the different types of cardiac calcifications. 2. Describe the pathogenesis and clinical implications of cardiac calcifications. 3. Characterize the different types of cardiac calcifications by MDCT. 4. Establish the differences between them and degenerative or pathological origin.
CONTENT ORGANIZATION
1. Epidemiology, etiology, pathophysiology and clinical findings in cardiac calcifications (pericardial, myocardial, left atrial, valvular, vascular and coronary artery). 2. Imaging findings of cardiac calcifications evaluated by multidetector CT.
SUMMARY
1. Cardiac calcifications are a common finding in multidetector CT. 2. They are usually the result of a secondary to a disease or degenerative process. However, under some clinical scenarios their presence may explain the patient´s symptoms. 3. Their correct recognition and assessment provide relevant information in establishing an appropriate management.

Behind the Slammed Door: The Diagnostic Value of Cardiac MRI in Patients with Implantable Cardiac Devices (ICD)

LL-CAE2568
Luba Frank , MD
Gisela C Mueller , MD *
Frank Bogun

PURPOSE/AIM
The purpose of this exhibit is: 1. To review current contraindications for cardiac MRI, including presence of implantable cardiac devices (ICD). 2. To discuss variety of clinical conditions in patients with ICDs, that can benefit from use of cardiac MRI for diagnosis and management. 3. To present findings on cardiac MRI in patients with ICDs, and in selected cases correlation with CT and pathology.
CONTENT ORGANIZATION
Review of current contraindications for performing cardiac MRI Recent technologic developments toward MRI safe devices Technical aspects and specific device related artifacts, limiting image quality Dignostic challenges in patients with ICD, variety of conditions that may require cardiac MRI for diagnosis Case by case presentation: from clinical dilemma to MRI findings to management decisions Future directions and summary
SUMMARY
The major teaching points of this exhibit are: 1. Presence of ICD still considered a contraindication for MRI, particularly cardiac. Recent studies show that MRI can be safe in patients with ICD. 2. Cardiac MRI in patients with ICD is limited due to technical aspects and artifacts. 3. Patients with certain cardiac conditions will benefit from cardiac MRI due to its superior tissue charachteristics and ability to detect scar tissue.

Expected and Unexpected Causes of Coronary Arterial Dilation: Evaluation and Diagnosis on MDCT

LL-CAE2569

Kazim Narsinh , MD
David S Ansdell , MD
Andrew C Yen , MD
Sharon S Brouha , MD, MPH

PURPOSE/AIM
To review the role of MDCT in the evaluation of coronary arterial dilation. We will emphasize the key imaging findings that direct a cogent differential diagnosis via a pictorial review of non-gated thoracic CT and gated cardiac CT examinations from a tertiary medical center.
CONTENT ORGANIZATION
Inflammatory:
- Kawasaki Disease
- Takayasu Arteritis
- IgG4 Deficiency Atherosclerotic:
- Positive Remodeling Congenital Connective Tissue Disorder:
- Loeys-Dietz Syndrome
- Marfan Syndrome
- Ehlers-Danlos Syndrome Compensatory Dilation:
- Anomalous left coronary artery from the pulmonary artery (ALCAPA)
- Post-surgical appearance of ALCAPA
- Coronary arteriovenous fistula
SUMMARY
Coronary arterial dilation is an uncommon but often unrecognized finding on non-invasive imaging evaluation of the thorax and/or heart. Cardiac CT is increasingly being performed in the emergency department and outpatient settings. The etiology of coronary arterial dilation spans a broad spectrum, including inflammatory, congenital, atherosclerotic, and other causes. A comprehensive understanding of the morphologic features of coronary arterial dilation as well as associated findings will enable non-invasive imaging specialists to provide a relevant differential diagnosis and ensure high quality interpretation of gated and non-gated thoracic CT.

Clinical Application of Iterative Reconstruction Technique in Coronary CT Angiography

LL-CAE2570

Young Jun Cho , MD

PURPOSE/AIM
To descrive clinical application of iterative reconstruction in coronary CT angiography
CONTENT ORGANIZATION
1, Introduction 2, Various iterative reconstruction techniques 3, Clinical application of iterative reconstruction 1) Evaluation of image noise 2) Evaluation of spatial resolution 3) Blooming artifact by coronary calcification and stenting 4) Obesity 5) Radiation dose reduction 4, Disadvantage 5, Conclusion
SUMMARY
Iterative reconstruction technique demonstrates powerful noise reduction and thereby permits further reduction in X-ray tube current/voltage for lower radiation dose, reducing patient risk and improving diagnostic outcomes.

Dosimetric Profiles Using Gafchromic Films during Cardiac-CT Scan Performed in Clinical Practice with a 256 Slices Scanner

LL-CAE2571

Manuel Belgrano
Alexia Rossi , MD
Luca De Paoli , MD
Biagio Cabibbo
Paola Bregant , PhD
Maria A Cova , MD

PURPOSE/AIM
A CT scan performed with a cardiac triggering is a quite simple procedure for the operators but the software of the scanner and the scan protocols hide many high complexity parameters which knowledge is useful to better understand a cardiac CT exam and to better optimize an exam protocol. The aim of this poster is to evaluate the dose profiles obtained from gafchromic films positioned on the patient's chest during different cardiac-TC exams, performed in clinical practice.
CONTENT ORGANIZATION
The dose profiles obtained from gafchromic films during scans were evaluated qualitatively. The exams were performed with retrospective (spiral) and prospective (axial) acquisition protocols. The poster will discuss the different curve characteristics and relate them to the scanner acquisition parameters.
SUMMARY
The study of dosimetric profiles makes possible to understand the characteristics of the acquisition method of CT in the different protocols hardly demonstrable otherwise. According to what has been observed, it makes also possible to formulate different practical considerations aimed at optimizing the dose in the different protocols of investigation.

How to Characterize Cardiac Devices and Valve Prosthesis on Chest Radiography?

LL-CAE2572

Francois Legou , MD
Julie Mayer
Gauthier Mouillet
Nicolas Lellouche
Costin Radu
Hicham H Kobeiter , MD
Alain Luciani , MD, PhD *
Alain Rahmouni , MD
Jean-Francois Deux

PURPOSE/AIM
To describe on chest radiography (CR) the appearance of cardiac devices and prostheses such as Implantable Cardioverter Defibrillator (ICD), Pacemaker (PM), Implantable Holter, cardiac prosthetic and percutaneous valves, annuloplasty ring and devices for percutaneous closure of left atrial appendage.
CONTENT ORGANIZATION
Introduction will be focus on location of normal cardiac structures on CR. In a second part, normal aspect and site of each sort of devices

and prostheses on CR will be detailed. Device abnormalities than may be detected on CR will be listed.
SUMMARY
Cardiac implanted devices are numerous and often detectable on chest radiography. Radiologist may be aware of their normal and abnormal aspect. Analysis of the shape of probes and pulse generator can help to distinguish ICD from PM. Strategies including areas of projection and orientation of devices are helpful to characterize cardiac prosthetic valve. Annuloplasty rings appear as continuous or partial circular structures in projection of mitral or tricuspid area. Two devices of percutaneous aortic valve may be encountered and have different appearance. Percutaneous closure left atrial appendage are new devices that appears as balloons or terraced wings in projection of the left atrial appendage on CR.

Edward's Vascular Ring: Aortic Arch Variants Simplified by an Interactive Model

LL-CAE2573
Jacobo Kirsch , MD
Carolina S Carcano , MD
Felipe Martinez-Gonzalez , MD

PURPOSE/AIM
1. To review Edward's aortic arch developmental model
2. To describe the imaging manifestations of the aortic variants using an interactive presentation.
3. To discuss the clinical significance of these variants
CONTENT ORGANIZATION
• Who was Jesse E. Edwards?
• Understanding Edward's aortic arch developmental model
• Diagrams and imaging examples of the possible configurations of the aortic arch made interactive by clicking on the different segments of Edward's model:
o Left arch with conventional branching
o Left arch with aberrant right subclavian artery
o Right arch with aberrant left subclavian artery
o Right arch with mirror image branching
o Double aortic arch
o Interrupted arch
• Clinical importance of vascular rings and aberrant arteries:
o Associated cardiovascular defects
o Symptomatic esophageal and tracheal compression
SUMMARY
Edward's aortic arch developmental model consists of a complete vascular ring that regresses to become the conventional aortic branching pattern. The abnormal regression of one or more of the otherwise persistent segments, accounts for each of the arch anomalies. Imaging evaluation with either MRI or CT provides detailed anatomy of the possible anomalous arch configurations and helps the detection of associated developmental cardiovascular defects.

Coronary Computed Tomography Angiography (CCTA) for Residents: A Step-by-Step and Problem Solving Guide

LL-CAE2574
Mariana Diaz-Zamudio , MD
Yazmin L Martinez Carbajal , MD
Edwin G Belalcazar Bolanos , MD
Jocelyn Hernandez Avila , MD
Eunice A Lara Garcia , MD
Francisco Castillo-Castellon , MD
Sergio A Criales Vera , MD

PURPOSE/AIM
The purpose of this exhibit is: 1.- To describe a step-by-step guide for residents of CCTA technique and appropriate use
2.- To explain how to resolve frequent trouble during CCTA
3.- To easily describe a basic interpretation guide for CCTA focused to residents
CONTENT ORGANIZATION
1.- Step-by-step guide for CCTA technique 2.- Frequent problems faced during CCTA and potential solutions 3.- Technique modifications focused in special patients depending on BMI, comorbidities, hemodynamic state and heart rate. 4.- Basic interpretation guide designed for residents to recognize relevant diagnoses: a) Coronary artery occlusion and stenosis b) Coronary artery dissection c) Alternate diagnoses in the Emergency Room (ER) i) Vascular emergencies ii) Noncardiac, nonvascular diagnoses 5.- Overview of CCTA role in ER practice
SUMMARY
The major teaching points of this exhibit are: 1.- The CCTA role in the ER setting is still debatable nevertheless availability of CCTA is frequently an issue. Residents must be familiarized with CCTA technique and interpretation. 2.- Despite some basic steps must be performed routinely for CCTA, there are some special considerations according to clinical setting. 3.- Most relevant cardiac and non-cardiac diagnoses can be timely performed by residents with some basic training.

Single Breath-hold Unenhanced Whole-heart Coronary MRA at 3.0 T MRI: Clinical Impact of Multitransmit 4D and DirectDigital RF Receive Technology

LL-CAE2575
Takeshi Nakaura , MD
Masafumi Kidoh
Atsushi Takemura *
Tomoyuki Okuaki
Kazunori Harada
Yasuyuki Yamashita , MD *

PURPOSE/AIM
Over the last ten years, whole-heart coronary MR angiography (MRA) with a respiratory gating method has been introduced for clinical use. However, the major drawback of this technique is the relatively long acquisition time. Additionally, specific absorption rate (SAR) and radiofrequency (RF) excitation uniformity at 3.0 T MRI are problems for coronary MRA. Recent introduced 3.0 T system (Ingenia 3.0 T, Philips) encompass two major innovative technologies for coronary MRA - Multitransmit 4D and DirectDigital RF receive technology. We aim to demonstrate the image quality of the single breath-hold whole-heart MRA with new 3T system.
CONTENT ORGANIZATION
1) Review of various techniques for unenhanced coronary MRA.
2) Review of the technical problems of unenhanced coronay MRA at high field MRI.
3) Advantages of Multitransmit 4D technology for coronary MRA at 3.0 T MRI.
4) Advantages of DirectDigital RF receive technology at 3.0 T MRI.
5) Various images from healthy volunteers and patients with various coronary diseases scanned with the single breath-hold unenhanced whole-heart coronary MRA.
SUMMARY

Multitransmit 4D and DirectDigital RF receive technology are promising techniques to improve the image quality of the single breath-hold unenhanced whole-heart coronary MRA at 3.0 T MRI.

Cardiac Case of the Day

LL-EDE3002
    Moderator
    Matthew D Cham , MD
    Gregory Kicska , MD, PhD *
    Dorith Shaham , MD
    Ronen Durst , MD
    Yelena Bekker-Milovanov , MD

PURPOSE/AIM
1) Review the diagnosis of a specific condition by using either a singley-modality or multi-modality approach. 2) Identify state-of-the-art imaging and methods of treatment for various pathologic conditions. 3) Assess new research on appplications of various imaging and therapeutic modalities.

Cardiac (Coronary CT/MR I)

Sunday, 10:45 AM - 12:15 PM ● S502AB

MR | CT | CA

SSA02 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
    Moderator
    Vincent B Ho , MD, MBA *
    Moderator
    Gisela C Mueller , MD *
    Moderator
    Lisa Diethelm , MD

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

    Yung-Liang Wan MD ; **Sophie Chan** MD (Presenter) ; **Zhonghua Sun** PhD ; **Yu-Hsiang Juan** MD ; **I-Chang Hsieh** ; **Ming-Shien Wen**

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

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

    Mio Uno MD (Presenter) ; **Ryohei Nakayama** PhD ; **Masaki Ishida** MD, PhD ; **Tatsuro Ito** MD ; **Yoshitaka Goto** MD ; **Motonori Nagata** MD, PhD ; **Kakuya Kitagawa** MD, PhD ; **Hajime Sakuma** MD *

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

Mi Sun Chung MD (Presenter) ; **Dong Hyun Yang** MD ; **Joon-Won Kang** MD ; **Young-Hak Kim** ; **Tae-Hwan Lim** MD, PhD

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

Martijn A Den Dekker MD, MS ; **Gert Jan Pelgrim** MSc ; **Rozemarijn Vliegenthart** MD, PhD (Presenter) ; **Edwin R Van Den Heuvel** MD, PhD ; **Gabija Pundziute** MD, PhD ; **Matthys Oudkerk** MD, PhD ; **Kevin G Ike**

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

Stefan Puchner MD (Presenter) ; **Maros Ferencik** MD ; **Akiko Maehara** ; **Paul Stolzmann** MD ; **Shixin Ma** ; **Synho Do** PhD * ; **Hans-Ulrich Kauczor** MD * ; **Gary Mintz** ; **Udo Hoffmann** MD ; **Christopher L Schlett** MD, MPH

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

Gianluca Pontone MD (Presenter) ; **Daniele Andreini** MD ; **Erika Bertella** ; **Saima Mushtaq** ; **Paola Gripari** ; **Sarah Cortinovis** ; **Monica Loguercio** ; **Andrea Baggiano** ; **Edoardo Conte** ; **Andrea Daniele Annoni** MD ; **Alberto Formenti** ; **Mauro Pepi**

PURPOSE
A high-definition computed tomography coronary angiography (HDCTCA) scanner, with improved in-plane spatial resolution of 230 ?m, 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 ● Efficacy of 256 Slice Dual Source CT Angiography in Evaluation of Patients with High Heart Rates and Its Comparison with Catheter Angiography: Do We Still Require Beta Blockers?

Neeraj Jain DMRD (Presenter) ; **Sunil Kumar Puri** MD ; **Vasanthakumar Venugopal** MD

PURPOSE
Comparative analysis of 256-slice dual source CT angiography (DSCTA) and catheter coronary angiography (CCA) in evaluation of coronary arteries (CA) in patients with clinical suspicion of coronary artery disease (CAD) and to study its effectiveness at higher heart rates (HR) without using beta blockers.

METHOD AND MATERIALS
This prospective study was conducted on patients (n=40) with suspected CAD using ECG triggered 256 slice DSCT (Somatom Definition Flash, Siemens). Patients were sub grouped according to HR (Group I: 85 -100) and (Group 2: 101-115 bpm). 22 patients had HR of 85 -100 bpm while 18 patients had HR 101-115 bpm. All patients were scanned with retrospective spiral scan protocol. Coronary artery segments were analyzed for image quality (IQ) on a 4 point scale (1 is worst while 4 is best) by two independent readers who were blinded to patients details. Accuracy to detect significant luminal stenosis was correlated with CCA (gold standard). Statistical significance of study was determined by chi-square test.

RESULTS
A total of 545 coronary artery segments were analyzed. The mean IQ score and standard deviation in group 1 and 2 were 3.45 ± 0.26 and 3.03 ± 0.36 respectively. Inter-observer agreement analysis was performed using Kappa analysis to determine consistency between DSCTA readers. The Kappa values for group 1 and 2 were 0.838 and 0.808 respectively. The sensitivity, specificity, PPV, NPV and accuracy for detecting significant stenosis in group 1 and group 2 were 97.3%, 98.6%, 100%, 98.7%, 98.9% and 91.3%, 96.9%, 95.4%, 95.6%, 96.9% respectively.

CONCLUSION
256 slice DSCTA is a reliable technique with high sensitivity, specificity, PPV and NPV for assessment of coronary arteries even at higher HR without using beta blocker to reduce the HR.

CLINICAL RELEVANCE/APPLICATION
256 slice dual source CT can be used effectively for patients with suspected coronary artery disease irrespective of their heart rate and without any premedication to lower the heart rate.

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

Stefan Puchner MD (Presenter) ; **Maros Ferencik** MD ; **Pal Maurovich-Horvat** MD ; **Masataka Nakano** ; **Fumiyuki Otsuka** ; **Hans-Ulrich Kauczor** MD * ; **Renu Virmani** ; **Udo Hoffmann** MD ; **Christopher L Schlett** MD, MPH

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
Plaque area

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

Dimitris Mitsouras PhD (Presenter) ; **Kanako K Kumamaru** MD, PhD ; **Chi Wai S Cheung** MBBS ; **Amir Imanzadeh** MD ; **Michael L Steigner** MD * ; **Frank J Rybicki** MD, PhD * ; **Elizabeth George** MBBS ; **Julie Miller** MD * ; **Hiraku Kumamaru**

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.

Cardiac (Radiation Dose Reduction)

Sunday, 10:45 AM - 12:15 PM • S504AB

QA IR CT CA

SSA03 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Gregory W Gladish , MD
Moderator
Konstantin Nikolaou , MD *

SSA03-01 • Detection of Coronary Artery Stenosis with Sub millisievert Radiation Dose by Prospectively ECG-triggered High Pitch Spiral CT Angiography and Iterative Reconstruction

Wei-Hua Yin (Presenter) ; **Bin Lu** MD ; **U. Joseph Schoepf** MD * ; **Zhi-Hui Hou** MD ; **Fang-Fang Yu** ; **Yang Gao** ; **Hui-Li Cao** ; **Zhi-Qiang Wang**

PURPOSE
To evaluate the diagnostic accuracy of sub-milliSievert (mSv) coronary CT angiography (cCTA) using prospectively ECG-triggered high-pitch spiral CT acquisition combined with iterative image reconstruction.

METHOD AND MATERIALS
IRB approval and informed patient consent were obtained. Forty consecutive, unselected patients (52.9±8.7 years; 30 men) underwent contrast (370mgI/mL iopromide) enhanced dual-source cCTA using prospectively ECG-triggered high-pitch spiral acquisition. Tube current-time product was set to 50% of standard-of-care CT examinations. Images were reconstructed with sinogram-affirmed iterative reconstruction. Image quality was scored and diagnostic performance for detection of =50% stenosis was determined with catheter coronary angiography (CCA) as the reference standard.

RESULTS
CT examinations were successfully performed in all 40 patients. Of the 601 assessable coronary segments, 543 (90.3%) had diagnostic image quality. Per-patient sensitivity for detection of =50% stenosis was 95.7% (95% confidence interval [CI], 76.0-99.8%) and specificity was 94.1% (95% CI, 69.2-99.7%). Per-vessel sensitivity was 89.5% (95% CI, 77.8-95.6%) with 93.2% specificity (95% CI, 86.0-97.0%). The area under the receiver-operating characteristic curve on per-patient and per-vessel levels was 0.949 and 0.913, respectively. Mean effective dose was 0.58±0.17mSv. Mean size-specific dose estimate was 3.14±1.15mGy.

CONCLUSION
High-pitch prospectively ECG-triggered cCTA combined with iterative image reconstruction provides high diagnostic accuracy with a radiation dose below 1 mSv for detection of coronary artery stenosis in an unselected patient population.

CLINICAL RELEVANCE/APPLICATION
Continuous reduction in radiation exposure associated with cardiac CT should widen the clinical acceptance and application of this non-invasive test.

SSA03-02 • Contrast Material and Radiation Dose Reduction Strategy for Triple-rule-Out Cardiac CT Angiography: Feasibility Study of Serial Non-ECG-Gated Low kVp Scan of the Whole Chest

Masafumi Kidoh ; **Takeshi Nakaura** MD (Presenter) ; **Shinichi Nakamura** MD ; **Kazunori Harada** ; **Shouzaburou Uemura** ; **Yasuyuki Yamashita** MD * ; **Tomohiro Namimoto** MD ; **Naritsugu Sakaino**

PURPOSE
The purpose of this study was to investigate the feasibility of a contrast material and radiation dose reduction triple-rule-out (TRO)-CT angiography (CTA) protocol with serial non-ECG-gated low kVp scan of the whole chest, which utilizes a recirculated contrast agent.

METHOD AND MATERIALS
This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. The 60 enrolled patients were randomly assigned to 2 TRO-CTA protocols. Thirty patients were scanned with the new TRO-CTA protocol; after the coronary scan with retrospective ECG-gating, non-ECG-gated whole-chest CTA was performed at 80 kVp to evaluate aortic arch (AAr) and pulmonary trunk (PT). The other 30 patients were scanned by our conventional TRO-CTA protocol at 120 kVp with retrospective ECG-gating. We compared estimated effective dose (ED), CM (contrast medium) dose and contrast-to-noise ratio (CNR) of the ascending aorta (AAo) between the two protocols. We also compared the rate of patients who could achieve adequate AAr attenuation (160 HU) and adequate PT attenuation (200 HU) between the two protocols. Two-tailed Student�s t-test was used to compare CM dose, ED and CNR

on new TRO-CTA and conventional TRO-CTA scans. To compare the success rate of adequate attenuations of the PT and AAr, we used the ?2 test.

RESULTS
The total ED of the new TRO-CTA protocol was significantly lower than that of the conventional protocol (23.5±2.6 mSv vs. 33.4±1.4 mSv, p0.05).

CONCLUSION
The new TRO-CTA protocol could feasibly reduce the total dose of radiation and the contrast dose and yielded adequate vascular enhancement compared with the conventional protocol.

CLINICAL RELEVANCE/APPLICATION
Triple-rule-out-CTA protocol with serial non-ECG-gated low kVp scan of the whole chest could feasibly reduce the total dose of radiation and the contrast dose compared with the conventional protocol.

SSA03-03 • Assessment of Image Quality and Radiation Dose of Prospectively Triggered Adaptive Coronary CT Angiography: In Comparison with Retrospectively Gated Mode and High Pitch Mode

Yunling Wang (Presenter) ; **Hong Wang**

PURPOSE
The purpose of this study was to evaluate the image quality and radiation dose of dual-source computed tomography (DSCT) application in coronary computed tomography angiography (CTA), using three different modes: prospectively electrocardiogram (ECG)-triggered sequential scan mode, retrospectively ECG gated spiral scan mode and Flash spiral scan mode.

METHOD AND MATERIALS
Ninety eligible patients (47 males and 43 females, mean age 54.3 years), with heart rate within 60 to 80 beat per minute (bpm) and relatively regular heart rhythm (fluctuation =10bpm), were included in this study. They are randomly distributed into three groups: 30 patients in Group A using prospectively ECG-triggered sequential mode, 30 in Group B using retrospectively ECG-gated spiral mode and 30 in Group C using Flash spiral mode. The X-ray tube voltages were selected according to body mass index (BMI). Both the radiation dose and image quality were evaluated and compared, which were based on statistics analysis of image score, HU value standard deviation (SD), Signal-Noise Ratio (SNR, mean/SD), Contrast-Noise Ratio (CNR).

RESULTS
The mean image score in Group A is 3.36±0.39, with effective radiation dose of 5.12±0.77 mSv, SD of 17.8±0.51, SNR of 23.64±0.49, and CNR of 20.77±0.45. The mean image score in Group B is 3.58±0.51, with effective radiation dose of 6.79±0.41 mSv, SD of 18.8±0.46, SNR of 22.12±0.55, and CNR of 27.87±0.38. The mean image score in Group C is 1.47±0.62, with effective radiation dose of 0.89±0.81 mSv, SD of 15.1±0.44, SNR of 34.9±0.67, and CNR of 47.77±0.56. There were significant differences in the radiation dose and image quality among these three groups (p
CONCLUSION
The prospectively triggered mode has a better image quality and lower radiation dose, compared with retrospectively gated mode and Flash mode, which may be the first choice in CTA imaging.

CLINICAL RELEVANCE/APPLICATION
The prospectively triggered mode has a better image quality and lower radiation dose, compared with retrospectively gated mode and Flash mode, which may be the first choice in CTA imaging.

SSA03-04 • Impact of Model Based Iterative Reconstruction on Noise Reduction of Ultra Low-dose Coronary CT Angiography

Tobias A Fuchs MD (Presenter) ; **Julia Stehli** MD ; **Sacha Bull** MD, PhD ; **Svetlana Dougoud** MD ; **Martin W Huellner** MD ; **Andreas Brauchlin** MD ; **Ronny R Buechel** ; **Oliver Gaemperli** MD ; **Philipp A Kaufmann** MD

PURPOSE
Reduction of tube voltage and current for lowering radiation exposure from coronary CT angiography (CCTA) is associated with an increase in noise which may render images uninterpretable. We evaluated the impact of model based iterative reconstruction (MBIR) on noise reduction in ultra-low submillisievert dose CCTA.

METHOD AND MATERIALS
Twenty-five patients underwent standard low-dose CCTA (100 -120 kV; 450 ◊ 700 mA) and an additional same-day ultra-low dose (ULD) CCTA (80 ◊ 100 kV; 150 ◊ 210 mA) using MBIR. After assessing attenuation in the left main (LMA) and right coronary artery (RCA) as well as noise in the aortic root the signal-to-noise-ratio (SNR) was calculated for LMA and RCA.

RESULTS
The mean body mass index of the study population was 25.4 ± 4.4 kg/m2 (range 18.4 ◊ 40.2 kg/m^2), and the mean weight 75.1 ± 15.3 kg (range 46.5 ◊ 112.0 kg). The mean effective radiation dose was 1.3 ± 0.4 mSv in standard and 0.2 ± 0.1 mSv in ULD CCTA (p < 0.001). Nevertheless mean image noise decreased significantly from 32 ± 7 HU in standard CCTA to 21 ± 4 HU in ULD MBIR CCTA (p < 0.001). Interestingly, this was paralleled by an increase in mean attenuation in LMA from 466 ± 85HU to 563 ± 119 HU, and in RCA from 446 ± 63HU to 503 ± 83 HU (p
CONCLUSION
MBIR efficiently compensates for increased noise in ULD CCTA. In combination with the shift towards higher beam attenuation by iodine in low tube voltage scanning this results in a SNR substantially higher than standard CCTA.

CLINICAL RELEVANCE/APPLICATION
New reconstruction algorithms such as MBIR achieve efficient noise reduction allowing substantial radiation dose reduction in cardiac CT scanning.

SSA03-05 • Dual Source Cardiac Computed Tomography Angiography (CCTA) in the Follow Up of Cardiac Transplant: Comparison of Image Quality and Radiation Dose Using Three Different Scan Protocols

Florian Wolf MD (Presenter) ; **Dietrich Beitzke** MD ; **Vanessa Berger-Kulemann** ; **Richard Nolz** ; **Gudrun Feuchtner** MD * ; **Christian Loewe** MD *

PURPOSE
Cardiac allograft vasculopathy represents a major cause of mortality in the later course of cardiac transplant. CCTA represents a valuable non-invasive imaging tool in the diagnosis of cardiac allograft vasculopathy with the disadvantage of radiation burden. Radiation dose reduction in CCTA of cardiac transplant is challenging as patients often present with elevated heart rates. The aim of this prospective randomized study was to evaluate image quality, diagnostic confidence, and radiation dose using 3 different CT scan protocols for dual-source CCTA in heart transplant recipients.

METHOD AND MATERIALS
Dual source CCTA was performed in 150 consecutive patients after heart transplantation using either the conventional retrospective-triggered spiral technique (120 kV/320 mA, tube current modulation) in group 1, the prospective ECG-gated sequence technique (120 kV/320 mA, main padding window 40-70%) in group 2, or the prospective ECG-gated sequence technique in the systolic phase with automated tube voltage selection (Automated kV, main padding window 35-45%) in group 3. Subjective image quality was rated using a 16 segment coronary artery model and a four-point scale (1=excellent, 2= good, 3= fair, 4 = non-diagnostic) for each segment. Effective dose (ED) was used to compare the differences in radiation dose.

RESULTS
No difference was observed in subjective image quality between the study groups regarding segments with excellent or good image quality (Group 1: 90.5%, group 2: 89.3%; group 3: 86.8%). The number of segments with non-diagnostic image quality was lowest in group 3 (Group 1: 1.8%, group 2: 2.1%; group 3: 1.1%) and did not differ between group 1 and 2. Mean ED did not differ significantly between group 1 and group 2 (9.9±2.7 mSv vs. 9.1±2.3 mSv; p=0.13), but was significantly lower in group 3 (4.6±1.9 mSv; p

CONCLUSION
Radiation dose of dual source CCTA in heart transplant recipients can be significantly reduced by using the ECG-gated sequence technique in the systolic phase and automated tube voltage selection, compared to the ECG-gated sequence technique using a wide padding window and the conventional spiral technique, while diagnostic image quality is maintained.

CLINICAL RELEVANCE/APPLICATION
Coronary CTA in heart transplant patients can be performed using a scan technique with relevant dose reduction with maintained image quality compared to conventional scan modes with higher doses.

SSA03-06 • Sub-mSv Coronary CT Angiography for Normal Size Patient Population (BMI

Qiang Ma (Presenter) ; **Xiang Ren** ; **Najia Liu** ; **Shaoning Yan** ; **Zhiyuan Zhang** ; **Jinrui Bao**

PURPOSE
To study the clinical feasibility of achieving sub-mSv radiation dose and acceptable image quality for normal size patient population (20.52) in prospective ECG-triggered coronary CT angiography (CCTA) with low tube voltage.

METHOD AND MATERIALS
One hundred and eighty patients [heart rate: 56±4bpm, 20.52, and 190mA if BMI 22.5-25.0kg/m^2). Radiation dose was recorded. CT value and image noise on aorta were measured, and signal-noise-ratio (SNR) was calculated. The image quality was evaluated blindly (5 for excellent). Independent-sample t-test was performed on dose and Mann-Whitney test on image quality scores.

RESULTS
The overall dose for group A with 100kV was 0.69mSv, 35% lower than the 1.06mSv for group B with 120kV. For the patient population with BMI2: the radiation dose for group A was 0.55±0.11mSv, 32% lower than the 0.81±0.09mSv for group B (p22.5kg/m^2: the radiation dose for group A was 0.73±0.09mSv, 35% lower than the 1.13±0.16mSv for group B (p0.05).

CONCLUSION
Prospective ECG-triggered CCTA with low tube voltage significantly reduces radiation exposure while maintaining acceptable image quality. For the patient population with BMI2, sub-mSv CCTA is achievable with prospective ECG-triggering and 100kV tube voltage.

CLINICAL RELEVANCE/APPLICATION
The use of prospective ECG-triggering and 100kV tube voltage in CCTA can reduce radiation to patients, and achieve sub-mSv dose for patient population with BMI2.

SSA03-07 • Low Tube Voltage and High Sensitive Detector Reduce the Radiation Dose of Coronary CTA

Jian Cao (Presenter) ; **Yining Wang** MD ; **Lingyan Kong** ; **Lin Lu** MD ; **Huadan Xue** MD ; **Zhiwei Wang** MD ; **Zhengyu Jin** MD

PURPOSE
To investigate the application of low tube voltage (80kV) for coronary artery computed tomography angiography (CCTA) in patients with normal body mass index (BMI) with second generation dual-source CT equipment with novel high sensitive detector.

METHOD AND MATERIALS

RESULTS

CONCLUSION
Tube voltage as 80kV in second generation dual-source CT equipped with novel high sensitive detector is feasible in patients with normal BMI. This scan mode can obviously reduce the radiation dose while with no influence on image quality.

CLINICAL RELEVANCE/APPLICATION
Tube voltage as 80kV in second generation dual-source CT equipped with novel high sensitive detector is feasible in patients with normal BMI.

SSA03-08 • Feasibility and Image Quality of Ultra-low Dose Submillisievert Radiation Exposure in Coronary CT Angiography Using Model Based Iterative Reconstruction: First Clinical Experience

Julia Stehli MD (Presenter) ; **Tobias A Fuchs** MD ; **Sacha Bull** MD, PhD ; **Svetlana Dougoud** MD ; **Martin W Huellner** MD ; **Andreas Brauchlin** MD ; **Ronny R Buechel** ; **Oliver Gaemperli** MD ; **Philipp A Kaufmann** MD

PURPOSE
To evaluate the feasibility and image quality of coronary CT angiography (CCTA) acquisition with a submillisievert fraction of effective radiation dose using model based iterative reconstruction (MBIR) for noise reduction.

METHOD AND MATERIALS
In 25 patients undergoing standard low-dose contrast enhanced CCTA (100 � 120 kV; 450 - 700 mA) an additional same-day ultra-low dose (ULD) CCTA was acquired (80 - 100 kV; 150 - 210 mA) and reconstructed with MBIR. Two independent readers semi-quantitatively assessed image quality on a four-point Likert scale in each coronary segment (1: non-diagnostic, 2: good, 3: adequate, 4: excellent).

RESULTS
Over a wide range of weight (47 - 112 kg) and body mass index (18.4 - 40.2 kg/m^2), the mean DLP from standard and ULD CCTA was 89.5 ± 29.4 mGycm (range 69.8 � 188.3 mGycm) and 15.9 ± 6.2 mGy cm (range 10.2 - 35.6 mGy cm) resulting in an estimated mean radiation dose exposure of 1.3 ± 0.4 mSv (range 1.0 - 2.6 mSv) for standard and 0.2 ± 0.1 mSv (range 0.1 - 0.5 mSv) for ULD CCTA (p < 0.001). Intravenous beta-blockers were administrated for heart rate control prior to CCTA in 20 patients (80%) (10.8 ± 9.5mg, range 3 � 25 mg). The mean heart rate for standard and ULD CCTA was 57.5 ± 5.6 and 57.0 ± 5.9 bpm (p = ns).
A total of 100 vessels and 330 coronary artery segments with a diameter of = 1.5 mm were evaluated and revealed an inter-observer agreement of image quality of ? = 0.8. The mean image quality score per segment was 3.3 ± 0.5 in standard CCTA vs. 3.4 ± 0.6 in ULD MBIR (p < 0.05). Diagnostic image quality (score 2 - 4) was found in 319 coronary segments (97%) of standard CCTA, and 317 (96%) segments of ULD MBIR (p = ns).

CONCLUSION
Our results document the feasibility of CCTA acquisition with diagnostic image quality at an ultra-low radiation dose of 0.2 ± 0.1 mSv in combination with MBIR reconstruction.

CLINICAL RELEVANCE/APPLICATION
CCTA scanning with an ultra-low radiation dose may pave the way for the broad clinical implementation of CCTA as an alternative for the invasive coronary angiography.

SSA03-09 • Optimization of Radiation and Contrast Dose for Cardiovascular Computed Tomography

Yajuan Wang PhD (Presenter) * ; **Kassem Soufan** ; **Anjali Kottha** ; **Corey Kemper** PhD * ; **John F Kalafut** PhD * ; **Sandra S**

Halliburton PhD *

PURPOSE
Lowering x-ray tube potential is an effective way to reduce both radiation exposure and contrast load from computed tomography (CT). This study evaluated a novel algorithm for optimizing both radiation and contrast dose at cardiovascular CT.

METHOD AND MATERIALS
67 patients referred for evaluation of thoracic aortic disease were imaged with a prospectively ECG-triggered axial technique on a 256-slice CT scanner (Brilliance iCT, Philips). X-ray parameters (tube potential,tube current) were determined from an attenuation measurement on the initial radiograph using a custom algorithm. Based on the tube potential, either 50 mL (100 kV) or 90 mL (120 kV) of contrast with a concentration of 370 mgI/mL was injected at a flow rate = 3.5 mL/s. Five circular regions of interest (ROI) were drawn at multiple locations in the lumen of the aorta along its length and the mean attenuation and standard deviation of attenuation (noise) were recorded. Average aortic attenuation, noise, and signal-to-noise ratio (SNR) were compared between 100 and 120 kV groups using Student�s t test.

RESULTS
100 kV [n=40] and 120 kV [27] cohorts had similar age (62±15 vs 59±13 yrs) and height (1.74±0.10 vs 1.78±0.07 m). The cohort imaged at 100kV had significantly lower body mass index (25.7±2.8 vs. 32.0±3.2 kg/m²) and percentage of males (67.5% vs. 92.6%). Patients scanned at 120 kV had a longer scan delay (33±8 vs. 26±4 s) but similar scan time (12±1 vs. 12±1 s) compared to 100 kV patients. Image quality metrics were equivalent between groups (aortic attenuation: 287±83 vs 281±48 HU; noise: 27±4 vs 26±3 HU; SNR: 11±3 vs 11±2) despite lower contrast dose (50 vs 90 mL) and effective radiation dose (1.8±0.3 vs 3.6±0.4 mSv) at 100 kV.

CONCLUSION
Simultaneous optimization of x-ray parameters and contrast protocols yielded equivalent image noise and blood enhancement across a range of patient sizes for cardiovascular CT. Smaller patients required 49% less radiation and 44% less contrast.

CLINICAL RELEVANCE/APPLICATION
Cardiovascular CT can be performed in smaller patients using lower radiation and contrast doses compared to those used for larger patients without compromising image quality.

Cardiac - Sunday Posters and Exhibits (12:30pm - 1:00pm)

Sunday, 12:30 PM - 01:00 PM ● Lakeside Learning Center

CA

LL-CAS-SUA ● *AMA PRA Category 1 Credit* ™:0.5
    Host
    W. Brian Hyslop , MD, PhD

LL-CAS-SU1A ● Radiation Reduction at Single-Heartbeat Coronary CT Angiography Combined with Automatic Exposure Control and Iterative Reconstruction at 320-MDCT Volume Scanning

Yoshinori Funama PhD (Presenter) ; **Daisuke Utsunomiya** MD ; **Katsuyuki Taguchi** PhD * ; **Seitaro Oda** MD ; **Toshiaki Shimonobo** ; **Yasuyuki Yamashita** MD *

PURPOSE
The purpose of this study was to evaluate the radiation dose and image quality at single-heartbeat coronary CT angiography (CTA) combined with automatic exposure control (AEC) and iterative reconstruction (IR) using a 320-MDCT volume scanner. Assessments were at multiple heart rates and phase window widths, and with different reconstruction techniques.

METHOD AND MATERIALS
Using an anthropomorphic chest CT phantom we performed prospectively ECG-gated single-heartbeat coronary CTA on a second-generation 320-MDCT volume scanner (Aquilion ONE ViSION, Toshiba). The tube voltage and rotation time were 120 kV and 275 msec. The tube current was automatically changed in response to the noise setting for AEC (20 and 25 HU) with and without IR (AIDR3D standard). Acquisitions were at multiple heart rates (60 - 80 bpm) and different phase window widths of the R-R interval. To measure the radiation dose, a pencil ionization chamber was inserted into the center of the phantom. We computed the effective dose and radiation reduction at different phase window widths and heart rates, and with and without IR. To compare the set AEC value and the actual image noise we measured the image noise and its variations along the z axis on all acquired images.

RESULTS
At half-reconstruction at a heart rate of 60 bpm and AEC of 20 and 25 HU without IR, the radiation dose to the center of the phantom was 18.63 and 12.40 mGy, respectively, at a phase window width of 70-80%; at AEC with IR it was 4.61 mGy at 20 HU and 3.10 mGy at 25 HU. This corresponds to a dose reduction of 75.3 and 74.97%. At two-segment reconstruction at a heart rate of 80 bpm, the radiation dose reduction was 76.13 and 75.78%, respectively, at AEC of 20 and 25 HU. However, the levels and variations of the image noise along the z-axis were almost the same with and without IR. With AEC and IR the effective dose at 60 bpm was 0.77 and 0.514 mSv at 20 and 25 HU, respectively. At a heart rate of 60 bpm and AEC of 20 HU, the radiation dose was 18.82-, 18.63-, 38.8-, and 89.44 mGy at a phase window width of 75%, 70-80%, 40-80%, and 0-100%, respectively. It was the same as at window widths of 75% and 70-80% (100 msec) because one rotation required less than 275 msec.

CONCLUSION
AEC and IR reduce the radiation dose substantially at single-heartbeat coronary CTA.

CLINICAL RELEVANCE/APPLICATION
In combination, AEC and IR allow for a reduction in the radiation dose without loss of image quality.

LL-CAS-SU2A ● A New Method for Noise Reduction at Coronary CT Angiography with Multi-phase Data-averaging and Non-rigid Image Registration

Fuminari Tatsugami (Presenter) ; **Toru Higaki** PhD ; **Masao Kiguchi** RT ; **Wataru Fukumoto** ; **Shuji Date** ; **Kazuo Awai** MD *

PURPOSE
We developed a new method for radiation dose reduction at cardiac CT that uses multi-phase data-averaging and non-rigid image registration. The purpose of our study was to investigate the clinical feasibility of our method.

METHOD AND MATERIALS
Twenty patients (8 women, mean age 65.9 ± 8.8 years) who underwent coronary CT angiography (CTA) using a 64-slice CT scanner (VCT, GE) at 120 kV and 400 - 750 mA with prospective ECG-triggering were enrolled. The range of the phase window was set at 70-80% of the R-R interval. First, we prepared three sets of consecutive volume data at 70-, 75-, and 80% of the R-R interval, reconstructed with adaptive statistical iterative reconstruction (40% ASIR). Second, we applied non-rigid registration to align the 70- and 80% images to the 75% image. Finally, we performed weighted averaging of the three images and generated a de-noised image. We measured the image noise and CT attenuation in the ascending aorta to calculate contrast-to-noise ratio (CNR). Two radiologists visually evaluated the image quality based on motion artifacts and noise-related blurring using a 5-point scale ranging from 1 = nondiagnostic to 5 = excellent. Image noise and contrast-to-noise ratio (CNR) between the conventional 75% images reconstructed with filtered back projection (FBP), 40% ASIR and de-noised images were compared using the paired t-test, image quality scores with the Wilcoxon signed-rank test.

RESULTS
Mean image noise on de-noised images was lower than on conventional 75% images reconstructed with FBP or 40% ASIR (14.6 ± 2.6 HU vs. 22.4 ± 4.1 HU; p < 0.01, 14.6 ± 2.6 HU vs.18.6 ± 3.5 HU; p < 0.01, respectively), and the CNR on de-noised images was also improved (p < 0.01). The mean image quality score for conventional 75% images reconstructed with FBP, 40% ASIR and de-noised images were 3.5, 4.1 and 4.5, respectively; the differences were also significant (p < 0.05).

CONCLUSION
As our method reduces image noise and improves image quality at coronary CTA, it may allow for a reduction in radiation exposure.

CLINICAL RELEVANCE/APPLICATION
Our new method combined with 40% ASIR achieved a 35% image noise reduction at coronary CTA and may allow for a reduction by 58% of the radiation exposure compared to the conventional method.

LL-CAS-SU3A ● Combined Novel Post-processing Technique with Non-rigid Registration in Cardiac Phases and Iterative Reconstruction to Reduce Image Noise in Coronary CTA Using 256-slice CT Scanner with 0.27sec/Rotation Speed

Yasuyuki Kobayashi MD, PhD (Presenter) ; **Kouichi Watanabe** ; **Iwao Uejima** MD ; **Kazuhito Nozu** MD ; **Sou Oode** MD ; **Yukihisa Ogawa** ; **Yasuo Nakajima** MD ; **Hiroshi Niimi**

PURPOSE
Radiation dose reduction remains crucial in cardiac CT. Recently iterative reconstruction (IR) algorithms has been reported to reduce image noise and improve image quality, compared to Filter Back Projection(FBP). And the post-processing technique with non-rigid registration (NRR) can also reduce image noise while preserving anatomical details. The purpose of this study is to evaluate the combination of this post-processed technique with NRR and IR in coronary CTA using 256-slice cardiac CT with 0.27sec/rotation speed.

METHOD AND MATERIALS
Coronary CTA was performed in 24 patients by using 256-slice CT scanner with 0.27sec/rotation speed (iCT, Phillips, Netherlands); 13 patients with Step and Shoot scan, and 11 patients with retrospective helical CT scan. The images were reconstructed by each 5% cardiac phases adjacent to optimal cardiac phase for CTA. These images were post-processed by workstation (PhyZiodynamics, QI imaging, CA, USA), using the deformable registration to align the voxels in each cardiac phase and the interphase filtering algorithms. SD and CT values of ascending aorta were statistically compared between the four different groups; 1) FBP, 2) IR, 3) FBP with NRR, 4) IR with NRR. And image quality of coronary artery and plaque was compared by using five-scale score method.

RESULTS
Mean heart rate of 24 patients was 64 +/- 9.7 bpm. IR showed significantly 29.7 +/- 7.9 % noise reduction in aorta, as comparison to the original FBP images (p
CONCLUSION
Both IR and NRR techniques could reduce noise while improving image quality in coronary CTA using 256-slice CT Scanner with 0.27sec/rotation speed. NRR technique can be combined with IR, and the combined IR and NRR technique enable less noise and less radiation dose.

CLINICAL RELEVANCE/APPLICATION
The post-processing technique with non-rigid registration can reduce noise and is recommended to be combined with iterative reconstruction algorithms to reduce radiation dose.

LL-CAS-SU4A ● Impact of Different Levels of Iterative Reconstruction on Quantitative and Qualitative Image Quality in CCTA

Bettina M Gramer MD (Presenter) ; **Daniela Muenzel** MD ; **Vivian Leber** MD ; **Michael Rasper** ; **Ernst J Rummeny** MD ; **Armin M Huber** MD

PURPOSE
To evaluate the ability of a new iterative reconstruction algorithm (IR) to improve quantitative and qualitative image quality (IQ) in coronary computed tomograpy 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

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.

LL-CAS-SU5A ● Impact of Increasing Levels of Advanced Iterative Reconstruction on Image Quality in Low-dose Cardiac CT Angiography

Patric Kroepil MD (Presenter) ; **Amir H Bigdeli** MD ; **Hans Dieter Nagel** * ; **Gerald Antoch** MD * ; **Mathias Cohnen** MD

PURPOSE
To investigate the effects of an advanced iterative reconstruction (IR) technique on subjective and objective image quality (IQ) in low-dose cardiac CT angiography (CCTA).

METHOD AND MATERIALS
30 datasets of prospectively triggered �step-and-shoot� CCTA acquired on a 256-slice CT-scanner were processed on a prototype IR-system using filtered back projection (FBP) and 4 levels of an advanced IR technique (iDose4, Philips) providing incremental rates of IR (level 2,4,6,7) involving both raw and image data space. In addition, effects of different reconstruction kernels (semi-smooth [CB], standard [XCB]) and �multi-resolution� technique [MR] to preserve the noise power spectrum at higher levels of IR were evaluated resulting in a total of n=480 image stacks. Contrast-to-noise ratios (CNR) were evaluated using ROI measurements at 9 coronary locations throughout all image stacks. Subjective IQ was rated on a 4-point-scale with �classical� image appearance and noise-related artifacts as main criteria.

RESULTS
Mean effective dose of CCTA was 1.7±0.7mSv. Mean CNR significantly improved with IR when compared to FBP and with every increasing level of IR (range 14.2-34.6; p
CONCLUSION
Objective IQ of CCTA progressively improves with increasing level of IR. Best subjective IQ, however, is reached at medium level of IR, XCB-kernel and �multi resolution� feature providing a more �classical� image appearance at minimal artifacts.

CLINICAL RELEVANCE/APPLICATION

Medium level of iterative reconstruction combined with an edge-enhancing algorithm leads to significant improvement of image quality in low dose CCTA suggesting application in clinical routine.

LL-CAE-SU6A ● Multimodality Imaging of the Tricuspid Valve: Normal Appearance and Pathological Entities

John P Nazarian MD ; **Trevor Jenkins** ; **Robert C Gilkeson** MD * ; **Prabhakar Rajiah** MD, FRCR (Presenter)

PURPOSE/AIM
Though paid relatively little attention in the literature, the tricuspid valve can be affected by a wide range of pathological entities. It is increasingly recognized that tricuspid valve disease has a significant impact on morbidity and mortality. The aim of this exhibit is to demonstrate the value of multimodality imaging, including CT, MRI and echocardiography in the evaluation of tricuspid valve abnormalities.

CONTENT ORGANIZATION
The exhibit will discuss and illustrate the following topics related to tricuspid valve. 1. Normal tricuspid valve anatomy and physiology
2. Tricuspid stenosis
3. Tricuspid regurgitation- Qualitative and quantitative grading using different imaging modalities
4. Tricuspid atresia/dysplasia
5. Ebstein�s anomaly
6. AV canal defect
7. Double-orifice valve
8. Cleft
9. Prolapse
10. Infective endocarditis
11. Thrombus
12. Tumors- fibroelastoma, myxoma, carcinoid, angiosarcoma, metastases
13. Amyloid
14. Pre and post surgical imaging of tricuspid valve replacement

SUMMARY
In this era of improved treatment options for tricuspid valve disorders, it is important for radiologists to understand the utility of imaging in the evaluation of such disorders. Knowledge of normal anatomy, pathophysiology and imaging appearances of several disorders is essential to make accurate diagnosis and guide treatment.

LL-CAE-SU7A ● MR-imaging of Cardiac Masses: A Pictorial Guide for Diagnosis

Gabriele Ironi (Presenter) ; **Antonio Esposito** MD ; **Paolo Marra** ; **Francesco A De Cobelli** MD ; **Alessandro Del Maschio** MD

PURPOSE/AIM
To show specific magnetic resonance features of the most frequent heart neoplasms providing a smart guide for differential diagnosis.

CONTENT ORGANIZATION
We introduce the rare problem of cardiac tumors presenting aspects that the radiologist needs to know in order to perform a correct diagnosis, such as epidemiology, clinical presentation and imaging features. In particular, the role of magnetic resonance (MR) imaging in the assessment of cardiac masses is discussed and the MR features, helping to differentiate benign tumors from malignancies, are presented. Subsequently, cases regarding the MR assessment of the commonest heart masses, collected from the archives of our Institution, are reported underlining MR imaging features that characterize each tumor, which are also summarized in schematic portraits.

SUMMARY
MR imaging is the modality of choice in the evaluation of cardiac tumors, helping to orient the diagnosis toward the benign or malignant nature and to guide the patient management toward biopsy, surgical resection, medical therapy or watchful waiting. However, to take advantages of these capabilities, radiologists should be familiar with the specific features characterizing each single mass, that are presented in this educational exhibit.

LL-CAE-SU8A ● Chagas Disease in the U.S. and the Importance of Cardiac MRI in Patients with Normal Electrocardiograms and Normal Echocardiograms

Stephanie A Lee-Felker MD ; **Ely R Felker** MD ; **Mariam Thomas** MD (Presenter) ; **Tony Koppula** MD ; **Salvador Hernandez** ; **Mahmoud Traina** MD ; **Margaret H Lee** MD ; **Sheba Meymandi** MD

PURPOSE
Chagas Disease was previously considered a rare disease in the U.S, but the Center of Disease Control considers Chagas Disease as one of the five neglected parasitic diseases in the U.S. The purpose of this study was to determine the importance of cardiac MRI in patient's with Chagas Disease in the U.S with negative electrocardiograms and normal echocardiographic findings.

METHOD AND MATERIALS
From June 1, 2008- April 4, 2013, 55 patients who were residing in Los Angeles County, with serology proven Chagas Disease, were evaluated with MRI to evaluate for delayed enhancement and scarring . MRI images were obtained using a 1.5 Tesla Avanto MRI system,. The sequences acquired included axial HASTE, cine- TruFISP in four chamber, three chamber, two chamber and short axis, contrast enhanced MRA and delayed enhancement inversion recovery gradient echo images. Retrospective analysis was performed of the electrocardiogram and echocardiographic findings of all the 55 patients that underwent MRI imaging. Correlation was made between the electrocardiograms and echocardiographic findings with the MRI findings. Of the 55 patients that underwent MRI, 35 patients (63.6%) had a normal electrocardiogram, 41 (74.5%) had normal contractility on echocardiogram and 29 patients (52.7%) had both normal electrocardiogram and normal contractility on echocardiogram. This was correlated with the cardiac MRI findings for delayed enhancement.

RESULTS
Myocardial fibrosis was present in 25..5%(14) of all patients. Of the patients with Myocardial fibrosis, 35.7 % had normal electrocardiogram findings and 42.9% had normal echocardiogram findings and 14.3 % had normal electrocardiogram and echocardiogram findings.

CONCLUSION
Chagas Disease is a chronic disease commonly seen in Latin America but Chagas Disease has been increasingly diagnosed in the U.S and Europe and it is crucial that the radiologist be aware of the radiographic manifestations of Chagas Disease. The cardiac manifestations is the main factor in the prognosis in Chagas Disease. Although Chagas Disease may manifest with electrocardiographic and echocardiographic abnormalities, negative electrocardiogram and echocardiograms do not preclude cardiac disease..

CLINICAL RELEVANCE/APPLICATION
Delayed enhancement cardiac MR is useful to evaluate damaged cardiac tissue and should be utilized in all patients with a diagnosis of Chagas regardless of the EKG and echocardiographic findings.

LL-CAE-SU9A ● Dual Origin, Course and Supply in Coronary Artery System: Role of CT Angiography

Zaihleen S Keller MD ; **Ashley E Prosper** MD ; **David Shavelle** MD ; **Farhood Saremi** MD (Presenter)

PURPOSE/AIM

1.Dual coronary artery variants are common and in some instances can be a confusing diagnosis or a misleading finding. 2. Misdiagnosis may increase the risk of incorrect placement of a coronary graft or stent and in certain interventional procedures may increase complications.

CONTENT ORGANIZATION
*Classifications: 1. Dual origin (real duplication): LAD (Type IV and V), RCA, left main 2. Dual course or termination (Duplication or early bifurcation?); Dual RCA, Dual LAD (Type I, II, III), Dual LCx, Dual PDA, Dual SANa, Dual AVNa 3. Dual Supply: SANa, PDA variants in codominant coronary circulation *Case examples and DDx *Associated congenital heart disease *Implications for surgery and percutaneous coronary revascularization *Implications for percutaneous ablations: PTSMA, atrial ablation,

SUMMARY
1. CT interpreters should be aware of these variants, their types, and the important implications for interventional and surgical planning. 2.Familiarity with the variants of dual LAD or PDA is important for avoiding incorrect placement of an arteriotomy and for revascularization of the correct vessel. 3. A short LAD can be the source of all septal perforators and its diagnosis is essential before alcohol ablations. 4. Variants of the sinuatrial or atrioventricular node arteries may be damaged during atrial RF ablations

Cardiac - Sunday Posters and Exhibits (1:00pm - 1:30pm)

Sunday, 01:00 PM - 01:30 PM ● Lakeside Learning Center

CA

LL-CAS-SUB ● *AMA PRA Category 1 Credit* ™:0.5

LL-CAS-SU1B ● Effect of a Vendor-specific Motion-correction Algorithm on Image Quality and Interpretability of Daily Routine Coronary CTA with Heart Rate Control

Heon Lee (Presenter) ; **In Wan Cho** ; **Sang Hyun Paik** MD ; **Eun Kyung Khil** MD ; **Soyeoun Lim** MD ; **Jai Soung Park**

PURPOSE
To assess a novel vendor-specific motion-correction (MC) algorithm for its effect on improvement of image quality and interpretability in patients undergoing daily routine coronary CT angiography (CTA) with heart rate control.

METHOD AND MATERIALS
Fifty consecutive patients undergoing coronary CTA with rate control were included. Using the best R-R interval for reconstruction, coronary CTAs were interpreted with standard (STD) and MC algorithm by 2 experienced readers who assigned quality scores (graded 1-4) on per segment level of 3 major coronary arteries. Interpretability was defined as grade > 1. The segments (177/450) both rated as 4 on STD and MC algorithm were excluded from the comparison. Then, we compared image quality and interpretability between standard and MC reconstruction.

RESULTS
Mean age was 56.7± 11 years; 31 were men. Mean heart rate was 64.3±8.71 (42-83 bpm) and mean heart rate variability was 6.26±13.1. MC reconstruction showed higher image quality on a per-segment level of right coronary artery (RCA, 2.94±0.57 vs 2.28± 0.54; P
CONCLUSION
The use of a novel MC algorithm improves image quality of RCA and LCx, and overall interpretability in patients undergoing daily routine coronary CTA with rate control.

CLINICAL RELEVANCE/APPLICATION
The use of this new motion correction algorithm may be used to improve image quality and interpretability in patient undergoing coronary CTA using single source CTwith insufficient temporal resolution

LL-CAS-SU2B ● Reverse Attenuation Gradient Sign at Coronary Artery Computed Tomographic Angiography (CCTA) for Differentiating Coronary In-stent Total Occlusion from Subtotal Occlusion

Li Yang MD, PhD (Presenter) ; **Shuping Tian** MD, PhD

PURPOSE
To evaluate the clinical value of the reverse attenuation gradient (RAG) sign(defined as the reverse intraluminal opacification gradient of vessels distal to the occlusive lesions, which has lower attenuation in the proximal segment and gradually increased attenuation along the vessel.) for Differentiating inplanted stent total occlusion from subtotal occlusion observed with coronary computed tomographic (CT) angiography.

METHOD AND MATERIALS
All patients gave written informed consent, and the study protocol was approved by the hospital ethics committee. Contrast material-enhanced coronary CT angiography was performed in 956 patients (651 men, 305 women; mean age, 63years±9[standard deviation] range, 34�88years) suspected of having stent restenosis. Scanning was retrospectively electrocardiographically gated, and an automatic bolus-tracking method was used. For image reconstruction, an edge-enhancing kernel(B46f) was used. The RAG sign were recorded. Coronary Conventional coronary angiographic findings were �Gold standard�. Two physicians analyzed coronary CT angiographic data, and conventional coronary angiographic results were interpreted by one of several observers in consensus for stent restenosis; they were blinded to coronary CT angiographic data. Mann-Whitney Wilcoxon and Fisher exact tests were used for comparison.

RESULTS
At CCTA, 196 stents had in-stent restenosis. Conventional coronary angiography confirmed 91 total occlusions (TOs) and 105 subtotal occlusions (SOs).The RAG sign appeared significantly more frequently in the TOs group than in the SOs group (71% [65 of 91] vs 8.5% [9 of 105]; P
CONCLUSION
The RAG sign which represents the retrograde collateral flow distal to an occlusive lesion is highly specific for TOs and helps to differentiate TOs from SOs

CLINICAL RELEVANCE/APPLICATION
The RAG sign is highly specific for TOs and helps to differentiate TOs from SOs.

LL-CAS-SU3B ● The Difference of Coronary Vasodilation Based on the Plaque Characteristics by the Use of Sublingual Nitroglycerin on a 64-slice Coronary CT Angiography

Munemasa Okada MD, PhD (Presenter) ; **Yoshiteru Nakashima** MD ; **Toshiro Miura** ; **Tomoko Nao** ; **Masayuki Yoshimura** ; **Yuichi Sano** ; **Naofumi Matsunaga** MD, PhD

PURPOSE
The purpose of our study was to evaluate the coronary vasodilatation in each coronary segment by the use of sublingual nitroglycerin and compare coronary vasodilation ratio (VR) with baseline coronary diameter base on the plaque characteristics using a 64-slice coronary dual-source CT angiography (CTA).

METHOD AND MATERIALS
Sixty-nine patients (mean: 66.3 years, 24 male and 45 female) having an atypical chest pain were prospectively included in this study and underwent coronary CTA before and after the administration of sublingual nitroglycerin without heart rate control. The institutional review board approved this protocol and written informed consent was obtained from all patients. Coronary diameters were measured in each coronary segment from #1 to #15, including high lateral branch, and VRs were compared with baseline coronary diameter and analyzed by the plaque characteristics classified into four groups; no plaques, non-calcified plaque, partial-calcified palque (soft plaque with spotty calcification), calcified plaque (spotty calcified plaque within 1/4 of coronary circumference and circular calcified plaque over 1/4 of coronary circumference).

RESULTS
A total of 989 coronary segments were evaluated, and coronary plaques were mainly noted in large vessels near the coronary ostium. VR without coronary plaque (14.9%) was significantly larger than those with various coronary plaques ranging from 1.7 to 8.0%. However, there no significant difference in VR among the coronary arteries with various plaque characteristics on this study. In the coronary arteries with its diameter more than 2.5mm, VR in the coronary arteries with circular calcification was significantly smaller than those with other plaques.

CONCLUSION
The coronary plaque might decrease coronary vasodilatation regardless of plaque characteristics and coronary plaque itself might cause the coronary vasodilatation dysfuction, even after the administration of nitroglycerine. Especially circular calcified plaques might deteriorate the coronary vasodilatation.

CLINICAL RELEVANCE/APPLICATION
Coronary CTA could show the decreased coronary vasodiatation based on the coronary plaques, suggesting the endothelial dysfunction of coronary artery after the administration of nitroglycerin.

LL-CAS-SU4B ● Second Generation Iterative Model Reconstruction Provides Diagnostic Quality Images with Substantial Reduction in Radiation Exposure

Ethan J Halpern MD (Presenter) ; **Eric L Gingold** PhD ; **Hugh White** MD ; **Katrina M Read** MS *

PURPOSE
Iterative Model Reconstruction (IMR), as implemented in the second generation Philips software for multislice CT, is a knowledge-based reconstruction with marked reduction in image noise. The purpose of this study was to evaluate the application of IMR to reduce radiation dose in coronary CT angiography (cCTA).

METHOD AND MATERIALS
We evaluated 25 consecutive cCTA studies acquired on a 256-slice iCT scanner with tube current modulation (TCM). TCM lowers systolic phase tube current to 20% of that in diastole, resulting in photon-limited systolic images. Systolic phase images from each study were reconstructed at 40% of the R-R interval with filtered back projection (FBP), first generation iterative reconstruction (iDose) and second generation IMR (Philips Medical Systems; Cleveland, OH). Each case was evaluated by two independent reviewers. The mean and standard deviation (sd) of pixel values were computed in a standardized region of interest in the left ventricle and left main coronary artery. Subjective rating scores were obtained from each reviewer (1-5 scale for poor-excellent) for definition of: 1) contours of small coronary arteries (
RESULTS
There was no significant difference in mean pixel intensity among FBP, iDose and IMR (p>0.8). However, image noise within a contrast-enhanced region of interest in the left ventricle was reduced by a factor of 2.4 from FBP to iDose (sd=348 vs 144,p 2.7 > 1.6 (p 2.8 > 1.6 (p 2.6 > 1.6 (p 3.0 > 1.7 (p
CONCLUSION
Second generation IMR reduces intravascular noise on cCTA by 88% compared with FBP, providing significantly improved image quality at radiation exposure levels 80% lower than those currently used with FBP and iDose.

CLINICAL RELEVANCE/APPLICATION
Second generation IMR reconstruction may allow diagnostic quality cCTA imaging with a substantial reduction in patient radiation exposure.

LL-CAS-SU5B ● Coronary Fistula-Experience of Cardiac CT and MR in a Western Population

Elham Najafpour MD (Presenter) ; **Cylen Javidan-Nejad** MD ; **Annalori Panunzio** ; **Eric T Kimura-Hayama** MD ; **Saman Panahipour** MD ; **Sanjeev Bhalla** MD

PURPOSE
We aim to characterize coronary artery fistulas (CAFs) by CT and MR angiography using the past 5-year experience of our tertiary referral center by assessing both imaging findings and patient factors.

METHOD AND MATERIALS
Medical charts of 5947 consecutive patients who underwent ECG-gated coronary CT angiography(CTA) or coronary MR angiography(MRA) from 2007 to 2012 were retrospectively reviewed. The studies were reviewed by 2 cardiac radiologists. The CAF were assessed for the following: origin, site of termination, single or multiple nature of fistulae, tortuosity, calcification, maximal cross-sectional diameter, dilation of the remaining coronary arteries and systemic arterial feeders. The following information were collected from the charts: age and symptom at presentation, coexisting congenital heart disease (CHD), results of stress echocardiography, scintigraphy, and catheter angiography(CA) were documented.

RESULTS
A total of 12 patients(9 female:3 male) were identified with an overall incidence 0.2%. The average age of presentation was 44 years old. 10 had CTA and 2 had coronary MRA. 9/12 (75%) presented with chest pain and dyspnea and 2/12 (17%) with cardiac murmur. 9 had a single CAF and 3 had multiple, totaling 16 CAFs. The frequencies of origins are: 10/16(63%) left anterior descending artery(LAD), 3/16(19%) left circumflex(LCX), 2/16(13%) right coronary artery(RCA) and 1/16(6%) left main coronary artery. None had an anomalous origin. The frequencies of insertion sites are: 6/16 (38%) to main pulmonary artery(PA), 5/16 (31%) to right ventricle(RV), 4/16 (25%) to right atrium or superior vena cava, and 1/16 (6%) to coronary sinus. 16/16 (100%) showed tortuosity and 4/1 6(25%) calcification, present in all CAFs measuring > 6mm in maximal diameter but absent in those < or = 6mm. Mean diameter was 8 mm (range 3-21). 2 patients had CHD, both single CAF originating from LAD and terminating in RV. 10 patients had CA confirming the CAF. 3/7 of the patients with a documented stress test had positive findings for ischemia, 2 of which had multiple CAF and 1 had a large LAD to RV fistula.

CONCLUSION
The most common origin of a CAF was LAD and the most common insertion site the PA. Aneurysmal dilation and tortuosity were present in all CAF, with calcification seen only in CAFs having a diameter above 6 mm.

CLINICAL RELEVANCE/APPLICATION
This is the first reported study from the US or other Western populations characterizing the CT and MR of a small series of CAF patients. The results differ from that in Asia.

LL-CAE-SU6B ● Skipping a Beat: Common Appearances of Malpositioned Conducting Device Leads and Associated Complications

Aditi Dhakar MD (Presenter)

PURPOSE/AIM
The purpose of this exhibit is to: 1) Introduce the basic components of pacemakers and AICD devices. 2) Demonstrate the optimal

positioning of cardiac leads and discuss the limitations of current imaging. 2) Elaborate on the early and late complications from malpositioned leads.

CONTENT ORGANIZATION
Pictures and radiographs with explanatory text will be presented in the following order. - The key components of various pacemakers and AICD devices. - The normal course and ideal imaging appearance of different cardiac leads. - The optimal imaging methods and limitations for evaluation. - Acute complications seen within minutes to days after lead placement. These include pneumothorax, hemothorax, dislodgement, perforation, and phrenic nerve stimulation. - Late complications seen with cardiac pacing devices including Twiddler's Syndrome and fractured leads.

SUMMARY
This presentation will have conveyed: 1) The optimal placement and accepted positional variations of cardiac conducting device leads. 2) The role of immediate post-operative and subsequent imaging. 3) The complications associated with cardiac leads in order of severity, chronicity, and the degree of follow-up required.

LL-CAE-SU7B • Imaging the Tricuspid Valve: Spectrum of Congenital and Acquired Conditions

Daniel Ocazionez MD (Presenter) ; **Demetrius L Dicks** MD ; **Gregory Kicska** MD, PhD * ; **Randolph K Otto** MD ; **Mark R Ferguson** MD ; **Rachael M Edwards** MD ; **Gautham P Reddy** MD

PURPOSE/AIM
1. To illustrate anatomy and embryology.
2. To describe the spectrum of congenital and acquired conditions.
3. To exemplify the role of different imaging modalities including echocardiography, CT and MR in the evaluation of the tricuspid valve.

CONTENT ORGANIZATION
1. Introduction 2. Anatomy and embryology 3. Use of imaging techniques (echocardiography, CT and MRI). 4. Congenital anomalies:
a) Stenosis/atresia
b) Ebstein anomaly
c) Valve dysplasia
d) Double-orifice tricuspid valve (DOTV) 5. Acquired conditions:
a) Functional regurgitation from RV failure and pulmonary hypertension
b) Myxomatous degeneration
c) Infectious endocarditis
d) Rheumatic heart disease
e) Carcinoid syndrome
f) Iatrogenic and traumatic injuries
g) Marfan syndrome
h) Systemic lupus erythematosus
6. Indications for valvular replacement.

SUMMARY
Upon reviewing this exhibit, the radiologist will become familiar with the spectrum of congenital and acquired conditions involving the tricuspid valve. Ecocardiography, CT and MRI are useful tools in the evaluation and characterization of these disease entities and provide significantly important anatomical and functional information not only in the initial workup, but also in future management decisions.

LL-CAE-SU8B • Multidetector Computed Tomography (MDCT) Imaging of Coronary Artery Fistulas: Pictorial Review

Sachin S Saboo FRCR, MD (Presenter) ; **Yu-Hsiang Juan** MD ; **Mike Landzberg** ; **Ashish R Khandelwal** MD ; **Anne Marie Valente** ; **Frank J Rybicki** MD, PhD * ; **Michael L Steigner** MD * ; **Kulbir Ahlawat** MD ; **Saurabh Gupta** MD ; **Rani D Bhivasankar** MBBS ; **Elizabeth George** MBBS

PURPOSE/AIM
Review clinical presentations and coronary artery anatomy on MDCT applicable to patients with coronary artery fistulas (CAF)
Review the MDCT appearance of various CAF
Discuss clinical implications of MDCT based information in the management of patients with CAF

CONTENT ORGANIZATION
a) Etiology, pathophysiology, and clinical presentation of CAF
b) MDCT technique and 3D post-processing of CAF with examples:
1) Coronary artery to cardiac chambers
2) Coronary artery to pulmonary artery
3) Coronary artery to cardiac and pulmonary veins
4) Coronary artery to bronchial artery fistula
c) Characteristic MDCT findings of CAF with regards to origin, course, diameter, aneurysm, termination and multiplicity along with associated congenital and acquired coronary artery disease
d) Post treatment MDCT findings
e) Clinical implications and the treatment options
f) Conclusion

SUMMARY
Coronary artery fistulas are one type of coronary artery anomalies with abnormal termination. Complex findings are occasionally encountered on MDCT images. These images are highly efficient to characterize CAF to plan intervention and in follow-up. This educational exhibit will familiarize radiologists and clinicians with MDCT features of various CAF along with its clinical implications to facilitate accurate diagnosis and management.

Cardiovascular Risk Assessment: The Role for the Radiologist

Sunday, 02:00 PM - 03:30 PM • N227

BQ CA
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RC103 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC103A • The Role of Carotid US

Joseph F Polak MD, MPH (Presenter)

LEARNING OBJECTIVES
1) Present the American Heart Association guidelines for the assessment of cardiovascular risk in individuals without clinical cardiovascular disease. 2) Define the carotid artery biomarkers:plaque and carotid artery intima media wall thickness (IMT). 3) Highlight the key elements of cardiovascular risk stratification and how imaging biomarkers can contribute. 4) Summarize the key evidence that carotid ultrasound imaging biomarkers help predict future myocardial infarctions and other cardiovascular events. 5) Describe a published carotid imaging protocol used to assess degree of cardiovascular risk in Cardiology office practices with emphasis on carotid artery

intima-media thickness (IMT). 6) Weigh the advantages against the limitations of carotid ultrasound imaging biomarkers.

ABSTRACT
Background: Carotid ultrasound imaging as practiced in Radiology typically focuses on the detection of hemodynamically significant carotid artery stenoses in order to triage patients for carotid artery surgery. The role of carotid ultrasound imaging is, however, much broader in current clinical practices, especially those based in Cardiology. Methods: Review of the literature shows that the focus of carotid ultrasound imaging has shifted from detecting stenotic lesions in need of surgical intervention to documenting the presence of early atherosclerotic lesions. Carotid ultrasound can identify and quantify two biomarkers of use in primary prevention: early carotid artery plaques and diffuse wall intima-media thickening (IMT). Results: Early forms of carotid artery disease are associated with increased risk of all forms of first time cardiovascular events. Both IMT and plaque show evidence of risk prediction. The American Heart Association recommends carotid ultrasound evaluation of IMT and plaque in asymptomatic individuals more highly than resting or exercise electrocardiograms. Implementation of carotid IMT and carotid plaque imaging with ultrasound is still limited by a lack of standardization. This is apparent in the guidelines published by the American Society of Echocardiography. The quantitative evaluation of IMT needs to be contrasted against subjective or quantitative measurements of plaque (IMT) height. Ultimately, the value of the carotid artery biomarkers needs to be contrasted agains standard risk stratification and improvement in classification of individuals as low, intermediate, or high risk. The data show promise in this regards. Conclusion: Carotid ultrasound biomarkers can be measured non-invasively without exposure to radiation. Carotid ultrasound is readily accepted by patients. The technical expertise required to perform these measurements is much more stringent that would appear at first glance.

RC103B ● The Role of Cardiac CT

John J Carr MD, MS (Presenter)

LEARNING OBJECTIVES
1) Discuss the utility of CT to detect and characterize coronary artery disease and subclinical disease. 2) Discuss CT findings predictive of cardiovascular risk factors.

ABSTRACT
Cardiac CT, without and with intravenous contrast, has for the first time provided a non-invasive measurements of coronary plaque in healthy people. We now have strong evidence that subclinical coronary artery disease by CT strongly predicts future clinical events but perhaps more importantly is consistent with :pathologic studies indicating that coronary artery disease begins in childhood and progresses over decades before resulting in clinical disease. This presentation will review the evidence that calcified plaque by CT is the single:strongest predictor of 5 year risk of acute myocardial infarction and:cardiovascular death. Likewise, CT angiography has provided new insights into features of coronary plaque (positive remodeling, low attenuation and spotty calcifications) that places individuals at high risk for clinical events. Beyond dramatic reductions in radiation exposure, new computational techniques are allowing CT to provide precise estimates of coronary blood flow, a:physiologic measure important for patient management.: Lastly, we will discuss how physicians should use every chest CT to help patients and their healthcare teams better understand their cardiovascular risk and guide clinical care.

RC103C ● The Role of Cardiac MRI

David A Bluemke MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Discuss use of MRI to assess the cardiovascular disease to detect and characterize early, subclinical disease. 2) Present information on left ventricular mass, volumes and myocardial scar as risk factors, as derived from large population-based studies.

ABSTRACT
Cardiovascular MRI has key characteristics of precision in disease detection combined with lack of radiation exposure. As a result, MRI has found tremendous use not only in evaluating sick patients, but also in screening for disease in individuals who may be healthy but who are at risk for cardiovascular disease. This presentation will review results from large population based trials that have used MRI to detect early, subclinical cardiovascular disease. Left ventricular mass in particular has proven to be an extremely powerful biomarker to identify individuals at risk for heart failure. Common risk factors, such as diabetes and smoking, have tremendous adverse effect on myocardial remodeling that have now been quantified. Myocardial scar detection with MRI is used routinely in the clinic, and its role in identifying early disease in asymptomatic individuals will also be discussed.

Introduction to Cardiac MR: Infarcts, Cardiomyopathies and Masses (How-to Workshop)

Sunday, 02:00 PM - 03:30 PM ● E261

| MR | CA |

RC151 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
Kristopher W Cummings , MD *
Michael K Atalay , MD, PhD
Antonio Luna , MD

LEARNING OBJECTIVES
1) Differentiate myocardial ischemia from myocardial infarction on dynamic stress perfusion myocardial MR. 2) Distinguish areas of infarcted myocardium unlikely to benefit from revascularization from those that would. 3) List three patterns of delayed contrast enhancement seen on cardiac MR which are not seen in infarct-related cardiomyopathy. 4) Provide a narrowed differential diagnosis in the case of non-ischemic cardiomyopathy using the predominate pattern of delayed contrast hyperenhancement on MR. 5) Analyze the key features in differentiation between tumoral and non tumoral cardiac masses, and MRI signs favoring malignancy. 6) Integrate the MRI information in the differential diagnosis of cardiac masses according to their location.

ABSTRACT
The use of magnetic resonance imaging for the evaluation of cardiac pathology continues to increase. Therefore, it is important for radiologists to be familiar with the basic techniques of cardiac MR and common pathologies encountered in such a referral population. Given the widespread prevalence of atherosclerotic coronary disease, cardiac MR is commonly used in the evaluation of myocardial infarction and viability prior to potential coronary revascularization. However, the role of cardiac MR has expanded in recent years to include assessment of ischemia by virtue of dynamic contrast injection without and during the administration of pharmacologic stress agents. Cardiac MR is extremely useful in the evaluation of non-ischemic cardiomyopathy which is often a challenging clinical diagnosis. Using delayed contrast enhanced sequences, non-ischemic causes can be differentiated from infarct-related disease and the etiological differential diagnosis can be narrowed. Finally, cardiac MR is frequently used in the evaluation of cardiac masses detected on other cross-sectional imaging or echocardiography. Utilizing a combination of MR signal characteristics, mass location and contrast enhancement, differentiation of tumoral from non-tumoral masses can be made and, in the case of neoplasms, characteristics suggestive of malignancy can be identified.

Cardiac CT Mentored Case Review: Part I (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, 08:30 AM - 10:00 AM ● S406A

| CT | CA |

MSMC21 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5

Moderator
Pamela K Woodard , MD *
Moderator
David A Bluemke , MD, PhD *

LEARNING OBJECTIVES

MSMC21A ● Normal Coronary Anatomy

Shawn D Teague MD (Presenter) *

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

ABSTRACT

MSMC21B ● Coronary Artery Anomalies

Cylen Javidan-Nejad MD (Presenter)

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

Imaging for Electrophysiology

Monday, 08:30 AM - 10:00 AM ● E351

MR CT CA
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RC203 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5

RC203A ● CT

Benoit Desjardins MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Identify the aspects of clinical cardiac electrophysiology which can benefit from imaging. 2) Compare the use of different imaging modalities in cardiac electrophysiology. 3) Understand the technical difficulties and solutions to image patients with arrhythmia and/or implanted devices. 4) Practice the current techniques for imaging in cardiac electrophysiology. 5) Assess the potential of the latest technological innovations and advances in imaging to enhance clinical practice and problem solving in cardiac electrophysiology.

ABSTRACT
This lecture is part of a vertical combined refresher course and scientific abstract session. The lectures will alternate with the relevant scientific abstracts, and will be tailored to provide the necessary background and overview relevant to the different accompanying scientific abstracts. The content of these refresher course lectures will therefore vary according to the content of the accompanying scientific abstracts. The lecture will include some of the following topics: - Overview of the aspects of clinical cardiac electrophysiology which can benefit from imaging. - Comparison of the different imaging modalities in cardiac electrophysiology, including CT, MRI, echocardiography, rotational angiography and electroanatomical mapping. - Technical difficulties and solutions to image patients with arrhythmia - Technical difficulties and solutions to image patients with implanted devices. - Latest cutting edge imaging techniques for cardiac electrophysiology. - Use of 3D imaging to guide cardiac ablation therapy - Real time image-guided cardiac electrophysiology

RC203B ● MRI

Scott D Flamm MD (Presenter) *

LEARNING OBJECTIVES
1) Recognize the advantages and limitations of MRI versus CT for the pre- and post-ablation imaging in cardiac electrophysiology. 2) Identify the clinical scenarios where clinical cardiac electrophysiology may benefit from MR imaging. 3) Understand the technical difficulties and potential solutions to image patients with arrhythmias. 4) Recognize the limitations and necessary precautions and planning needed when considering imaging patients with implanted devices.

ABSTRACT
See Abstract above.

RC203C ● Clinical Perspective

Bradley Knight MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the value of intracardiac echocardiography in the EP laboratory. 2) Define the role of MR and CT prior to ablation procedures for atrial fibrillation. 3) Appreciate the indications for TEE guided EP procedures including LAA occlusion.

Cardiac CT Mentored Case Review: Part II (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, 10:30 AM - 12:15 PM ● S406A

CT VA CA
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MSMC22 ● *AMA PRA Category 1 Credit* ™:1.75 ● ARRT Category A+ Credit:2
Moderator
Geoffrey D Rubin , MD *
Moderator
Vincent B Ho , MD, MBA *

LEARNING OBJECTIVES
1) Understand how to interact with 4D cardiac CTA data for proper interpretation. 2) Compare methods for characterizing coronary stenoses and learn what is most appropriate in various situations.

MSMC22A ● Coronary Artery Disease I: Native Vessel Disease

Geoffrey D Rubin MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

MSMC22B ● Coronary Artery Disease II: Native Vessel Disease

Smita Patel MBBS (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT

MSMC22C ● Valves and Cardiac Function

Andrew J Bierhals MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

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

Cardiac (Coronary CT/MR II)

Monday, 10:30 AM - 12:00 PM ● S405AB

| MR | | CT | | CA |

SSC01 ● *AMA PRA Category 1 Credit* ™:1.5 ●ARRT Category A+ Credit:1.5
  Moderator
  Lisa Diethelm , MD
  Moderator
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SSC01-01 ● Improving the Image Quality of Coronary CTA in High Heart Rates Using a Novel Non-rigid Registration Based Motion Correction Algorithm

Zhilian Zhao PhD (Presenter) ; **Dongdong Rong** ; **Xiangying Du** MD ; **Kuncheng Li** MD

PURPOSE
A novel non-rigid registration based motion correction algorithm (Snap-Shot-Freeze, SSF) has been recently introduced for coronary CTA with 64-row MDCT. The aim of this study was to evaluate the efficiency of SSF in coronary CTA with high heart rates, by comparing the image quality with that of single sector and bi-sector reconstructions.

METHOD AND MATERIALS

RESULTS

CONCLUSION
SSF can effectively improve the image quality of coronary CTA in patients with high heart rates.

CLINICAL RELEVANCE/APPLICATION
Successful motion correction of coronary CTA images may expand the use of this non-traumatic method to more suspected CAD patients.

SSC01-02 ● The Feasibility of Half-cycle Reconstruction Improve Image Quality of Free-breathing 320-detector Multidetector CT Angiography

Zhen Wang BMedSc, RT (Presenter) ; **Jianhua Yuan** MD ; **Xiang Zhong Ding** MD

PURPOSE
In patients with heart rates above 65 beats per minute, 320-detector multidetector CT uses multi-cycle reconstruction to improve the effective temporal resolution by using data from more than one R-R interval of the cardiac cycle to reconstruct an image. Sometimes the heart does not follow the same pattern of motion with every beat (e.g. some patients cannot hold their breath). In the situation, the multi-cycle reconstruction might not improve image quality of coronary computed tomography angiography (CCTA) due to respiration artifacts. Our aim was to investigate the feasibility of Half-cycle reconstruction improve image quality of free-breathing CCTA in patients with heart rates above 65 beats per minute using with a 320-detector multidetector CT.

METHOD AND MATERIALS
A total of 1489 coronary computed tomography angiography were performed in patients with heart rates above 65 beats per minute during the study period from October 2010 to February 2013. All CCTA examinations were produced with the standard breath-holding method, but the images in 22 patients existed respiration artifacts. Half-cycle reconstruction image and multi-cycle reconstruction image were reconstructed for each patient. The quality scores for 15 segments of all coronary arteries were analyzed and defined as: 1 (excellent), 2 (good), and 3 (poor). The signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), and effective radiation dose of each image were compared between the two methods.

RESULTS
In patients with half-cycle reconstruction, diagnostic quality images (scores of 1 or 2) were obtained in 97.9% of the analyzed segments, compared with 69.5% in the group with multi-cycle reconstruction ($p < 0.001$). The SNR and CNR were not significantly different between the two methods. The median effective radiation dose was 1.2 mSv for the group with multi-beat acquisition and simulative effective radiation dose was 8.9 mSv for the group with half-cycle reconstruction ($p < 0.001$).

CONCLUSION
Half-cycle reconstruction can improve image quality of free-breathing CCTA in patients with heart rates above 65 beats per minute using with a 320-detector multidetector CT. For patients with difficulties of breath-holding, free-breathing CCTA with single beat acquisition can be an alternative solution for coronary artery evaluation.

CLINICAL RELEVANCE/APPLICATION
320-detector MDCT offers new opportunities for the breathless patient by using half-cycle reconstruction.

SSC01-03 ● Diagnostic Accuracy of Dual-source Computed Tomography for Selecting Coronary Artery Bypass Graft Surgery Candidates

Young Joo Suh MD (Presenter) ; **Young Jin Kim** MD ; **Sae Rom Hong** MD ; **Yoo Jin Hong** MD ; **Hye-Jeong Lee** MD ; **Jin Hur** MD ; **Byoung Wook Choi** MD

PURPOSE
To investigate the diagnostic performance of dual-source computed tomography coronary angiography (CTCA) in terms of selecting coronary artery bypass graft surgery (CABG) candidates according to the 2011 American College of Cardiology Foundation and American Heart Association guidelines for CABG and to assess the added value of Syntax score for selecting CABG candidates.

METHOD AND MATERIALS
Institutional review board approval was obtained. We included 250 patients (mean age, 63.9 years; 150 men and 100 women) with a suspicion of coronary artery disease who underwent both dual source CTCA and conventional coronary angiography (CCA). We established eligible criteria for CABG based on 2011 American College of Cardiology/American Heart Association practice guidelines: 3-vessel disease, left main coronary artery disease, and proximal left anterior descending artery (pLAD) disease with other one major coronary artery disease. Results of CTCA and CCA were retrospectively reviewed. SYNTAX scores were obtained based on both CCTA and CCA. Diagnostic performances of CTCA, CT-based SYNTAX score and combining CTCA with SYNTAX score for selecting CABG candidates were calculated, with CCA as the reference standard.

RESULTS

CONCLUSION
Dual-source CTCA showed comparable diagnostic accuracy for selecting CABG candidates compared with CCA. Combining CT-based SYNTAX score with CTCA can be highly specific method for selecting CABG candidates.

CLINICAL RELEVANCE/APPLICATION
Dual-source CTCA showed comparable diagnostic accuracy for selecting CABG candidates and combining CT-based SYNTAX score with CTCA can be highly specific method.

SSC01-04 ● Effect of Snapshot Freeze Motion Correction Algorithm on Image Quality of Retrospective ECG-triggered Coronary CT Angiography

Lijuan Fan (Presenter) ; **Jiwang Zhang** ; **Donghai Fu** ; **Liren Zhang** MD

PURPOSE
We assessed Snapshot Freeze Motion Correction algorithm for its effect on image quality of coronary CT angiography (CCTA) with retrospective ECG-triggered.

METHOD AND MATERIALS
Thirty consecutive patients undergoing CCTA with retrospective ECG- triggered. Two types of reconstruction methods of standard (STD) and snapshot freeze motion correction (SSF) were used to produce the 75% and 45% R-R interval images. We compared image quality and interpretability between STD and SSF reconstructions of each heart cycle. CCTA images were interpreted with Likert 5-points score by two experienced radiologists. The image quality and interpretability were respectively assessed on per-patient, per-artery and per-segment levels. Comparisons of variables were performed with Wilcoxon rank sum test and McNemar test.

RESULTS

CONCLUSION
The use of SSF improves image quality and interpretability of coronary CTA . The image quality of the 45% R-R interval was best.

CLINICAL RELEVANCE/APPLICATION
The use of SSF improves image quality and interpretability of coronary CTA .

SSC01-05 ● Improved Non-calcified Plaque Delineation on Coronary CT Angiography by Sonogram-affirmed Iterative Reconstruction with Different Strength and Relationship with BMI

Lei Zhao MD (Presenter) ; **Fabian Plank** ; **Andrea Klauser** MD ; **Florian Wolf** MD ; **Werner R Jaschke** MD, PhD ; **Gudrun Feuchtner** MD *

PURPOSE
To prospectively compare non-calcified plaque delineation and image quality of coronary artery computed tomography angiograms (CCTA) obtained with sonogram-affirmed iterative reconstruction (SAIR) with different strengths and filtered back projection (FBP).

METHOD AND MATERIALS
A total of 53 patients (body weight 90.4±21.6 kg, BMI 29.5±6.6) were investigated. CCTA was performed using 128-slice dual-source CT. Images were reconstructed with standard FBP and sonogram-affirmed iterative reconstruction using different strength (I2f, I3f, I4f). Image quality score (IQS) of overall CCTA exam and a non-calcified plaque outer border delineation scores (PDS) were evaluated respectively by using a 5-scale score: from 1= non-diagnostic to 5=excellent. Image noise, contrast-to-noise ratio (CNR) of aorta root, left main and right coronary artery proximal part, and the non-calcified plaques were quantified and compared among the 4 image reconstructions. IQS and PDS were compared between different BMI groups (BMI
RESULTS
There were 69.8% patients in FBP, 98.0% in I2f, 98.1% in I3f and 100% in I4f who had good overall CCTA IQS. There were statistical differences in CCTA exam IQS among the 4 image reconstructions (P28 (P
CONCLUSION
SAIR offers improved image quality and non-calcifying plaque delineation as compared with FBP, especially if BMI is increasing. Importantly, 18.3% of non-calcifying plaques were missed with FBP but detected by SAIR. I4f shows the best IQS and PDS among the different SAIR strength.

CLINICAL RELEVANCE/APPLICATION
SAIR improves non-calcifying plaque delineation and detection, and image quality in CCTA. In high BMI patients, highest SAIR strength I4f is most beneficial.

SSC01-06 ● Enhanced Diagnostic Accuracy of In-stent Patency in Low-dose High-pitch Dual-source CT Angiography with Iterative Image Reconstruction

Jun-Jie Yang (Presenter)

PURPOSE
Recent studies demonstrated that sinogram affirmed iterative reconstructions can produce higher-resolution images with greater robustness for the reduction of various imaging artifacts. The aim of this study was to assess the diagnostic accuracy of in-stent restenosis (>50% luminal narrowing) using low-dose high-pitch dual-source CT coronary angiography (Flash CTCA) with sinogram affirmed iterative reconstructions (SAFIRE) in symptomatic patients referred for conventional coronary angiography (CCA).

METHOD AND MATERIALS
137 stents in 70 patients (average heart rate was 57±8 bpm), were prospectively evaluated. The interval between stenting and inclusion in the study was 21 ± 12 months. Before scheduled CCA, Flash CTCA was performed between September 2011 and December 2012. In-stent noise, signal-to-noise ratio (SNR) and stent-lumen attenuation increase ratio (SAIR), as well as subjective image quality score, were measured and compared between SAFIRE reconstruction (group A) and traditional filtered back projection (FBP) reconstruction

(group B). CCA was served as the standard of reference to further analyze accuracy of both groups on detecting in-stent restenosis.

RESULTS
Of the 137 stents, group A were superior to group B on in-stent noise (22.5±8.6 vs. 36.1±13.9; P0.05). However, in subgroup of smaller stent (0.05). CCTA average effective dose was (1.41±0.45) mSv.

CONCLUSION
Low-dose high-pitch dual-source CT angiography can be performed well in the detection of in-stent patency. Iterative image reconstruction singnificantly improve diaonostic accuracy of in-stent restensis even in smaller stents.

CLINICAL RELEVANCE/APPLICATION
Iterative image reconstruction singnificantly improve diaonostic accuracy of in-stent restensis even in smaller stents.

SSC01-07 ● Use of 80kV, 100kV and 120kV in Coronary CT Angiography with Prospectively Electrocardiogram (ECG)-triggered Spiral Acquisition by Dual-source CT: Image Quality and Radiation Dose

Shuo Li MD (Presenter) ; **Yining Wang** MD ; **Lingyan Kong** MD ; **Zhengyu Jin** MD

PURPOSE
To compare the image quality (IQ) and radiation exposure using of 80kV, 100kV and 120kV tube voltage with prospectively electrocardiogram (ECG)-triggered spiral acquisition in coronary CT angiography.

METHOD AND MATERIALS
Totally ninety consecutive patients with irregular heart rate (
RESULTS
There was no difference in age, heart rate, mean scan time and body mass among the three groups (P>0.05). The mean tube current was 269.75±40.30 (80kV), 317±33.68 (100kV), 322.57±70.45 (120kV). That of 80kV group was remarkably lower than the other two groups. The average IQ score was 1.01±0.26 (80kV), 1.00±0.19 (100kV), and 1.14±0.38 (120kV). The IQ score was significantly higher for 120 kV group. No statistical difference was found between 80kV and 100kV groups (P 0.05). The mean effective radiation dose was 0.31±0.04 mSv (80kV), 0.77±0.10 mSv (100kV), and 1.31±0.30 mSv (120kV) respectively. There was statistical difference among them (P=0.00).

CONCLUSION
In patients with a low and stable heart rate (< 70bpm), use of low tube voltage reduces radiation dose and may result in improved image quality.

CLINICAL RELEVANCE/APPLICATION
As increased applications of CCTA continue to emerge, concerns exist in regards to patient radiation exposure. lowering the tube voltage, have been developed for lowering radiation dose with CCTA.

SSC01-08 ● Sub-millisievert CT Coronary Angiography (CTCA) Using Adaptive Iterative Dose Reduction

Masoud Shariat MD (Presenter) ; **Aparna Deshpande** MBBS ; **Vikram M Raju** MBBS, FRCR ; **Bahiyah Alnafisi** MD ; **Narinder S Paul** MD *

PURPOSE
To determine whether Adaptive Iterative Dose Reduction (AIDR) increases the proportion of patients with diagnostic quality submillisievert CTCA studies compared to Filtered Back Projection (FBP).

METHOD AND MATERIALS
Retrospective analysis of 80 consecutive patients referred for CTCA. Group A (FBP) = 40 patients; (25 M), aged 60.2 ± 9.0 years, BMI 28.0± 5.1, and group B (AIDR) = 40 patients; (20 M), aged 59.4 ± 12.9 years, BMI 27.8± 6.6. All patients had the same preparation with oral/IV metoprolol 75-150mg/0-40mg to achieve a target heart rate (HR) of =60bpm and s/l NTG 300mcg. CTCA was performed using 320 x 140-160mm detector rows (Aquilion One, TMS, Otawara, Japan), gantry rotation of 350ms and power injection of 80cc iodinated CM at 6cc/s. In both groups, the X-ray tube settings (kVp, mA) were optimized to pre-defined levels of image noise using proprietary software (SureExposure, Toshiba Medical Systems). Assessment of image quality was performed by 2 level III trained cardiac radiologists independently, blinded to the scan parameters. Qualitative assessment used a 4 point visual score (1=excellent, 2=good, 3= adequate, 4=poor). Quantitative assessment compared the signal to noise ratio (SNR) in the ascending aorta. The console readout (CTDI, DLP) provided the radiation dose. Qualitative statistical analysis and two-tailed P test were performed to compare radiation dose and image quality. P
RESULTS
The patients were matched for age, gender and BMI. **Radiation Dose**: Group A, CTDI = 13.86± 5.99 (range 2.8-28mGy), DLP = 188.26± 81.60 (range 44.30-391.70 mGy.cm); Group B, CTDI = 10.40 ± 6.17 (range 2.3-22.9), DLP = 136.44± 80.65 (range 28.8-288.60 mGy.cm) resulting in a mean CTDI reduction of 25% with AIDR (p=0.019).
SNR: Group A =20.84 ± 5.58 (range 1.19-28.74), Group B= 23.70± 7.80 (range 7.56-43.03), an increase of 14% (p=0.062). **Visual score**: Group A= 3.24±0.64, Group B = 3.27±0.67 (p=0.8466). **Number of sub-mSv scans**: Group A= 2 (5%), Group B = 10 (25%). Table 1

CONCLUSION
CTCA performed using AIDR results in diagnostic image quality with an average dose reduction of 25% compared to an optimized FBP protocol and a five-fold increase in the number of sub-mSv scans.

CLINICAL RELEVANCE/APPLICATION
CTCA accurately detects CAD. Radiation dose concerns restrict widespread use of CTCA but IR algorithms demonstrate significant dose reduction with preservation of diagnostic image quality.

SSC01-09 ● Anomalous Origin of the Coronary Artery from the Wrong Coronary Sinus Evaluated with Computed Tomography

Maciej Krupinski (Presenter) ; **Malgorzata Urbanczyk Zawadzka** ; **Malgorzata Irzyk** ; **Bartosz Laskowicz** ; **Tomasz Miszalski-Jamka** ; **Robert Pawel Banys** ; **Jan Baron**

PURPOSE
Anomalous origin of coronary artery is an abnormality occurring in around 1% of patients. The aim of the study was to perform cardiac computed tomography (CT) evaluation of the coronary arteries originating from the wrong coronary sinus, including their anatomy.

METHOD AND MATERIALS
7115 patients, who were scheduled for 64-slice or dual source cardiac CT were screened for the presence of isolated anomalous origin of the coronary artery from the wrong coronary sinus. Those, who revealed abnormal origin of coronary artery were evaluated for: high risk anatomy features (acute angle of takeoff, slitlike orifice, intramural course and course between aorta and pulmonary artery), presence and type of clinical symptoms and occurrence of cardiac events during follow up.

RESULTS
Anomalous origin of coronary artery was found in 54 (0.76 %) patients (29 males, 25 females, mean age 60.9 ± 11.6 years). 22 (41%) patients presented circumflex artery originating from the right coronary artery sinus (ALCx), 16 (30%) patients right coronary artery originating from the left coronary artery sinus (ARCA), 13 (24%) patients left coronary artery originating from the right coronary artery sinus (ALCA) and 3 (5%) patients left coronary artery originating from the noncoronary artery sinus. The mean value of angle of takeoff was lower (p

CONCLUSION
Anomalous origin of the coronary artery from the wrong coronary sinus is a rare occurring anomaly in cardiac CT. High risk anatomy features are the most common in patients with right coronary artery originating from the wrong coronary sinus. Patients with ARCA also reveal higher prevalence of chest pain and cardiac events in the follow up than individuals with ALCA and ALCx.

CLINICAL RELEVANCE/APPLICATION
Cardiac CT enables detection and evaluation of the anomalous origin of the coronary artery, including its high risk anatomy features.

Cardiac (Anatomy and Function I)

Monday, 10:30 AM - 12:00 PM ● S502AB

| MR | CA |

SSC02 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5

Moderator
Bernd J Wintersperger , MD *
Moderator
Robert M Steiner , MD *
Moderator
Jacobo Kirsch , MD

SSC02-01 ● Assessment of Mean Pulmonary Arterial Pressure and Diagnosis of Pulmonary Hypertension Based on Vertical Blood Flow in the Main Pulmonary Artery

Gert Reiter (Presenter) * ; **Ursula Reiter** ; **Gabor Kovacs** MD ; **Horst Olschewski** MD ; **Michael H Fuchsjaeger** MD

PURPOSE
To establish a relationship between mean pulmonary arterial pressure (mPAP) and period of existence of vortical blood flow in the main pulmonary artery derived from magnetic resonance phase-contrast imaging (MR-PCI) to 1) evaluate accuracy of non-invasive vortex-based estimation of mPAP and 2) define cut-off values for the diagnosis of manifest pulmonary hypertension (PH).

METHOD AND MATERIALS
The prospective study was approved by the local ethical review board. 145 patients with suspected PH (69 patients with and 76 without manifest PH) underwent right heart catheterization (RHC) and ECG-gated, time resolved three-dimensional MR-PCI of the main pulmonary artery. Velocity fields derived from MR-PCI were visualized with dedicated software and evaluated for period of existence of vortical blood flow (t_{vortex} in percent of the cardiac interval) in the main pulmonary artery. Relationship between mPAP and t_{vortex} was analyzed by means of regression, Bland-Altman and receiver operating characteristic curve analysis.

RESULTS
Relationship between mPAP and t_{vortex} was excellently (goodness-of-the-fit parameter $R^2 = 0.95$) described as increasing linearly from t_{vortex} = 0% (mPAP = 16 mmHg) with a slope of 1.6% per mmHg. Employing this relation to estimate elevated mPAP from t_{vortex} in patients with manifest PH resulted in a standard deviation of 4 mmHg between MR-PCI vortex-based and RHC-derived mPAP values. Manifest PH, defined as mPAP = 25 mmHg, corresponded to t_{vortex} = 14% of cardiac interval.
Area under the curve was 0.99 (95% confidence interval 0.98-1.00) for tvortex-based diagnosis of manifest PH. Applying the cut-off value t_{vortex} = 14% resulted in a sensitivity of 0.97 (95% confidence interval 0.90-0.99) and a specificity of 0.96 (95% confidence interval 0.89-0.99) for diagnosis of manifest PH.

CONCLUSION
MR-PCI based determination of periods of existence of vortical blood flow in main pulmonary artery allows for both, accurate diagnosis of PH and accurate estimation of elevated mPAP.

CLINICAL RELEVANCE/APPLICATION
Vortex based assessment of mPAP has the potential to become the non-invasive, non-ionizing method of choice for early recognition and longitudinal follow up of patients with PH.

SSC02-02 ● Myocardial Adaption in Previously Untrained Men after Four Months of High-intensity Running Training (HIT): A Comprehensive Longitudinal Cardiac MR Imaging Study

Michael Scharf MD (Presenter) * ; **Axel Schmid** MD ; **Michael Uder** MD * ; **Michael M Lell** MD *

PURPOSE
To prospectively evaluate whether short term endurance high intensity training (HIT) induces detectable morphologic cardiac changes in previously untrained men, as assessed with magnetic resonance imaging (MRI), and to compare findings to inactive control subjects.

METHOD AND MATERIALS
84 untrained volunteers were randomly assigned to a HIT-group (n=42; 44.1±4.7 years; range 33-51 years) or an inactive control group (n=42; 42.3±5.6 years; range 31-51 years). Before and after 4 months of HIT subjects underwent cardiac MRI (cine, late gadolinium enhancement, tagging) to assess myocardial morphology and function of the left and right ventricle. In addition, a stepwise progressive-intensity treadmill test with continuous assessment of ventilation parameters and determination of heart rate at the anaerobic threshold was performed. Ejection fraction, end-diastolic volume, end-sytolic-volume, stroke-volume, myocardial mass and cardiac index were measured for the left and right ventricle. LV and RV remodeling index (myocardial mass/end-diastolic volume) were calculated to determine the pattern of ventricular remodeling. Evaluation of LGE was performed according to the 17-segment model of the American Heart Association guidelines. We evaluated myocardial strain using Intag-Software.

RESULTS
Indexed volume and mass for the left and right ventricle were significantly greater after HIT whereas values in control subjects remained unchanged. Changes in ventricular EDV and MM were significantly correlated with changes in indexed VO_2max (Pearson correlation, 0.609 and 0.588: P
CONCLUSION
A relatively short period of HIT in previously untrained men leads to significant changes in left and right ventricular morphologic characteristics and function. These findings are not associated with pathologic features predisposing for sudden cardiac death.

CLINICAL RELEVANCE/APPLICATION
A short period of HIT leads to significant changes in cardiac morphologic characteristics and function which are not associated with pathologic features predisposing for sudden cardiac death.

SSC02-03 ● MRI Based Non-invasive Measures Correlates with Invasive Measurements of Left Atrial Diastolic Function in Atrial Fibrillation Patients

Irfan M Khurram MD (Presenter) ; **Farhan Maqbool** MBBS ; **Roy Beinart** MD ; **Hugh Calkins** ; **Saman Nazarian** MD * ; **Stefan L Zimmerman** MD

PURPOSE
Atrial fibrillation (AF) is the most common cardiac arrhythmia and is a major source of morbidity due to diminished cardiac function. This

study describes a novel methodology for non-invasive measurement of left atrial (LA) function in patients with AF.

METHOD AND MATERIALS
A total of 55 patients (81% male, 55% paroxysmal, age 60.4±10.2 years) underwent cardiac MRI prior to AF ablation. LA pressure was measured during sinus rhythm following trans-septal puncture for AF ablation. LA pressure (invasive) and volume (MRI derived) loops were prepared for all patients. LA diastolic function was assessed using a diastolic dysfunction score, defined as the ratio of the change in LA pressure to the change in LA volume during passive LA filling. Additionally, the ratio of pulmonary vein flow velocities during ventricular systole and diastole were obtained using phase contrast MRI (Figure, top panel, S/D ratio). LA volumes from 30 phases of the cardiac cycle were obtained from cine-MRI. LA systolic functions were calculated from the active emptying fraction during atrial contraction. Diastolic dysfunction scores greater than the 90th percentile (>1.6mmHg/ml) were considered to signify severe diastolic dysfunction.

RESULTS
The mean diastolic dysfunction score was 0.76±0.7 mmHg/ml. The score was higher (worst) in patients with persistent versus paroxysmal AF (1.0±0.9 versus 0.60±0.5,p=0.02). The mean S/D ratio was 1.04±0.6; and was lower in patients with persistent versus paroxysmal AF (0.9±0.5 versus 1.2±0.5, p=0.04). There was a negative linear association between diastolic dysfunction scores and S/D ratio measures (Figure, bottom panel, R2 0.262, p
CONCLUSION
The non-invasive MRI derived ratio of pulmonary vein flow velocities during systole and diastole are associated with the MRI/invasive derived diastolic dysfunction score, and appear to be a reasonable surrogate of LA diastolic function.

CLINICAL RELEVANCE/APPLICATION
Non-invasive PV flow characteristics by MRI yield comparable results to pressure/volume loops and may ease the assessment of LA diastolic function. More studies are needed to validate this association

SSC02-04 • A Qualitative and Quantitative Assessment of Ungated Free-breathing Cardiac Imaging Using Through-time Radial GRAPPA for Left Ventricular Functional Evaluation

Gunhild E Aandal MD (Presenter) ; **Vidya Nadig** MD ; **Victoria Yeh** ; **Prabhakar Rajiah** MD, FRCR ; **Trevor Jenkins** ; **Abdus Sattar** PhD ; **Mark A Griswold** PhD * ; **Robert C Gilkeson** MD * ; **Vikas Gulani** MD, PhD * ; **Nicole Seiberlich** PhD *

PURPOSE
To determine whether LV functional parameters and image quality of free-breathing, ungated scans reconstructed with through-time radial GRAPPA are comparable to those of gold-standard breathhold cine techniques.

METHOD AND MATERIALS
Volumetric data was collected in 78 subjects (14 volunteers, 64 patients) on a 1.5T MRI scanner. Both gold-standard breathheld cardiac functional scans with ECG gating (tailored to the patient with spatial resolutions between 1.4-2.6 mm^2 and temporal resolutions of 31-62ms) and free-breathing, ungated highly undersampled radial bSSFP scans (spatial resolution of 2.3mm^2, temporal resolution of 42.2ms) were acquired. Reconstruction of the radial data was performed with through-time radial GRAPPA. ESV, EDV, and EF were assessed for both methods, and correlation coefficients and Bland-Altman plots were generated. The images were rated by two cardiothoracic radiologists for specific features on a scale of excellent, good, poor, no visibility; obvious visual differences precluded blinding. Ordinal logistic regression analysis (corrected for clustering) of the radiologists' ratings was performed.

RESULTS
Correlation coefficients indicated significant correlation between the methods (EF R=0.97, EDV R=0.99, and ESV R=0.99). Bland-Altman analysis showed that 72 of the 78 of the EF measurements were within the 95% limits of agreement (mean difference=-0.93%, SD=2.49%). Similar results were found for the EDV and ESV values. Radiologist ratings showed that the free-breathing method was preferred for depiction of endocardial borders (p 0.05), and mitral valve visualization and blood pool contrast with the breathhold method were preferred (p
CONCLUSION
Differences in EF, EDV, and ESV between the gold-standard and free-breathing, ungated images generated using through-time radial GRAPPA are not clinically significant. Radiologist review demonstrated that some features including endocardial borders are better visualized with the free-breathing scan due to their reduced motion artifacts, while the breathhold method was preferred for valve visualization and blood pool contrast.

CLINICAL RELEVANCE/APPLICATION
Free-breathing ungated scans with through-time radial GRAPPA can be used to find LV functional parameters quickly and cost-effectively even for patients with difficulty breathholding or arrhythmia.

SSC02-05 • Fat Accumulation in Skeletal Muscle Quantified by MRS: Relationship to Global Myocardial Function

Radwa A Noureldin MD, MSc (Presenter) ; **Ronald Ouwerkerk** PhD ; **Roderic I Pettigrew** MD, PhD ; **Ahmed M Gharib** MBChB

PURPOSE
Obesity has a detrimental effect on cardiac function, we aimed to evaluate relationship between musculoskeletal fat deposition and myocardial function.

METHOD AND MATERIALS
Seventy-seven HIPPA-compliant subjects, without history of cardiac disease, were scanned after IRB approval and signing a written informed consent. We used a Siemens Verio 70cm bore 3T-MRI. Short axis (SA) and 4-chamber SSFP cine were obtained for evaluation of global myocardial function; EF, EDV, ESV, SV and LV mass, variables were indexed to BSA. Pericardial fat volume was quantified on SA images at end systole, extended from level of mitral valve to the apex. MRS was performed using PRESS technique, TR/TE = 4000/24ms. PRESS voxel was targeting the vastus lateralis (VL), anterior tibial (AT) and soleus muscles. Musculoskeletal fat fraction (FF) was quantified using Amares/MRUI. IMCL was also calculated. Axial T1 weighted images at L4-L5 level were acquired for abdominal fat measurement.

RESULTS

CONCLUSION
In population without known cardiac disease, musculoskeletal fat accumulation (lipid fraction) is associated with decreased systolic ejection and diastolic filing (compliance).

CLINICAL RELEVANCE/APPLICATION
Early reduction of cardiac compliance is demonstrated in obesity and correlates with fat accumulation in skeletal muscles.

SSC02-06 • Caffeine and Taurine Containing Energy Drink Improves Systolic Left-ventricular Contractility in Healthy Volunteers Assessed by Strain Analysis Using Cardiac Magnetic Resonance Tagging (CSPAMM)

Jonas Doerner (Presenter) ; **Daniel Kuetting** ; **Claas P Naehle** MD * ; **Hans H Schild** MD ; **Daniel K Thomas** MD, PhD

PURPOSE
Energy drinks (ED) usually contain a high amount of caffeine, taurine, and sugar as their main ingredients. Although their consumption appears not uncritical, there is little or no regulation on ED sales so far. Concerns about adverse side effects especially focus on heart function in adolescents and young adults. In this study, we investigated the effect of ED consumption on myocardial function in healthy volunteers using MRI tagging and strain analysis.

METHOD AND MATERIALS
18 healthy volunteers (15 male, 3 female, mean age: 27.5 years) were investigated using cardiac magnetic resonance imaging (CMR). CMR was performed on a 1,5-Tesla whole body scanner directly before and 1h after consumption of a taurine (400 mg/ 100 ml) and caffeine (32 mg/100 ml) containing ED (168 ml/m^2 body surface area). For left-ventricular (LV) myocardial tagging, complementary spatial modulation of magnetization (CSPAMM) was used. Strain was calculated for peak strain (PS), peak systolic strain rate (PSSR) and peak diastolic strain rate (PDSR) using TagTrack (Gyrotools, Zurich, Switzerland). Steady state free precision (SSFP) cine imaging was used for determination of LV-function. Additionally vital parameters such as heart rate (HR) and blood pressure (BP) were recorded throughout the investigation.

RESULTS
PS and PSSR as parameters for systolic LV-contractility were significantly increased 1h after ED consumption compared to baseline (PS: w/o ED -22.33 ± 1.7; w ED -24.15 ± 2.4; p=0.01; PSSR: w/o ED -1.18 1/s ± 0.08; w ED -1.30 1/s ± 0.16, p=0.01). PDSR as a parameter for diastolic LV-relaxation was slightly, but not significantly higher compared to baseline (PDSR: w/o ED 1.90 1/s ± 0.33; w ED 2.09 1/s ± 0.44, p=ns). No significant changes were found for LV-function (LV-EDV: w/o ED 141 ml ± 31; w ED 145 ml ± 33; LV-EF: w/o ED 64 % ± 4; w ED 66 % ± 8) and vital parameters (HR: w/o ED 63 1/min ± 9; w ED 62 1/min ± 7; BP: w/o ED 113/62 mmHg; w ED 117/64 mmHg).

CONCLUSION
This work reveals that ED consumption has a short-term impact on cardiac contractility, therefore further studies have to evaluate the impact of long-term ED consumption and the effect of ED on patients with heart disease to determine potential risks or benefits of ED consumption.

CLINICAL RELEVANCE/APPLICATION
ED consumption lead to changes in LV-contractility, which can be assessed by CMR tagging and strain analysis.

SSC02-07 • Left Ventricular Strain Analysis by Cardiac MR Using Deformation Field Analysis at Bright Blood Cine SSFP Imaging: A Comparison with Speckle Tracking Echocardiography

Kevin Kalisz (Presenter) ; **Edouard Semaan** ; **Daniel H Katz** ; **Xiaoming Bi** PhD * ; **Marius Cordts** * ; **Christoph Guetter** PhD * ; **Marie-Pierre Jolly** * ; **Benjamin Freed** ; **Daniel Lee** * ; **Preeti Kansal** ; **Sanjiv Shah** MD * ; **Michael Markl** PhD ; **James C Carr** MD * ; **Jeremy D Collins** MD *

PURPOSE
To demonstrate the feasibility of strain analysis using deformation field analysis on steady state free precession (SSFP) cardiac MR images with speckle tracking echocardiography (STE) as the reference standard.

METHOD AND MATERIALS
44 patients (29 males, average age 52 years) referred to CMR for scar assessment or evaluation of infiltrative disease were imaged on a 1.5T scanner (Magnetom Avanto or Aera, Siemens Healthcare, Erlangen, Germany). Bright blood cine short axis images (TR/TE 42/1.2, FA 79 degrees, frame rate 25, BW 930) were analyzed using prototype software (Siemens Corp., Corporate Technology, Princeton, NJ). Similar to speckle tracking, the spatio-temporal deformation of the LV muscle on cine images was used to derive deformation fields and quantify in-plane strain indices. A subset of images (15 patients) were analyzed again by the first reviewer and independently by a second reviewer. Global peak radial and circumferential strains were compared to values obtained at STE using the Pearson coefficient. The intraclass correlation coefficient (ICC) was used as a measure of inter-observer and intraobserver variability.

RESULTS
CMR peak radial and circumferential strains demonstrated fair and good correlation with STE (r=0.36 and 0.63, respectively). CMR underestimated (p
CONCLUSION
LV myocardial strain using deformation field analysis on cine SSFP CMR imaging is feasible with excellent and good inter- and intraobserver agreement for radial and circumferential strain respectively. Fair to good agreement was noted between LV global strain by CMR and STE, however. Work is ongoing to determine optimal cine SSFP acquisition parameters, to improve the deformation field algorithm for strain calculation, and to correlate CMR strain values with patient symptoms.

CLINICAL RELEVANCE/APPLICATION
Myocardial strain has been applied to predicting changes in cardiac function is a variety of disease processes. We describe the use of a novel algorithm to compute strain at cinegraphic cardiac MR.

SSC02-08 • Cardiac Computed Tomography (CCT) for Predicting Left Atrial Appendage Occluder Device Size

Orly Goitein MD (Presenter) ; **Grupper Avisahy** ; **Elio Di Segni** MD ; **Eli Konen** MD ; **Ashraf Hamdan** MD ; **Victor Guetta** * ; **Ilan Hai** ; **David Luria** MD ; **Michael Glikson** MD

PURPOSE
Atrial fibrillation (AF) may cause thromboembolic stroke. The left atrial appendage (LAA) is the thrombi source in more than 90% of strokes. Several devices have been developed to occlude the LAA. Inaccurate LAA orifice sizing may lead to utilization of more than one device per procedure, or inadequate LAA occlusion.
The purpose of this study was to assess the contribution of cardiac Computed Tomography (CCT) measurements for LAA device sizing with.

METHOD AND MATERIALS
All subjects underwent ECG gated CT scans prior to LAA closure device insertion. CCT scans were performed using a 256-slice scanner with retrospective electrocardiographic gating .
Assessed parameters included: LAA maximal and minimal diameters (mm), LAA depth (mm). These values were compared with final implanted device size. Echocardiographic follow up at six weeks was performed in order to document the presence of regurgitation, as evidence for incomplete LAA occlusion.

RESULTS
This study cohort included 22 chronic AF patients (9 males, average age 76 years). Two procedures failed, the maximal LAA diameter was 39 mm in both. The total number of devices used was 24 in 20 patients (1.2 devices per patient). Mean maximal CCT and minimal diameters were 27±5 and 22±5 mm respectively. Mean LAA depth was 22±4 mm. Mean device size was 24±4. Good correlation was found between maximal CCT diameter and device size (Pearson correlation=0.45; p=0.04). No correlation was found between minimal LAA diameter, LAA depth and device size (Pearson correlation=-0.0.08; p=0.7 and -0.02;p=0.9, respectively). LAA diameter >30 mm (N=5) was associated with adverse device sizing ; procedure failure (2/5) and incomplete LAA occlusion (2/5) with regurgitation on echocardiographic follow up.

CONCLUSION
CCT should be considered as an important adjunct modality for device sizing. LAA maximal diameter > 30 mm was predictive of unfavorable procedure outcome including procedure failure and incomplete LAA occlusion in 80% of cases with large LAA ostia.

CLINICAL RELEVANCE/APPLICATION
Cardiac CT is an important imaging modality before LAA occluder insertion. It allows accurate LAA size evaluation and can identify potential problematic cases prior to device implantation.

SSC02-09 • Characterisation of Myocardial Function and Structure in Patients with Rheumatoid Arthritis: A Cardiovascular Magnetic Resonance Study

Ntobeko A Ntusi MBBCh, MD (Presenter) ; **Jane M Francis** ; **Paul M Matthews** MD, DPhil ; **Paul B Wordsworth** MBBS, FRCPC ; **Stefan Neubauer** ; **Theodoros D Karamitsos**

PURPOSE
To assess global and regional left ventricular (LV) function and myocardial fibrosis in patients with rheumatoid arthritis (RA), using cardiovascular magnetic resonance (CMR) and examine the additional effect of traditional cardiovascular risk factors (CVRFs) in RA patients.

METHOD AND MATERIALS

RESULTS

CONCLUSION
CMR demonstrates impaired myocardial strain and a high incidence of non-ischaemic fibrosis in RA patients. The cardiac abnormalities in RA appear to be incremental to those due to traditional CVRFs.

CLINICAL RELEVANCE/APPLICATION
Cardiovascular disease is common in asymptomatic RA patients and traditional CVRFs need to be aggressively controlled as they appear to confer incremental risk in this cohort.

Cardiac (Quantitative Imaging)

Monday, 10:30 AM - 12:00 PM ● S504AB

MR BQ CA

SSC03 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5

Moderator
E. Kent Yucel , MD
Moderator
Suhny Abbara , MD *
Moderator
Pamela K Woodard , MD *

SSC03-01 ● Role of 4D Flow MRI in Detecting Hemodynamic Changes in Patients with Pulmonary Arterial Hypertension

Pegah Entezari MD (Presenter) ; **Susanne Schnell** ; **Naomi C Chesler** PhD ; **Christopher J Francois** MD ; **Alejandro Roldan** PhD ; **Oliver Wieben** PhD ; **Jeremy D Collins** MD * ; **James C Carr** MD * ; **Alex Barker** ; **Michael Markl** PhD

PURPOSE
To evaluate peak velocity, net flow, vessel diameter and wall shear stress (WSS) in the proximal pulmonary arteries of normotensive controls and patients with pulmonary arterial hypertension (PAH) using 4D flow MRI.

METHOD AND MATERIALS
With IRB approval, 10 patients (age: 57±10, 5 females) and 9 volunteers (age: 40 ±12, 6 females) were scanned on a 3T MR system. Time-resolved 3D pulmonary flow was measured using 4DMRI with full coverage of the right ventricular outflow tract, pulmonary trunk (PT) and right and left pulmonary branches (RPA and LPA). Net flow and maximum velocity were quantified at the level of PT, RPA and LPA. WSS and vessel diameter were also measured in analysis planes positioned at these three levels in both groups.

RESULTS
Net flow in PAH patients (PT: 52.7±11, LPA: 21.5±5, RPA: 26.2±7 ml/cycle) was significantly lower compared to controls (PT: 68.3±13, LPA: 29.3±7, RPA: 32.7±5 ml/cycle, p-value< 0.05). The same pattern was observed for peak velocity in PAH patients (PT: 0.5±0.1, LPA: 0.3±0.1, RPA: 0.4±0.1 m/s) compared to the controls (PT: 0.8±0.1, LPA: 0.7±0.2, RPA: 0.9±0.2 m/s, p-value< 0.05). In addition, PAH arteries had a significantly larger diameter (PT: 3.4±0.5, LPA: 2.3±0.3, RPA: 2.4±0.3 cm) compared to the normal population (PT: 2.6±0.2, LPA: 1.8±0.2, RPA: 1.7±0.3 cm, p-value< 0.001). As shown in Figure 1, PAH patients had reduced WSS at all three measurement positions, compared to volunteers.

CONCLUSION
4D flow MRI illustrates distinct hemodynamic changes in PAH patients compared to a normal population. The significant reduction in net flow, peak velocity and an increase in PA lumen diameter in patients resulted in decreased WSS values, as compared to normal volunteers.

CLINICAL RELEVANCE/APPLICATION
Pulmonary hypertension is associated with right heart failure, but its effect on arterial diameter and hemodynamic factors (i.e. velocity, flow, WSS) and their role in disease progression is not clear

SSC03-02 ● Serum Biomarkers of Atherosclerosis and Myocardial Remodeling: Correlation with Quantitative Imaging Markers of Coronary Heart Disease at Cardiac CT

Lucas L Geyer MD (Presenter) * ; **Balazs Ruzsics** ; **Aleksander Krazinski** ; **Justin R Silverman** ; **Christopher L Schlett** MD, MPH ; **U. Joseph Schoepf** MD * ; **Ullrich Ebersberger** MD ; **Fabian Bamberg** MD, MPH * ; **Maximilian F Reiser** MD ; **Michael R Zile** MD

PURPOSE
We aimed at correlating the plasma levels of several novel circulating biomarkers of atherosclerotic disease activity and myocardial remodeling with quantitative imaging markers of coronary heart disease obtained by coronary CT angiography (cCTA).

METHOD AND MATERIALS
In an IRB-approved, HIPAA compliant study, 75 patients with suspected coronary artery disease underwent contrast enhanced, retrospectively ECG-gated coronary dual-source CT angiography. Patients were evaluated for the type of coronary plaque and the presence and severity of coronary artery stenosis on a per patient and per segment basis. Semi-automated software was used for measuring the volume of non-calcified and mixed plaques; lipid-rich and fibrous contents were differentiated. Cardiac function parameters were obtained using cine CT reconstructions across the RR cycle. Plasma samples were collected from each patient and a cytokine and protease profiling panel was performed by multiplex analysis. The plasma concentrations of seven biomarkers with a reported relationship with atherosclerosis and myocardial remodeling were measured: TNF?, IL-6, IL-8, matrix metalloproteinase (MMP)-2, MMP-3, MMP-7, MMP-8. Data were analyzed using Spearman�s rank correlation coefficient and Mann-Whitney-U-Test.

RESULTS
Data of 61 men and 14 women (59±10 years) were evaluated. 60/75 patients showed atherosclerotic changes in at least one vessel based on cCTA. 34/75 had significant (>50%) stenosis in at least one coronary artery. 46 non-calcified, 129 calcified, and 86 mixed plaques were identified. We found a statistically significant (p
CONCLUSION
Our study suggests that elevated levels of MMP-8 are associated with greater atherosclerotic plaque volume at cCTA. Moreover, IL-8 and TNF? may indicate more active myocardial remodeling with higher myocardial mass at CT.

CLINICAL RELEVANCE/APPLICATION
Integration of quantitative cardiac CT imaging with novel serum biomarkers of atherosclerosis and myocardial remodeling may enhance insights into the patho-mechanisms of coronary heart disease.

SSC03-03 • Coronary Artery Calcification Scoring with CT Scanners from Four Different Vendors Results in Different Scores

Martin J Willemink MD (Presenter) ; **Richard A Takx** MD ; **Mathias Prokop** MD, PhD * ; **Johan De Mey** * ; **Marco Das** MD * ; **Pim A De Jong** MD, PhD ; **Ricardo P Budde** MD, PhD ; **Arnold Schilham** PhD ; **Ronald L Bleys** MD, PhD ; **Nico Buls** DSc, PhD * ; **Joachim E Wildberger** MD, PhD ; **Tim Leiner** MD, PhD *

PURPOSE
Coronary artery calcifications have emerged as an important biomarker for cardiovascular risk stratification. New guidelines recommend evaluation of these calcifications using cardiac computed tomography (CT) in asymptomatic adults with low-to-intermediate and intermediate cardiovascular risk, concerning approximately 40% of the United States adult population. Treatment strategies depend on coronary artery calcification scores on CT. However, it is unknown whether different new generation CT scanners result in similar Agatston scores. Therefore, the purpose was to determine the inter-vendor variability of coronary artery calcifications expressed as Agatston scores with state-of-the-art CT scanners from the four major vendors.

METHOD AND MATERIALS
We evaluated the differences in coronary calcium scores between state-of-the-art CT scanners from four different vendors using fifteen ex-vivo human hearts placed in a commercially available anthropomorphic chest phantom. These hearts were scanned with unenhanced prospectively ECG-triggered step-and-shoot protocols at equal radiation dose settings. Thickness and increment of slices were 3mm. Agatston scores, calcification volume and mass scores were quantified with clinically used semi-automatic software from the same vendor as the CT system. Differences were analyzed with the Friedman test (significance level P
RESULTS
Fourteen hearts had coronary calcifications. Agatston scores, calcification volume and mass scores differed significantly (P3, respectively. Median (interquartile range) calcification mass scores were 70 (27-245), 84 (42-326), 85 (43-337), and 69 (35-246) mg, respectively.

CONCLUSION
CT scanners from different vendors result in significantly different Agatston scores, calcification volume scores and mass scores.

CLINICAL RELEVANCE/APPLICATION
Dependent on the CT vendor of a hospital, differences in coronary calcium scoring may result in different treatment strategies.

SSC03-04 • Impact of Iterative Reconstruction on CT Coronary Calcium Quantification

Akira Kurata (Presenter) ; **Anoeshka S Dharampal** MD ; **Admir Dedic** MD ; **Pim Feyter** MD, PhD ; **Marcel L Dijkshoorn** RT * ; **Gabriel P Krestin** MD, PhD * ; **Koen Nieman** MD

PURPOSE
Coronary artery calcium (CAC) score by computed tomography (CT) is widely used for cardiovascular risk stratification. Iterative reconstruction algorithms reduce image noise and potentially decrease radiation exposure. We evaluated the influence of sonogram-affirmed iterative reconstruction (SAFIRE) on the CCS score.

METHOD AND MATERIALS
In 70 consecutive patients, who underwent CAC imaging by 128-slice dual-source 128-slice CT, CAC volume, mass and Agatston score were calculated from images reconstructed by filtered back projection (FBP) without and with incremental degrees of iterative reconstruction (SAFIRE algorithm: 10-50%). We used the repeated measuring test and the Steel-Dwass test for multiple comparisons of values and the difference ratio among different SAFIRE groups, using the FBP (0% SAFIRE) as reference.

RESULTS
The median Agatston score (range) decreased with incremental IR: 163 (0.1 ~ 3393.3), 158.4 (0.3 ~ 3079.3), 137.7 (0.1 ~ 2978.0), 120.6 (0 ~ 2783.6), 102.6 (0 ~ 2468.4), and 84.1 (0 ~ 2186.9) for 0% (FBP), 10%, 20%, 30%, 40%, and 50% SAFIRE, respectively (Figure 1; P
CONCLUSION
SAFIRE noise reduction techniques significantly affected the coronary calcium quantification, with potential clinical consequences.

CLINICAL RELEVANCE/APPLICATION
Iterative reconstruction techniques should not be used, because it significantly reduced quantitative coronary calcium quantification.

SSC03-05 • Higher Myocardial Extracellular Volume Fraction in Women than Men: Study by Contrast Enhanced Cardiac Magnetic Resonance Imaging

Shi-Jun Zhang (Presenter) ; **Sheng Hong Ju** MD, PhD

PURPOSE
To investigate whether the myocardial extracellular volume fraction (ECV) of women differs from that of men in healthy population.

METHOD AND MATERIALS
Institutional review board approval and informed consent were obtained. Twenty-eight healthy volunteers (11 men and 17 women, aged 19 to 63 years) were recruited and underwent MRI scan with a 0.15 mmol/kg intravenous bolus of Gd-DTPA. A mid-cavity short-axis plane was selected for T1 mapping precontrast and repetitively after contrast injection, using the modified Look-Locker inversion recovery (MOLLI) sequence. Regions of interest (ROIs) were selected from four segments (the septal, anterior, lateral and inferior wall of the left ventricular) within the myocardium for ECV calculating in each person. The ECV was calculated as: ECV = ? � (1 - hematocrit), where ? is the myocardial contrast partition coefficient, and was calculated by relating change in longitudinal relaxation rate (R1 = 1/T1) of myocardium ($R1_m$) versus that of left ventricular blood pool ($R1_b$). Independent-samples t tests were applied to compare ECV between the two sexes groups on both per-segment and per-person basis.

RESULTS
Three out of the 112 segments were excluded from two men due to sever artifact, remaining 41 segments in men and 68 segments in women. The mean values (±standard deviation) of ECV within the septal, anterior, lateral and inferior left ventricular wall were 0.238±0.023, 0.235±0.024, 0.245±0.032 and 0.240±0.022 in the 11 men, while in the 17 women, the values were 0.273±0.023, 0.275±0.033, 0.279±0.025 and 0.276±0.034. The mean difference (95% confident interval, 95%CI) for the four segments between the two sexes groups were 0.034 (0.016-0.053), 0.040 (0.016-0.063), 0.034(0.012-0.057) and 0.036 (0.010-0.063). The overall mean ECV values of these two groups on per-segment basis were 0.239 ± 0.025 and 0.275 ± 0.029, $P < 0.001$. The per-person ECV were calculated as the arithmetic mean value of the ROIs from the 4 segments, and the mean values of the two groups were 0.239 ± 0.024 and 0.275 ± 0.024, $P = 0.001$.

CONCLUSION
Women�s myocardial extracellular volume fraction is higher than men�s in healthy population.

CLINICAL RELEVANCE/APPLICATION
The higher myocardial ECV in healthy women than men indicates studies ideally consist of subgroups of each gender may help to interpret the research and clinical results involving myocardial ECV.

SSC03-06 • Automatic Quantification of Blood Flow from Real-time Phase-contrast MRI

Markus Huellebrand (Presenter) ; **Anja Hennemuth** MS ; **Jens Frahm** PhD * ; **Lennart Tautz**

PURPOSE
2D phase-contrast (PC) MRI is an established technique for the analysis of vascular hemodynamics. A recently developed real-time MRI technique allows for respective acquisitions under free breathing and without the need for ECG synchronization. However, quantitative evaluations become more complicated than for conventional methods because of potential changes in contrast, the management of multiple cycles without manual interference, and the influence of respiratory displacements. In order to overcome such problems, we developed a new method for the automatic analysis of blood flow parameters from real-time PC MRI.

METHOD AND MATERIALS
Real-time 2D PC MRI of the ascending aorta was performed in 5 healthy subjects (mean age 25 years) were at 3-T (TrioTim, Siemens, Erlangen, Germany). Acquisitions were based on a highly undersampled radial FLASH sequence with and without a bipolar flow-encoding gradient (VENC=200 cm/s, flip angle 10�) and image reconstruction by regularized nonlinear inversion. The spatial resolution was 1.33x1.33x6.0mm^3 and the temporal resolution corresponded to 40 ms. The images were analyzed with use of the research software prototype CAIPI. After an initial segmentation of the aortic vessel wall, the vessel contour is automatically propagated to all frames using a registration based on a quadrature filter. The results of the automatic analysis were compared to the manual results of three experts.

RESULTS
The segmentation results of the three observers and the automatic segmentation (duration 39 ± 4 s) were compared pair-wise. The average dice coefficient between observers and the algorithm was 0.86 ±0.04, the inter-observer comparison was 0.92±0.03. The average symmetric absolute surface distance error was 1.09±0.4mm for the algorithm and 0.71±0.22mm for the observers. The mean absolute error of the stroke volume was 4.67±2.28ml for the algorithm and 6.14±3.5ml for the observers.

CONCLUSION
The comparison of the manual and automatic quantification shows good agreement. Because no manual correction is needed, the proposed method is suited for the automatic analysis of the temporal evolution of flow velocities, peak velocities, stroke volumes and flow rates over multiple cardiac cycles.

CLINICAL RELEVANCE/APPLICATION
Automatic quantification of real-time 2D PC MRI enables analysis of patients with aperiodic heartbeats (e.g. arrhythmias) and monitoring of hemodynamic responses to stress or physiologic manoevers.

SSC03-07 ● Normal Diastolic and Systolic Myocardial T1 Times at 1.5 T: Correlations and Blood Normalization

Ursula Reiter (Presenter) ; **Gert Reiter** * ; **Katrin Dorr** MD ; **Andreas Greiser** PhD * ; **Ralph Maderthaner** MD ; **Michael H Fuchsjaeger** MD

PURPOSE
To evaluate regional differences between systolic and diastolic myocardial longitudinal relaxation time (T1), and to investigate variances of myocardial T1 values associated with T1 time of blood to derive relations between blood normalized systolic and diastolic myocardial T1 times in healthy subjects.

METHOD AND MATERIALS
In the current prospective study, approved by the local ethical review board, 40 healthy subjects (20 female, 20 male; age range 20-35 years) underwent ECG-gated 1.5 T magnetic resonance imaging. A modified Look-Locker inversion recovery (MOLLI) sequence was used to acquire basal, mid-ventricular and apical short-axis myocardial T1 maps in systole and diastole. Regional myocardial T1 times were evaluated in 16 AHA-segments, blood T1 values were derived from blood pool in the center of the left ventricular cavity. Linear regression slopes between myocardial and blood T1 values were employed to normalize measured myocardial T1 values to the mean blood T1 time of the study population. Means of T1 values were compared by t-test, considering $p < 0.05$ as significant.

RESULTS
Mean myocardial T1 times (984 ± 28 ms in diastole, 959 ± 21 ms in systole) as well as all segmental T1 values in diastole and systole differed significantly ($p2 = 0.53$ for diastole, $R^2 = 0.52$ for systole): After blood normalization variances of segmental and mean myocardial T1 times decreased (to 17 ms in diastole and 13 ms in systole in case of mean myocardial T1 times) and significant differences in segmental and mean myocardial T1 times with gender completely disappeared. Blood normalized diastolic and systolic myocardial T1 values strongly correlated with each other on segmental ($r = 0.72$) as well as mean myocardial ($r = 0.89$) level.

CONCLUSION
In normal myocardium, diastolic and systolic myocardial T1 times significantly differ but strongly correlate with each other. Besides elimination of gender differences in myocardial T1 values, blood normalization reduces variability of myocardial T1 times.

CLINICAL RELEVANCE/APPLICATION
Blood normalization allows improving the definition of threshold values to distinguish normal from pathologically affected myocardium in diastole and systole.

SSC03-08 ● 4-Dimensional Magnetic Resonance Velocity Mapping Based Evaluation of Elevated Mean Pulmonary Arterial Pressure: Comparison of Vector, Streamline and Particle Trace Flow Visualization

Ursula Reiter (Presenter) ; **Gert Reiter** * ; **Gabor Kovacs** MD ; **Aurelien F Stalder** * ; **Mehmet A Gulsun** * ; **Andreas Greiser** PhD * ; **Horst Olschewski** MD ; **Michael H Fuchsjaeger** MD

PURPOSE
To compare relative period of existence of vortical blood flow in the main pulmonary artery in patients with pulmonary hypertension (PH) from velocity vector field, streamline and particle trace visualization of time resolved three-dimensional (4D) magnetic resonance phase-contrast imaging (MR-PCI) data and to compare their linear relationship with invasively determined mean pulmonary arterial pressure (mPAP).

METHOD AND MATERIALS
This prospective study was approved by the local ethical review board. 23 patients with manifest PH underwent right heart catheterization (RHC) and 4D MR-PCI of the main pulmonary artery. Blood flow patterns were visualized as 3D velocity vector fields projected on 2D anatomical images (3D-vector visualization), as 3D streamlines and as 3D particle traces and evaluated for period of existence of vortical blood flow (t_{vortex} in percent of the cardiac interval) in the main pulmonary artery. Dependence of t_{vortex} on visualization and relation to mPAP were analyzed by means of correlation, linear regression and Bland-Altman analysis.

RESULTS
t_{vortex} derived from different visualizations strongly correlated ($r = 0.94$ for 3D-vector versus streamline and $r = 0.92$ for 3D-vector versus particle trace visualization). Bias and 95%-limits-of-agreement were -4% and ±14% for comparison 3D-vector versus streamline visualization and were -3% and ±15% for 3D-vector versus particle trace visualization. In all techniques t_{vortex} showed strong correlation with mPAP with small standard errors from regression lines ($r = 0.96$, SE = 3.4 mmHg for 3D-vector, $r = 0.95$, SE = 3.6 mmHg for streamline, and $r = 0.92$, SE = 4.4 mmHg for particle trace visualization).

CONCLUSION
Although periods of existence of vortical blood flow determined from 3D-vector visualization correlated best with mPAP, visualization of streamlines and particle traces provide similar results.

CLINICAL RELEVANCE/APPLICATION
4D velocity mapping represents an emerging tool in the analysis of PH hemodynamics and enables estimation of elevated mPAP

SSC03-09 • 3T 1H-MR Spectroscopy of Myocardial Steatosis: Relationship to Fat Depots throughout the Body

Radwa A Noureldin MD, MSc (Presenter) ; **Ronald Ouwerkerk** PhD ; **Roderic I Pettigrew** MD, PhD ; **Ahmed M Gharib** MBChB

PURPOSE
To quantify amount of fat accumulated in the heart using high field MRH1 and to determine its relationship to metabolic lipid profile and other fat depots in the human body.

METHOD AND MATERIALS
After IRB approval, ninety HIPPA-compliant subjects, not known to have cardiac disease, underwent 1H-MRS using wide bore 3T scanner. B0 shimming parameters were optimized with a rapid B0 mapping method. MRS of heart was performed using ECG gated PRESS breath navigated technique, TR/TE =1R-R/30ms. PRESS voxel was located in the septum at isovolumic phase of diastole planned on a 4-chamber SSFP with saturation slabs across subcutaneous and pericardial fat. The same sequence was used for musculoskeletal 1H-MR; PRESS voxel targeting the vastus lateralis, tibialis anterior and soleus muscles. Fat was quantified with Amares/MRUI and related to water in unsuppressed spectra. Axial images of the heart were obtained at end systole for pericardial fat quantification. Axial T1 weighted images at L4-L5 level were acquired for abdominal fat measurement. All subjects had lipid profile assessment including serum cholesterol, HDL, LDL and serum triglycerides and were obtained within one month of the scan.

RESULTS

CONCLUSION
1H-MR spectroscopy quantifies ectopic fat deposition in the heart. In population with no cardiac disease, myocardial steatosis is correlated with high circulating triglycerides, musculoskeletal fat other fat depots in the human body.

CLINICAL RELEVANCE/APPLICATION
1H-MR spectroscopy is an important tool to investigate and monitor the effects of circulating serum lipids on fat metabolism and its accumulation within cardiac muscle and other ectopic fat depots.

Cardiac - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

CA

LL-CAS-MOA • *AMA PRA Category 1 Credit* ™:0.5
    Host
    Vincent B Ho , MD, MBA *

LL-CAS-MO1A • Prevalence and Findings of Coronary to Bronchial Artery Fistula on Cardiac CT in Patients with Coexistent Bronchiectasis

Yon Mi Sung MD ; **Hye Y Oh** MD (Presenter) ; **Eun Young Kim** ; **Yoon Kyung Kim** MD ; **Hye-Young Choi** MD, PhD

PURPOSE
The aim of this study was to evaluate prevalence and related findings of coronary to bronchial artery fistula (CBF) on electrocardiogram-gated cardiac CT in patients who had coexistent bronchiectasis.

METHOD AND MATERIALS
In 3,856 patients who underwent electrocardiogram-gated cardiac CT from April 2009 to November 2012, 207 patients (95 males and 112 females, mean age, 62.1±11.6 years) with bronchiectasis were retrospectively included to assess the prevalence of CBF. Presence or absence of CBF was reviewed and relation to extent of bronchiectasis and bronchial artery engorgement was assessed. For statistical analysis, four grades were given to the extent of bronchietasis (minimal, mild, moderate, and severe) and the degree of bronchial artery engorgement (none, mild, moderate, and severe). In the presence of CBF, origin of the coronary artery, size of the communicating artery and dominant lung with bronchiectasis were evaluated. Missed rate of CBF on the initial radiological reports was also assessed.

RESULTS
Fourteen cases of CBF (6.8%) were found in patients with coexistent bronchiectasis; 10 originated from the left circumflex artery and 4 from the right coronary artery. In one patient, a single right coronary artery gave rise to a left circumflex artery as an origin. Mean size of the communicating artery of CBFs was 1.9 mm (range, 1.0 � 2.9 mm). There was no association between origin of the coronary artery and dominant lung with bronchiectasis (p=0.176). CBFs were more frequently seen in patients with moderate and severe bronchiectasis (p
CONCLUSION
Electrocardiogram-gated cardiac CT was found to be useful for detecting CBF and providing anatomic details of the fistula in patients with bronchiectasis. Presence of CBF was significantly related to the extent of bronchiectasis and degree of bronchial artery engorgement.

CLINICAL RELEVANCE/APPLICATION
Careful evaluation of CBF as a potential cause of chest pain or hemoptysis is needed on cardiac CT particularly in patients with severe bronchiectasis and severe engorgement of the bronchial arteries.

LL-CAS-MO2A • Quantitative Adverse Plaque Features from Coronary CT Angiography Predict Impaired Myocardial Flow Reserve by 13N-Ammonia-PET

Damini Dey PhD (Presenter) * ; **Erick Alexanderson-Rosas** MD ; **Annika Schuhback** ; **Yuka Otaki** ; **Xiaowei Ding** ; **Luis E Orozco** ; **Aloha Meave-Gonzalez** MD ; **Daniel S Berman** MD * ; **Stephan Achenbach** MD * ; **Debiao Li** PhD ; **Piotr Slomka** PhD

PURPOSE
We aimed to evaluate whether integrated quantitative measurement of adverse plaque features from coronary CT Angiography (CTA) predicts impaired Myocardial Flow Reserve (MFR) and ischemia, measured by 13N-ammonia PET myocardial perfusion imaging.

METHOD AND MATERIALS
Forty patients underwent combined rest-stress 13N-ammonia PET and coronary CTA scans by hybrid PET/CT. Regional MFR and ischemia (% stress-rest perfusion deficit) were automatically derived from PET. From CT, 120 arteries were evaluated by automated software, computing arterial non-calcified (NCP), low-density NCP, and total plaque, as well as maximum diameter stenosis, maximum remodeling index and maximum contrast density drop over the lesions. Visually, maximum stenosis was assessed by standard grading (0-6). Quantitative CT measures and measured myocardial mass were combined by boosted ensemble machine learning algorithm into a composite score to predict impaired MFR (MFR = 2.0) and ischemia (=2% stress-rest perfusion deficit) by PET, in each artery.

RESULTS
Patients with impaired regional MFR had significantly higher NCP, low density NCP and total plaque in the corresponding arteries (NCP: 156.9 ± 152.9 vs 82.6 ± 124.7 mm3[p=0.02]; low density NCP: 36.8 ± 44.9 vs 19.4 ± 31.9 mm3[p=0.04]; total plaque: 168.6 ± 163.0 vs 93.3 ± 142.7 mm3 [p=0.03]). CP was not significantly different (10.7 ± 26.7 vs 11.7 ± 29.3 p=0.88). For prediction of impaired MFR, Receiver Operator Characteristic area-under-curve (AUC) for the composite score was 0.80 (95% CI: 0.69-0.92), higher than for visual stenosis grade (0.60, 95% CI: 0.49-0.72, p

CONCLUSION
Quantitative analysis of adverse plaque features from CTA allows significantly improved prediction of impaired MFR and ischemia compared to visual stenosis grade, the current clinical standard.

CLINICAL RELEVANCE/APPLICATION
Quantitative measurement of adverse plaque features from coronary CT Angiography predicts impaired Myocardial Flow Reserve by 13N-Ammonia-PET

LL-CAS-MO3A ● Age-gender Normal Values of Native Myocardial T1 Relaxation Times and Lambda on 1.5T and 3T Using MOLLI: A Single Centre, Single Vendor Card

Darius Dabir MD (Presenter) ; **Toby Rogers** ; **Eduardo Arroyo Ucar** ; **Rocio Hinojar** ; **Valentina Puntmann** ; **Eike Nagel** MD, PhD *

PURPOSE
T1 mapping is an increasingly promising non-invasive method for quantitative assessment of conditions affected by diffuse myocardial fibrosis. Using a validated MOLLI-type sequence, we have shown that conservative septal sampling (ConSept) is more reproducible compared to the whole short-axis slice approach and has superior discriminatory ability between normal and abnormal myocardium. On the premise that the septum is representative of the diffuse pathology affecting all of the myocardium, we propose that native T1 using ConSept may allow for a simple, robust, and standardized approach to interrogate diffuse myocardial involvement. Our aim was to examine age and gender related normal values at clinically used field strengths, 1.5 Tesla (T) and 3T, in a single centre and single vendor study.

METHOD AND MATERIALS
167 subjects with no history of cardiovascular or systemic disease and taking no regular medication underwent native and post-contrast T1 imaging with modified look-locker inversion recovery (MOLLI; 3,3,5) either at 1.5T or 3T (Achieva, Philips Healthcare, Best, The Netherlands) with advanced cardiac package. Parameters for native and post-contrast MOLLI were identical (FOV 320x320; TR/TE/flip-angle: 3.3ms/1.57ms/50�, interpolated voxel size 0.9x0.9x8mm, phase encoding steps n=166, HR adapted trigger delay, with 11 (3-3-5) phase sampling arrangements. An adiabatic pre-pulse was used to achieve complete inversion. ROIs were automatically propagated across all eleven images in the MOLLI sequence with a prior image- co-registration step for motion-correction (figure).

RESULTS
Subject characteristics, mean T1 values, and calculated Lambda for the overall cohort per field strength as well as per age group and gender are presented in the table. Results revealed no significant age related differences, neither for native T1 relaxation times, nor for Lambda at both field strengths. Gender related native T1 values on the other hand showed significant differences between males and females at 1.5T being greater for the female population, whereas neither native T1 values at 3T, nor Lambda at both field strengths revealed significant differences.

CONCLUSION
For the first time we report age and gender normal values for native and post-contrast myocardial imaging using the Consept approach. We furthermore demonstrate gender related differences for native T1 at 1.5T.

CLINICAL RELEVANCE/APPLICATION
Differentiation between normal/diseased.

LL-CAS-MO4A ● Cardiac MRI Predictors of Clinical Outcomes in Patients with Apical Hypertrophic Cardiomyopathy

Kate Hanneman MD (Presenter) ; **Andrew M Crean** MD ; **Lynne Willimas** ; **Hadas Moshonov** PhD ; **Susan H James** MD ; **Laura Jimenez-Juan** MD ; **Chritiane Gruner** ; **Patrick Sparrow** ; **Harry Rakowski** ; **Elsie Nguyen** MD

PURPOSE
Apical hypertrophic cardiomyopathy (ApHCM) is a morphological subtype of HCM which was previously considered to have a relatively good prognosis. The aim of the study was to describe cardiac MRI imaging findings and to determine their prognostic impact in patients with ApHCM.

METHOD AND MATERIALS
Institutional review board approval was obtained for this retrospective study. Cardiac MRI studies of 101 consecutive patients with pure ApHCM performed on a 1.5T scanner over a 10 year period were included. The extent of late gadolinium enhancement (LGE) was determined using a gray-scale threshold of 5SD above the mean signal intensity of normal remote myocardium, and was expressed as a percent of total left ventricular myocardial mass (%LGE). Statistical analysis included two-sample t-test, Fisher�s exact test and logistic regression. Interclass correlation (ICC) was used to evaluate inter-observer agreement.

RESULTS
Mean age of patients was 48.3±14.0 years, 73.5% (n=75) male, with mean clinical follow-up 5.1±6.2 years. Mean %LGE was 12.4±9.7%, and was highest in apical segments (22.9±23.1%); however, LGE was also noted in non-hypertrophied mid and basal segments. Right ventricular involvement, apical aneurysm, and intracardiac thrombus were identified in 24.8%, 17.8% and 4.0%, respectively. Thirty-eight (37.6%) subjects experienced an adverse clinical outcome; heart failure (6.9%), appropriate AICD discharge (2.0%), sustained ventricular tachycardia (VT) (2.0%), non-sustained VT (21.8%), atrial fibrillation (18.8%) and/or stroke (6.9%). There were no deaths. Subjects who experienced a clinical outcome had a statistically significant greater %LGE compared to those who did not (15.96±11.88% vs. 10.16±7.3%, p=0.011). Percent LGE was an independent predictor of adverse outcomes (odds ratio (OR) 1.1 (95%CI (1.02, 1.13), p=0.010). Females and patients who experienced shortness of breath were more likely to experience an outcome (p=0.007 and p=0.037, respectively). High levels of inter-observer agreement were achieved for %LGE (ICC 0.93, 95%CI (0.87, 0.96)).

CONCLUSION
Late gadolinium enhancement by cardiac MRI is a frequent finding and has prognostic value in predicting adverse outcomes in patients with ApHCM.

CLINICAL RELEVANCE/APPLICATION
The clinical course of ApHCM may not be as benign as previously thought. Cardiac MRI detection of LGE may improve risk stratification in this population.

LL-CAS-MO6A ● CMR Assessment of Isovolumetric Relaxation Time for the Transplanted Heart with Comparison to Echocardiography

Parag M Amin MD (Presenter) ; **James C Carr** MD * ; **Rob Gordon** ; **Benjamin Freed** ; **Jeremy D Collins** MD *

PURPOSE
Echocardiography is currently the standard non-invasive method of obtaining diastolic indices; however, post-operative variability in left atrial size in cardiac transplant patients complicates assessment of diastolic abnormalities. Cardiac magnetic resonance (CMR) with high temporal resolution cine imaging offers an alternative for evaluating ventricular diastolic function. The purpose of this study is to evaluate the assessment of a diastolic index, isovolumetric relaxation time (IVRT), in a cohort of heart transplant patients, comparing results to echocardiography.

METHOD AND MATERIALS
Upon approval by our institution�s review board, a retrospective search was performed for cardiac transplant patients with echocardiograms and CMR examinations obtained within 1 week of each other. High temporal resolution (avg TR: 11.85 msec) cine images were acquired from 1.5T scanners (Magnetom Avanto or Espree, Siemens Healthcare, Germany) in the 3-chamber orientation

using segmented steady state free precession (SSFP) sequence (FOV: 276x340mm; voxel size: 1.7x1.7x6cm; TE: 1.16ms; TA: 15sec; acceleration factor of 2). The SSFP cine images from 20 exams in a cohort of 18 patients (13 males, average age 45.6 yrs) enabled calculation of time elapsed between aortic valve closure and mitral valve opening (isovolumetric relaxation time, IVRT). Bland-Altman and linear regression analyses were performed to assess agreement and correlation respectively between CMR and echocardiography.

RESULTS
Bland-Altman agreement plot of IVRT reveals a clinically insignificant bias of -1.4 msec between the two methods (Figure 1a). Figure 1b shows high positive correlation between IVRT values obtained from echocardiography and CMR (correlation R = 0.8061; P < 0.01) on linear regression analysis.

CONCLUSION
High temporal resolution segmented SSFP cine imaging provided acceptable estimates of IVRT in our small cohort of heart transplant patients with good correlation to the current standard, echocardiography. As such, CMR-obtained IVRT value may be used as a surrogate marker in the evaluation of diastolic function and allograft rejection in post-transplant patients. Work is ongoing to validate this approach in a larger subject cohort.

CLINICAL RELEVANCE/APPLICATION
High temporal resolution cine CMR can evaluate diastolic function via IVRT values with good correlation to the current standard, echocardiography, and is recommended in cardiac transplant patients.

LL-CAS-MO7A ● Investigation of Arterial Pulse Wave Velocity Based on 4D Phase Contrast MR Flow Imaging (4D PC MRI)

Hanieh Mirzaee (Presenter) ; **Johann Drexl** ; **Anja Hennemuth** MS ; **Andreas Harloff** *

PURPOSE
It is common practice to measure PWV as a distance traveled by specific characteristic points identified on spatially-varying flow profiles, per unit of time. The purpose of this study is to investigate the impact of different choices of these transient points on the value of PWV measured in the aorta.

METHOD AND MATERIALS
4D PC MRI of 7 healthy young volunteers (average age 24) were previously performed on a 3-T MR system (TRIO; Siemens, Erlangen, Germany). For flow analysis a phase contrast gradient echo sequence with prospective ECG-gating covering the entire thoracic aorta was used (voxel size 1.7×2.0×2.2 mm3, temporal resolution = 40.8 ms, venc= 150cm/s).
Data was processed using home-developed research software tool. PWV was then computed by automatically placing cross-sectional planes, 10 mm apart, starting a few millimeters above the root of the aorta. For each plane, a through flow curve was computed. A characteristic time point was then identified on each of the flow curves and a line was fitted to the resulting time points over all the flow profiles. The slope of the line was then used to determine the value of PWV. We investigated three different choices of the characteristic point:
1. The time point where the flow is 50% of the peak flow,
2. The intersection of a line fitted to the upslope portion of the flow curve with the time axis. We refer to this as time-to-foot (TTF),
3. The time point where the steepest increase in the through flow is observed.
We note that all the major steps are automatized and the PWV processing time on average was less than 30sec. A comparison with a realistic digital phantom was performed to ensure the correctness of the computations.

RESULTS
PWV analysis based on the 50% rule and TTF resulted in less scattered data along the path of the aorta. The average PWV for the 7 volunteers were 4.73±0.31 (range, 4.51 to 5.41 m/s), 4.48±0.36 (range, 4.16 to 5.18 m/s) and 4.49±0.74 (range, 3.14 to 5.14 m/s) for the 50% rule, TTF and steepest increase respectively.

CONCLUSION
Based on our experiments, the 50% rule was slightly superior to TTF in terms of more stable estimation of waveform changes; however, an analysis using a larger population data is needed.

CLINICAL RELEVANCE/APPLICATION
This technique might evolve to a noninvasive alternative to catherization for assessment of pulse wave velocity in the aorta.

LL-CAS-MO8A ● Functional Evaluation of the Left Ventricle in Hypertrophic Cardiomyopathy Patients after Alcohol Septal Ablation Using Magnetic Resonance Imaging: Focus on Correlations between the dv/dt Curves and the Remodeling Parameters in Long-term Follow-up

Yan Zhang (Presenter)

PURPOSE
To estimate quantitatively the significance of the unique left-ventricular (LV) diastolic parameter (dv/dt curve) acquired by stead-state free-precession (SSFP) cardiac magnetic resonance imaging (CMRI) in hypertrophic cardiomyopathy (HCM) patients for the evaluation of curative effects in long-term follow-up after alcohol septal ablation(ASA).

METHOD AND MATERIALS
CMRI examinations were performed in 23 (11 women) clinically-diagnosed HCM patients within 2 weeks before and a long interval (23-65months, mean 34moths) after ASA. Left-ventricular dv/dt curves were generated by delineating manually the endocardial borders of stack of short-axis cine images, from which the peak ejection rate (PER) and the peak filling rate (PFR) were reckoned out and indexed automatically. Meanwhile other important LV morphological and functional parameters were also acquired.

RESULTS

CONCLUSION
Our preliminary results provided new insights into the unusual MRI dynamic parameters that reflected both systolic and diastolic functions of the left ventricle in HCM patients after ASA and showed the clinically valuable relations with the golden standard.

CLINICAL RELEVANCE/APPLICATION
We demonstrated the clinical potential of evaluating non-invasively the left-ventricular functions of HCM patients with valuable MRI indicators in the follow-up after ASA treatment.

LL-CAE-MO9A ● Multimodality Evaluation of Congenital Heart Disease (CHD) and Correlation with Intraoperative Findings

Anurag Yadav MBBS (Presenter) ; **Tarvinder B Buxi** MD ; **Kishen S Rawat** MBBS, MD ; **Samarjit S Ghuman** MBBS, MD ; **Raja Joshi** ; **Neeraj Agarwal** ; **Abhishek Agarwal** ; **Hiren Panwala**

PURPOSE/AIM
To evaluate CT angiography as an ideal imaging modality for diagnosis of CHD and correlate it with 2D and 3D echocardiography, catheter angiography and intra operative findings.

CONTENT ORGANIZATION
At a single institute, 30 patients underwent CT angiography over a period of 2 years. It was performed on 128 slice CT using a collimation of 64 X 0.625mm, slice thickness 0.9mm, pitch 0.8, rotation time 0.5sec with a 512 matrix and iDose. The dose and rate of intravenous contrast varied according to patient weight. The diagnosis included Tricuspid Atresia, Right Atrial Diverticuli, Double Aortic Arch, Hypoplastic Ascending Aorta, Coarctation of Aorta, William Syndrome, Total and Partial Anomalous Pulmonary Venous Drainage,

Pulmonary Veno-occlusive disease and Abernethy Malformation to mention a few. Imaging findings were interpreted in conjunction with echocardiography, catheter angiography and intra operative findings

SUMMARY
Multimodality evaluation is necessary for diagnosis and effective management of CHD. Ideal diagnostic modality should be able to delineate all aspects of the anatomy, including abnormalities of cardiac structure as well as extra cardiac vessels. Low Dose CT angiography with advanced reconstruction techniques is fast, highly accurate, non invasive, reproducible and correlates well with intraoperative findings.

Cardiac - Monday Posters and Exhibits (12:45pm - 1:15pm)

Monday, 12:45 PM - 01:15 PM ● Lakeside Learning Center

CA

LL-CAS-MOB ● *AMA PRA Category 1 Credit* ™:0.5

LL-CAS-MO1B ● The Combination of Lower Concentration Contrast Agent with 80 kVp in Coronary Computed Tomography Angiography (CCTA)

Qian Li MSc (Presenter) ; **Guan Hanxiong** MD

PURPOSE
To study the clinical value of combining flow concentration contrast agent (iodixanol 270 mgI/ml) with 80 kVp in coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS
60 patients were randomly divided into 2 groups to take CCTA examinations on a GE Discovery CT750 HD scanner with prospective ECG-triggered axial scans. Half patients for group A (iodixanol 270 mgI/ml) underwent 80kVp scan with 50% ASiR reconstruction and the other half for group B (iodixanol 370mgI/ml) underwent 120kVp scan and regular FBP reconstruction. The rest scan parameters were the same and the total contrast dose was at 0.9 ml/kg and was injected at 5 ml/s rate for both groups. Image slice thickness was 0.625 mm. CT value in the ostium of left coronary artery, and the CT value and SD value of subcutaneous fat tissue were measured. Contrast-noise-ratio (CNR) of the aorta was calculated and compared between the two groups using statistical method. Radiation dose (dose-length-product, DLP) was recorded.

RESULTS
The mean CT value of the ostium of left coronary artery for group A (511.99 ± 33.24 HU) was statistically higher than that of for group B (395.71 ± 22.93 HU), (p 0.05). It was statistically lower for the radiation dose in group A (437.38 ± 80.14 mGy*cm) than group B (1151.12 ± 123.07 mGy*cm) ,(p
CONCLUSION
The combination of lower concentration of contrast agent with 80 kVp used in coronary CTA provided similar image quality with 27% contrast dose reduction and and up to 62% lower radiation dose reduction compared to conventional CCTA.

CLINICAL RELEVANCE/APPLICATION
The combination of lower concentration of contrast agent with 80 kVp used in coronary CTA provided similar image quality with 27% contrast dose reduction and and up to 62% lower radiation dose reduct

LL-CAS-MO2B ● Relationship between Impaired Cardiac Sympathetic Activity and Spatial Dyssynchrony in Patients with Nonischemic Heart Failure: Assessment by MIBG Scintigraphy and Tagged MRI

Masato Yonezawa (Presenter) ; **Michinobu Nagao** MD * ; **Yoshio Matsuo** ; **Satoshi Kawanami** MD * ; **Shingo Baba** ; **Takeshi Kamitani** MD ; **Takuro Isoda** ; **Mikako Jinnouchi** MD ; **Yasuhiro Maruoka** ; **Yuzo Yamasaki** MD ; **Kohtaro Abe** ; **Taiki Higo** ; **Takashi Yoshiura** MD, PhD ; **Hiroshi Honda** MD

PURPOSE
MIBG imaging has been widely used for the assessment of cardiac sympathetic function in heart failure (HF), and it was reported that impaired cardiac adrenergic innervation as assessed by MIBG imaging was closely associated with mortality in patients with HF. Left ventricular (LV) dyssynchrony is present in more than 25% of patients with HF and has been associated with a poor prognosis. Our purpose was to investigate the relationship between LV dyssynchrony and cardiac sympathetic activity in non-ischemic HF.

METHOD AND MATERIALS
Twenty-seven patients with non-ischemic HF were enrolled. Cardiac sympathetic activity was assessed by heart-to-mediastinum ratio (H/M ratio) on ^{123}I-MIBG scintigraphy. LV dyssynchorony was assessed by cross-correlation analysis of time-curves of myocardial circumferential strains delivered from cine-tagging MR images. Temporal dyssynchrony was defined as contraction delay between septal and lateral segments > 110 msec. Spatial dyssynchrony was defined as the negative value of the maximum correlation for the two strain time-curves.

RESULTS
H/M ratio was significantly lower for patients with spatial dyssynchrony compared to patients without (1.8 ± 0.3 vs. 2.1 ± 0.3, p
CONCLUSION
Impairment of cardiac sympathetic activity was found to be associated with spatial dyssynchrony in patients with non-ischemic HF.

CLINICAL RELEVANCE/APPLICATION
Evaluation of both LV dyssynchrony and cardiac sympathetic function provide information regarding the treatment strategy such as beta-blocker or cardiac resynchronization therapy in HF patients.

LL-CAS-MO3B ● Association between Left Atrial Function from Cine MRI by Multimodality Tissue Tracking and Diffuse Left Ventricular Myocardial Fibrosis by T1 Mapping in the Multi-Ethnic Study of Atherosclerosis (MESA)

Masamichi Imai (Presenter) ; **Bharath Venkatesh** ; **Sanaz Samiei** ; **Sirisha Donekal** ; **Mohammadali Habibi** MD ; **Anderson Armstrong** ; **Susan Heckbert** ; **Colin Wu** ; **David A Bluemke** MD, PhD * ; **Joao A Lima** MD *

PURPOSE
The purpose of study is to explore the association between left atrial (LA) function and diffuse left ventricular (LV) myocardial fibrosis with cardiac magnetic resonance (CMR).

METHOD AND MATERIALS
Of 1346 participants that had T1 mapping, 108 had of myocardial scar (detected by late gadolinium enhancement in the LV). Age, gender, and ethnicity matched controls (n = 207) without myocardial scar were chosen from the same population. Multimodality tissue tracking (MTT) was leveraged to analyze LA with 2- and 4-chamber long-axis cine CMR images (SSFP, Siemens 1.5 T scanner), and assessed maximal indexed LA volume (LAVi), LA ejection fraction (LAEF), maximal LA strain (Smax), LA strain rate at maximum (SRmax) and LA strain at early ventricular-diastolic peak (SR). T1 mapping was performed at mid-ventricle of LV using Modified Look Locker Inversion Recovery (MOLLI) sequence before and (12 and 25 minutes) after contrast administration. The association between LA parameters and pre- and post-contrast T1 times was assessed by Pearson�s correlation and multivariable linear regression adjusted for age, gender, ethnicity, and presence of scar.

RESULTS
The participants were of average age 71 ± 9 years, 87% male, and 57% Caucasian, 26% African-American, 10% Hispanic, and 7% Chinese. Lower 12� post-contrast T1 was associated with lower LAEF (r = 0.23, p < .001), Smax (r = 0.23, p < .001), and SRmax (r = 0.25, p < .001) and higher SR$_E$ (r = -0.21, p < .001) by Pearson�s correlation. Lower 25� post-contrast T1 had the same tendency, but it was also associated with higher LAVi (r = -0.12, p = .034). SRmax remained significantly associated with post-contrast T1 times after adjustment for all covariates. The association between T1 times and SRmax remained significant when analysis was performed only on the control group.

CONCLUSION
In the MESA population, lower post-contrast T1 times were associated with higher LA volume, lower LAEF, lower strain, and lower absolute value of strain rate. Lower LA function was associated with increased fibrosis as assessed by lower post-contrast T1 times irrespective of the presence of myocardial scar.

CLINICAL RELEVANCE/APPLICATION
LA function from CMR is an important indicator of effect of fibrosis of the left ventricle.

LL-CAS-MO4B ● Assessing Image Quality and Radiation Dose of Cardiac Computed Tomography Angiography Using a 320-Row Detector with Adaptive Iterative Dose Reduction 3D

David Tso MD (Presenter) ; **Andrew Van Der Westhuizen** MD ; **Patrick McLaughlin** FFRRCSI ; **Darra T Murphy** FFRRCSI ; **John R Mayo** MD * ; **Savvas Nicolaou** MD

PURPOSE
The purpose of this study was to compare image quality and radiation dose of Cardiac CT angiography (CCTA) utilizing iterative reconstruction technology compared to CCTA utilizing standard filtered back projections (FBP).

METHOD AND MATERIALS
This is a retrospective review of 59 consecutive patients scanned with the Toshiba Aquilion ONE 320-slice MDCT scanner using a low-dose CCTA protocol with iterative reconstruction (Adaptive Iterative Dose Reduction 3D or AIDR 3D) who were compared with 60 consecutive patients scanned using our institution standard CCTA protocol with FBP. The two cohorts were compared with respects to effective radiation dose, as well as signal and noise measurements of cardiac vascular structures. Qualitative image quality of cardiac anatomy was assessed using a 4-point scale (3-clear, 2-minor motion, 1-significant motion, 0-non-diagnostic).

RESULTS
There was no significant difference between the two cohorts with respect to age, BMI, and AP and lateral measurements. No significant difference in signal or noise measurements of the aorta and coronary arteries were appreciated. There was a 58% reduction in the mean effective radiation dose between the FBP and AIDR 3D cohorts (4.66 mSv vs. 1.97 mSv; p < 0.0001). Although there was a reduction in signal-to-noise ratio between FBP and AIDR 3D (32.03 vs. 25.94; p=0.012) and contrast-to-noise ratios (29.13 vs. 24.20; p=0.03), there was a statistically significant improvement in qualitative image quality of cardiac anatomy in the AIDR 3D group (2.06 vs. 2.44; p

CONCLUSION
AIDR 3D is a technology which uses iterative reconstruction in both raw and image data space to provide better qualitative image quality while allowing CCTA to be conducted at significantly less radiation dose than traditional methods utilizing FBP.

CLINICAL RELEVANCE/APPLICATION
AIDR 3D uses iterative reconstruction to provide better qualitative image quality while allowing CCTA to be conducted at significantly less radiation dose than traditional methods utilizing FBP.

LL-CAS-MO5B ● Percutaneous Pulmonary Valve Implantation: Long-term Follow-up with Cardiac Magnetic Resonance

Elda Chiara Resta ; **Francesco Secchi** MD (Presenter) ; **Paola Maria Cannao** ; **Giovanni Di Leo** ; **Mario Carminati** MD ; **Francesco Sardanelli** MD *

PURPOSE
To evaluate the diagnostic value of Cardiac Magnetic Resonance (CMR) before and after percutaneous pulmonary valve (Melody, Medtronic) implantation (PPVI).

METHOD AND MATERIALS
After IRB approval and informed consent, patients with congenital heart diseases and pulmonary conduit dysfunction were prospectively scheduled for 1.5-T CMR before and after 36 and 48 months from PPVI. We used a cine true-FISP sequence (TR/TE=45/1.5 ms, thickness 8 mm) to study the right (RV) and left ventricles (LV) function. MR angiography after administration of contrast material (0.01 mmol/kg Gd-BOPTA) was performed to define pulmonary arteries anatomy before PPVI. Wilcoxon test was used.

RESULTS
From January 2008 to January 2013, we enrolled 36 patients (21±8 years old), all of them studied within one week before valve implantation and 10 of them studied after 36 months from PPVI and 6 after 48 months. One patient was excluded from the study after surgical implantation of Elan conduit. End-diastolic volume index (EDVI), end-systolic volume index (ESVI), and ejection fraction (EF) of the RV before PPVI were 83±38 mL/m², 44±34 mL/m², and 50±13%, the same data after 36 months were 72±19 mL/m² (P=.241), 33±15 mL/m² (P=.028), and 56±10% (P=.047), respectively; the same data after 48 months were 67±17 mL/m² (P=.916), 26±15 mL/m² (P=.042), and 62±12% (P=.027), respectively. EDVI, ESVI, and EF of LV before valve implantation were 67±17 mL/m², 30±13 mL/m², and 56±9 %, respectively, the same data after 36 months were 78±19 mL/m² (P=.333), 34±11 mL/m² (P=.475), and 57±7% (P=.085); the same data after 48 months were 79±20 mL/m² (P=.345), 35±11 mL/m² (P=.599), and 58±7% (P=.116).

CONCLUSION
Four years after PPVI, we observed a significant improvement of RV EF and ESVI. A borderline significant change was observed for the left ventricle systolic function.

CLINICAL RELEVANCE/APPLICATION
CMR can be used for a comprehensive noninvasive long-term follow-up after percutaneous pulmonary valve implantation.

LL-CAS-MO6B ● Preliminary Study of 80 kVp on Coronary CT Angiography with 300 mg I/ml Iodixanol with Iterative Reconstruction

Rui Wang PhD (Presenter) ; **He Wang** MD ; **Baocui Zhang** ; **Xiaoying Wang** MD

PURPOSE
To evaluate the feasibility of 80 kVp and 300 mg I/ml iodixanol in coronary CT angiography (CTA) with 64-slice CT scanner, by using iterative reconstruction.

METHOD AND MATERIALS
Totally 25 patients(16 men, 9 women, BMI 20-25) were recruited with clinical indication of coronary CTA in this perspective study, with permission of ethical committee. All the patients underwent coronary CTA with prospective ECG-gated protocols, with following parameters: 80 kVp, automatic mA and 30% adaptive statistical iterative reconstruction (ASiR). All the patients were injected 60ml iodixanol 300 mg I/ml, with flow rate of 5ml/s and 30ml normal saline flush. Dose report was recorded in each patient. Two experienced radiologists evaluated the CT images. The coronary artery was divided into 16 segments to subjectively evaluate the image quality, including aorta, LM, LAD (proximal, middle and distal), D1, D2, LCX (proximal, middle and distal), OM, RCA (proximal, middle and distal), PDA, PL, AM. The image quality was scaled as score 1 to 5, which was defined as poor, adequate, good, very good and excellent image

quality, respectively. Intravascular CT value was measured of each segment. The ROI, larger than half of lumen, was placed in the center of vessel lumen. The data from segment which lumen diameter less than 2mm was excluded.

RESULTS
The BMI was 22.29±1.15 in average. The average radiation dose were as following: CTDIvol 7.87±0.49 mGy, SSDE 10.53±1.13 mGy, and ED 1.66±0.27 mSv, respectively. Eleven segments were excluded. For the 389 segments, the maximum intravascular CT value was 606.20±114.10 HU in aorta, while the minimum CT value was 489.14±144.86 HU in D2. For subjective evaluation, 343 were scored 5, 34 were scored 4, 12 were scored 3. No segment was scored less than 3.

CONCLUSION

CLINICAL RELEVANCE/APPLICATION
With image noise reduction by iterative reconstruction, low kVp image can be applied. CT value of iodine was higher in low kVp image, which means we can try to use less idione in CT vascular imaging.

LL-CAS-MO7B ● Clinical Correlation of Left Atrial Systolic and Diastolic Functions Evaluated by Cine-MRI and Invasive Monitoring of Left Atrial Pressure

Irfan M Khurram MD (Presenter) ; **Farhan Maqbool** MBBS ; **Roy Beinart** MD ; **Hugh Calkins** ; **Saman Nazarian** MD * ; **Stefan L Zimmerman** MD

PURPOSE
Atrial fibrillation (AF) is associated with significant abnormalities of left atria (LA) systolic and diastolic functions. The LA diastolic functions are routinely estimated with 2-D speckled tracking echocardiography with its own limitaions. This study describes a MRI based volume measures along with invasive left atrial pressure tracing to accurately estimate extent of LA diastolic and systolic functions.

METHOD AND MATERIALS
A total of 55 AF patients (55% paroxysmal, 45% persistent) undergoing AF ablation were enrolled after IRB approved consent. Cine-MRI was obtained in sinus rhythm before the ablation procedure. Left atrial pressures were acquired following trans-septal puncture prior to applying ablation lesions. Patients, if not in sinus rhythm, were cardioverted at the start of the procedure for accurate pressure measurements. Atrial pressure and volume loops were prepared for all patients. LA diastolic function was estimated by the slop of the passive LA filling curve and was quantified by creating diastolic dysfunction score defined by the ratio of change of LA pressure to volume during passive filling of LA (?P/?V).

RESULTS
The study population included 81% male, age 60.4±10.2 years, and mean CHADS2 score of 0.9±1. The mean diastolic dysfunction score for AF patients was 0.76±0.7 mmHg/ml (paroxysmal AF 0.60±0.5 and persistent AF 1.0±0.9; p-value 0.02). Linear regression analysis showed rise in diastolic dysfunction score with age with increase of 0.02 per year (p-value 0.03). The diastolic score appeared to have trend in patients undergoing multiple ablations for AF (first ablation patient 0.65±0.6 vs. repeat ablation patients 1.0±0.8; p-value 0.06). Left atrial active emptying fraction was found to be 13.7±9.3% (paroxysmal 15.5±9.8% vs. Persistent 11.5±8.2%; p-value - NS). Regression analysis showed linear relationship between LA diastolic score and active LA emptying fraction (R-squared=0.197; p-value 0.001).

CONCLUSION
Left atrial diastolic functions appear to get worse in persistent AF and is increasing age. It is also shown a trend towards higher dysfunction score with repeat AF ablations. LA diastolic and systolic functions appear to follow the same trend in atrial fibrillation patients.

CLINICAL RELEVANCE/APPLICATION
Cine-MRI based volume data can be combined with invasive pressure data to obtain true left atrial diastolic and systolic functions.

LL-CAS-MO8B ● Detecting Diffuse Myocardial Fibrosis in Cardiomyopathy: Quantification of CT Extracellular Volume Fraction

Songtao Liu MD (Presenter) ; **Karl H Schuleri** MD ; **Mark A Ahlman** MD ; **Samuel Won** ; **Cynthia Davies-Venn** ; **Fabio Raman** BS ; **Marcus Y Chen** MD ; **John Schuzer** ; **Jing Han** ; **Christopher Sibley** ; **Yixun Liu** ; **Jianhua Yao** PhD * ; **Ronald M Summers** MD, PhD * ; **Christopher Baines** ; **Albert C Lardo** ; **Craig Emter** ; **David A Bluemke** MD, PhD *

PURPOSE
Diffuse myocardial fibrosis (DMF) is present in a variety of cardiomyopathies and heart failure. DMF is associated with increased extracellular volume fraction (ECV) on gadolinium MRI studies. The aim of this study was to evaluate CT ECV quantification for the detection of DMF in a swine model of compensated heart failure.

METHOD AND MATERIALS

RESULTS
70% reduction in ascending aortic area was achieved in the HF and HF-CsA groups. There was reduced ejection fraction in the HF-CsA group (47%), but not in the control (54%) or HF groups (56%, p=NS). The HF-CsA group was characterized by increased end diastolic volume (HF-CsA:80ml, CON:70ml, HF:56ml, p=0.04), increased end systolic volume (HF-CsA:43ml, CON:32ml, HF-CsA:24ml, p
CONCLUSION
CT with delayed scanning for calculation of extracellular volume fraction was able to detect altered myocardial composition in a large animal model of heart failure and diffuse myocardial fibrosis.

CLINICAL RELEVANCE/APPLICATION
CT Extracellular Volume Fraction (CTECV) quantification has the potential to be a non-invasive imaging biomarker for diffuse myocardial fibrosis.

LL-CAE-MO9B ● Multi-detector CT Coronary Angiographic Findings of Coronary-to-Pulmonary Artery Fistula

Jiyeon Lim (Presenter) ; **Eun-Ah Park** MD ; **Jae Hyung Park** MD ; **Whal Lee** MD, PhD ; **Jin Wook Chung** MD *

PURPOSE
To evaluate the multi-detector CT (MDCT) coronary angiographic findings of coronary-to-pulmonary artery fistula (CPAF).

METHOD AND MATERIALS
We retrospectively reviewed cases of CPAF from our coronary CT angiography (CCTA) database between January 2008 and December 2010. All CCTA examinations were performed with a 64-channel MDCT or DSCT. We analyzed the MDCT coronary angiographic findings for the number and origin of feeding arteries, number, size and location of draining fistulous openings, association with peripulmonary arterial aneurysms, and the presence of CPAF communication with bronchial arteries.

RESULTS
Among the 15,042 patients who underwent CCTA examinations during the selected period, a total of 55 patients (0.37%) were diagnosed with CPAF on the basis of CCTA findings. The feeding artery was single in 19 patients and multiple in 36 patients. The feeding arterial branch originated from the conal (n=40), left anterior descending (n=40), left main (n=14), and diagonal branches (n=3). The draining fistulous opening was single in 54 cases and multiple in 1 case, located mostly in the anterior sinus of the main pulmonary artery (MPA, n=54) except in one case (anterior-left sinus junction). The mean diameter of fistulous openings was 2.7 ± 1.4mm. Peripulmonary arterial aneurysms were aneurysmal dilatations of 3-6 mm in 17 cases (31 %) and saccular aneurysms = 6 mm in diameter (mean 10.3 ± 7.3 mm, range 6.2~26.0 mm) in 7 cases (13%). CPAF communication with bronchial arteries was present in 9 cases (diameter 3.5 ± 2.2 mm).

CONCLUSION
The frequency of CPAF observed at MDCT coronary angiography examinations seems to be more common (0.37%) than previously reported (0.002%). MDCT coronary angiography may provide more comprehensive and detailed findings of CPAF potentially replacing diagnostic coronary angiography.

CLINICAL RELEVANCE/APPLICATION
Detailed MDCT coronary angiographic findings of CPAF can provide understanding of embryologic development and help determine surgical or interventional management strategy for this condition.

Cardiac CT Mentored Case Review: Part III (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, 01:30 PM - 03:05 PM ● S406A

CT VA CA

MSMC23 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
Moderator
James P Earls , MD *
Moderator
U. Joseph Schoepf , MD *

MSMC23A ● Pulmonary Veins and Pericardium

Jacobo Kirsch MD (Presenter)

LEARNING OBJECTIVES
1) Describe normal versus anomalous pulmonary venous anatomy. 2) Understand the imaging findings of complications of ablation for atrial fibrillation. 3) Describe abnormalities of the pulmonary veins identifiable on routine CT. 4) Identify the most common pericardial abnormalities evaluated with CT.

MSMC23B ● Coronary Artery Disease III: Native Vessel Disease

Elliot K Fishman MD (Presenter) *

LEARNING OBJECTIVES
1) Understand pathology of the native coronary arteries beyond simple plaque disease. Topics will include coronary artery aneurysms, anomalies, and fistulae. 2) How to optimize the study performance and interpretation will be addressed as well.

ABSTRACT
The goal of this session is to learn how to interpret pathology involving the coronary arteries beyond the detection of coronary artery stenosis. Focus on exam acquisition protocols, study interpretation protocols, and minimizing radiation dose are addressed. Specific topics addressed will also include coronary artery aneurysm, myocardial bridging, anomalous coronary arteries as well as vasculitis. Potential pitfalls will be addressed and pearls for study optimization will also be discussed.

Cardiac (Valve Disease)

Monday, 03:00 PM - 04:00 PM ● S502AB

CT CA

SSE03 ● *AMA PRA Category 1 Credit* ™:1 ● ARRT Category A+ Credit:1
Moderator
Bernd J Wintersperger , MD *
Moderator
Scott D Flamm , MD *

SSE03-01 ● Quantification of Stenotic Mitral Valve Area by Dual-source Computed Tomography in Patients with Atrial Fibrillation and Mitral Stenosis: Comparison with Cardiac Magnetic Resonance and Transthoracic Echocardiography

Song Soo Kim MD, PhD (Presenter) ; **Sung Min Ko** ; **Jae-Hwan Lee** ; **Heung Gon Hwang**

PURPOSE
To evaluate the utility of dual-source computed tomography (DSCT) for quantification of the mitral valve area (MVA) in patients with atrial fibrillation (AF) and mitral stenosis (MS), with comparing those from the cardiac magnetic resonance (CMR) and transthoracic echocardiography (TTE).

METHOD AND MATERIALS
We retrospectively enrolled 102 patients (77 women, 52.4 ± 10.9 years old) with AF and MS who underwent ECG-gated DSCT, TTE, and CMR prior to operation. The MVAs were determined planimetrically by DSCT, CMR, TTE as well as assessed by Doppler TTE using the pressure half-time method (TTE-PHT) and they were compared among each other using linear regression and Bland-Altman analyses. Grade of MS (mild, moderate, and severe) was determined according to the results of TTE (TTP-planimetry, TTE-PHT, and TTE-overall) and diagnostic accuracy of DSCT for detecting severe MS was assessed using each TTE as reference.

RESULTS
The MVA on DSCT (mean, 1.27 ± 0.27 cm2) was significantly larger than those seen with TTE-planimetry and TTE-PHT (1.16 ± 0.28 cm2 and 1.07 ± 0.30 cm2, respectively; p
CONCLUSION
Planimetry of MVA measured by DSCT may offer a reliable, alternative method for the quantification of MS in patients with AF, even though systemically overestimated, as compared with MVA calculated by CMR and TTE.

CLINICAL RELEVANCE/APPLICATION
In MS with AF patients, DSCT could be an alternative to TTE in patients with poor acoustic windows or whenever MVA using TTE is indeterminate severity of MS to clinicians.

SSE03-02 ● Initial Systolic Flow Displacement in Patients with Bicuspid Aortic Valve Predicts Ascending Aortic Enlargement

Nicholas S Burris MD (Presenter) ; **Monica Sigovan** PhD ; **Elaine Tseng** MD ; **David A Saloner** PhD ; **Michael D Hope** MD

PURPOSE
Bicuspid aortic valve (BAV) is a common anomaly, which is associated with dilation of the ascending aorta (AsAo), causing significant morbidity and mortality. Prior retrospective cardiac MR (CMR) studies utilizing 4D flow techniques have shown that eccentric flow patterns caused by bicuspid valve anatomy are correlated with AsAo enlargement. However, 4D Flow methods require significant post-processing

time and specialized training which limits its broad applicability. Peak systolic flow displacement, a previously described parameter, can quantify flow eccentricity in the AsAo and can be easily calculated from phase contrast (PC) data, a commonly obtained CMR sequence. We hypothesize that systolic flow displacement will positively correlate with AsAo growth rate.

METHOD AND MATERIALS
Cardiac MRI/MRA data were reviewed from 23 patients with BAV who had at least 2 CMR studies >1 year apart, age =16 years, with PC data acquired in the AsAo on initial study. Ascending aortic diameter measurements were made at standard levels, and growth rates of maximally enlarged segments were determined. Flow displacement measurements on initial study were compared with maximal aortic diameter growth rate in a prospective manner.

RESULTS
Average follow-up was 3.1±2.1 years and average patient age at first study was 33.7±11.9 years. Displacement at initial study was significantly correlated with AsAo growth rate by Pearson�s correlation (r=0.39, p=0.03). In a comparison of means, AsAo growth rate was 2.5 times greater in patients with high initial flow displacement of =0.2 (1.0±0.7 mm/y, n=11) vs. patients with low initial flow displacements
CONCLUSION
We demonstrate that high peak systolic flow displacement at initial study significantly correlates with greater subsequent AsAo enlargement, and that patients with high initial flow displacement values have 2.5 times greater growth rate compared with patients with low initial flow displacement values. Flow displacement measurement may be a simple way of risk stratifying patients with BAV.

CLINICAL RELEVANCE/APPLICATION
Cardiac MR systolic flow displacement measurement in the ascending aorta can predict interval enlargement in patients with bicuspid aortic valve and is recommended for risk stratification.

SSE03-03 • Functional Classification of Aortic Regurgitation with Cardiac Computed Tomography: Comparison with Surgical Inspection and Transesophageal Echocardiography

Hyun Jung Koo MD (Presenter) ; **Dong Hyun Yang** MD ; **Joon-Won Kang** MD ; **Joon Bum Kim** ; **Tae-Hwan Lim** MD, PhD

PURPOSE
To evaluate the diagnostic performance of cardiac computed tomography (CT) for assessing the mechanisms of aortic regurgitation (AR) using surgical inspection and transesophageal echocardiography (TEE) as reference standards

METHOD AND MATERIALS
CT findings of 101 consecutive patients (62 males, mean age: 55.0±14.0 years) with AR who underwent aortic valve or root surgery were evaluated. As reference standards, surgical inspection and TEE were reviewed for determining repair-oriented functional classification of AR: type I, dilated aortic root with cusp tethering; type II, whole prolapse of cusp; type III, cusp retraction; and type IV, rheumatic or degenerative valves, infective endocarditis or aortic dissection. Multiphase CT images were analyzed by two readers in consensus. Aortic valve (AV) morphology, root dilatation, and aortic regurgitation orifice (ARO) were evaluated on CT, and cusp morphology was categorized as normal, partial prolapse (prolapse of the distal part of a cusp), whole prolapse (prolapse of the entire body of a cusp), and retraction. TEE data were reviewed including ventricular functional parameters and direction of AR flow. Classification of AR based on CT was compared to the reference standards, and cusp-by-cusp comparison was performed.

RESULTS
Agreement between CT and the reference standards was 96.7% for functional classification of AR, and the number of patients in each type were as follows: type I (n=36), type II (n=13), type III (n=12), and type IV (n= 40). In cusp-by-cusp comparison for AV morphology, CT showed 82.5% of concordance. Whole prolapse was noted in 13 patients, and all of them represented eccentric AR. Among 41 patients with partial prolapse, 23 patients were found in type I, and 26 % of them showed eccentric AR. In 12 patients with cusp retraction, 33.3 % of eccentric AR was demonstrated. Although the percentage of eccentric AR in partial prolapse was larger than that in normal AV, there was no statistically significance (p=0.07). The ARO measuring on CT was significantly correlated with end-diastolic volume on echocardiography (p=0.002).

CONCLUSION
CT clearly defines the functional classification of AR with high concordance rate to the reference standards.

CLINICAL RELEVANCE/APPLICATION
By showing the detailed valve morphology, CT can help in decision making for the aortic valve repairability.

SSE03-04 • Differences of Cardiac Function and Characteristics of Aortic Valve according to Myocardial Fibrosis in Patients with Severe Aortic Stenosis

Tae Hyung Kim (Presenter) ; **Jin-Woo Choi** ; **Hweung Kgon Hwang** ; **Meong Gun Song** ; **Sung Min Ko**

PURPOSE
To investigate the differences of cardiac function and characteristics of aortic valve according to myocardial fibrosis (MF) in patients with severe aortic stenosis (AS).

METHOD AND MATERIALS
Eighty-one patients (48 male, mean age 59 years) with pure severe AS (n=33) or severe AS with mild aortic regurgitation (n=48) were included in the study. All patients underwent transthoracic echocardiography (TTE), cardiac computed tomography (CCT) and cardiac magnetic resonance (CMR) and subsequent valvuloplasty operation. CCT was performed using the dual-source CT scanner and used for the assessment of valvular and coronary calcium score, valvular calcium grade, and coronary artery disease. TTE was used for assessment of AS severity using established parameters. CMR exams were performed on a 1.5-T system and a 3.0-T system. Cine-CMR was used for the assessment of LV volumes, mass and function. Detection of MF (midwall late enhancement) was based on the assessment of the short-axis delayed-enhancement CMR with phase-sensitive inversion recovery technique. The differences of cardiac function and valvular characteristics between two groups were statistically analyzed.

RESULTS
MF was observed in 34 patients. There were no differences in valvular morphology and clinical characteristics between two groups, except mild aortic regurgitation being more prevalent patients with MF (n = 28) than without MF (n=20, p= 0.0008). Patients with MF had higher aortic valve calcium volume score (2941 ± 1960 mm3 vs 1660 ± 1092 mm3, p= .0003) and calcium grade by CCT (p=.008), more severe AS [aortic valve area by CMR (0.73 ± 0.15 cm2 vs 0.82 ± 0.13 cm2, p= .002), peak velocity (5.0 ± 0.7 m/sec vs 4.5 ± 0.7 m/sec, p= .005) and mean pressure gradient by TTE (60 ± 19 mmHg vs 51 ± 17 mmHg, p< .005)], higher indexed LV mass by CMR (90.2 ± 34.9g/m2 vs 63.3 ± 17.9 g/m2, p< .0001), lower indexed LV ejection fraction by CMR (37.1 ± 9.5 vs 41.4 ± 8.9, p= .04), and larger indexed LV end-diastolic volume (93.2 ± 20.5 ml/m2 vs 79.3 ± 19.4 ml/m2, p= .016) by CMR compared with patients without MF.

CONCLUSION
MF is associated with more severe calcific AS, worse LV functional parameters, and higher LV mass index in patients with severe AS. Early detection of MF using CMR may increase the chances for early surgical treatment in severe AS.

CLINICAL RELEVANCE/APPLICATION
MF occurs in severe AS and is associated with long-term clinical outcome. MF is detected by delayed contrast-enhanced CMR.

SSE03-05 • Evaluation of Cardiac Reverse Remodeling after MitraClip Procedure Using MRI

Patrick Krumm (Presenter) ; **Christine S Zuern** ; **Bernhard Klumpp** MD ; **Claus D Claussen** MD ; **Andreas E May** ; **Ulrich Kramer** MD ; **Thomas Wurster** ; **Stefanie Mangold** MD ; **Achim Seeger** ; **Christiane Bretschneider**

PURPOSE
The MitraClip System (Abbott Vascular) is a novel percutaneous interventional method for mitral valve repair. It is predominantly applied on patients that are not eligible for surgical valve repair. The purpose of this study was to examine reverse remodelling by evaluating pre- and postinterventional cardiac function and atrial dilatation.

METHOD AND MATERIALS
33 patients (age 75.5±8.1 years; 11 female) were prospectively included in this study. Magnetic resonance imaging was performed before and 6 weeks after intervention in 20 patients. 13 patients had to be excluded due to implantable pacemakers. Cardiac function was evaluated using steady-state free precession (SSFP) cine sequences by assessment of enddiastolic volume (EDV), ejection fraction (EF) myocardial mass (MM) and myocardial mass index (MMI). Planimetry of the left atrium (LA) was performed in identical slices in four-chamber view.

RESULTS
EDV was preinterventional 179,2 ml; postinterventional 171,9 ml (p=0.01). EF was was preinterventional 39,7%; postinterventional 44,0% (p=0.001). MM was preinterventional 156,7 g; postinterventional 153,6 g (p=0.03). MMI was preinterventional 85,0 g/m²; postinterventional 84,3 g/m² (p=0.6). Left atrium plane was preinterventional 41,1 cm²; postinterventional 38,6 cm² (p

CONCLUSION
The MitraClip procedure has a positive effect on cardiac morphology and function and induces reverse remodelling: Significant reduction of LA and LV dilatation has been considered as cardiac reverse remodelling in the literature.
The quantifiable left atrial dilatation as well as the left ventricular dilatation decreased significantly as an indirect sign of reduced mitral regurgitation. Myocardial mass decreased significantly in the context of reduced dilatation. MMI has not decreased for less body weight at follow up due to cardiac recompensation.

CLINICAL RELEVANCE/APPLICATION
The clinical benefit of a successful MitraClip intervention can be monitored and validated using MRI in clinical follow-up examinations.

SSE03-06 ● Assessment of Leaflet Closing Angles in Mechanical Prosthetic Heart Valves with Multidetector-row CT Compared to Cinefluoroscopy: An In Vitro Study

Dominika Sucha MD (Presenter) ; **Petr Symersky** MD ; **Evert-Jan Vonken** MD, PhD ; **Esther Provoost** MMedSc ; **Steven Chamuleau** MD, PhD ; **Ricardo P Budde** MD, PhD

PURPOSE
Cinefluoroscopy is the gold standard for leaflet motion evaluation in mechanical prosthetic heart valves (PHV). In the past decade multidetector-row computed tomography (MDCT) has shown the ability to evaluate PHV leaflet motion in patients as well, however the actual accuracy of leaflet restriction assessment is unknown. In this study leaflet restriction measurements with MDCT were compared to cinefluoroscopy measurements in four common mechanical PHVs in optimal in vitro conditions.

METHOD AND MATERIALS
Three blinded observers independently measured leaflet closure angles on both cinefluoroscopy and retrospectively ECG-gated MDCT images and scored leaflets as normal or restricted. For this, three mechanical bileaflet and one monoleaflet PHVs (St. Jude, Carbomedics, ON-X and Medtronic Hall) were imaged in a pulsatile in vitro model. For each PHV four various grades of leaflet closure restriction were simulated of one of the leaflets. Hence, five image acquisitions were made of each PHV; one without and four with restriction. Data was analyzed using the intraclass correlation coefficient (ICC) and Bland-Altman plots.

RESULTS
MDCT and cinefluoroscopy agreement was high, with ICCs >0.989. Per observer analysis showed maximal differences between MDCT and cinefluoroscopy closure angle measurements of -2 to +3 degrees in both restricted and non-restricted leaflets. Overall, sensitivity and specificity for detection of leaflet restriction was 0.88-0.94 and 1.00, respectively for CT and 0.94 and 0.89-1.00, respectively for fluoroscopy. Interobserver agreement was high in restricted and non-restricted leaflets on both CT and cinefluoroscopy images (ICCs >0.995).

CONCLUSION
The maximal difference in optimal in vitro conditions between leaflet angles measured with MDCT and cinefluoroscopy is 3 degrees. MDCT and fluoroscopy both accurately detect incomplete leaflet closure.

CLINICAL RELEVANCE/APPLICATION
Multidetector-row CT allows accurate leaflet closure angle measurements in both restricted and non-restricted prosthetic heart valves.

Cardiac (Nonischemic Cardiomyopathy)

Monday, 03:00 PM - 04:00 PM ● S504AB

MR CA

SSE04 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
Moderator
Richard D White , MD
Moderator
Vincent B Ho , MD, MBA *
Moderator
Suhny Abbara , MD *

SSE04-01 ● Myocardial MR Spectroscopy (MRS) as Early Indicator of Athlete's Heart and Hypertrophic Cardiomyopathy

Francesco Secchi MD (Presenter) ; **Maddalena Belmonte** ; **Marcello Petrini** ; **Paola Maria Cannao** ; **Giovanni Di Leo** ; **Francesco Sardanelli** MD *

PURPOSE
To evaluate myocardial energetic metabolism with ^{31}P-MRS and ^{1}H-MRS in healthy volunteer, athletes and patients affected with hypertrophic cardiomyopathy (HCM) in order to define early metabolic modifications.

METHOD AND MATERIALS
We prospectively performed a cardiac 1.5-T MR (Siemens, Sonata) in 24 subjects: 10 athletes (A), 7 patients affected with HCM (H) and 7 healthy volunteers (V). With subjects in supine position, ECG-triggered cine steady-state free precession (true-FISP) and ^{1}H-MRS point resolved spectroscopy sequence (PRESS) were performed. For the ^{1}H-MRS a single voxel was placed into the septum. With patients in prone position a ^{31}P-MRS multivoxel chemical shift imaging sequence was acquired. Heart function was measured segmenting cine images with Syngo-Argus software. ^{1}H-MRS spectra were processed using jMRUI software; ^{31}P-MRS spectra using Spectroscopy-Argus (Siemens). Kruskal-Wallis and Jonckheere-Terpstra tests were used. Data were reported as median (interquantile interval).

RESULTS
Ejection fraction (%), indexed end-diastolic volume (ml/m2), end-systolic volume (ml/m2), mass (g/cm2) and septal thickness (mm) were 68, 95, 30, 72 and 10 for group A, respectively; 68, 73, 20, 81 and 18 for group H, respectively; 63 (P=.865), 78 (P=.011), 29 (P=.013), 45 (P=.008) and 6 (P

CONCLUSION
An alteration of energetic metabolism in HCM patients with a reduction of PCR/GATP ratio and an increase of Pi concentration is confirmed. Athlete�s heart is not associated with energy metabolism alterations. In HCM patients there is a significantly increase of myocardial lipids. A reduction of PCR/GATP associated with an increase of lipids could represent an indicator of early stage of HCM.

CLINICAL RELEVANCE/APPLICATION
Myocardial ^{1}H- and ^{31}P-MRS could help in detection of early HCM in particular in case of young asymptomatic athletes.

SSE04-02 ● Cardiac Remodeling after Pulmonary Vein Isolation in Patients with Atrial Fibrillation Is Related to the Degree of Baseline Left Ventricular Diffuse Fibrosis

Murilo Foppa MD, DSc (Presenter) ; **Reza Nezafat** PhD ; **Warren J Manning** MD ; **Mark E Josephson** MChir ; **Hussein Rayatzadeh** ; **Neville Gai** PhD ; **Jaime Shaw** ; **Sebastien Weingartner** ; **Harsh Parmar**

PURPOSE
Pulmonary vein isolation (PVI) using radiofrequency (RF) ablation is becoming a reasonable therapy for the treatment of paroxysmal atrial fibrillation (AF). The impact of the PVI on short and long-term cardiac remodeling is not yet known. Recent data demonstrate higher level of left ventricular (LV) diffuse fibrosis as measured by T1 mapping in patients with AF. In this study, we sought to identify short-term cardiac remodeling after PVI and how they relate to baseline characteristics including left ventricular myocardial T1 time.

METHOD AND MATERIALS
All patients with AF who underwent RF ablation for PVI and had CMR prior and post-PVI procedure from 2006 to 2011 were identified. CMR parameters of LV, right ventricular (RV) sizes and function, left atrial axial length (LA), right atrial axial length (RA), pulmonary veins total cross sectional area (PVA), and LV diffuse fibrosis as measured by T1 relaxation time in the septum using a Look-Locker sequence were measured in all patients pre and post-PVI. T1 measurements were corrected for age, weight, contrast dose, eFGR, and time after injection. The two scans were compared using paired t test and multiple linear regression to account for covariates.

RESULTS
We studied 141 patients (58±10 years, 70% male, BMI 29.1±5.6 kg), 46% had high blood pressure and 11% had diabetes. Sixty-five percent of patients were in SR at the pre PVI scan and 90% at the post PVI scan, 38 [IQR 33-57] days after the PVI. The PVA was associated with SR at post PVI scan. After the PVI procedure, patients showed statistically significant reduction in LA (59±7.8 vs 57.3±8.1 mm; P=0.01), RA (56.6±7.0 vs 54.9±7.6 mm; P=0.006), PVA (10.9±3.0 vs 9.7±3.0 cm2; P
CONCLUSION
PVI causes changes in atrial sizes and RV ejection fraction. LV T1 associations suggest that the severity of LV myocardial fibrosis at baseline may influence the degree of structural changes post PVI.

CLINICAL RELEVANCE/APPLICATION
PVI may affect cardiac structures other than LA and the magnitude of it may be related to baseline LV myocardial diffuse fibrosis severity.

SSE04-03 ● Effect of 2010 Task Force Criteria on Reclassification of Cardiac MRI Criteria for ARVC

Ting Liu MD (Presenter) ; **Amit Pursnani** MD ; **Umesh C Sharma** MD, DPhil ; **Yongkasem Voorasettakarnkij** ; **Daniel Verdini** MD ; **Ashley M Lee** BS ; **Peerawut Deeprasertkul** ; **Heidi Lumish** ; **Manavjot S Sidhu** MD, MBBS ; **Hector M Medina** MD ; **Suhny Abbara** MD * ; **Godtfred Holmvang** ; **Udo Hoffmann** MD ; **Brian B Ghoshhajra** MD

PURPOSE
We sought to evaluate the effect of the revised 2010 Task Force Criteria (TFC) on the prevalence of major and minor MRI criteria for Arrythmogenic Right Ventricular Cardiomyopathy (ARVC) versus the original 1994 TFC. We also assessed the utility of CMR to identify alternative diagnoses for patients referred for ARVC evaluation.

METHOD AND MATERIALS
968 consecutive patients referred for cardiac magnetic resonance imaging (CMR) with clinical suspicion of ARVC from 1995 to 2010, were evaluated for the presence of major and minor CMR criteria per the 1994 and 2010 ARVC TFC. MRI criteria included right ventricle (RV) dilatation, reduced RV ejection fraction, RV aneurysm, or regional RV wall motion abnormality. Quantitative and qualitative RV measures of end diastolic volume (RVEDV) and RV ejection fraction (RVEF) were present in 45% and 85% of patients, respectively.

RESULTS
Of 968 patients, 220 (22.7%) fulfilled either a major or a minor 1994 TFC, and 25 (2.5%) fulfilled any of the 2010 TFC criteria. (See Figure) Among patients meeting 1994 criteria, only 25 (11.4%) met the 2010 criteria. All patients who fulfilled the 2010 criteria also satisfied the 1994 criteria. Per the 2010 TFC, 21 (2.2%) patients met major criteria and 4 (0.4%) patients fulfilled minor criteria. 8 patients meeting 1994 minor criteria were reclassified as satisfying 2010 major criteria, and 4 patients fulfilling the 1994 major criteria reclassified to minor or no criteria. 89 (9.1%) patients had other cardiac diagnoses, including 43 (4.44%) with clinically important potential ARVC mimics. These included sarcoidosis, RV volume overload conditions (e.g ASD, PAPVR), and other cardiomypathies.

CONCLUSION
Compared with the 1994 TFC, the 2010 TFC significantly reduced the overall MRI diagnosis of ARVC from 22.7% to 2.5%. CMR identified alternative cardiac diagnoses in 9.1% of patients.

CLINICAL RELEVANCE/APPLICATION
There is a dramatic reduction in the prevalence of major and minor CMR criteria when applying the revised 2010 Task Force Criteria for ARVC compared to the original 1994 criteria.

SSE04-04 ● Three-Dimensional Visualization of Hemodynamic Derangement in the Left Ventricular Outflow Tract and Ascending Aorta: A Novel Imaging Parameter in Hypertrophic Cardiomyopathy

Bradley D Allen MD (Presenter) ; **Lubna Choudhury** MD ; **Pim Van Ooij** ; **Alex Barker** ; **Jeremy D Collins** MD * ; **Robert O Bonow** MD ; **James C Carr** MD * ; **Michael Markl** PhD

PURPOSE
To study the left-ventricular outflow tract (LVOT) pressure gradient and 3D blood flow patterns in the ascending aorta (AAo) in hypertrophic cardiomyopathy (HCM) patients using 4D flow MRI.

METHOD AND MATERIALS
Patients with HCM (n = 14, age = 59.8 ± 11.2 yrs) and controls (n = 10, age = 54.8 ± 9.0) were included in this IRB approved study. Patients had echocardiography assessment within 60 days of MRI and met at least one of the following criteria: LVOT obstruction defined as pressure gradient >30 mmHg on echo (n = 5), MRI-measured septal thickness > 1.5 cm or septum /free wall thickness ratio >1.3, or systolic anterior motion (SAM) of the mitral valve on MRI. 4D flow MRI was performed on patients during cardiac MRI for HCM assessment. Age-matched controls were selected from a volunteer database. Blood flow visualization and quantification were performed in dedicated software (EnSight, CEI, Apex, NC). Peak velocity was measured in a cylindrical analysis volume placed in the LVOT. Peak LVOT pressure gradient was calculated using the simplified Bernoulli equation $P = 4v^2$ (P = gradient, v = velocity). Time-resolved pathlines were generated to depict blood flow over one cardiac cycle. Flow pattern was graded for helical flow in the AAo (minimal = 0, moderate = 1, severe = 2). Data were analyzed using a Wilcoxon signed-rank test or t-test as appropriate. Linear regression was used to correlate continuous measurements.

RESULTS
Helical flow (1.4 ± 0.7 vs. 0.1 ± 0.3, p
CONCLUSION

Comprehensive outflow tract hemodynamic assessment with MRI may be useful in the diagnosis of HCM and LVOT obstruction.

CLINICAL RELEVANCE/APPLICATION
Hemodynamic derangement in obstructive HCM is known to impact patients symptoms and disease progression. 3D hemodynamic assessment can provide novel insight into the pathophysiology of this disease.

SSE04-05 ● Incidence of Non-Task Force Criteria Findings by CMR in Subjects with Various Arrhythmogenic Right Ventricular Cardiomyopathy Scores

Neda Rastegar MD (Presenter) ; **Stefan L Zimmerman** MD ; **Cynthia James** PhD ; **Brittney Murray** MS ; **Anneline S. J. M. Te Riele** MD ; **Aditya Bhonsale** MD ; **Crystal Tichnell** MSc ; **Hugh Calkins** ; **Harikrishna Tandri** ; **David A Bluemke** MD, PhD * ; **Ihab R Kamel** MD, PhD *

PURPOSE
To determine the incidence of abnormal morphologic findings, in addition to the standard task force criteria (TFC), by cardiac MRI (CMR) in subjects with variable degrees of severity of arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVC/D).

METHOD AND MATERIALS

RESULTS
The incidence of definite ARVC (Group A), borderline ARVC (Group B), and those who did not meet TFC (Group C) was 58 (61.7%), 19 (20.2%) and 17 (18.1%), respectively. With respect to CMR-based criteria only, 30/94 (31.9%) fulfilled major, while 3/94 (3.2%) fulfilled minor CMR criteria, and the remaining 61 (64.9%) did not fulfill any CMR criteria. In the entire cohort, 47 subjects (50%) had one or more abnormality on CMR. 60% of subjects who met major CMR criteria had LV fat and/or delayed enhancement (DE). We stratified the subjects in Group A based on the TFC score into three subgroups (score 4 and 5, 6 and 7, 8-10). The percentage of LV fat and DE increased with increase in TFC score. RV ejection fraction was significantly lower (43.4% vs. 52%, p=0.001) and RV end-diastolic volume index was significantly higher (96 mL/m2 vs. 69 mL/m2, p=0.0006) in Group A compared with Group C.

CONCLUSION
In patients with definite ARVC LV fat infiltration and DE are increasingly seen with higher TFC scores.

CLINICAL RELEVANCE/APPLICATION
Ventricular fat infiltration and DE, although not considered diagnostic criteria for evaluation of ARVC, may help in suggesting more advanced ARVC/D.

SSE04-06 ● Post-myocarditis Scars Underlying Ventricular Tachicardia: Correspondence between Delayed-enhanced CMR or MDCT Imaging and Electroanatomic Mapping

Anna Palmisano (Presenter) ; **Antonio Esposito** MD ; **Francesco A De Cobelli** MD ; **Giuseppe Maccabelli** ; **Paolo Della Bella** ; **Alessandro Del Maschio** MD

PURPOSE
Catheter ablation guided by electroanatomic mapping (EAM) is an effective treatment for patients with ventricular tachycardia (VT) recurrence also in patients suffering from nonischemic cardiomyopathy. Post-myocarditis scars are more challenging than post-ischemic scars because are scarcely identified at EAM using a common approach with bipolar voltages. At this aim, unipolar mapping, including larger region of myocardial activity, may be more effective but it is less specific. Delayed enhancement imaging provide high accurate identification of myocardial scars. Aim of the study was to compare scars identified at delayed-enhanced imaging with different EAM approaches: bipolar-endocardial; unipolar-endocardial; bipolar-epicardial; unipolar-epicardial

METHOD AND MATERIALS
19 patients (pts) with post-myocarditis VT were enrolled. 4 pts with ICD underwent MDCT including a delayed low-energy (80 kV) scan for scars identification; the remaining 15 pts underwent CMR including IR T1w sequences acquired 10-15 min after gadolinium injection. Scar� site, extension and transmural distribution (subendocardial, mid-wall, subepicardial, transmural) were evaluated at imaging and compared with bipolar and unipolar voltages at endocardial and epicardial EAMs.

RESULTS
All patients showed myocardial scars at imaging, with subepicardial distribution in 10/19 pts and epicardial to midwall distribution in the remaining 9 pts. EAMs found low voltages suggestive for scar in 18/19 pts. Imaging-revealed scars were more frequently identified by unipolar mapping (71,1% for epicardial map, 24,7% for endocardial map) rather than bipolar one (63,2% for epicardial map, 1% for endocardial maps). In particular, epicardial unipolar mapping identified 100% of epicardial scars vs 44% by bipolar map.

CONCLUSION
Unipolar electroanatomic mapping guided by pre-ablation CMR or MDCT late enhanced imaging increases the chances for the identification of postmyocarditis scars underlying recurrent ventricular tachycardia, amplifying the possibilities of a successful radio-frequency ablation treatment in these patients.

CLINICAL RELEVANCE/APPLICATION
. Merged pre-ablation late enhanced imaging and unipolar mapping allow a better identification of VT-substrate in patients with postmyocarditis scars, increasing the chances of successful trans-cathe

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Cardiac CT Mentored Case Review: Part IV (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, 03:30 PM - 06:00 PM ● S406A

CT VA CA

MSMC24 ● *AMA PRA Category 1 Credit* ™:2.5 ● ARRT Category A+ Credit:3
Moderator
Arthur E Stillman , MD, PhD
Moderator
Frank J Rybicki , MD, PhD *

LEARNING OBJECTIVES
1) To understand the clinical indications for retrospective ECG gated cardiac CT. 2) To illustrate methods to assess myocardial function from cine cardiac CT images. 3) To illustrate methods to assess normal and abnormal valvular function from cine cardiac CT images.
ABSTRACT
The mentored case review provides the opportunity for the attendees to learn the image acquistion, post-processing, and diagnosis for a wide variety of cardiac diseases commonly encountered in CT.

MSMC24A ● Coronary Artery Disease and Incidental Noncardiac Findings

Jill E Jacobs MD (Presenter)

LEARNING OBJECTIVES

1) Identify and evaluate coronary plaques and stenosis. 2) Identify and characterize common incidental extracardiac findings on coronary CT aniography.

MSMC24B ● Adult Congenital Heart Disease

S. Bruce Greenberg MD (Presenter)

LEARNING OBJECTIVES
1) Understand the increasing incidence and morbidity of congenital heart disease in adults. 2) Understand the long term complications of treated and untreated congenital heart disease. 3) Describe CT techniques for imaging adults with congenital heart disease. 4) Demonstrate morphologic changes in the heart and great vessels in untreated, palliated and corrected congenital heart disease.

MSMC24C ● Coronary Artery Disease IV: Native Vessel Disease and Arterial and Venous Bypass Grafts

Harold I Litt MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Identify focal areas of stenosis in the coronary arteries on CT. 2) Understand how to minimize artifacts to improve accuracy on coronary CT. 3) Describe common extracardiac incidental findings on coronary CT.

ABSTRACT

Essentials of Cardiac Imaging

Tuesday, 08:30 AM - 10:00 AM ● S100AB

CT CA

MSES31 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5

MSES31A ● Evaluation of Coronary Artery Bypass Grafts

Smita Patel MBBS (Presenter)

LEARNING OBJECTIVES
1) To discuss CTA technique for coronary artery bypass graft (CABG) imaging. 2) To review the surgical anatomy of conduits used for CABG and their CT appearance. 3) To review post CABG complications.

MSES31B ● Quantification of Coronary Stenosis by CTA - Accuracy, Difficulties, and Functional Significance

John W Hoe MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the difference between diagnostic accuracy of coronary CTA for detection of coronary artery stenosis compared to invasive coronary angiography and quantification of coronary stenosis by coronary CTA compared to invasive angiography. 2) To understand the different methods available to quantify coronary stenosis by CTA and also that stenosis can be quantified by diameter stenosis as well as area stenosis. 3) To understand that coronary CTA cannot accurately grade stenosis severity with wide limits of agreement and reasons for this. 4) How to report stenosis seen on coronary CTA and what constitutes significant or severe stenosis. 5) To understand why prediction of myocardial ischemia coronary CTA is limited and what methods are available to try to overcome these limitations.

ABSTRACT
The accuracy of coronary CTA to detect significant coronary artery stenosis (=>50%) compared to invasive angiography, has been well established. In clinical practice, quantification of degree of the stenosis of the coronary artery is expected from referring physicians. Coronary CTA does not perform as well when compared to quantitative coronary angiography (QCA),which is usually used as the gold standard. This is due to difference in spatial resolution. Other factors affecting accuracy of quantification include presence of positive remodeling and interobserver variation in assessing stenosis at invasive angiography or when compared to QCA. Coronary CTA , even if performed with latest generation scanners, currently can only quantify stenosis in 90%-95% of patients to an accuracy of ±25% .Methods of reporting degree of stenosis should follow the broad categories recommended by the SCCT and will influence further management of the patient.. Methods of quantifying stenosis include visual estimation, manual quantification using workstation tools as well as automated software that can quantify stenosis (QCCTA) and how to use there methods and their accuracy will be discussed. Assessment of stenosis is usually based on estimating % diameter stenosis (%DS),after comparison with a reference diameter proximal or distal to the lesion. Use of minimal luminal area (mm2) or percent area stenosis is another technique, which can also be used to help quantify coronary stenosis and may be more reproducible The accuracy of coronary CTA to assess for presence of myocardial ischemia compared to myocardial perfusion imaging is limited using current criterion of => 50% stenosis but is improved using criterion of >70% . New methods to improve prediction of functional significance of stenosis such as using contrast gradient measurements and computational fluid dynamics (CT-FFR) but these are still under investigation.

MSES31C ● Cardiac Masses (CT/MRI)

Ruth P Lim MBBS,MMed (Presenter)

LEARNING OBJECTIVES
1) To review the pros and cons of CT and MRI in the work up of cardiac masses. 2) To discuss optimization of image quality including appropriate patient preparation, and potential challenges including arrhythmia. 3) To review potential mimics of cardiac masses including review of basic anatomy. 4) To review neoplastic and non-neoplastic masses and their appearance at cross-sectional imaging.

ABSTRACT
Cardiac CT and MRI are now firmly within the clinical domain for a number of indications, including mass evaluation. This session aims to discuss the somewhat complementary role of these modalities for this indication. CT offers advantages of speed and relatively high spatial resolution, with clear depiction of macroscopic fat or calcification. MRI is particularly helpful when functional as well as anatomic evaluation is desirable, and offers superior soft tissue contrast without exposure to ionizing radiation. Patient factors may also influence the choice of the most appropriate modality. Sound knowledge of the principles of CT and MRI imaging are necessary to obtain diagnostic quality imaging, and cardiac-specific issues will be discussed, including the limitations that heart rate, rhythm and breath-holding capability may place on imaging parameters. Technical tips for MRI and factors influencing radiation dose for CT will be briefly discussed. Finally, pearls and pitfalls for interpretation will be discussed. Cardiac anatomy will be reviewed, with examples of potential mass mimics and don't-touch lesions, where CT and MRI may play a problem-solving role. Some of the more common and distinctive non-neoplastic masses, and neoplasms will be reviewed, with discussion of imaging features that may help to suggest a benign or malignant etiology.

Cardiac Perfusion Imaging

Tuesday, 08:30 AM - 10:00 AM ● N226

CT CA

RC303 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5

RC303A • FFRCT

Jonathan A Leipsic MD (Presenter) *

LEARNING OBJECTIVES
1) Discuss the current evidence supporting FFR guided revascularization. 2) Provide an overview of the technical background of Fractional Flow Reserve derived from a resting coronary CT angiogram. 3) Review the data validating FFRCT for the detection and exclusion of lesion specific ischemia by invasive FFR.

RC303B • Adenosine Stress/Rest CT

Ricardo C Cury MD (Presenter) *

LEARNING OBJECTIVES
1) To review the available evidence supporting the use of Stress CT perfusion. 2) To understand the importance of combining anatomy and physiology in the non-invasive evaluation of chest pain patients. 3) To describe the limitations and understand the future directions of Stress CTP.

ABSTRACT
A major limitation of coronary CTA is that the physiological significance of stenotic lesions identified is often unknown. Stress myocardial computed tomography perfusion (CTP) is a novel examination that provides both anatomic and physiological information. Multiple single-center studies have established the feasibility of stress myocardial CTP. Furthermore, it has been illustrated that a combined CTA/CTP protocol improves the diagnostic accuracy to detect hemodynamic significant stenosis as compared with CTA alone; this combined protocol can also be accomplished at a radiation dose comparable to nuclear myocardial perfusion imaging exams. Stress CTP is a modality with significant potential, particularly in the evaluation of chest pain patients, given the advantages of short exam time and comprehensive data acquisition. This lecture will summarize the current literature, indications, limitations and discuss future directions of Stress CTP.

RC303C • MRI

Matthys Oudkerk MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand that perfusion MRI can be implemented in every radiology department. 2) Learn how to differentiate normal from abnormal perfusion of the myocardium. 3) Compare the performance of perfusion MRI with other imaging modalities. 4) Identify indications and patient populations for perfusion MRI.

RC303D • Nuclear
Jack A Ziffer MD, PhD (Presenter) *

Mentored Case Approach to Pediatric Cardiovascular Disease 2: Cardiac Disease (An Interactive Session)

Tuesday, 08:30 AM - 10:00 AM ● S402AB

PD CA

RC324 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Director
S. Bruce Greenberg , MD
Director
Rajesh Krishnamurthy , MD *
Rajesh Krishnamurthy , MD *
Frandics P Chan , MD, PhD *
Laureen M Sena , MD

LEARNING OBJECTIVES
1) Understand the morphology, treatment, and long term complications of treated and untreated congenital heart disease via an interactive mentored-case approach with audience response system. 2) Highlight appropriateness of MRI and CT with regard to technique, pitfalls, indications and critical imaging findings that affect management for common imaging scenarios, including conotruncal anomalies, single ventricle, cardiomyopathy and myocarditis. 3) Provide an opportunity for general radiologists, pediatric radiologists and cardiac imagers who have limited exposure to this area in their workplace an opportunity to refresh their pediatric cardiovascular imaging skills in a focused manner.

Cardiac CT Angiography (A Practical Guide) (How-to Workshop)

Tuesday, 08:30 AM - 10:00 AM ● E260

IR CT VA CA

RC350 • *AMA PRA Category 1 Credit* ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Alison Wilcox , MD *

RC350A • Pre-, Peri-, and Postprocedural Care of Cardiac CT Angiography Patients

Bonnie Garon MD (Presenter)

LEARNING OBJECTIVES
1) Review preprocedural patient preparation including appropriate patient selection, beta blockade, contraindications and alternatives beta blockers. 2) Discuss how to manage nonstandard patients (atrial fibrillation, pacemaker, young adults). 3) Periprocedural issues including vasodilation, continued heart rate control, and breathholding requirements. 4) Image acquisition including radiation dose reduction techniques, technique choice, and post CABG patient. 5) Postprocedural complications include contrast reactions and their management.

ABSTRACT
Cardiac CTA involve slightly more preparation than the standard CT acquisition. Heart rate control is the most important aspect that needs to be addressed prior to the patient arriving in the radiology department. Periprocedural issues mostly involved how to optimize technique while having the lowest radiation dose especially in the new age of dose reduction. Almost as important as heart rate management is how to treat postprocedural complications especially contrast reactions. This presentation will discuss these aspects and include treatment options as well as their alternatives.

RC350B ● Clinical Indications for Cardiac CT Angiography

Alison Wilcox MD (Presenter) *

LEARNING OBJECTIVES
1) What is some of the history behind the indications for cardiac CTA. 2) What are the resources available to decide what the clinical indications are for cardiac CTA which may affect reimbursement and patient care. 3) Effectively deliver information to referring clinicians about the uses of cardiac CTA. 4) Discuss indications for cardia cta in the ED. 5) Some examples of these clinical indications and how they can be applied in daily practice.

ABSTRACT
Although there are many studies the prove the usefulness and cost-effectiveness of cardiac CTA, there remains some skepticism in the medical community. Medicare and other private insurance company reimbursements have limited the use of cardiac CTA. Radiologists and referring clinicians need to be aware of the clinical indications for cardiac CTA and what resources are available to them to make these decisions. The resources are available both from radiology and cardiology groups, as well as from the government. This presentation will discuss those resources and provide examples of those indications. In addition a brief discussion of Cardiac CTA in the ED will be included as a potential use to improve patient care and reduce cost to the ED.

RC350C ● Nonatherosclerotic Disease Noted at Cardiac CT Angiography

Jabi E Shriki MD (Presenter)

LEARNING OBJECTIVES
1) Enhance knowledge of normal and abnormal coronary and cardiac anatomy, with an emphasis on differentiating benign from significant variants. 2) Demonstrate the spectrum of nonatherosclerotic congenital and acquired diseases that may affect the coronary arteries. 3) Demonstrate the spectrum of non-atherosclerotic congenital and acquired diseases that may affect the heart.

ABSTRACT
A variety of non-atherosclerotic conditions are detectable on cardiac CT scans, including diseases of the heart, and disease processes which may affect the coronary arteries, or other vascular structures. Cardiac CT has a number of unique advantages in detecting non-atherosclerotic conditions, including congenital and acquired diseases. The focus of this presentation will be non-atherosclerotic conditions of the coronary arteries and of the heart. Variants of normal and abnormal anatomy of the coronary arteries will be discussed, including tips for identifying when coronary anatomic variants are significant. Acquired, non-atherosclerotic diseases of the coronary arteries will also be discussed. This presentation will also discuss the spectrum of non-atherosclerotic diseases of the heart which may be detected at cardiac CT, including congenital and acquired valvular and cardiac diseases. At the end of this exhibit, the viewer will have a better appreciation for abnormal coronary and cardiac anatomy and the broad spectrum of non-atherosclerotic cardiovascular diseases which may be seen at cardiac CT.

Pediatric Radiology Series: Chest/Cardiovascular Imaging I

Tuesday, 08:30 AM - 12:00 PM ● S102AB

PD VA CH CA

VSPD31 ● *AMA PRA Category 1 Credit* ™:3.25 ● ARRT Category A+ Credit:3.5
Moderator
Shreyas S Vasanawala , MD, PhD *
Moderator
Taylor Chung , MD
Moderator
Daniel W Young , MD

VSPD31-01 ● State of the Art MRI and MRI of Congenital Heart Disease

Frandics P Chan MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) To review the MRI environment and anethesia requirements for pediatric patients with congenital heart disease. 2) To understand what MRI can do that echocardiography or catheter angiography cannot, and how this is used to advantage in congenital heart disease. 3) To explore advanced techniques, such as four-dimensional phase contrast imaging, real-time imaging, and non-contrast coronary angiography, that can expedite and increase the capability of cardiac MRI studies.

ABSTRACT
Cardiac MRI is an established imaging tool for the assessment of congenital heart disease in children and adults. The lack of oncogenic radiation makes MRI the preferred tool over CT. However, in young patients who require general anesthesia, the imager should be familiar with the risks involved. While usually safe, general anesthesia has heightened risk in patients with aortic obstruction, pulmonary hypertension, arrhythmia, and ventricular failure. In current clinical practice, the three-dimensional capability of cardiac MRI is used to accurately assess ventricular volume and function. Flow measurement by two-dimensional phase contrast is used to assess shunt ratio, cardiac output, and valvular regurgitation. Comprehensive cardiac MRI examination for a patient with complex congenital heart disease can be time-consuming, and it requires an MRI operator with considerable skill and knowledge of cardiac anatomy. Four-dimensional phase contrast imaging capture a volume of the cardiac anatomy and flow physiology, which can be analyzed by post-processing, thereby simplifying the scan protocol and shortening the study time. Other advanced MRI techniques include real-time and pseudo-gated imaging for fetal studies, delayed-enhancement of myocardium for endocardial fibroelastosis, and MR coronary angiography for coronary anomalies.

VSPD31-02 ● Clinical Validation of Free Breathing Navigator Triggered Retrospectively Cardiac Gated Cine Steady-state Free Precession (NAV-SSFP) Imaging in Sedated Children

Lamya A Atweh MD (Presenter) ; **Amol Pednekar** PhD * ; **Siddharth P Jadhav** MD ; **Esben S Vogelius** MD ; **Raja Muthupillai** PhD * ; **Rajesh Krishnamurthy** MD *

PURPOSE
The cine steady-state free precession (SSFP) is the preferred sequence for ventricular function evaluation, however it requires suspended respiration which is difficult in sedated children. Many groups perform multi-NSA acquisitions (MN) during free breathing. In this work, we validate a navigator triggered SSFP (NAV-SSFP) sequence that drives the magnetization to steady-state before cardiac gated cine acquisition in the sedated free-breathing pediatric population.

METHOD AND MATERIALS
This prospective study was performed with IRB approval on 20 sedated children with congenital heart disease (age: 7±6 yrs, HR: 97±22 bpm, RespR: 22±9 bpm). The cine SSFP sequence was modified to include respiratory triggering with Navigator [1]. Imaging was performed on a 1.5T MR scanner. Identical imaging parameters were used for MN (4 NSA) and NAV sequences, covering both ventricles in short-axis orientation (TR/TE/flip angle: 3/1.5/60◌; acquired voxel size: 1.3-1.6 x 1.3-1.8 x 4-9.5 mm3; SENSE acceleration factor: 2; temporal resolution: 30-45 ms). Image quality assessment (Figure 1) and quantitative volumetric analysis was performed by a single blinded user. One-sided Wilcoxon signed rank test and Box plot analysis were performed to compare the clinical scores. Bland-Altman (BA) analysis was performed on LV and RV volumes.

RESULTS
The clinical scores for NAV-SSFP were consistently better than MN-SSFP (Table 1). Total score with equal weights to each clinical score category was significantly better for NAV compared to MN. EDef scores were significantly better for NAV-SSFP than MN-SSFP. ISA scores were identical. The BMC scores were not significantly different. BA analysis for LV volumes indicates that variability between NAV and MN acquisitions is comparable to inter and intra-observer variability reported in the literature (Table 2) [2]. Total scan duration for NAV-SSFP (4.1±1.6 min) was shorter than MN-SSFP (5.2±0.8 min).

CONCLUSION
Modifying the cardiac gated cine SSFP sequence for free-breathing and navigator triggering allows clinically diagnostic images in sedated patients without penalty for contrast, spatio-temporal resolution, or total scan time while significantly decreasing RF duty cycle and improving spatial detail. 1 ISMRM 3938, 2012 2 JMRI 28(39-50), 2008

CLINICAL RELEVANCE/APPLICATION
Free-breathing navigator triggered cine SSFP allows diagnostic images in sedated patients with improved spacial resolution and shorter scan times.

VSPD31-03 ● Noninvasive 4D Pressure Difference Mapping Derived from 4D Flow MRI in Patients with Repaired Aortic Coarctation: Comparison with Young Healthy Volunteers

Fabian Rengier MD (Presenter) ; **Michael Delles** DiplEng ; **Joachim Eichhorn** MD ; **Hendrik Von Tengg-Kobligk** MD * ; **Hans-Ulrich Kauczor** MD * ; **Roland Unterhinninghofen** PhD ; **Sebastian Ley** MD

PURPOSE
In patients with aortic coarctation, pressure measurements before and after repair currently are obtained by invasive catheterization or by echocardiography using the Bernoulli equation. Purpose of this study was to assess spatial and temporal pressure changes in patients with repaired aortic coarctation compared to young healthy volunteers using 4D flow MRI and derived 4D pressure difference maps.

METHOD AND MATERIALS
4D flow MRI of the thoracic aorta was performed at 1.5T in 13 patients after aortic coarctation repair without recoarctation (mean age 18.8 years, 5 female, 8 male) and 13 healthy volunteers (mean age 22.9 years, 4 female, 9 male). Spatial/temporal resolution was 1.6x1.6x2.1mm^3/28ms. Using published algorithms and in-house developed image processing software, 4D pressure difference maps relative to the proximal ascending aorta were computed based on the Navier-Stokes equation. The thoracic aorta was divided into four segments: ascending aorta, aortic arch, proximal descending aorta and distal descending aorta. For each segment, spatial pressure range at mid systole and maximum slope of local pressure amplitudes were calculated.

RESULTS
Mean spatial pressure range at mid systole for patients/volunteers was (in mmHg): ascending aorta 1.8/1.6 (p=ns), arch 4.8/1.7 (p=0.02), proximal descending 8.9/1.6 (p
CONCLUSION
Noninvasive 4D pressure difference mapping derived from 4D flow MRI showed significant spatial and temporal changes in patients with repaired aortic coarctation compared to young healthy volunteers, particularly affecting aortic arch and proximal descending aorta, but also distal descending aorta. The technique can characterize such changes not only noninvasively but also in greater detail than echocardiographic pressure gradient measurements.

CLINICAL RELEVANCE/APPLICATION
4D pressure difference mapping can characterize spatial and temporal changes of intraluminal aortic pressure and may evolve into a noninvasive alternative to catheterization in coarctation follow-up.

VSPD31-04 ● Assessment of Conduit Size prior to Percutaneous Pulmonary Valve Replacement: Which MR Sequence Is Best?

Ladonna J Malone MD (Presenter) ; **Jane Gralla** ; **Uyen Truong** ; **Brian Fonseca** ; **Thomas Fagan** MD ; **Lorna Browne** MD, FRCR

PURPOSE
The advent of percutaneous pulmonary valve replacement (PVR), providing a nonsurgical approach to the management of severe pulmonary regurgitation in patients with right ventricle to pulmonary artery (RV-PA) conduits, has transformed treatment of patients with repaired congenital heart disease. Cardiac MRI (CMR) is increasingly relied upon to determine candidacy for percutaneous PVR using angiographic size criteria. In order to optimize the CMR assessment, our goal was to determine which pulse sequence had the best agreement with conventional angiographic measurement of the right ventricle to pulmonary artery (RV-PA) conduit obtained during percutaneous PVR.

METHOD AND MATERIALS
15 patients had CMR performed prior to percutaneous PVR procedure. Measurements of the narrowest diameter of the RV-PA conduit were obtained on the following sequences: cine gradient echo (GE) at end-systole and at end-diastole, T1 TSE obtained in systole, 3D gadolinium enhanced MRA, and 3D SSFP. Multiplanar reformats using 3D reconstruction software were used to measure both AP and transverse dimensions on 3D sequences, but only AP diameters if an RVOT plane was obtained (cine GE and T1 TSE). These were compared to angiographic measurements using Bland Altman plots and Intraclass Correlation Coefficient (ICC).

RESULTS
Cine GE measurements at end-systole had the best agreement with angiogram with a mean difference of 0.8 mm (95% limits of agreement -3.86 to 5.46 and ICC 0.75). The AP dimension on 3D MRA also had a high ICC (0.85) and a relatively narrow 95% limits of agreement (-0.89-5.67), but demonstrated a consistent over-measurement bias with a mean difference from angiogram of 2.39 mm. The 3D SSFP measurements demonstrated the worst agreement, likely due to inherent artifacts in stenosed conduits. Slow flow artifact on T1 TSE impaired accurate measurement in irregularly calcified conduits.

CONCLUSION
RV-PA conduit measurements obtained from cine GE at end-systole and 3D MRA demonstrate strongest agreement with conventional angiographic measurements in evaluating percutaneous PVR candidacy.

CLINICAL RELEVANCE/APPLICATION
Standardization of RV-PA conduit measurements with improved angiographic agreement should decrease incidence of unsuccessful percutaneous PVR procedures related to failure to meet size criteria.

VSPD31-05 ● Noninvasive Quantification of Aortopulmonary Collateral Flow and Intracardiac Shunt Flow for the Patients who Underwent Bidirectional Glenn Shunting

Rongpin Wang MD (Presenter) ; **Qiping Deng** MD ; **Meiping Huang** MD

PURPOSE
To explore the feasibility of calculating aortopulmonary collateral flow (APCF) and intracardiac shunt flow (ICSF) in patients underwent bidirectional Glenn shunt (BGS) by using phase-contrast MRI (PC-MRI) sequence.

METHOD AND MATERIALS
Twenty-two BGS patients (patient group) and 15 healthy volunteers (control group) were performed at 3.0 tesla MR system by using PC-MRI sequence to measure the flow of great vessels of right pulmonary artery (RPA), left pulmonary artery (LPA), ascending aorta (AA), superior vena cava (SVC) and inferior vena cava (IVC). The quantity of AA (Q_S), pulmonary (Q_D) and venous return (Q_V) per minute

were calculated by using Report Card software. APCF and ICSF was calculated as the formula: APCF= Q_S-Q_V, ICSF= $2Q_S- (Q_V+Q_P)$. The end-diastolic volume index (EDVI) of major ventricle were performed with cine-MRI sequence, and the regurgitation area of atrioventricular valve were measured with ultrasound cardiography. The difference of Q_P, Q_S and Q_V and blood flow of great vessels intragroup were assessed by using paired samples t-test. The relationship of ICSF with EDVI of major ventricle and with the regurgitation area of atrioventricular valve was evaluated with correlation and regression analysis.

RESULTS
In control group, Q_P: Q_S: Q_V were found to be 1: 1.009: 0.974. In patient group, Q_S was found significantly higher than Q_V, and Q_V was significantly higher than Q_P. The blood flow of great vessels in patient group were found to be significantly lower than that of in control group except the flow of AA, while the regurgitation fraction of great vessels in patient group were found to be significantly higher than that of in control group. The APCF ranged from 0.23 to 1.63 l/min/m² (mean 0.88 l/min/m²), and the ICSF ranged from 0.22 to 1.29 l/min/m² (mean 0.61 l/min/m²). A positive relationship between ICSF and EDVI and the regurgitation area of atrioventricular valve were found (r=0.685, and r=0.806).

CONCLUSION
The parameters of blood flow of great vessels can be reliably measured with PC-MRI sequence on 3.0 tesla MR system. And then, the SPCF and ICSF can be calculated.

CLINICAL RELEVANCE/APPLICATION
The APCF and ICSF can be calculated simultaneously in BGS patients by using phase-contrast MRI sequence, which may play an important role for therapeutic decision-making and evaluating prognosis.

VSPD31-06 ● Evaluation of the Pulmonary Vasculature in Mouse Models of Congenital Diaphragmatic Hernias

Michael Phillips ; **Daku Siewe** BS (Presenter) ; **Joshua C Tan** ; **Scott Moore** ; **Sean McLean** ; **Yueh Z Lee** MD, PhD *

PURPOSE
Congenital diaphragmatic hernia (CDH) is a common birth defect that leads to pulmonary hypertension. Decreased arterial development in the lung contributes to the pulmonary hypertension observed in CDH. The Slit3 knockout mouse is a viable mouse model for CDH that develops pulmonary hypertension (PHtn). We sought to quantitatively assess pulmonary artery blood vessel development using specimen CT scanning of the perfused pulmonary vasculature of mouse models of CDH.

METHOD AND MATERIALS
We perfused the pulmonary vasculature of 3 month old Slit3 wild type mice (no hernia) to Slit 3 knock mice (CDH/PHtn) using a radio-opaque material (microfil) with density tailored to minimize venous contamination. Vessel overfill was determined through examination by microscope. The mouse lungs with the filled vasculature were excised and scanned on a specimen scanner (Scanco microCT 40) at 8 micron resolution. The data was transferred for offline analysis using iNtuition (Terarecon). Vessel branching, length and diameter were measured.

RESULTS
5 wildtype (Slit3) and 5 CDH (Slit3 KO) were scanned. Severe hypoplasia was evident in the lungs from the CDH mice. Total lung volume was decreased in the knockout mice, consistent with the presence of a CDH. Vessel overfill The pulmonary vasculature was also altered, reflecting the abnormal development. Branch by branch vessel quantitation analysis is ongoing.

CONCLUSION
Quantitative analysis of pulmonary vasculature specimens from mice is readily feasible, providing a powerful new tool for the evaluation of mouse models of disease that effect the lung and lung development. We hope to combine our novel methods of in-vivo and ex-vivo imaging of these mouse models of CDH to add to the armamentum of pediatric radiologists. Though the imaging and analysis approaches are demonstrated in mice, the techniques may be readily translatable to clinically relevant imaging.

CLINICAL RELEVANCE/APPLICATION
Quantitiative measures of the pulmonary vasculature are possible in mouse models of CDH, enabling a powerful tool for the evalution of treatment effects that may be translated into children with CDH.

VSPD31-07 ● High Temporal versus High Spatial Resolution in MR Quantitative Pulmonary Perfusion Imaging of 2-year Old Children after Congenital Diaphragmatic Hernia Repair

Meike Weidner (Presenter) ; **Frank G Zoellner** ; **Claudia Hagelstein** MD ; **Stefan O Schoenberg** MD, PhD * ; **Katrin Zahn** ; **Thomas Schaible** ; **Lothar R Schad** PhD ; **Wolfgang Neff** MD, PhD

PURPOSE
Congenital diaphragmatic hernia (CDH) leads to lung hypoplasia. Using dynamic contrast enhanced (DCE) MR imaging, lung perfusion can be quantified. As according to simulations absolute MR perfusion values depend on temporal resolution, we compared two different MR protocols to investigate firstly if impaired ipsilateral lung perfusion is present with both protocols in 2-year old children after CDH repair, secondly if simulation results can be confirmed and thirdly which protocol should be preferred.

METHOD AND MATERIALS
DCE-MRI was performed in 36 children after CDH repair using a 3D TWIST sequence. Two MR protocols were applied: protocol A (n=18) based on a high spatial (3.0sec;voxel size:1.25x1.25x1.25mm3) and protocol B (n=18) on a high temporal resolution (1.5sec;voxel size:2x2x2mm3). 0.05mmol/kg body weight of contrast agent (Dotarem, Guerbet, France) was administered. Pulmonary blood flow (PBF) was calculated for both lung sides by placing 6 cylindrical regions of interest (ROI), apical, middle and basal, in the ventral and the dorsal lung, respectively. Peak signal to noise ratio (PSNR) was calculated.

RESULTS

CONCLUSION
In 2-year old children after CDH repair ipsilateral lung perfusion is significantly reduced. Higher temporal resolution and increased voxel size show a gain of PSNR and significantly decrease the underestimation of PBF. Protocol B should therefore be preferred, as a 2 mm3 isotropic voxel resolution is sufficient to detect side-differences of lung perfusion.

CLINICAL RELEVANCE/APPLICATION
In the long-term follow up of children after CDH, MR-perfusion imaging can help to quantify lung impairment without ionizing radiation. A temporal resolution of 1.5 sec is advisable.

VSPD31-08 ● Translational Experience in the Treatment of Duchenne Muscular Dystrophy (DMD) by Intra-arterial Transplantation of Mesoangioblasts (MABs): From a Toxicity Study in 10 Beagle Dogs to the First, Phase-1 Study in 3 Dystrophic Children

Massimo Venturini MD (Presenter) ; **Giulio Cossu** ; **Letterio S Politi** MD ; **Michele Colombo** ; **Giulia Agostini** ; **Alessandro Del Maschio** MD

PURPOSE
Literature lacks of complete, single-center translational studies. DMD, a genetic syndrome characterized by progressive absence of dystrophin protein, causes progressive muscle degeneration, paralysis and death. Corticosteroids are not effective, while novel therapies (gene/stem cells) are on work. Our aim was to assess MABs intra-arterial infusion in Beagle dogs and, subsequently, in 3 dystrophic children, at escalating dose, to preliminarily assess the safety.

METHOD AND MATERIALS
Every 3 weeks, 10 dogs, under immunosuppressive treatment (cyclosporine-A), were submitted to 4 intra-arterial infusions each (2 in one lower limb, 2 in aorta), of either MABs (n=6) or placebo (n=4). Dogs were sacrificed to assess toxicity after 251 days. One year later, after the approval on behalf of the institutional ethical committee and obtaining written informed consent from the children�s parents, every 2 months 3 DMD children (mean age=10 years) under immunosuppressive treatment (tacrolimus) were submitted to 4 allogeneic MABs intra-arterial infusions each (2 in one lower limb, 2 multidistrict) using a 4-Fr introducer/catheter. Efficacy was assessed every 2 months by quantitative strength measurements (Kin-Com-test) and thighs/legs fibro-fatty degeneration/quantification (MRI), and after 8 months by gastrocnemius biopsies.

RESULTS
No mortality related to MABs in Beagle dogs was recorded. The 12 intra-arterial MABs infusions were regularly performed with no peri-procedural complications, except for one successfully treated vasospasm. The only relevant complication was 1 focal thalamic ischemia of 1-cm (MRI) that occurred 5 hours after the fourth infusion, after sporadic atrial fibrillation (ECG) (Atrial-fibrillation-related-thrombosis? Late vasospasm?), without consequences. Relative stabilization/decrease in disease progression was observed. At MRI, a stabilization of fibro-fatty degeneration was more evident in the child treated at an earlier disease stage.

CONCLUSION
Our translational experience about MABs intra-arterial transplantation in DMD, showed no signs of toxicity in beagle dogs and a relative safe and partial effective in dystrophic children, with encouraging future perspectives.

CLINICAL RELEVANCE/APPLICATION
In DMD, a major MABs intra-arterial concentration, transplanted exclusively in the lower limbs, at an early disease stage, could determine an improvement of dystrophin restoration and clinical impact.

VSPD31-09 ● Coronary Artery Imaging in Children

Cynthia K Rigsby MD (Presenter)

LEARNING OBJECTIVES
1) To provide an overview of the imaging modalities used to image coronary arteries in children. 2) To show examples of anomalies of coronary artery origin, course, and termination. 3) To illustrate coronary artery anomalies associated with congenital heart disease. 4) To demonstrate coronary artery findings in Kawasaki disease.

ABSTRACT
Coronary artery anomalies can be classified as anomalies of origin and course, anomalies of coronary termination, coronary anatomy with congenital heart disease and acquired coronary abnormalities. Normal coronary artery anatomy and an imaging focused discussion of each of the different type of coronary abnormalities will be presented.

VSPD31-10 ● Correlation of CT and MR findings with Surgery for Anomalous Aortic Origin of Coronary Arteries (AAOCA)

Lamya A Atweh MD (Presenter) ; **Carlos M Mery** MD ; **Prakash M Masand** MD ; **Silvana M Lawrence** MD, PhD ; **Dean E McKenzie** ; **Rajesh Krishnamurthy** MD *

PURPOSE
Anomalous aortic origin of the coronary artery (AAOCA) is commonly evaluated with magnetic resonance imaging (MRI) or computed tomography (CT) prior to surgery. Imaging targets include ostial location and morphology, intramurality, and presence of proximal stenosis. Precise description of the AAOCA morphology is important for surgical planning. Our objective is to correlate CT and or MRI with surgical findings in this high-risk population.

METHOD AND MATERIALS
IRB approval was obtained for our retrospective study. We identified all patients with AAOCA who were operated at our institution from 2003-2013. Patients who had no imaging available for review were excluded. Imaging was reviewed by a pediatric radiologist with 13 years of experience in cardiac imaging who was blinded to the results of the surgeries. Studies were assessed for the type of AAOCA, location and morphology of the anomalous ostium, right-left ostial relationship, and presence and length of intramural course. Surgical findings were reviewed for the same variables. The imaging interpretations were compared to the surgical data for concordance.

RESULTS
The patient population consisted of 16 patients (M:F = 10:6; age: 10 years ± 5), with 8 CT and 10 MR exams. 2 patients had both MRI and CT. CT was more accurate than MRI for all imaging targets (Table). MRI accurately predicted the type of coronary artery anomaly (90%) and ostial location (80%), but fared poorly in predicting type of R-L ostial relationship (60%), ostial morphology (10%) and intramurality (30%). Apart from its high accuracy for imaging targets, CT also provided virtual angioscopic views of the ostia that simulated surgical exposure.

CONCLUSION
CT is more accurate than MRI for characterization of critical imaging targets of AAOCA.

CLINICAL RELEVANCE/APPLICATION
CT is more accurate than MRI in defining ostial morphology, ostial relationship and intramural course and should be the imaging method of choice for AAOCA.

VSPD31-11 ● Compression of the Left Anterior Descending Artery during Percutaneous Pulmonary Valve Replacement: The Protective Role of Epicardial Fat?

Ladonna J Malone MD (Presenter) ; **Uyen Truong** ; **Brian Fonseca** ; **Thomas Fagan** MD ; **Lorna Browne** MD, FRCR

PURPOSE
The advent of percutaneous pulmonary valve replacement (PVR), providing a nonsurgical approach to the management of severe pulmonary regurgitation in patients with right ventricle to pulmonary artery (RV-PA) conduits, has transformed treatment of patients with repaired congenital heart disease. Extrinsic compression of the left anterior descending artery (LAD) during percutaneous PVR is a rare but potentially catastrophic complication, necessitating preoperative selective coronary angiogram with test balloon inflation to assess risk. If LAD occlusion is demonstrated, the percutaneous PVR is aborted. Cardiac MRI (CMR) is the gold standard in measuring RV size and optimal timing of PVR. Although LAD anatomy is well delineated on CMR, the minimum separation between the RV-PA conduit and LAD that would prevent LAD compression is unknown.

METHOD AND MATERIALS
16 patients underwent CMR prior to percutaneous PVR. Prior to PVR, 2 patients demonstrated extrinsic compression of the LAD during test balloon inflation while the other 14 did not. CMRs in both groups were retrospectively reviewed and the following data recorded in each: i) shortest distance between LAD and RV- PA conduit, ii) presence of circumferential epicardial fat surrounding the LAD, iii) thickness of conduit calcification, iv) proximal LAD course and v) relative position of the great vessels. Mean distance and minimum distance between LAD and RV-PA conduit were calculated in all patients and parameters in both patient groups compared.

RESULTS
In patients without extrinsic LAD compression, the mean distance from LAD to RV-PA conduit was 6.8 mm. The minimum distance was 1.6 mm. All these patients demonstrated a circumferential cuff of epicardial fat between the LAD and RV-PA conduit. Both patients with LAD compression had no measureable distance (0 mm) between the conduit wall and LAD, and a circumferential cuff of epicardial fat was absent. There was no significant difference in conduit calcification thickness between the two groups.

CONCLUSION
A circumferential cuff of epicardial fat between the LAD and RV-PA conduit decreases risk of extrinsic LAD compression during percutaneous PVR.

CLINICAL RELEVANCE/APPLICATION
The absence of a circumferential cuff of epicardial fat between the LAD and RV-PA conduit on a pre PVR CMR should raise concern for potential LAD compression during percutaneous PVR.

VSPD31-12 ● Cardiovascular CT in Neonates and Infants: Comparison of Effective Radiation Dose between Target-mode Prospective EKG-gated Volumetric CT Using 320 Detector Scanner and Ungated CT Using 64-slice Scanner

Siddharth P Jadhav MD (Presenter) ; **Prakash M Masand** MD ; **Rajesh Krishnamurthy** MD *

PURPOSE
The target mode of prospective EKG gating with the volumetric 320 detector scanner provides cardiac pulsation-related motion compensation for cardiovascular imaging without increasing radiation exposure when compared to ungated volumetric studies. The objective of this study is to compare target mode volumetric imaging (320) to ungated 64 slice imaging (64) for cardiovascular studies in neonates and infants for image quality, diagnostic efficacy and radiation exposure.

METHOD AND MATERIALS
Following IRB approval, a retrospective evaluation of our experience with CTA for cardiovascular indications in neonates and infants aged 0-6 months was performed. 29 patients who underwent ungated imaging with 64 slice scanner from 2010-2012, and 22 patients who underwent volumetric imaging with the target protocol on the 320 detector scanner in 2012-2013 were included. Parameters collected included clinical history, indication for CT, qualitative assessment of image noise and pulsation related blurring, diagnostic efficacy, and radiation dose parameters (CTDI and DLP). Comparison was made to catheterization data and surgical reports for diagnostic accuracy.

RESULTS
The distribution of clinical indications was comparable between the 64 and 320 groups, and included status of branch pulmonary arteries in Tetralogy of Fallot, evaluation of aortopulmonary collaterals or ductal dependent pulmonary flow in pulmonary atresia, anomalous pulmonary venous return, pulmonary vein stenosis, coarctation, heterotaxy, and vascular mediated airway compromise. All studies were diagnostic for the main clinical indication. Average DLP for target 320 studies was 11.6, with average effective dose of 0.75 mSv using conversion tables from ICRP publication 103. Average DLP for 64 slice studies was 63.88, with average effective dose of 4.31 mSv. The 320 studies resulted in higher image quality related to less pulsation artifact, with visualization of coronary origins in all but one case.

CONCLUSION
Volumetric imaging with the target mode offers several advantages over previous generation scanners for cardiovascular indications in infants, including a 82% reduction in effective dose, ability to perform free-breathing studies, and improved image quality.

CLINICAL RELEVANCE/APPLICATION
Volumetric imaging with target-mode of EKG gating offers improved image quality and reduced radiation dose when compared to 64 slice CT for cardiovascular imaging in neonates and infants.

VSPD31-13 ● Radiation Dose and Image Quality Comparison of Three Scan Schemes in Retrospective ECG-gated Coronary CT Angiography for Pediatric Patients

Zhiming Liu MD (Presenter) ; **Yong Li Cao** ; **Yun Peng** MD

PURPOSE
Retrospective ECG-gated coronary CT angiography (CCTA) is often used in children because of their higher heart rates. In this study, we assessed the image quality and radiation dose of three scan schemes in order to select an optimal retrospective CCTA technique for maximum dose reduction.

METHOD AND MATERIALS
60 consecutive patients (ages: 2months - 13years) were randomly assigned to three groups (20 in each group) for retrospectively ECG-gated CCTA with different tube current (mA) selection schemes. The tube voltage was 80kV, gantry rotation speed was 0.35s and helical pitches were between 0.16 and 0.20 based on patient heart rates for all groups. Group A used a fixed 350mA, group B used ECG modulated mA (350mA for 40-80% cardiac phases and 70mA for other phases), and group C also applied patient-dependent mA selection scheme for ECG modulation. The patient-dependent mA selection method was based on the CT value measurement in the scout view for individual patients. Image quality was assessed and image noise and CTDI value were measured for the three groups, and statistically compared with SPSS13.0.

RESULTS
Image noises and their standard deviations were 25.5±4.3HU, 25.0±4.8HU and 24.8±1.2HU, respectively, with no difference among the three groups (p>0.05). Group C had much less deviation in image noise than groups A and B. There were no statistical difference between image quality scores among the three groups (4.3±0.4, 4.4±0.3 and 4.5±0.4, all p>0.05). The effective doses were 4.39mSv, 3.23mSv and 2.34mSv for groups A, B and C, respectively. Dose reductions of 26% and 47% were achieved for groups B and C, respectively, compared with group A with the use of a fixed mA. Group C with the patient-dependent mA for ECG modulation had the lowest effective dose.

CONCLUSION
Patient-dependent tube current scheme in retrospective CCTA for pediatric patients allows us to achieve a desired and consistent image quality across patient population, with the lowest radiation dose to patients.

CLINICAL RELEVANCE/APPLICATION
Low kVp and patient-dependent mA in retrospective CCTA for pediatric patients allows us to achieve a consistent image quality across patient population, with the lowest radiation dose to patients.

VSPD31-14 ● Head Tracked Stereoscopic Pre-surgical Evaluation of Major Aortopulmonary Collateral Arteries in the Newborns

Frandics P Chan MD, PhD (Presenter) * ; **Sergio Aguirre** * ; **Holly Bauser-Heaton** MD, PhD ; **Frank Hanley** MD ; **Stanton B Perry** MD

PURPOSE
Children born with pulmonary atresia (PA) with major aortopulmonary collateral arteries (MAPCA) undergo early surgery to reconstruct their central pulmonary arteries. This surgery, unifocalization, requires precise mapping of all native vessels supplying the lungs and this is currently accomplished by catheter angiography (CA), with supplemental 3D information from CTA. As each patient has his unique vascular anatomy, visual comprehension can be extremely challenging. A recently developed head tracked stereoscopic system, True 3D, helps user manipulate and inspect �holographic� objects in free space. We test the hypotheses that interpretation of CTA in MAPCA cases using True 3D is faster than and as accurate as traditional tomographic readout.

METHOD AND MATERIALS
With IRB approval, newborns less than 10-days old diagnosed with PA and MAPCA, who had CA and CTA of the chest within 2 weeks, were identified between 2007 and 2011. The CA images were evaluated by an experienced cardiologist for the origins and destinations of each native pulmonary artery and MAPCA to the lung segments. The CTA images were similarly scored by a cardiac radiologist using traditional tomographic readout and True 3D in two sessions separated by 4 weeks. Using CA as the reference standard, sensitivity, specificity, accuracy, these two approaches were calculated. Interpretation times were compared using paired Student�s t-test.

RESULTS
9 newborns (mean weight 3.2kg) produced 25 traceable MAPCAs in addition to native pulmonary arteries. Using an 18-segments lung model, 774 distinct vessel-segment combinations were compared. The sensitivity, specificity, and accuracy of tomographic readout are 81%, 93% and 91% respectively. For True 3D, they are 90%, 91% and 91% respectively. The average time for interpretation is significantly shorter with True 3D, 13 +/- 4 min, than with tomographic readout, 22 +/- 7 min (P=0.0004).

CONCLUSION
This preliminary study demonstrates that head tracked stereoscopic interpretation of complex, minute pulmonary vessels in the newborn is as accurate as traditional readout.. The interpretation time is significantly faster with True 3D, and this is likely due to enhanced visual cognition using the stereoscopic approach.

CLINICAL RELEVANCE/APPLICATION
Advanced digital stereoscopy enhances visual cognition of complex anatomic relationship and is recommended for the evaluation of congenital anomalies of the pulmonary vasculature.

VSPD31-15 ● Determining the Normal Aorta Size in Infants and Children

S. Bruce Greenberg MD ; **Shilpa Hegde** MD (Presenter) ; **Shelly Lensing**

PURPOSE
No adequate standards for determining the normal range of effective diameters of the aorta or iliac arteries in children using CT or MRI exist. Our purpose is to establish normal standards for the effective diameter of the aorta at multiple levels and of the iliac artery origins.

METHOD AND MATERIALS
Chest, abdomen and pelvis computed tomography examinations with intravenous contrast performed in children without cardiovascular disease provided the data sets. Body surface area (BSA) was calculated from patient height and weight for each patient. Children age ranged from 0 to 20 years (mean 9.5 years, sd 5.7). Body surface area ranged from 0.2 to 2.5 meter^2 (mean 1.23 meter^2, sd 0.59). Chest measurements were performed on 88 children and abdomen measurements on 110 children. Double-oblique 1 mm reconstructions were used to measure aorta and iliac artery effective diameter at multiple locations by two pediatric radiologists. Pearson correlation and linear regression compared the body surface area and effective diameter measurements.

RESULTS
The results are summarized in the table. Very strong correlation between BSA and effective diameter were present at all measured levels of the aorta and the iliac arteries. The derived linear regression equations and beta standard error are included in the table. **Aorta or iliac artery level Pearson correlation Effective diameter (mm) Beta S.E.** aorta annulus 0.94 10 + (7.8) BSA 0.30 sinus of Valsalva 0.93 11.8 + (9.5) BSA 0.41 STJ 0.90 8.9 + (8.2) BSA 0.43 Ascending aorta 0.91 9.1 + (8.6) BSA 0.43 Aorta arch 0.93 6.8 + (8.2) BSA 0.35 Isthmus 0.94 6.5 + (7.1) BSA 0.29 Prox desc aorta 0.93 6.5 + (6.6) BSA 0.29 Aorta at diaphragm 0.93 6.2 + (5.2) BSA 0.24 Superior to celiac axis 0.92 5.8 + (5.2) BSA 0.22 Renal artery level 0.91 4.2 + (5.0) BSA 0.22 Distal abdominal aorta 0.91 4.0 + (4.6) BSA 0.21 Right iliac artery 0.88 2.8 + (3.2) BSA 0.17 Left iliac artery 0.89 2.9 + (3.1) BSA 0.16

CONCLUSION
The expected effective diameter for children of any expected body surface area can be calculated from the equations at 8 levels in the chest and three levels in the abdomen. The common iliac artery effective diameters can also be calculated.

CLINICAL RELEVANCE/APPLICATION
The linear regression analysis equations allow radiologists to quantitatively determine if the aorta is hypoplastic or aneurysmal in children rather than rely on subjective impression.

VSPD31-16 ● Imaging of Adolescents and Young Adults with Congenital Heart Disease

Lorna Browne MD, FRCR (Presenter)

LEARNING OBJECTIVES
1) Describe the relevant complex cardiac anatomy encountered in CHD adolescents and young adults, many of whom have undergone prior surgical repairs. 2) Describe the most likely lesions encountered in CHD adolescents and young adults. 3) Discuss some common surgical repairs and encountered complications. 4) Determine appropriate MR protocols for evaluating congenital heart disease according to the anatomic, pathologic, and hemodynamic characteristics of the defect and type of previous surgical repair. 5) Discuss the main clinical questions that are specifically posed in individual cases of pre and post operative CHD in adolescents and young adults.

Cardiac (Coronary CT/MR III)

Tuesday, 10:30 AM - 12:00 PM ● S504AB

IR CT CA

SSG03 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
    Moderator
    Jill E Jacobs , MD
    Moderator
    Robert M Steiner , MD *
    Moderator
    Srini Tridandapani , PhD, MD

SSG03-01 ● Submillisievert Radiation Dose Coronary CT Angiography: Clinical Impact of the Iterative Model Reconstruction (IMR) with Low kVp Scan

Takeshi Nakaura MD (Presenter) ; **Shinichi Tokuyasu** RT * ; **Masafumi Kidoh** ; **Shinichi Nakamura** MD ; **Kazunori Harada** ; **Yasuyuki Yamashita** MD * ; **Ryo Itatani**

PURPOSE
Recently, the submillisievert radiation dose coronary CT angiography becomes clinically available by the techniques such as the iterative reconstruction technique, prospective ECG gating and low kVp setting. However, increased image noise is a problem except the extremely small body size patients. The purpose of this study was to evaluate the usefulness of the recent introduced iterative model reconstruction (IMR, Philips Healthcare) in ultra-low dose cardiac CT.

METHOD AND MATERIALS
This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. We performed submillisievert radiation dose coronary CT angiography (CTA) to 25 patients who had suspicious or past history of ischemic heart disease. We also performed phantom study to evaluate the influence of object size with AEC phantom (CT-AEC Cone Phantom, Kyoto Kagaku). We reconstructed clinical and phantom studies with filtered back projection (FBP), hybrid-iterative reconstruction (iDose^4) and IMR. We compared CT number, image noise and contrast noise ratio (CNR) in ascending aorta of each reconstruction technique. We compared relationship between image noise and body mass index (BMI) for clinical study, and object size for phantom study.

RESULTS

Calculated effective dose of patients was 0.98 mSv. The image noise of IMR reconstructed images is significantly lower than that of FBP and iDose[4] reconstructed images (IMR: 16.7±2.8; FBP: 67.5±14.5; iDose[4]: 28.3±5.9, respectively) (p4 (r = 0.42, p < 0.01); however, this correlation was not significant in IMR reconstruction technique (r = 0.31, p = 0.14). The phantom study suggested that there are the exponential regressions between image noise and object size in each reconstruction technique, and image noise of IMR reconstructed images were about 36% less influenced by the object size than that of FBP and iDose[4] reconstructed images.

CONCLUSION
The IMR reconstruction offers stable and dramatic noise reduction in ultra low dose cardiac CT in various patient size as compared with FBP and iDose[4] reconstruction.

CLINICAL RELEVANCE/APPLICATION
The IMR reconstruction offers stable and dramatic noise reduction, and it might offer submillisievert radiation dose coronary CTA for most patients with diagnostic image quality.

SSG03-02 ● Impact of 100-kV on Image Quality, Noise and Radiation Dose of Coronary Angiography with 320-row CT in Patients with Different Body Mass Index

Liu H Yan (Presenter) ; **Yang Dongliang** ; **Xing Chen** * ; **Haibo Zhou** ; **Qingqian Zeng** ; **Huang Junyi**

PURPOSE

METHOD AND MATERIALS

RESULTS

CONCLUSION
The 100kV setting is feasible for patients with BMI
CLINICAL RELEVANCE/APPLICATION
This method of 320-row CTCA has been used in dailly clinic works.

SSG03-03 ● Is Coronary Artery Imaging Feasible with Non-ECG-Triggered CT? Comparison of Image Quality and Radiation Dose of Non-ECG-Triggered High-Pitch Dual-source CT Angiography Versus Non-ECG-Triggered Standard-Pitch CT Angiography of Thoracoabdominal Aorta

Sung Mok Kim MD (Presenter) ; **Hee Young Lee** MD ; **Eun Young Kim** MD ; **Sohee Song** ; **Yeon Hyeon Choe** MD, PhD

PURPOSE
The purpose of this study was compare image quality of coronary arteries and radiation dose in patients undergoing non-ECG-triggered high-pitch helical CT or non�ECG- triggered helical CT of thoracoabdominal aorta. To evaluate average heart rate(HR) required for diagnostic imaging of coronary arteries with high-pitch dual-source CT angiography(CTA) of thoracoabdominal aorta, we also compared image quality of coronary arteries in patients undergoing high-pitch helical CT based on the HR.

METHOD AND MATERIALS
We retrospectively assessed data from 137patients(77men, 60women; mean age, 59±15[SD] years) undergoing CTA of thoracoabdominal aorta on 128-slice dual-source scanner using either non-ECG-triggered high-pitch helical mode(group1, n=92) or non�ECG-triggered standard-pitch helical mode(group2, n=45). Group1 was divided into two subgroups according to HR. Group1A was defined as patients with HR
RESULTS
Interobserver agreement on grade of image quality for 1,507 coronary segments evaluated by both observers was good(?=0.68). In group1, diagnostic image quality was found for 963 of 1,012segments(86.1%) in 92patients(95.2%).Whereas, in group2, diagnostic image quality was found in 3 of 45patients (6.6%). Average HR was 53.4±4.8 in group1A and 73.2±11.7 beats/min in group1B. However, within group1, average, HR was not significantly higher in patients with at least one nondiagnostic coronary segment compared with those without. All patients with average HR less than 60beats/min had diagnostic image quality in all coronary segments. Group 2 scans displayed higher image noise at root of aortic valve. Effective radiation dose was lower in group1(mean±SD, 4.3±0.7mSv) than group2(5.4 ±1.2mSv).

CONCLUSION
Coronary artery imaging is feasible with non-ECG-triggered high-pitch CTA, especially in patients with lower HR. Thoracoabdominal aorta CTA with non-ECG-triggered high-pitch mode provides higher quality images of aortic valves and coronary arteries with lower effective radiation doses compared with non�ECG-triggered standard-pitch helical CT.

CLINICAL RELEVANCE/APPLICATION
Coronary artery imaging is feasible with non-ECG-triggered high-pitch CTA, especially in patients with lower HR.

SSG03-04 ● Application of a Novel Motion Correction Algorithm in Prospective ECG-gated Coronary CTA of Patients with Relative High Heart Rates: Preliminary Study

Peng-Yu Li (Presenter) ; **Qianwen Li** ; **Zhuangzhi Su** ; **Xinyu Yao** ; **Xiangying Du** MD ; **Kuncheng Li** MD

PURPOSE
Prospective ECG-gated CT coronary CTA was usually carried out under low heart rates because of limited temporal resolution. Our study is to evaluate the effect of a novel motion correction algorithm (SnapShot Freeze, SSF) in improving the image quality of patients with relative high regular heart rates using the prospective ECG-gated scan mode.

METHOD AND MATERIALS
Patients with heart rates ranged from 65 to 75bpm underwent prospective ECG-gated CTCA using a 64-slice high definition CT system (GE, Discovery HD750). The X-ray exposure covered both the end-systole and middle-diastole of cardiac cycle. All image datasets were reconstructed at the optimal phase for each coronary artery with (group B) or without SSF (group A). Two experienced readers independently analyzed the image datasets according to a standard 15-segment model and a 5-score method (based on the interpretability of vessels in axial images): very poor(1), poor(2), adequate(3), good(4), and excellent(5). The coronary vessels with diameter no less than 1.5mm were accessed. Scoring discordance was assigned by the third reader for consensus. X2 test of paired comparison of enumeration data was used to test the difference in image quality between group A and B on per-segment level. Values of P< 0.05 were considered to reveal statistically significant differences.

RESULTS

CONCLUSION
Motion correction algorithm is useful in improving the image quality of patients with relative high heart rates in prospective ECG-gated coronary imaging.

CLINICAL RELEVANCE/APPLICATION
As a new method to reduce the motion artifact of coronary artery, SSF will expand the use of prospective ECG-gated coronary CTA to higher heart rates and subsequently reduce patients radiation dose.

SSG03-05 ● Coronary CT Angiography Visualization of Coronary Plaques: An Investigation of Intraluminal Appearances and Correlation of Left Bifurcation Angulation with Plaque Formation

Zhonghua Sun PhD (Presenter)

PURPOSE
The aim of this study was to characterize the intraluminal appearances of coronary plaques and identify the relationship between left coronary bifurcation angle and plaque formation using coronary CT virtual intravascular endoscopy (VIE).

METHOD AND MATERIALS
Fifty patients suspected of coronary artery disease undergoing coronary CT angiography were included in the study. 3D VIE images were generated to visualize the intraluminal appearances of coronary wall due to presence of coronary plaques. Left coronary bifurcation angle formed by left anterior descending (LAD) and left circumflex (LCx) was measured on 3D volume rendering and multiplanar reformatted images to determine the relationship between plaque formation and corresponding coronary dimensional changes.

RESULTS

CONCLUSION
VIE provides unique information about intraluminal appearances of coronary wall due to presence of plaques. There is a direct correlation between atherosclerotic changes and coronary angulation at the left coronary artery, with wide angles leading to high risk of plaque formation and corresponding coronary diameter changes.

CLINICAL RELEVANCE/APPLICATION
Wider bifurcation angles are closed related to the presence of plaques in the left coronary artery, thus leading to the development of coronary artery disease, with subsequent coronary diameter change

SSG03-06 ● Effect of a Novel Motion-correction Algorithm in the Improvement of Image Quality of Coronary CTA with Higher Heart Rates

Xiangying Du MD (Presenter) ; **Kuncheng Li** MD

PURPOSE
To verify the motion correction effect of a novel algorithm in coronary CTA of patients with higher heart rates

METHOD AND MATERIALS
15 patients with high heart rate (67bpm-85bpm, 73.7±5.5bpm) underwent retrospective ECG-gated coronary CTA using a GE CT scanner (GE Discovery CT750HD) with a speed of 0.35s/rotation. Images at 30%-80% R-R interval were reconstructed with single sector reconstruction at 5% intervals to select the best phase at end-systole and middle-diastole. Based on the best phasing, a motion correction algorithm (Snap shot freezing, SSF) was carried out to reconstruct the SSF images at the corresponding phases. In accordance with AHA staging, the right coronary artery was divided into three sections for evaluation. All images were independently assessed by 2 experienced radiologists who were blinded to each other. Image quality was graded with a 5-point scale and the images from the two reconstruction methods were compared accordingly.

RESULTS
A higher score of image quality was achieved at the SSF group. In end-systole, through the application of SSF algorithm, the rate of qualified images increased from 86.7% to 94.4%, with 58.3% of the images of 2 points increased to 3 points or more. While in middle-diastole, the rate of qualified images increased from 48.9% to 67.8%, with 50% of the images of 2 points increased to 3 points or more.

CONCLUSION
SSF can be used to improve the image quality of coronary CTA in higher heart rates

CLINICAL RELEVANCE/APPLICATION
The SSF algorithm is an effective way to improve image quality of coronary CTA in higher heart rates.

SSG03-07 ● What Is the Clinical Utility of Computed Tomography Angiography in Patients with a Previous Functional Test?

Maria C Ziadi MD (Presenter) ; **Juan Manuel Montero** ; **Juliana Fiorenza** ; **Roberto L Villavicencio** MD

PURPOSE
Computed tomography angiography (CTA) represents an excellent imaging modality to exclude obstructive coronary artery disease (CAD) noninvasively. We sought to assess the utility of CTA in patients (pts) without overt CAD and a previous functional test.

METHOD AND MATERIALS
Among 133 consecutive adult pts who underwent CTA, 78 pts (58.6%) had a previous functional study (^{99m}Tc SPECT, an exercise treadmill test (ETT) or a stress Echo) = 6 months. Test conclusions were categorized as follows: normal; abnormal due to ischemic ECG response; equivocal o inconclusive; myocardial ischemia; and/or necrosis. Coronary artery lumen on CTA was considered: normal=0%, mild= 1-49%, moderate= 50-69% and severe =70% stenosis. Obstructive CAD was defined as a =50% stenosis in any major vessel. Pre-test likelihood of CAD was considered : low, intermediate or high according to Diamond and Forrester classification.

RESULTS
Mean age was 56 ±14 years old, 42 pts were males. Most pts had a low (n=42) and intermediate (n=31) pre-test likelihood of CAD. A total of 58 pts (74%) had a previous SPECT, 17 pts (22%) an ETT and 3 pts (4%) a stress Echo. The prevalence of obstructive CAD was 19% (n=15). In 4 out of 15 pts (27%) with a normal test, CTA uncovered obstructive CAD. In 10 out of 14 pts (72%) with an ischemic ECG response, CTA showed 0% coronary stenosis, in 3 pts (21%) mild CAD and in 1 pt (7%) moderate CAD. Most pts with an equivocal or inconclusive test (n=26/29, 90%) presented not hemodynamically significant CAD. Among pts with myocardial ischemia (n=17), 6 pts (35%) had 0% stenosis, 5 pts mild CAD (29%) and 6 pts (36%) obstructive CAD. One out of 3 pts (34%) with a previous SPECT suggestive of necrosis had non-obstructive CAD on CTA .

CONCLUSION
CTA is clinically useful in pts with a previous false negative functional test. An ischemic ECG response may be associated with non-obstructive CAD, subject to secondary prevention. CTA is valuable to rule out significant CAD in pts with attenuation artifacts on SPECT, often mislabelled as necrosis or ischemia, and particularly in pts with a previous equivocal test.

CLINICAL RELEVANCE/APPLICATION
CTA yields high negative predictive value to exclude obstructive CAD, specially in intermediate risk pts and in those with previous equivocal tests. CTA provides additional data to functional imaging.

SSG03-08 ● 256-slice CT Angiographic Evaluation of Coronary Artery Bypass Grafts: Effect of Heart Rate, Heart Rate Variability and Z-axis Location on Image Quality

Bettina M Gramer MD (Presenter) ; **Patricia Diez Martinez** MD ; **Anne S Chin** MD ; **Nicolas Noiseux** MD, MSc ; **Ernst J Rummeny** MD ; **Carl Chartrand-Lefebvre** MD *

PURPOSE
To assess the effect of heart rate (HR), heart rate variability (HRV) and z-axis location on coronary artery bypass graft (CABG) image quality using 256-slice CT.

METHOD AND MATERIALS
Approval was obtained by the institutional review board and written informed consent provided by all subjects. This prospective study

includes 78 consecutive patients (71 men; age 68.6 ± 7.5 years) for a total of 254 CABG (762 graft segments) (postoperative time 23.5 ± 16.4 mo) which underwent 256-slice CT, with 270-msec gantry speed rotation and prospective ECG-gating. The standard deviation of patient HR was used for HRV measurement. Two observers rated graft segments for image quality (5-point scale). Predictors of image quality were assessed with logistic and cumulative link mixed models.

RESULTS
Mean HR during scan was 59.7 ± 9.8 bpm (range 38-98 bpm), and mean HRV 7.2 ± 1.6 bpm. Prescan beta-blockers were used in 37 patients (47.4%). Mean CT coverage was 251.9 ± 28.7 mm. Graft image quality was judged as diagnostic (scores 5 (excellent), 4 (good) and 3 (moderate)) in 96.6% of the 762 segments, with excellent interobserver agreement (kappa values = 0.90). Low quality scores were significantly associated with HRV = 1 bpm, with an odds ratio (OR) of 4.31 (95% confidence interval (CI) 1.10 - 16.84; p = 0.036). Association between low scores and body-mass index was near significance level (p = 0.053), with an OR of 1.15 (95% CI 1.00 � 1.32). There was no significant association between quality scores and HR, age, prescan nitroglycerine, NYHA class and LV ejection fraction. Quality scores were in the diagnostic range (scores 3-5) in 99.4% of proximal graft segments, as well as in 97.2% and 93.2% of middle and distal graft segments, respectively. Scores were significantly lower in distal segments, more susceptible to cardiac motion (p values = 0.02).

CONCLUSION
CABG imaging with 270-msec rotation 256-slice MDCT and prospective ECG-gating showed an adequate image quality in 96.6 % of graft segments, and an excellent interobserver agreement. Graft image quality was not influenced by HR level. Image quality scores were however significantly decreased in patients with high HRV, as well as in distal graft segments.

CLINICAL RELEVANCE/APPLICATION
With 270-msec rotation 256-slice CT, CABG image quality is significantly decreased with high HRV and in distal segments near to the heart. Beta-blockers should still be considered for CABG imaging.

SSG03-09 ● Prospective ECG-gated Coronary CT Angiography: Clinical Value of Noise-based Tube Current Reduction Method with Iterative Reconstruction

Junlin Shen (Presenter) ; **Kuncheng Li** MD ; **Xiangying Du** MD ; **Daode Guo** ; **Yan Gao** MD ; **Lizhen Cao** ; **Jiabin Liu**

PURPOSE
We developed the noise-based tube current reduction method, which was used to calculate the required tube current to obtain the desired noise according to the test bolus image noise measurement. The aim of this study was to evaluate the clinical value of noise-based tube current reduction method with iterative reconstruction for obtaining consistent image quality with dose optimization in prospective electrocardiogram (ECG)-gated coronary CT angiography (CCTA).

METHOD AND MATERIALS
We performed a prospective randomized study evaluating 338 patients undergoing CCTA with prospective ECG-gating. Patients were randomly assigned to fixed tube current with filtered back projection (Group 1, n=113), noise-based tube current with filtered back projection (Group 2, n=109) or with iterative reconstruction (Group 3, n=116). Tube voltage was fixed at 120 kV. Qualitative image quality was rated on a 5-point scale (1= impaired, to 5= excellent, with 3-5 defined as diagnostic). Image noise and signal intensity were measured; signal-to-noise ratio was calculated; radiation dose parameters were recorded. Statistical analysis included one-way analysis of variance, chi-square test, Kruskal-Wallis test and multivariable linear regression.

RESULTS
Image noise was maintained at the target value of 35 HU with small interquartile range for Group 2 (35.00-35.03 HU) and Group 3 (34.99-35.02 HU), while from 28.73 to 37.87 HU for Group 1. All images in the three groups were acceptable for diagnosis. A relative 20% and 51% reduction in effective dose for Group 2 (2.9 mSv) and Group 3 (1.8 mSv) were achieved compared with Group 1 (3.7 mSv). After adjustment for scan characteristics, iterative reconstruction was associated with 26% reduction in effective dose.

CONCLUSION
Noise-based tube current reduction method with iterative reconstruction maintains image noise precisely at the desired level and achieves consistent image quality. Meanwhile, effective dose can be reduced by more than 50%.

CLINICAL RELEVANCE/APPLICATION
Noise-based tube current reduction method with iterative reconstruction can further reduce radiation dose while maintaining consistent image quality in coronary CT angiography.

Cardiac - Tuesday Posters and Exhibits (12:15pm - 12:45pm)

Tuesday, 12:15 PM - 12:45 PM ● Lakeside Learning Center

CA

LL-CAS-TUA ● *AMA PRA Category 1 Credit* ™:0.5
  Host
  Bernd J Wintersperger , MD *
  Host
  E. Kent Yucel , MD

LL-CAS-TU1A ● Feasibility of Phase-contrast Computed Tomography to Differentiate Types of Coronary Atherosclerotic Plaque in Comparison with Histopathology

Fabian Bamberg MD, MPH (Presenter) * ; **Tobias Saam** MD * ; **Christopher Habbel** ; **Julia Herzen** ; **Marian Willner** ; **Holger Hetterich** MD ; **Michael Chabior** ; **Franz Pfeiffer**

PURPOSE
Phase-contrast computed tomography (PCT) is a novel imaging technology providing high-resolution, non-destructive histpathology with improved soft-tissue contrast. Early evidence indicates that atherosclerotic plaque components, such as fibrous and lipid-rich tissue can be visualized. In this ex-vivo validation study we determined the ability of a laboratory-based PCT to differentiate atherosclerotic plaque lesions as classified histopathologically according to the American Heart Association (AHA).

METHOD AND MATERIALS
In this ex-vivo validation study we examined ten human coronary artery specimens using a laboratory-based PCT set-up consisting of X-ray tube (35kV) and grating-interferometer with an effective pixel size of 100�m). Following histopathology (1 mm sections), image data sets were matched independently using anatomical landmarks. Atherosclerotic plaques were classified using modified AHA criteria as normal/type I-II, III, IV/V, VI, VIIor VIII by an experienced vascular pathologist. Conventional measures of diagnostic accuracy applying histopathology as the goldstandard were derived taking into account the clustered data structure.

RESULTS
A total of 286 corresponding histopathology/PCT sections were included in the analysis, 25 (8%) were excluded due to impaired image quality. In histopathology, the prevalence of plaque was high (>10% for all plaque types) with 19.3% sections were classified normal/type I-II. Overall, PCT detected all sections with any atherosclerotic change (sensitivity: 100%) with high level of agreement across all lesion types (?: 0. 78). Specifically, the diagnostic accuracy was highest for type VII and type VI lesions (sensitivity: 100% and 93%; specificity: 95% and 91%; respectively), and lowest for type VIII lesions (82% and 79%). Also, the diagnostic accuracy for

normal/type I-II was high (85%, specificity: 80%).

CONCLUSION
Our initial results suggest that in an experimental laboratory set-up PCT can accurately visualize and differentiate atherosclerotic lesions types in human coronary arteries.

CLINICAL RELEVANCE/APPLICATION
Phase-contrast computed tomography might provide high-resolution coronary atherosclerotic plaque imaging with improved soft-tissue resolution in an ex-vivo setting.

LL-CAS-TU2A ● Three-dimensional Phase-sensitive Inversion Recovery Sequence in the Evaluation of Left Ventricular Myocardial Scar: Comparison to Three-dimensional Inversion Recovery Sequence

Tomoyuki Kido (Presenter) ; **Masashi Nakamura** ; **Yuki Tanabe** ; **Rami Yokoyama** ; **Takuya Matsuda** ; **Yoshiko Nishiyama** MD ; **Naoto Kawaguchi** MD ; **Teruhito Kido** ; **Masao Miyagawa** MD, PhD ; **Teruhito Mochizuki** MD

PURPOSE
The most widely used pulse sequence type to depict late gadolinium enhancement (LGE) in myocardium is inversion recovery (IR) method. Recently, the phase-sensitive inversion recover (PSIR) method has been developed to detect LGE. The aim of this study was to compare 3D PSIR to an established 3D IR method for to detect myocardial scar caused in ischemic and non-ischemic cardiac diseases.

METHOD AND MATERIALS
A hundred consecutive patients who were suspected of myocardial scar were prospectively examined LGE magnetic resonance image (MRI) on a 3 Tesla MR scanner using IR followed by PSIR method. The image quality was scored by two independent readers using a four-point scale. The volume of the LGE was calculated using a semi-automated method based on signal-intensity thresholds with dedicated software. The distribution area of LGE in 16-segment was scored by the proportion of LGE to each segment (0%, 1� 25%, 26� 50%, 51� 75%, 76� 100%). The volume and distribution area of LGE was quantitatively compared between the two methods.

RESULTS
The image quality score did not differ significantly in both methods (p=0.22, Wilcoxon test). PSIR improved the image quality in 6/7 patients whose image quality was poor or fair in IR. LGE were detected and the image quality was acceptable in 58 patients (21 patients with ischemic cardiac disease, 37 patients with non-ischemic cardiac disease). There was strong correlation in LGE volume between the IR and PSIR results (R^2=0.96; P
CONCLUSION
The 3D PSIR method improves the diagnostic performance and quantitative assessment of LGE in patients with non-ischemic cardiac disease.

CLINICAL RELEVANCE/APPLICATION
The PSIR sequence is a promising approach to assess left ventricular myocardial scar.

LL-CAS-TU3A ● Evaluation of the Efficacy of Vector Dynamic Analysis on Motion Artifact Reduction of Coronary CT Angiography

Junichi Kishimoto (Presenter) ; **Yasutoshi Ohta** MD ; **Yasuhiro Kaetsu** ; **Toshihide Ogawa** MD

PURPOSE
The aim of this study was to evaluatethe efficacy of vector dynamic analysis on motion artifact reduction of coronary CT angiography.

METHOD AND MATERIALS
A total of 60 patients underwent coronary CT angiographyusing multidetector CT scanner (DiscoveryCT 750HD, Freedom Edition: GE) with ECG-gated helical scan. Motion artifact collection software (Snap Shot Freeze: SSF, GE) was applied to reduction of motion artifact. Two datasets with and without SSF between 30% and 85% of the R-R interval in 5% increments were reconstructed. For both images with and without SSF, the motion artifact was evaluated on a 3-point scale (0=no motion artifact, 1=visible motion artifact but clear visualization of coronary lumen, 2=blurring of coronary lumen which can make evaluation of coronary lumen stenosis impossible) for each coronary artery (right coronary artery; RCA, left main trunk; LMT, left anterior descending coronary artery; LAD,left circumflex coronary artery; LCX).The score of 0 or 1 was considered as clinically acceptable. The worst score of the arterial segment was assigned to the score of the each coronary artery. The worst score of the each coronary artery was assigned for the patient score.

RESULTS

CONCLUSION
SSF using vector dynamic analysis in coronary CT angiography is useful for motion artifact reduction in a wide range of cardiac cycle.

CLINICAL RELEVANCE/APPLICATION
Motion artifact collection software based on vector dynamic analysis can improve the image quality and success rate of coronary CT angiography.

LL-CAS-TU4A ● T1 Contrast in the Myocardium and Blood-pool: A Quantitative Assessment for Gadofosveset Trisodium and Gd-DTPA at 1.5 T and 3 T

Kai Lin MD, MSc (Presenter) ; **Donald Lloyd-Jones** MD ; **Bruce Spottiswoode** PhD * ; **Xiaoming Bi** PhD * ; **Ying Liu** MD, PhD ; **Biao Lv** MD ; **Huadan Xue** MD ; **Yining Wang** MD ; **Debiao Li** PhD ; **James C Carr** MD *

PURPOSE
To assess T1 contrast (T1c) evolution between major cardiovascular tissues, commmon used contrast media and standard magnetic field strengths.

METHOD AND MATERIALS
This HIPPA compliant study was IRB approved and written inform consent was obtained from all participants. Eight healthy volunteers were recruited to undergo 4 consecutive MR scans with the same imaging parameters. Scans 1 and 2 were performed on a 3 T MR scanner and scans 3 and 4 were performed on a 1.5 T MR scanner. Gadofoveset trisodium (0.03mmol/Kg) was injected for scans 1 and 3, and Gd-DTPA (0.01mmol/Kg) was applied for scans 2 and 4. Modified Look-Locker Inversion recovery (MOLLI) T1 maps with a mid-ventricular short-axis view were acquired pre-contrast and repeated every 5 minutes until 45 minutes after the contrast agent administration. T1c-tissue (T1-myocardium - T1-blood), T1c-media (T1-Gd-DTPA - T1-Gadofosveset) and T1c-field (T1-3T - T1-1.5T) were calculated and compared by using t-tests.

RESULTS
The 3 T scanner provided a significantly larger T1c-tissue between the myocardium and blood-pool than did the 1.5 T scanner at 9 post-contrast time points induced by both gadofosveset trisodium (205.7 ± 30.0 ms vs. 189.0 ± 24.3 ms, p < 0.001) and Gd-DTPA (118.4 ± 46.1 ms vs. 91.6 ± 37.3 ms, p < 0.001). The T1c-tissue induced by Gd-DTPA decayed more rapidly than that induced by gadofosveset trisodium at both 1.5 T (94.2 ± 24.3 ms vs. -8.1 ± 27.8 ms, p < 0.001) and 3 T (100.3 ± 21.8 ms vs. -1.22 ± 24.9 ms, p < 0.001) during the 45-minute time window. The 1.5 T scanner provided a significant larger T1c-media than did the 3 T scanner in the myocardium (251.6 ± 60.3 ms vs. 134.8 ± 62.4 ms, p < 0.001) and blood-pool (348.9 ± 90.2 ms vs. 222.0 ± 88.2 ms, p < 0.001). Gadofosveset trisodium provided significantly larger values of T1c-field in the myocardium (214.9 ± 40.7 ms vs. 98.1 ± 40.0 ms, p < 0.001) and blood-pool (198.1 ± 42.2 ms vs. 71.2 ± 43.0 ms, p < 0.001) than did Gd-DTPA. See figure 1 for the trends of T1c evolutions and a typical case.

CONCLUSION

Post-contrast T1c is affected by timing, contrast agent type and magnetic field strength under general physical conditions. Our results provided useful benchmark data describing different T1c evolutions for two contrast media at standard magnetic field strengths.

CLINICAL RELEVANCE/APPLICATION
The behavior of T1c is useful for optimizing MR imaging protocols for the quantitative evaluation of cardiovascular diseases in clinical studies.

LL-CAS-TU5A • Cardiac Mortality and Morbidity in Breast Cancer Survivors after Radiation Therapy-Is Coronary Atherosclerosis the Culprit?

Paul Apfaltrer MD (Presenter) ; U. Joseph Schoepf MD * ; James R Spears BS ; Lothar R Pilz ; Stefan O Schoenberg MD, PhD * ; Rozemarijn Vliegenthart MD, PhD ; Garrett W Rowe BS

PURPOSE
Breast cancer survivors after radiation therapy (RT) have increased rates of cardiac morbidity and mortality. We sought to investigate whether accelerated coronary artery disease (CAD) is to blame by comparing coronary calcium scores (CCS) in breast cancer survivors with and without RT.

METHOD AND MATERIALS
334 women with history of breast cancer were included. 67 patients underwent chest CT studies =6 months after the start of RT (RT-group), while 239 patients had a CT scan either prior to or without undergoing RT (noRT). Indications for performing CT studies varied, and involved contrast enhanced acquisitions. Coronary calcium was quantified by applying a threshold-based automated algorithm using a dedicated workstation. Statistical analysis included the Fisher�s exact test, Wilcoxon-Mann-Whitney Test, and the Siegel-Tukey Test. Cox regression analysis was performed to evaluate the risk of a positive CCS, adjusted for time between diagnosis/RT and CT imaging.

RESULTS
Mean age at diagnosis for the noRT group was 57.1±11.9 years, versus 58.4±12.9 years for the RT group (p>0.05). The groups showed no significant differences in race, smoking history, laterality of breast cancer, or cancer stage. Median interval between diagnosis/RT and CT image acquisition was 119 (25th, 75th percentile: 50, 238) days for the noRT group and 449 (211, 979) days for the RT group (p0.05). The median CCS for both groups was 0 (25th, 75th percentile: 0, 4; p>0.05). When adjusting for the time between diagnosis/RT and CT, RT patients had a significantly lower risk of a positive CCS compared to noRT patients, with a hazard ratio of 0.54 (95% confidence interval, 0.32-0.93, p

CONCLUSION
Breast cancer survivors after RT are not more likely to show coronary calcifications on subsequent CT imaging. Our preliminary results thus do not support radiation-induced accelerated CAD as an explanation for higher rates of heart disease in this group. However, suboptimal CT technique for evaluation of CCS along with a limited patient population may have influenced our results.

CLINICAL RELEVANCE/APPLICATION
The search for a culprit should be widened to include other potential causes of higher heart disease rates in breast cancer survivors after RT.

LL-CAS-TU6A • Value of Late Gadolinium Enhancement Cardiac Magnetic Resonance (LGE-CMR) to Predict Non-Sustain Ventricular Tachyarrhythmia (NSVT) and Sustain Ventricular Tachyarrhythmia (SVT) in Hypertrophic Cardiomyopathy (HCM)

Guido Ligabue MD (Presenter) ; Serena Bertugno ; Luca Nocetti PhD ; Andrea Barbieri ; Antonio Esposito MD ; Francesco A De Cobelli MD ; Federica Fiocchi ; Pietro Torricelli MD

PURPOSE
To investigate the role of LGE-CMR to predict the risk of NSVT and SVT in HCM patients throughout a LGE% cut-off determination.

METHOD AND MATERIALS
LGE-CMR was performed in 140 consecutive HCM patients (mean age: 56±16; 73% males) using a 1.5T scanner to determine cardiac functional parameters. LGE images were obtained 15 min after injection of 0.2 mmol/kg of Gadolinium. LGE was quantified by using 6SD method. Indexed end-diastolic left ventricular (IEDLV) mass was assessed and LGE extension was defined as percentage of IEDLV mass. Patients were followed prospectively for a mean of 40,2±11,1 months, during which period occurrence of NSVT and SVT were recorded. Multivariate analysis was performed to determine independent CMR parameters with a statistically significant correlation with NSVT or SVT. ROC analysis was performed to determine the optimal cut-off value for the parameter already individuated.

RESULTS
The mean IEDLV mass was 89±27 g/m2. On LGE-CMR, 114 (82%) patients showed myocardial scar (mean LGE%: 7.5±7.5). During the follow-up period 28 (20%) NSVT and 13 (9%) SVT were recorded. Multivariate analysis revealed that only LGE% was independently associated with NSVT (P=0.001) and SVT (P=0.001) while there was no statistically significant association with clinical (age, sex, familiar form, obstructive disease, NHYA class, dyspnea, angina, atrial fibrillation) and/or other MR parameters (ejection fraction, parietal thickness, end-systolic and end-diastolic volumes). According to the ROC curve, patients with a LGE% higher than 8%, have a high risk to present NSVT, with a sensitivity of 82% and a specificity of 67% whereas considering SVT, the LGE% cut off to select HCM patients with high risk was 8% with a sensitivity of 92% and a specificity of 62%. Respective AUC were 0.792 for NSVT and 0.790 for SVT (figure 1).

CONCLUSION
Extension of fibrosis on LGE-CMR predicts the occurrence of NSVT and SVT in HCM patients.

CLINICAL RELEVANCE/APPLICATION
We suggest the LGE% cut-off, assessed by LGE-CMR, as a new tool to select HCM patients with a high arrhythmic risk.

LL-CAS-TU7A • Histopathologic Correlates of Delayed Enhancement in Hypertrophic Cardiomyopathy: A Comparison of Cardiac Magnetic Resonance Imaging Findings and Myectomy Specimens

Celia P Corona-Villalobos MD (Presenter) ; Mark Halushka * ; Linda C Chu MD ; Neville Gai PhD ; David A Bluemke MD, PhD * ; Theodore Abraham MD ; Ihab R Kamel MD, PhD * ; Stefan L Zimmerman MD

PURPOSE
Myocardial fibrosis is common in hypertrophic cardiomyopathy (HCM) and is thought to contribute to sudden cardiac death and heart failure. Delayed enhancement (DE) on cardiac MRI (CMR) has been used to estimate myocardial fibrosis in HCM, however, evidence correlating DE to histopathology is limited. Therefore, the purpose of this study was to determine the histopathologic correlates of DE in HCM.

METHOD AND MATERIALS
This retrospective study was approved by our internal IRB. Subjects from the Johns Hopkins HCM registry who underwent CMR and surgical septal myectomy were identified. Inclusion criteria were a CMR that included post-contrast TI scout and DE images and an adequate myectomy specimen. DE and myocardial T1 times in the basilar and mid- anteroseptum were quantified using dedicated software (Mass, Medis, Netherlands). Myectomy specimens were assessed by a cardiac pathologist for quantification of fibrosis and related findings.

RESULTS
Twenty-nine subjects were included; 20 males (69%) and 9 females (31%), with mean age 48 + 14 years. Myectomy specimens demonstrated mean replacement fibrosis of 11 + 16%, myocardial disarray of 4 + 4%, interstitial fibrosis of 42 + 21%, vacuolated myocytes of 15+21%, and 36+21 of dysplastic vessels per specimen. On CMR, 16 subjects had DE and 13 did not. Among those with DE,

the mean percentage of DE in the basilar and mid-anteroseptum was 20.2 + 12.2% (Table 1). Mean septal myocardial T1 time for our cohort was 370 + 67ms. There was good correlation between DE percentage for the mid anteroseptum by CMR and percent of replacement fibrosis in myectomy specimens [r=0.54, p=0.02], however, not for the basilar anteroseptum. Subjects with myocardial DE showed a strong trend to greater percent replacement fibrosis than subjects without DE (Table 1). Vacuolated myocytes, a non-specific finding due to myofibril abnormalities, were also more common in subjects with DE. There was no significant correlation of normalized T1 times with percent replacement or interstitial fibrosis.

CONCLUSION
HCM subjects with DE in the septum tend to have more extensive replacement fibrosis in myectomy specimens, supporting the hypothesis that DE in HCM represents myocardial scar.

CLINICAL RELEVANCE/APPLICATION
Cardiac magnetic resonance imaging (CMR) may offer a non-invasive approach to identify of replacement fibrosis in patients with HCM.

LL-CAE-TU8A ● Anatomical Variations of Left Atrial Appendage on 256-slice Spiral Computed Tomography Coronary Angiography

Li Caiying MD, PhD (Presenter) ; **Xiaowei Liu** MD ; **Zuojun Geng** ; **Pingyong Feng** ; **Zhenhu Song** ; **Guojing Ma** ; **Peng Song**

PURPOSE
To investigate anatomical variations of left atrial appendage (LAA) on 256-slice spiral computed tomography coronary angiography (coronary CTA) in order to improve imaging diagnosis as well as clinical management for patients with LAA-related diseases.

RESULTS
The most common types were Types 2c ,2b, 2a and 2d found in 38.4% (n = 257), 21.8% (n = 146),9.7% (n = 65) and 6.7% (n = 45), respectively, followed by Type 5,Type 1a, Type 4, Type 6, Type 3, Type 1b,and Type 7 found in 5.5% (n = 37), 4.9% (n = 33), 4.0% (n = 27), 3.7% (n = 25), 3.1% (n = 21), 1.3% (n = 9) and 0.7% (n = 5), respectively. Only Type 5 was more frequently found in women than men (P
CONCLUSION
Coronary CTA can objectively evaluate the morphological structure of multiple LAA variations and has the potential to improve clinical management for patients with LAA-related diseases.

CLINICAL RELEVANCE/APPLICATION
Understanding the variations of LAA before invasive treatments has the potential to increase the success rate and to avoid post-procedure�s complications for patients with LAA-related diseases.

LL-CAE-TU9A ● Effective Ways of Using Iterative Reconstruction Algorithms in Routine Clinical Practice

Sadahiro Yamamura (Presenter) ; **Seitaro Oda** MD ; **Daisuke Utsunomiya** MD ; **Hideaki Yuki** MD ; **Yoshinori Funama** PhD ; **Yasuyuki Yamashita** MD *

PURPOSE/AIM
Iterative reconstruction algorithms for CT are now widely used in clinical examinations. We aim to demonstrate the effectiveness of iterative reconstruction algorithms in improving image quality and reducing radiation dose.

CONTENT ORGANIZATION
1. Principles of iterative reconstruction algorithms
- First-generation iterative reconstruction
- Hybrid iterative reconstruction
- Knowledge-based iterative reconstruction
2. Combined use with low tube voltage techniques
- Reduction in radiation and contrast material dose
- Protocol optimization
3. Combined use with high-resolution kernel
- CT angiography of the peripheral arteries
- Improved coronary in-stent visualization
4. Combined use with ultra high resolution scan mode
5. Application to obese patients
6. Application to pediatric examinations

SUMMARY
There are various effective ways to use iterative reconstruction algorithms. These techniques can improve the image quality and diagnostic performance, and reduce the radiation and contrast material dose.

Cardiac - Tuesday Posters and Exhibits (12:45pm - 1:15pm)

Tuesday, 12:45 PM - 01:15 PM ● Lakeside Learning Center

CA

LL-CAS-TUB ● *AMA PRA Category 1 Credit* ™:0.5

LL-CAS-TU1B ● Determination of Myocardial Triglyceride Content in Patients with Fabry Disease by Localized High-field 1H-Magnetic Resonance Spectroscopy

Bernhard Petritsch (Presenter) ; **Michael Horn** ; **Andreas M Weng** ; **Jan P Goltz** MD ; **Julian Donhauser** MD ; **Christian O Ritter** MD ; **Dietbert Hahn** MD ; **Meinrad J Beer** MD * ; **Thorsten A Bley** MD ; **Herbert Koestler** PhD *

PURPOSE
In Fabry disease progressive deposition of sphingolipids in different organs has been reported. High-field ^{1}H-MR-spectroscopy (MRS) allows non-invasive determination of myocardial lipid content. This study investigates the role of myocardial steatosis in the complex pathomechanism of Fabry cardiomyopathy.

METHOD AND MATERIALS
In 14 patients (9 female, 5 male; 39 ± 13 years [range 17-52 years]) with genetically proven Fabry disease, myocardial triglycerides were quantified by ^{1}H MRS (respiratory motion compensated, ECG triggered) *in vivo* using a 3 T scanner (Magnetom TRIO, Siemens Sector HealthCare, Germany). Single-voxel-spectroscopy was performed with and without water suppression. The voxel was positioned in the interventricular septum using a four-chamber and short-axis orientation at end systole to avoid signal contamination by epicardial fat. Two triglyceride peaks were measured (methylene groups at 1.3 ppm, methyl groups at 0.9 ppm) relative to the resonance from tissue water at 4.7 ppm. The myocardial lipid content was expressed as triglycerides-to-water ratio (%). In addition left ventricular (LV) mass and ejection fraction (EF) were assessed by MRI. Nine healthy volunteers (4 female, 5 male) without a history of cardiac or metabolic disease served as control group.

RESULTS
In all patients ^{1}H spectra were successfully acquired. In patients the mean triglyceride-to-water ratio was 1.7% (min. 0.1%; max. 6.2%). On average the control group showed a lower (p=0.05) triglyceride-to-water ratio of 0.49% (min. 0.1%; max. 1.9%). Compared to

healthy controls, LV mass (mean ± standard deviation; 120 ± 36 g) tended to be higher in Fabry patients (FP) (142 ± 43.9 g) (p=0.1). Mean EF was similar in both groups (67 % in FP vs. 66 % in controls).

CONCLUSION
High-field ^{1}H-MR-spectroscopy using 3T scanners allows non-invasive assessment of myocardial lipid content in FP. In a relatively small patient collective we observed an elevated myocardial triglyceride content. This finding warrants further studies with larger patient groups, especially concerning sub-group analysis of LE positive and negative FPs.

CLINICAL RELEVANCE/APPLICATION
Besides data regarding functional and morphological alterations MRS delivers new insights into myocardial lipid metabolism in FP. This might help to further optimize the therapy for this rare disease.

LL-CAS-TU2B ● Sensitivity and Accuracy of Measures for Discrimination of Myocardial Fibrosis

Neville Gai PhD (Presenter) ; **Marcelo S Nacif** MD, PhD ; **Christopher Sibley** ; **Songtao Liu** MD ; **David A Bluemke** MD, PhD *

PURPOSE
To determine accuracy and sensitivity of post-contrast myocardial T1, partition coefficient (?) and ECV in discriminating healthy tissue from diffuse fibrotic tissue in hear failure (HF) subjects.

METHOD AND MATERIALS
Nine healthy and seventeen subjects (age and sex matched) with heart failure (HF) underwent cardiac MRI on 3T scanners after administration of 0.15mmol/kg of gadopentetate dimeglumine. Pre- and post-contrast T1 mapping was done using the MOLLI sequence. The measured T1 values in myocardium and blood pool were used to determine ? and ECV (as defined in literature) at two post-contrast time points � 12 min and 25 min. Coefficient of variation (COV) at each time point in each group (healthy or HF) and for each of the three measures was determined as a surrogate for accuracy. Similarly, a Student�s t-test for the three measures between healthy and HF subjects for each time point served as a marker of sensitivity. In addition, COV and t-test were also performed on T1 values obtained at time = (12, 25) min which were corrected to time = (25, 12) min for both normals and HF subjects using a previously described analytical model.

RESULTS
The mean COV for the post-contrast T1, ? and ECV at the two time points was 0.0896, 0.0962 and 0.1158 for normals; COV was 0.0935, 0.1091 and 0.103 for HF. A lower value of COV reflects better homogeneity in the two separate populations (healthy and HF) which indirectly reflects on the accuracy of the three measures. Student�s t-test between normal and HF subjects resulted in mean p-values (one tailed) of 0.0211, 0.0551 and 0.0883 for post-contrast T1, ? and ECV, indicating better sensitivity of post-contrast T1 values. Despite employing a previously described analytical correction for time, mean COV for post-contrast T1 values (healthy and HF) was 0.0917 while mean p-value was 0.023.

CONCLUSION
Post-contrast T1 measurements controlled for dose and time showed the best accuracy and sensitivity when compared with derived values such as partition coefficient and ECV. Even after employing a correction for time based on a previously described analytical model, post-contrast T1 performed better than ? and ECV as a discriminatory measure.

CLINICAL RELEVANCE/APPLICATION
Determining sensitivity and accuracy of measures such as post-contrast T1, partition coefficient and extracellular volume (ECV) is important for discriminating between healthy and fibrotic myocardium.

LL-CAS-TU3B ● Congenital Cardiac Septal Defect in Adult: Role of Cardiac Computed Tomography in Preoperative Planning

Hyejoung Eom MD (Presenter) ; **Dong Hyun Yang** MD ; **Joon-Won Kang** MD ; **Tae-Hwan Lim** MD, PhD

PURPOSE
To evaluate a role of cardiac computed tomography (CT) in preoperative planning of adult congenital cardiac septal defect.

METHOD AND MATERIALS
Fifty seven consecutive patients (47% male; mean age 46.9 years) who had preoperative cardiac CT and surgery were included (ASD n=46, VSD n=9, Both ASD and VSD n=2). For the evaluation of intracardiac structures, retrospective ECG-gated scan with ECG pulsing (30-80%) was done by using second generation dual source CT. The size and location of the defect were evaluated using multiplanar reconstruction images. The defects were categorized as follows: primum, secundum, sinus venosus and unroofed coronary sinus for ASD; perimembranous, muscular and subarterial for VSD. Accuracy of subtype classification was determined by using surgical findings as the reference standard. Maximum size of the defect on CT was correlated with surgical findings and limits of agreement were calculated (Bland-Altman method). Additional anatomic details detected on CT were described.

RESULTS
The number of secundum ASD and perimembranous VSD was 41 (72%) and 6 (11%), respectively. Detection of the defect on CT was available in all cases except for one patient with subarterial VSD (Only diastolic images were available in this patient) and subtype classification was correct in 55 patients (55/57, 96%). Echocardiography (ECHO) was able to detect the defects in all cases and subtype classification was correct in 54 patients (54/57, 95%). CT misclassified one patient;secundum ASD as sinus venosus ASD. ECHO misclassified three patients; muscular VSD with secundum ASD as perimembranous VSD, secundum ASD with sinus venosus ASD as multiple secundum ASDs and subarterial VSD as a fistulous tract between aortic sinus and right ventricle. All these patients were correctly diagnosed on CT. Maximum size of the defect on CT correlated well with surgical findings (r=0.79, p
CONCLUSION
Cardiac CT may have an incremental role in preoperative planning of adult congenital cardiac septal defect, particularly in patients with more complex anatomy.

CLINICAL RELEVANCE/APPLICATION
In adult patients with congenital cardiac septal defect, cardiac CT may be helpful in surgical planning by providing detailed septal anatomy and associated anomalies.

LL-CAS-TU4B ● Diluted Contrast Material Injection Protocol for Coronary CT Angiography Using 256-slice Multi-detector CT to Uniform Intra-Coronary Enhancement

Naoto Kawaguchi MD (Presenter) ; **Teruhito Kido** ; **Yuki Tanabe** ; **Takuya Matsuda** ; **Masashi Nakamura** ; **Yoshiko Nishiyama** MD ; **Tomoyuki Kido** ; **Rami Yokoyama** ; **Masao Miyagawa** MD, PhD ; **Teruhito Mochizuki** MD

PURPOSE
The purpose of this study was to propose and evaluate a new injection protocol using diluted contrast material (CM) injection to uniform intra-coronary enhancement (HU) in coronary CT angiography (CTA).

METHOD AND MATERIALS
Four scan protocols of different CM injection methods and tube voltages were compared in consecutive 200 patients with suspected coronary artery disease using a 256-slice multi-detector CT (retrospective ECG gated scan). In the diluted CM injection protocol (protocol A; 120kV, N=50 and protocol B; 100kV, N=50), the target luminal enhancement was set at 350 HU. From the time density curve of the diluted CM test scan (20%-diluted CM at 5ml/s, 10s injection), optimal concentration of CM in the real scan was calculated using the formula; A%=20%* (350 � base CT value) / (peak enhancement of the test scan � base CT value). Then the CM was administrated at the optimized scan timing, that was also decided by the diluted test scan. In the BW-adjusted protocol (protocol C; 120kV, N=50 and protocol D; 100kV, N=50), only scan timing was decided by the test scan. Then, CM of 225 (protocol C) or 175 (protocol D) mg-iodine/kg

was administered in the real scan. CT attenuation in the ascending aorta and the proximal coronary segments (#1, #5, #6, and #11) were recorded, and the uniformity of the intra-coronary enhancement in four protocols was compared.

RESULTS

CONCLUSION
The diluted CM protocol enables us to uniform intra-coronary enhancement regardless of different tube voltages.

CLINICAL RELEVANCE/APPLICATION
This new injection protocol using diluted contrast material enables us to uniform intra-coronary enhancement in coronary CT angiography.

LL-CAS-TU5B ● Study of an Individually Optimized Contrast Material Injection Protocol for 64-detector Row Computed Tomography Coronary Angiography

Yuan Jiang (Presenter) ; **Jian-Xing Qiu** MD ; **Xiaoying Wang** MD ; **Jianxin Liu**

PURPOSE
To determine if the injection rate and volume of contrast material in 64-detector row CT coronary angiography could be individually optimized based on the weight of patients.

METHOD AND MATERIALS
Patients examined by 64-detector row CT coronary angiography in April 2011 were divided into group A (n=56), B(n=32) and C(n=32). The weight-rate index (Ew) was set to group A 0.06, groupB 0.07 and group C 0.08. The injection rate (IR) and injection volume (IV) of contrast material were calculated based on the formula, IR(ml/s)=Ew×W(Kg), IV(ml)=IR×[t(s)+t�(s)]. W, t and t' represented patients' weight, the scan time that obtained after setting up the scan scope and the pre-scan time (3s). Scan parameters were as follows: slice acquisition,64×0.625 mm,120kVp, auto mAs℗). The ROI in proximal segment of left anterior descending (pLAD), proximal segment of left circumflex coronary artery (pLCX), proximal and distal segment of right coronary artery (pRCA, dRCA) should be as large as the vessel lumen and the obvious calcified or fibrous plaque was avoided. Kruskal-Wallis test was used for the difference of sex and other information (CT values included) were analysis by One-way ANOVA among three groups.

RESULTS
There was no significant difference of sex, age, BMI and heart rate among three groups. The IR and IV of group A (4.4ml/s, 37.6ml) were significantly lower than that of group B (4.9ml/s, 41.4ml) and C(5.2ml/s, 44.7ml) ($p$pp=0.042).

CONCLUSION
The injection protocol of contrast material in 64-detector row CT coronary angiography can be individually optimized based on the weight-rate index of 0.07.

CLINICAL RELEVANCE/APPLICATION
The injection volume of contrast material in 64-detector row CT coronary angiography can be decreased.

LL-CAS-TU6B ● Influence of Vessel Enhancement on the Motion Correction Effect of SnapShotFreeze Technique in Coronary CT Angiography

Xiaoguang Yang (Presenter) ; **Xiangying Du** MD ; **Kuncheng Li** MD ; **Peng-Yu Li** ; **Qianwen Li**

PURPOSE
SnapShotFreeze (SSF) is a recently introduced vendor-specific motion correction technique in coronary CTA, which is base on automatic recognition of the centerlines of enhanced coronary arteries and non-rigid registration algorithm. The purpose of this study is to investigate the influence of vessel enhancement on the motion correction effect of SSF in coronary CT angiography(CTA).

METHOD AND MATERIALS

RESULTS
Images reconstructed by SSF technique showed less motion artifact and better image quality both in group A and B (p
CONCLUSION
Better vessel enhancement ensures better motion correction by SSF in coronary CTA. Contrast enhancement should be noted when applying SSF technique for motion correction.

CLINICAL RELEVANCE/APPLICATION
SSF provides the opportunity for the use of CT scanners with relatively low rotation speed in higher heart rates.

LL-CAS-TU7B ● CT-related Independent Predictors for Cardiac Events in Individuals without Significant Coronary Stenosis

Jiwoon Seo (Presenter) ; **Eun Ju Chun** ; **Sang Il Choi** MD ; **Yeo Goon Kim** MD ; **Jin Young Yoo** MD

PURPOSE
Cardiac events may be occurred in individuals without significant coronary stenosis. Therefore, we aimed to evaluate the independent predictors for cardiac events in adults without significant coronary stenosis on coronary CT angiography (CCTA).

METHOD AND MATERIALS
From ESCORT study of 4,502 asymptomatic individuals who underwent self-referred coronary calcium score (CACS) and CCTA between 2006 and 2007, we enrolled 4,271 adults (2,525 males, 57±10 yrs) without significant coronary stenosis and assessed the major adverse cardiac event (MACE; cardiac death, nonfatal MI and unstable angina requiring hospitalization) and total cardiac event (TCE: MACE plus coronary revascularization later than 90 days after CCTA). CT images were analyzed in terms of stenosis degree, plaque composition (non-calcified, mixed, calcified and high-risk plaque), and location (proximal versus distal). High-risk plaque (HP) was defined as plaque density with 1.1. Clinical risk factors and Framingham risk score (FRS) were also evaluated from all patients.

RESULTS
During a median of 55 months of follow-up, MACE occurred in 12 subjects (0.3%) and TCE occurred in 24 subjects (0.6%). In multivariate analysis, familial history of premature CAD (FHX_CAD) (hazard ration [HR], 3.7; 95% confidence interval [CI], 21.0 to 13.7; p=0.048) and HP (HR 5.7, 95% CI 1.1 to 28.8, p=0.034) were independent predictor for MACE, while FHX_CAD (HR 4.3, 95% CI, 1.7 to 11.0, p=0.002), HP (HR=4.1, 95% CI, 1.2 to 13.8, p=0.023) and non-calcified plaque (NCP) (HR 4.8, 95% CI 1.4 to 17.1, p=0.014) were independent predictors for TCE. However, FRS and CACS were not independent predictors for MACE or TCE. Importantly, the absence of plaque by CCTA was associated with excellent outcome (0.05%).

CONCLUSION
FHX_CAD and plaque composition (HP and NCP) were independent predictors for cardiac event in asymptomatic individuals without significant coronary stenosis. CCTA might be useful for risk stratification for cardiac events regardless of significant coronary stenosis.

CLINICAL RELEVANCE/APPLICATION
Although in adults without significant coronary stenosis, CCTA findings may be useful to provide the plaque composition as predictors for cardiac events.

LL-CAE-TU8B ● Radiologic Review of Acquired Pulmonary Vein Stenosis- A Potential Missed Diagnosis

Mauricio S Galizia MD ; **Rahul D Renapurkar** MD ; **Michael A Bolen** MD ; **Joseph T Azok** MD ; **Charles T Lau** MD ; **Ahmed El-Sherief** MD (Presenter)

PURPOSE/AIM
- Review pulmonary vein embryology and anatomy
- Review primary and secondary imaging findings in acquired pulmonary vein stenosis
- Review the treatment options for acquired pulmonary vein stenosis and the role of imaging in pre and post-procedural assessment

CONTENT ORGANIZATION
-Pulmonary Vein Embryology
-Variation of Pulmonary Vein Branching Pattern
-Acquired Pulmonary Vein Stenosis
-Etiology
-Post Radiofrequency Ablation
-Extrinsic Compression
-Neoplastic (Lung Cancer, Lymphoma)
-Non-neoplastic (Fibrosing mediastinitis, Bronchogenic cyst)
-Primary Imaging Findings (US/CT/MR/Angio)
-Secondary Imaging Findings (CT)
-Waxing and Waning pulmonary edema or hemorrhage
-Lung volume loss
-Mixing artifact in the stenosed pulmonary vein
-Non-opacification of distal pulmonary veins -Treatment of Pulmonary Vein Stenosis
-Treatment options
-Surgical
-Transcatheter interventions
-Balloon Angioplasty
-Stent Implantation
-Role of imaging in pre-procedural planning and post-procedural evaluation (CT and MRI)

SUMMARY
From this exhibit, the attendee will be able to:
-Indentify various etiologies of acquired pulmonary vein stenosis
-Indentify primary and secondary imaging findings in acquired pulmonary vein stenosis
-Understand the role of imaging in pre and post-therapy evaluation of acquired pulmonary vein stenosis

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Cardiac (Contrast II)

Tuesday, 03:00 PM - 04:00 PM ● E350

CT | CA

SSJ03 ● *AMA PRA Category 1 Credit* ™:1 ● ARRT Category A+ Credit:1

Moderator
Richard D White , MD
Moderator
Gregory W Gladish , MD
Moderator
Lisa Diethelm , MD

SSJ03-01 ● Optimization of Contrast Injection Protocol for Tube Potential during Cardiovascular Computed Tomography

Yajuan Wang PhD (Presenter) * ; **Anjali Kottha** ; **Corey Kemper** PhD * ; **John F Kalafut** PhD * ; **Sandra S Halliburton** PhD *

PURPOSE
X-ray tube potential affects iodine attenuation on CT images but is rarely considered in contrast protocol planning. This study investigated modification of a commercial contrast injection algorithm (P3T�, Bayer Radiology) to account for tube potential at cardiovascular CT.

METHOD AND MATERIALS
59 patients referred for evaluation pre- or post- endovascular stent graft repair were imaged (Definition FLASH, Siemens). Prospectively ECG-triggered helical techniques were used with a tube potential of 100 (n=34) or 120 kV (n=25), depending on patient size. Patient weight, timing bolus characteristics, and scan time were inputs to the contrast protocol algorithm. Average attenuation and noise (standard deviation of attenuation) from 6 circular regions of interest (ROI) placed along the length of the aorta were computed and compared using a Student�s t test. A pharmacokinetic model (ACES, Bayer Radiology) was used to simulate aortic attenuation at 100kV and investigate the potential to achieve a desired enhancement (350HU) at contrast volume reductions of 20, 30 and 40%.

RESULTS
Both cohorts had similar age, M/F ratios, scan duration and scan length. 100kV cohort had lower body mass index (24.8±3.4 vs. 29.4±3.5 kg/m^2), total contrast volume (93±19 vs 106±6 mL) and size-specific dose estimates (2.9±0.9 vs 4.4±1.2 mGy). Average aortic attenuation was 27% higher at 100kV (482±96 HU vs 381±62 HU) and image noise was slightly greater (36±6 vs. 30±4 HU). Simulated aortic attenuation using recommended contrast protocols matched measurements at 100kV validating ACES for this application. A 30% contrast volume reduction at 100 kV yielded simulated aortic attenuation closest to measured attenuation at 120kV (362±101 vs. 381±62 HU; P=0.44) and to the target attenuation.

CONCLUSION
This study demonstrated that P3T� algorithm yielded higher attenuation in cardiovascular CT patients scanned at 100 vs 120 kV. Simulation results suggest contrast protocol optimization for tube potential could allow a 30% contrast reduction. Additional studies are needed to validate simulation results in vivo.

CLINICAL RELEVANCE/APPLICATION
Contrast injection protocols can be optimized for tube potential permitting use of less contrast in some patients to achieve the desired blood enhancement.

SSJ03-02 ● Transluminal Attenuation Gradient in Normal Coronary Arteries with 320-row Prospectively ECG-gated Computed Tomography Angiography (CTA) in Three Consecutive Cardiac Cycles: Association with Intracoronary Mean Contrast Effect and Cardiac Functions

Yukihiro Nagatani MD (Presenter) ; **Masashi Takahashi** MD ; **Norihisa Nitta** MD ; **Noritoshi Ushio** RT ; **Hiroshi Sakai** ; **Takashi Yamamoto** ; **Hideji Otani** MD ; **Kazumasa Kobashi** ; **Jyousei Ueda** ; **Kiyoshi Murata** MD

PURPOSE
To compare both mean contrast effect (MCE) and transluminal attenuation gradient (TAG) among three consecutive cardiac cycles (CC) and evaluate their relations to cardiac functions and body habitus indices in respective three normal coronary arteries (NCA).

METHOD AND MATERIALS

Study group consisted of 40 patients with NCA who underwent both 320-row ECG-gated CTA and trans-thoracic echocardiography within 1 month of each other. They were classified into 20 patients in group-A (prospectively ECG-gated CTA in the three consecutive CC) and 20 patients in Group-B (retrospectively ECG-gated CTA: r-CTA). Each patient received 240mg/kg body weight of a non-ionic contrast medium in 10-sec, and data acquisition was started when both a threshold of 250 Hounsfield Unit (HU) in left atrium and that of 80 HU in descending aorta was reached. In group-A, image data were reconstructed at each CC. Both TAG and MCE were calculated as linear regression coefficient between luminal attenuation and axial distance based on multiple measurements with even 10-mm intervals, and as average of CT attenuation value in all the measurements, respectively. Pearson's correlation coefficients between TAG and some cardiac functional indices were obtained in each CC and r-CTA. Both TAG and MCE were compared among three consecutive CC using Friedman and Wilcoxon signed-rank test in group-A, and between each CC and r-CTA using Man-Whitney U test.

RESULTS
In all the 3 NCA, MCE at the 3rd CC was higher than MCE at the 1st CC. In right coronary artery (RCA), TAG at the 3rd CC (-1.6±5.3) was larger than that at r-CTA (-6.7±3.6) (p=0.01) In left circumflex artery (LCX), TAG was larger at the 3rd CC (-14.9±16.4) than at the 2nd CC (-18.5±14.2) (p=0.041). In RCA, MCE at every CC correlated with body mass index. In left anterior descending artery, MCE at the 3rd CC and TAG at the 1st CC correlated with body surface area (r=0.658 and 0.634, respectively).In LCX, TAG at the 3rd CC correlated with ejection fraction (r=0.526).

CONCLUSION
Increase in MCE at the 3rd CC could have potentiality to approximate TAG to 0-level in RCA and LCX regardless of considerable influence of body surface area and ejection fraction.

CLINICAL RELEVANCE/APPLICATION
Approximation of TAG to level due to increased MCE in three consecutive CC may enhance value of TAG as a novel non-invasive indicator of coronary stenosis.

SSJ03-03 ● Oral Use of Gadobenate Dimeglumine for Visualization of Oesophagus during MRA in Patients Candidated to Catheter Ablation

Alessandro Rapellino MD ; **Riccardo Faletti** (Presenter) ; **Angela Grasso** MD ; **Camilla Bogetti** MD ; **Chiara Perazzini** MD ; **Annelis Dominguez** MD ; **Paolo Fonio** ; **Giovanni Gandini** MD

PURPOSE
Atrio-oesophageal fistula was first reported as a fatal complication of surgical endocardial and percutaneous endocardial radiofrequency ablation for atrial fibrillation, with an incidence after catheter ablation between 0.03% and 0.5%. Cardiac magnetic resonance angiography (MRA) was usually performed to obtain pre-procedural 3D images, used to create an electro-anatomical map guiding step-by-step ablation strategy of AF. Our purpose was to assess oesophagus anatomy during MRA due to obtain a 'real-time' visualization of the oesophageal position during RFCA

METHOD AND MATERIALS
In 35 consecutive patients a MRA sequence, was performed in axial plane 24 hours before catheter ablation using intravenous gadobenate dimeglumine contrast media and oral administration for oesophagus intensification of 2-3 spoonfuls of a gel solution (0,8-1 ml gadobenate dimeglumine contrast media mixed with approximately 50 mg thickened water gel), while they were on scanning table immediately before MRA breath-old sequence acquisition.

RESULTS
Oesophagus visualization was obtained in all patients and well merged, as left atrium and pulmonary veins, during percutaneous endocardial radiofrequency ablation, succesfully creating an electro-anatomical map. All patients well tolerate the study protocol and any immediately or late complication was observed after oral contrast agent administration. MRA acquisition time with double contrast agent administration did not show any significance difference from conventional MRA.

CONCLUSION
In our experience oesophagus visualization with gadobentetate dimeglumine oral administration MRA is a feasibly imaging technique for Integration of esophagus anatomy images into the electroanatomical map preventing oesophageal injuries during AF ablation without patients undesirable side effects and without increasing significatevely cost and examination time.

CLINICAL RELEVANCE/APPLICATION
Oesophagus visualization in electro-anatomical map during RFCA procedure is an important help to avoid fatal complication as atrio-esophageal fistula

SSJ03-04 ● Gadofosveset versus Gadobenate for Steady-state 3D Contrast-Enhanced MRA (SS CE-MRA) Evaluation of the Thoracic Aorta: Is a Blood Pool Agent Required?

Vikram Bamra MD (Presenter) ; **Jeffrey H Maki** MD, PhD * ; **Dinesh Kumar** MBBS

PURPOSE
Compare the image quality (SNR and vessel edge sharpness) of gadobenate (MultiHance, Bracco) vs. gadofosveset trisodium (Ablavar, Lantheus) for steady state, ECG-triggered 3D CE-MRA evaluation of the thoracic vasculature. Gadofosveset is a blood pool contrast agent with extended intravascular retention and high R1 relaxivity designed for MRA. These properties allow for steady-state (equilibrium phase) high resolution ECG-gated MR angiograms. The objective was to determine whether similar imaging could be performed with the high relaxivity extracellular agent gadobenate.

METHOD AND MATERIALS

RESULTS
No significant difference noted in mean SNR (15.5 vs. 15.2) or image sharpness (2.4 vs. 2.1 mm) for gadofosveset vs. gadobenate (both p >> 0.05). Vessel sharpness trended better with gadobenate, with a trend also toward more blurring and less SNR in the ascending aorta that may be due to greater flow and motion.

CONCLUSION
Steady-state ECG-triggered thoracic CE-MRA performed in the early equilibrium period (within 5 min) with a high relaxivity contrast agent is equivalent to that with a blood pool agent.

CLINICAL RELEVANCE/APPLICATION
Gadofosveset and gadobenate provide similar image quality for thoracic SS CE-MRA when gadobenate SS MRA is started relatively quickly after contrast. Therefore the additional cost of gadofosveset might not be justified for routine thoracic MRA studies.

SSJ03-05 ● A Pilot Study of Optimized Injection Rate of Contrast Media(CM) on Image Quality of Coronary CT Angiography(CCTA)

Shujing Yu MD (Presenter) ; **Lianli Zhao** ; **Yanfeng Xu** MD ; **Jing Zheng** MD ; **Li Zhang** MD ; **Zhi Wang** MD

PURPOSE
The higher the injection rate of CM, the more danger for the patients who had heart disease and needed CCTA. In this study, the optimized injection rate will be found for different patients with different Body Weight Index(BMI) for using Dynamic Volume CT(DVCT) angiography.

METHOD AND MATERIALS

We enrolled 252 patients, aged between 30 and 70, with normal heart and lung functions and all the subjects were scanned using DVCT(Aquilion ONE, Toshiba, 16cm detector). The heart rate of all the subjects was controlled below 65 beats per minutes, which guaranteed the data acquisition within one heart beat. Of these, patients were assigned to 2 groups: A, BMI>24, scanned using 120kV tube voltage with 65ml CM and B, BMI=24, scanned using 100kV with 55ml CM. Each group was divided into six sub-groups by giving 370 or 350 mg I/ml of CM (65 ml) at the rate of 4, 5 or 6 ml/s. The three coronary trunks were divided into 15 segments. The objective and subjective methods were used for evaluating the image quality for each of the 15 segments. For the objective method, signal-to-noise ratio(SNR) and contrast-to-noise ratio(CNR) of each segment were calculated and compared between groups. For the subjective one, two experienced radiologists evaluated the image quality by 4-point(1=bad, 2=good, 3=very good, 4=perfect).

RESULTS
The injection rate had no significant effect on the image quality of coronary artery for both Group A and B (p>0.05).The image quality of Group B was significantly higher than that of Group A (p

CONCLUSION
Different injection rate had no effect on image quality, that means we can try to use lower injection rate, such as 4ml/s for CCTA. This should be further tested in a large cohort of subjects.

CLINICAL RELEVANCE/APPLICATION
This study confirmed that lower injection rate will generate similar image quality with the higher ones. This conclusion will have very good benefit for patients.

SSJ03-06 • Quantification of Iodine Concentration at Various Heart Rates by Using Cardiac Gemstone Spectral Imaging: An In Vitro Validation

Zhang Zhang (Presenter) ; **Ningnannan Zhang** PhD ; **Chun-Shui Yu** ; **Dong Li** MD ; **Jing Yu** ; **Wenjia Zhang** ; **Jiaojiao Li** ; **Qingqing Lu** ; **Huiting Liu** ; **Qian Cui** ; **Tielian Yu**

PURPOSE
CT attenuation values from the traditional polychromatic X-ray imaging (TPXI) are variable due to X-ray absorptivity varying on different energy levels. It is hard to make accurate diagnoses only based on the CT attenuation values, which cannot distinguish the different tissues or materials, such as iodine and calcium in coronary plaques. Material decomposition, which derived from gemstone spectral imaging (GSI), may allow us to measure the relative value for certain material. The purpose of the current study was to validate the iodine concentration quantification, and to discuss the relationship between the CT attenuation value and iodine concentration at various heart rates by using cardiac GSI.

METHOD AND MATERIALS
A polypropylene phantom (Quantitative Standard Pulsating Phantom QSP-1, Fuyo Corporation) with eight test tubes (in which iodine concentrations of solution were 50, 40, 30, 20, 15, 10, 5, 1 mg/ml) underwent TPXI and cardiac GSI on a single-source dual-energy spectral CT (Discovery CT750 HD CT FREEdom Edition scanner, GE Healthcare, Milwaukee, WI, USA) at various simulated pulsating rates (0, 40, 50, 60, 70bpm). All the spectral imaging data were analyzed with GSI viewer to reconstruct the virtual monochromatic spectral (VMS) images. The CT attenuation values of both TPXI and VMS were measured for each data set. The iodine concentration was measured on the water� suppressed image (iodine-water as the basic substances)

RESULTS
The correlation coefficients between the CT attenuation value and known iodine concentration were improved by the VMS (r2=0.999749, 0.999717, 0.999664, 0.999585, 0.999192, 0.998731, 0.997761, 0.996838, 0.995368, 0.993482 on 40~140 keV with interval of 10 keV) comparing to TPXI (r2=0.997364, 0.997052, 0.996878, 0.996385 on 80,100,120, and 140 kVp). From the Bland� Altman analysis, the mean differences between the measured and the known iodine concentration were 2.5±3.5 on stationary condition, 2.3±3.0, 1.7±2.9, 2.7±4.0, 2.5±3.8 at 40~70bpm with 5mm amplitude; and 2.0±3.0, 2.7±4.0, 2±3.0, 2.3±3.6 at 40~70bpm with 10mm amplitude, respectively.

CONCLUSION
Comparing to TPXI, VMS can produce better correlation coefficients between the CT attenuation values and iodine concentrations. And the iodine concentration could be accurately quantified from the iodine-water basic substances imaging.

CLINICAL RELEVANCE/APPLICATION
The cardiac GSI may provide an accurate coronary artery assessment for the clinicians.

Cardiac (Contrast I)

Tuesday, 03:00 PM - 04:00 PM ● S502AB

IR CT CA

SSJ04 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1

Moderator
Bernd J Wintersperger , MD *
Moderator
E. Kent Yucel , MD
Moderator
Srini Tridandapani , PhD, MD

SSJ04-01 • Effect of Reduced X-ray Tube Voltage, Low Iodine Concentration Contrast Medium and Iterative Reconstruction on Image Quality and Radiation Dose at Coronary CT Angiography: A Prospective Multicenter Study

Wei-Hua Yin (Presenter) ; **Bin Lu** MD ; **U. Joseph Schoepf** MD * ; **Zhi-Hui Hou** MD ; **Zhi-Qiang Wang** ; **Yang Gao** ; **Fang-Fang Yu** ; **Hui-Li Cao**

PURPOSE
To explore the effect of reduced (100 kVp) x-ray tube voltage, low iodine concentration (270 mgI/ml) contrast medium and iterative image reconstruction on image quality and radiation dose at coronary CT angiography (cCTA).

METHOD AND MATERIALS
With IRB approval, 123 consecutive symptomatic patients with suspected coronary artery disease were randomly assigned to one of two dual-source cCTA protocols: 120kVp, 370mgI/ml iopromide and filtered back projection reconstruction (n=62; 26 women; 54.1±9.5 years); or 100kVp, 270mgI/ml iodixanol and sinogram affirmed iterative reconstruction (n=61; 24 women; 55.5±10.4 years). Other scan parameters and the contrast injection protocol were held constant. Attenuation in the ascending aorta and coronary arteries along with image noise were measured. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated. Image quality was scored on a four-point scale. Effective dose was calculated based on volume CT dose index and dose length product. Data were compared using Student�s t-test and x^2.

RESULTS
All patient scans were successfully completed. There were no significant differences in patient body mass index (24.9kg/m2±3.4 vs 25.0kg/m2±2.9; p=0.800), contrast volume (68.4 ml±3.4 vs 68.5ml±6.2; p=0.880) and image quality scores (3.5±0.6 vs 3.4±0.6; p=0.265) between groups. Differences in mean attenuation between 100kVp (401.4HU±72.3) and 120kVp (403.0HU±78.1) protocols were not statistically significant (p=0.909). This was also true for image noise (17.3HU±3.7 vs 17.3HU±3.2; p=0.988), SNR (24.3±7.1 vs

23.9±5.9; p=0.710), and CNR (41.4±17.9 vs 36.2±20.0; p=0.136). Mean iodine dose was 27% lower with the 100kVp protocol than with 120kVp (25.3g±1.2 vs 18.5g±1.7; p

CONCLUSION
Use of low x-ray tube voltage and iterative image reconstruction allows decreasing the iodine load and effective radiation dose at cCTA while image quality is maintained.

CLINICAL RELEVANCE/APPLICATION
Continuous reduction in radiation exposure and iodine load associated with cCTA should enhance the safety and clinical acceptance of this test.

SSJ04-02 ● CT Coronary Angiography: Effect of Iodine CONcentration on Vascular Attenuation: The CT-CON Multicentric Study Preliminary Results

Marco Rengo MD (Presenter) ; **Anoeshka S Dharampal** MD ; **Marco Das** MD * ; **Marc C Kock** MD ; **Andre Niezen** ; **Fiek Van Tilborg** ; **Damiano Caruso** MD ; **Koen Nieman** MD ; **Gabriel P Krestin** MD, PhD *

PURPOSE
To explore the relative impacts of iodine concentration versus iodine delivery rate on intra-coronary attenuation. To describe the effect of iodine concentration on contrast bolus characteristics.

METHOD AND MATERIALS
675 patients were prospectively randomized in 4 groups and underwent CT Coronary Angiography (CTCA). Four CM with different iodine concentrations (300, 350, 370, 400 mgI/ml) were delivered at a fix iodine delivery rate (2.0 mgI/s). Intracoronary attenuation values were measured and grouped on a per-vessel and per-segment bases. Time-to-peak, and pressure curves during CM injection were evaluated and compared.

RESULTS
Injection fluxes were 6.7 ml/sec, 5.7 ml/sec, 5.4 ml/sec and 5 ml/sec for group A, B, C and D respectively. No significant differences were observed among four groups in terms of intravascular density on a per-segment and per-vessels analysis. Time-to-peak was significantly earlier in group A (15.3 sec) than in the other three groups. The injection peak pressure was significantly lower in group A (185.16 psi) and C (189.05 psi) than in group B (215.89 psi) and D (243.33 psi). No extravasations were noted in all groups.

CONCLUSION
Contrast media with different iodine concentrations, if injected at the same IDR, provide similar intravascular attenuation values. The lower concentration contrast medium provided significantly lower injection pressure values and a significantly shorter time to peak enhancement.

CLINICAL RELEVANCE/APPLICATION
Intravascular attenuation in CT coronary angiography is mainly influenced by iodine delivery rate and is independent by iodine concentration.

SSJ04-03 ● Postmarketing Surveillance Study with Iodixanol (VISIPAQUE®) 270/320 mgI/mL Injection in 20,185 Chinese Patients in Routine Clinical Settings

Bin Lu MD (Presenter) ; **Ya-Wei Xu** ; **Wei-Hua Yin** ; **Zhi-Hui Hou** MD ; **Yang Gao** ; **Fang-Fang Yu** ; **Bu-Chun Zhang** ; **Lei Hou**

PURPOSE
This study was to investigate the incidence and nature of immediate and delayed adverse drug reactions (ADRs) as well as patient discomfort in patients using iodixanol.

METHOD AND MATERIALS
A multicenter, open-label, prospective, observational study was conducted at 95 centers in China from June 2011 to October 2012. Demographics, medical conditions, details of the diagnostic procedure, contrast agent administration and ADR data were collected using a standardized case report form. Patients were asked to report immediate (occurring within one hour of administration of iodixanol) or delayed (occurring from 1 hour up to 7 days after administration of iodixanol) adverse reactions. Discomfort was rated by patients on a scale of from 0 to 10 for pain , heat, and coldness (score 0 = no discomfort; 1 � 3 = mild; 4 � 7 = moderate; 8 � 10 = severe); individual scores were combined into a composite score (0 � 30). The incidence of ADR was summarized and discomfort score was converted to no, mild, moderate or severe discomfort and summarized.

RESULTS
A total of 20,185 patients were enrolled. The mean age of this group was 60.4 years. Overall incidence of ADRs were 1.52% (307/20,185 patients), of which 0.58% was immediate, and 0.97% was delayed onset. Five patients experienced both immediate and delayed ADR. The most common immediate ADRs were nausea, vomiting, and other gastrointestinal disorders with an incidence of 0.22% (45/20,185 patients). The most common delayed ADRs were rash, pruritus, mucocutaneous rash and other skin and subcutaneous tissue disorders with a total incidence of 0.68% (138/20,185 patients). Serious ADRs occurred in two patients (0.01%). There were 73.3% (14,791/20,185) of patients in this study had no pain after injection of iodixanol, and 21.5% (4, 338) reported a composite score of 1 � 3 (mild discomfort), 5.2% of 4 � 15 (moderate discomfort), 2 reported over 15 (severe discomfort).

CONCLUSION
There were no unexpected serious ADRs were observed. Patients� discomforts during administration were mild or absent. The results of this postmarketing surveillance study indicated that iodixanol was a safe contrast agent in Chinese population.

CLINICAL RELEVANCE/APPLICATION
Iodinated radiographic contrast media are considered as safe diagnostic drugs with a low incidence of adverse drug reactions.

SSJ04-04 ● A Prospective Study of Low Concentration of Contrast Medium in Coronary CT Angiography with Low kVp Technique

Xu Li (Presenter) ; **Liren Zhang** MD ; **Yanping Liu** ; **Dongsheng Xu**

PURPOSE
To prospectively investigate the utility of low tube voltage to reduce contrast medium dose in coronary CT angiography (CCTA).

METHOD AND MATERIALS
90 consecutive patients (BMI < 28, 52 men, 38 women; mean age:54.42±8.64 years) suspected with cardiac disease were randomly divided to two groups.Group A(n=46) underwent conventional CCTA with 120kVp and normal contrast medium (Omnipaque, 350 mg/ml) dose at 0.8ml/kg on a LightSpeed VCT scanner, group B underwent modified CCTA with 100kVp and low contrast medium (Visipaque, 270 mg/ml) dose at 0.8ml/kg (n=44) on a Discovery CT 750 HD scanner. FBP image and 30% ASiR-FBP images were reconstructed for group A and B respectively. The CT value and SD value of aortic root(AO), left main coronary artery(LM),left anterior descending artery(LAD),left circumflex(LCX), and right coronary artery (RCA) were measured. The CNR of AO,LM,LAD,LCX,RCA were calculated. Two radiologists assessed all images with 4-point scale. Data were analyzed using student T-test and Wilcoxon rank sum test by SPSS 13.0 statistical analysis software.

RESULTS
Both the mean ages and BMIs of two groups(age, 53.00±8.39 vs 55.8±8.47, P=0.12; BMI,24.44±2.93 vs 24.16±1.71, P=0.58) had no significant difference. The mean ED in group B (0.87±0.22mSv) was reduced by 44.9% than that in group A (1.58±0.46mSv). The mean enhancements of three main coronary arteries were similar between two groups (LAD, 384.59±64.98 vs 390.69±59.87; LCX 370.5±58.23 vs 374.77±57.4; RCA 408.75±66.44 vs 412.79±52.62, each P>0.05). The SD values of three main coronary arteries in group A were

lower than in group B (LAD, 24.67±7.05 vs 31.39±8.35; LCX, 28.52±7.33 vs 36.31±10.58; RCA 24.76±6.88 vs 38.14±7.77; both P0.05.

CONCLUSION
For BMI < 28 patients, modified CCTA with low concentration of contrast medium reduce 44.9% radiation dose and provide compatible enhancement and image quality than conventional CCTA.

CLINICAL RELEVANCE/APPLICATION
Low concentration of contrast medium in coronary CT angiography with Low kVp technique is recommended in BMI< 28 patients.

SSJ04-05 ● Initial Experience of Contrast Agent Dose Reduction with Low Tube Voltage and Adaptive Statistical Iterative Reconstruction (ASiR) in Coronary Computed Tomography Angiography

Hao Zhang (Presenter) ; **Tong Zhang** MD ; **Bao-Zhong Shen**

PURPOSE
To evaluate the feasibility of reducing both contrast and radiation doses using lower concentration contrast agent and a lower peak kilovoltage (kVp) with adaptive statistical iterative reconstruction (ASiR) in coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS
100 patients with stable and low heart rates of (
RESULTS
The mean CNR values for the 4 coronary arteries were 13.4±3.2 in group A and 13.1±3.2 in group B, with no difference (P > 0.05)There was also no difference between the two groups in image quality score (3.53±0.58 vs. 3.48±0.59, p>0.05). On the other hand, Contrast dose was reduced by 33% in group B, and effective radiation dose was about 43% lower with the 80kVp protocol (1.8±0.7mSv) than with the 120kVp (4.21±1.20mSv).

CONCLUSION
33% contrast and 43% radiation dose reduction can be achieved by using 270mgI/ml concentration contrast agent and 80kVp tube voltage with 50%ASiR in CCTA without image quality deterioration.

CLINICAL RELEVANCE/APPLICATION
This coronary CTA method is suitable for patients with renal dysfunction, and can reduce the contrast-induced nephropathy and the potential carcinogenic of risk of coronary CTA.

SSJ04-06 ● Novel Connecting Tube for Saline Chaser in Contrast-enhanced CT: The Effect of Spiral Flow of Saline on Contrast Enhancement

Masafumi Kidoh ; **Takeshi Nakaura** MD (Presenter) ; **Kazuo Awai** MD * ; **Koji Yuba** * ; **Kazunori Harada** ; **Yasuyuki Yamashita** MD * ; **Takayuki Kobayashi** MS ; **Young-Kwang Park** ; **Takanobu Yagi**

PURPOSE
We developed a new connecting tube for the saline chaser, which generates a spiral flow of saline. The purpose of this study was to evaluate the effect of a newly developed connecting tube on aortic and hepatic contrast enhancement during hepatic-arterial and portal venous phase (HAP, PVP) Computed Tomography.

METHOD AND MATERIALS

RESULTS

CONCLUSION
Our study demonstrated that the new connecting tube increased the effect of saline chaser and significantly improved aortic contrast enhancement during HAP.

CLINICAL RELEVANCE/APPLICATION
The new connecting tube increases the effect of saline chaser. The new connecting tube may further reduce the volume of contrast material without a subsequent decrease in arterial attenuation in CTA.

Cardiac (CV Outcomes and Risk Assessment)

Tuesday, 03:00 PM - 04:00 PM ● S504AB

CT CA

SSJ05 ● *AMA PRA Category 1 Credit* ™:1 ● ARRT Category A+ Credit:1
   Moderator
   Jill E Jacobs , MD
   Moderator
   Scott D Flamm , MD *
   Moderator
   Pamela K Woodard , MD *

SSJ05-01 ● Prognostic Value of Coronary CT Angiography (CCTA) for the Prediction of Major Cardiovascular Events - 'Warranty Time' after a Normal (No Visible Plaque) CCTA

Hugo M Marques MD (Presenter) ; **Antonio Ferreira** ; **Rosana G Santos** MD ; **Cecilia I Leal** ; **Nuno Cardim** MD ; **Vasco V Mascarenhas** MD ; **Adalgisa Guerra** MD ; **Pedro A Goncalves** MD ; **Pedro Araujo Goncalves**

PURPOSE
Coronary CT angiography is now an established method for the evaluation of patients with suspected coronary disease. The time without major cardiac events after a normal (no visible plaque) CCTA is still to be completely accessed and is of particularly importance since it may impact on the downstream use of other tests. The purpose of this study was to evaluate the mid/long term prognostic value of a normal CCTA.

METHOD AND MATERIALS
From a prospective registry of consecutive 2062 patients that underwent CCTA (dual-source 64s) from February 2007 to December 2010, we excluded all with previous revascularization and/or those undergoing the study for suspected acute coronary syndrome. The presence of coronary plaque and the severity of stenosis (< 50% vs >or =50%) was assessed. The final study population was followed-up (telephone interviews and/or clinical records) for the occurrence of major adverse events (all cause mortality, myocardial infarction or revascularization> 90 days after CCTA). The information from 1352 was obtained (89% completion rate).

RESULTS
623 patients (46%) had a normal CCTA (without visible plaque), 514 (38%) had plaque with 50% stenosis) There were no events on patients with a normal CCTA within the first 2,5years of follow up.

CONCLUSION

CCTA provides important and durable prognostic information. There were no events on patients with a normal CCTA (no plaque visualized) within the first 2,5years of follow up.

CLINICAL RELEVANCE/APPLICATION
The time without major cardiac events after a normal (no visible plaque) CCTA is still to be completely accessed and is of particularly importance since it may impact on the downstream use of other

SSJ05-02 ● Predictors of Recurrent Stroke in Patients with Ischemic Stroke: Comparison Study between Transesophageal Echocardiography and Cardiac Computed Tomography

Kye Ho Lee MD (Presenter) ; **Jin Hur** MD ; **Young Jin Kim** MD ; **Hye-Jeong Lee** MD ; **Yoo Jin Hong** MD ; **Byoung Wook Choi** MD

PURPOSE
Determinants of stroke recurrence after ischemic stroke using cardiac computed tomography (CCT) is not well established. We investigated the CCT findings predictive of recurrent stroke in ischemic stroke patients and determined the incremental risk stratification benefit of CCT findings as compared to transesophageal echocardiography (TEE) in ischemic stroke patients.

METHOD AND MATERIALS
Among 465 consecutive patients, 374 ischemic stroke patients (67.9% were male with a mean age of 63.1 years) who underwent TEE and CCT were prospectively enrolled in this study. TEE and CCT images were assessed for cardioembolic sources including thrombus, tumor, spontaneous echo contrast (SEC), valvular vegetation, septal abnormality, and aortic plaque. The primary end-point was recurrence of stroke. We assessed prognostic factors with Cox univariate and multivariate analysis. Time-dependent receiver operating characteristic (ROC) curve method was used and integrated area under the curve (iAUC) was calculated to compare the predictive prognosis between CT and TEE parameters.

RESULTS
During the median follow-up period of 239 days, there were a total of 24 recurrent stroke. CT parameters of plaque thickness (HR: 1.178, 95% CI: 1.015-1.366, p = 0.031) and complexity of plaque (HR: 5.304, 95% CI: 2.264-12.425, p =
CONCLUSION
Complex aortic plaque determined by CCT was associated with an increased risk of stroke recurrence in ischemic stroke patients. In addition, CT parameter of aortic plaque had risk-predictive advantages compared to TEE parameters.

CLINICAL RELEVANCE/APPLICATION
Cardiac CT can be used to assess cardioembolic sources and also determine risk of recurrent stroke in stroke patients.

SSJ05-03 ● Incremental Prognostic Value of Whole-body MRI beyond Cardiac MRI for the Occurrence of Cardiovascular Events in Patient with Diabetes Mellitus

Fabian Bamberg MD, MPH (Presenter) * ; **Roy Marcus** BS ; **Daniel Theisen** MD ; **Christopher L Schlett** MD, MPH ; **Hannes Findeisen** MD ; **Klaus G Parhofer** * ; **Stefan O Schoenberg** MD, PhD * ; **Maximilian F Reiser** MD ; **Sabine Weckbach** MD

PURPOSE
Cardiac magnetic resonance imaging (MRI), especially late-gadolinium enhancement, has been shown to provide valuable prognostic information in patients with diabetes. However, diabetes mellitus is a systemic disease affecting all micro- and macrovascular territories. Thus, we studied the incremental prognostic value of whole-body (WB) MRI beyond cardiac findings in a cohort of subjects with diabetes.

METHOD AND MATERIALS
This prospective cohort study enrolled 65 diabetic patients (type 1 and 2), who underwent a comprehensive, contrast-enhanced WB-MRI protocol (1.5/3 T), including dedicated brain, cardiac, arterial (carotid, abdominal, pelvic, and peripheral arteries) sequences at baseline. Follow-up was performed after five years by phone interview by an independent investigator and endpoints were verified. The primary endpoint was occurrence of a MACE, defined as fatal cardiovascular event, non-fatal myocardial infarction, stroke, coronary revascularization, or heart failure (NYHA =III). Beyond cardiac findings (function, enhancement), MRI was assessed for the presence of atherosclerotic vessel changes, and chronic ischemic cortical changes. Kaplan-Meier-Survival and Cox-regression analysis was performed to determine independent associations.

RESULTS
Follow-up was completed in 60 subjects (92%, 62.8±13 years, 48% female) with a median follow-up period of 70 months. At the end of the follow-up, 14 (23%) patients experienced MACE. While a normal whole-body MRI excluded MACE over the follow-up period (0%), any detectable ischemic/atherosclerotic changes on WB-MRI (prevalence: 66%) conferred a cumulative event-rate of 15% at 2 years, 31% at 5 years and 40% at 7 years. While cardiac MR findings conferred a high independent risk for events (OR: 5.52, 95%-CI: 0.87-42.9), 15% (2/14) of subjects without cardiac finding developed MACE. Among these, all subjects had findings on WB-MRI (14/14, 100%). Also, the AUC increased significantly to 0.904 (95%CI: 0.84-0.97; p=0.01) when adding the WB-MRI findings to the model that contained the cardiac MR findings.

CONCLUSION
Systemic assessment of subclinical disease burden by WB-MRI may provide incremental prognostic information beyond cardiac MR findings in patients with diabetes mellitus.

CLINICAL RELEVANCE/APPLICATION
Assessment of atherosclerotic / ischemic changes on whole-body MRI may enhance current risk stratification schemes in patients with diabetes mellitus, including findings on cardiac MRI.

SSJ05-04 ● Aortic Stiffness by MRI Is Predictive of Cardiovascular Events and Mortality among Subjects with Metabolic Syndrome

Christopher Maroules MD (Presenter) ; **Amit Khera** MD, MSc ; **Colby Ayers** MS ; **Akshay Goel** BS ; **Ronald M Peshock** MD ; **Kevin S King** MD

PURPOSE
To determine the predictive value of aortic stiffness by MRI for future cardiovascular events and mortality among subjects with metabolic syndrome.

METHOD AND MATERIALS
The study consisted of 790 participants with metabolic syndrome from the Dallas Heart Study who underwent aortic MRI at 1.5 Tesla. Aortic stiffness was assessed by ascending aortic compliance (AC) and aortic arch pulse wave velocity (PWV) using phase-contrast velocity-encoded MRI. Participants were monitored for cardiovascular death, non-fatal cardiac events, and non-fatal extra-cardiac vascular events over 7.8 ± 1.5 years. Cox proportional hazards regression was used to assess for independent associations of aortic stiffness and cardiovascular events.

RESULTS
A total of 75 participants (9.5%) experienced a cardiovascular event and 17 participants (2.2%) succumbed to cardiovascular death during the surveillance period. AC was independently associated with increased risk for composite cardiovascular events (HR 1.41 per 1SD increase, p=0.04). Compared with participants in the highest quartile AC (most compliant), those in the lowest quartile AC (least compliant) were 3.5-fold more likely to experience a composite event (p=0.03). PWV was not independently associated with composite events after multivariate adjustment (HR 1.16 per 1SD increase, p=0.09). Both AC and PWV were independently associated with increased risk for cardiovascular death (HR 2.27 per 1SD increase, p=0.02; and HR 1.46 per 1SD increase, p=0.004, respectively). Similarly, both AC and PWV were independently associated with increased risk for nonfatal extra-cardiac vascular events (HR 2.08 per

1SD increase, p=0.02; and HR 1.33 per 1SD increase, p=0.02, respectively).

CONCLUSION
Among subjects with metabolic syndrome, MRI measures of aortic stiffness are independently predictive of future cardiovascular events and mortality.

CLINICAL RELEVANCE/APPLICATION
Among patients with metabolic syndrome, the presence of a stiffer aorta on MRI indicates increased risk for death and future adverse cardiovascular events.

SSJ05-05 ● Cardiovascular Risk Associated with Non-obstructive Coronary Artery Disease on CCTA Stratified by Sex Among Stable Individuals: Results from an International Multicenter Study of 18,158 Patients

Jonathan A Leipsic MD (Presenter) * ; **Gilat Grunau** PhD ; **Carolyn Taylor** MD ; **Cameron J Hague** MD ; **Leslee Shaw** PhD * ; **James Min** MD * ; **Gudrun Feuchtner** MD * ; **Ricardo C Cury** MD * ; **Matthew J Budoff** MD * ; **Stephan Achenbach** MD *

PURPOSE
Coronary artery disease (CAD) detected by coronary computed tomographic angiography (CCTA) has been shown to predict death and major adverse cardiac events (MACE) in men and women. To date, potential difference in gender-based prognostic utility of non-obstructive CAD identified on CCTA for myocardial infarction and death has not been adequately examined

METHOD AND MATERIALS
From an international multicenter observational cohort study of 27,725 individuals consecutively undergoing CCTA from 12 centers, we identified 18,158 patients without known CAD with normal CCTA or non-obstructive disease (defined as
RESULTS
At a 2.3 + 1.1-year follow-up, MACE occurred in 251 patients (0.6% annual event rate). Women were more likely to be dyslipidemic, hypertensive, diabetic and have a family history of CAD (p
CONCLUSION
Non-obstructive CAD on CCTA confers similar risk of death and myocardial infarction in men and women when matched for underlying cardiovascular risk. The absence of plaque is associated with a similarly low event rate in men and women.

CLINICAL RELEVANCE/APPLICATION
Our data confirms similar risk of non-obstructive CAD on CCTA between men and women helping to better understand CAD related sex differences.

SSJ05-06 ● Cardiac Mortality and Morbidity in Breast Cancer Survivors after Radiation Therapy - Is Coronary Atherosclerosis the Culprit?

Paul Apfaltrer MD (Presenter) ; **U. Joseph Schoepf** MD * ; **James R Spears** BS ; **Lothar R Pilz** ; **Stefan O Schoenberg** MD, PhD * ; **Rozemarijn Vliegenthart** MD, PhD ; **Garrett W Rowe** BS ; **Aleksander Krazinski** ; **Andrew D McQuiston** BS

PURPOSE
Breast cancer survivors after radiation therapy (RT) have increased rates of cardiac morbidity and mortality. We sought to investigate whether accelerated coronary artery disease (CAD) is to blame by comparing coronary calcium scores (CCS) in breast cancer survivors with and without RT.

METHOD AND MATERIALS
334 women with history of breast cancer were included. 67 patients underwent chest CT studies =6 months after the start of RT (RT-group), while 239 patients had a CT scan either prior to or without undergoing RT (noRT). Indications for performing CT studies varied, and involved contrast enhanced acquisitions. Coronary calcium was quantified by applying a threshold-based automated algorithm using a dedicated workstation. Statistical analysis included the Fisher�s exact test, Wilcoxon-Mann-Whitney Test, and the Siegel-Tukey Test. Cox regression analysis was performed to evaluate the risk of a positive CCS, adjusted for time between diagnosis/RT and CT imaging.

RESULTS
Mean age at diagnosis for the noRT group was 57.1±11.9 years, versus 58.4±12.9 years for the RT group (p>0.05). The groups showed no significant differences in race, smoking history, laterality of breast cancer, or cancer stage. Median interval between diagnosis/RT and CT image acquisition was 119 (25th, 75th percentile: 50, 238) days for the noRT group and 449 (211, 979) days for the RT group (p0.05). The median CCS for both groups was 0 (25th, 75th percentile: 0, 4; p>0.05). When adjusting for the time between diagnosis/RT and CT, RT patients had a significantly lower risk of a positive CCS compared to noRT patients, with a hazard ratio of 0.54 (95% confidence interval, 0.32-0.93, p
CONCLUSION
Breast cancer survivors after RT are not more likely to show coronary calcifications on subsequent CT imaging. Our preliminary results thus do not support radiation-induced accelerated CAD as an explanation for higher rates of heart disease in this group. However, suboptimal CT technique for evaluation of CCS along with a limited patient population may have influenced our results.

CLINICAL RELEVANCE/APPLICATION
The search for a culprit should be widened to include other potential causes of higher heart disease rates in breast cancer survivors after RT.

Cardiac PET/CT and PET/MR

Tuesday, 04:30 PM - 06:00 PM ● N228

NM MR CT CA

RC403 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5

RC403A ● Clinical Indications, Methods and Interpretation of Cardiac Magnetic Resonance Imaging

Gilbert Raff MD (Presenter) *

LEARNING OBJECTIVES
1) To learn appropriate indications for the use of cardiac magnetic resonance imaging. 2) To appreciate the strengths and weaknesses of cardiac MRI in relation to other cardiovascular imaging modalities. 3) To define the relative and absolute contraindications in selecting patients for cardiac MRI. 4) To know the spectrum of clinical information available from cardiac MRI. 5) To learn the basic pulse sequences and MRI protocols most commonly used in cardiac MRI.

ABSTRACT
Cardiac magnetic resonance imaging (CMR) is a noninvasive imaging modality most commonly available in tertiary referral centers. In general, it is a secondary, rather than primary test. However, in many appropriately referred patients, echocardiography, computed tomography, nuclear scintigraphy and/or invasive angiography are insufficient for definitive diagnosis. Additionally, in certain clinical situations primary referral for CMR is preferable due to unique capabilities or institutional preferences and/or expertise. The evaluation of cardiomyopathies is a frequent use of CMR; in particular to differentiate ischemic, infiltrative, restrictive, inflammatory, hypertrophic and idiopathic myopathies. This is due to its unique capacity for tissue characterization using first pass and delayed contrast enhancement and

T1 and T2 sensitive pulse sequences. Another use is in pre- and post-operative evaluation of congenital heart disease, in which the ability to provide anatomic, functional and vascular information from the entire thorax is unique, and particularly advantageous in young, radiation sensitive patients. Another frequent indication is analysis of suspected intracardiac or pericardial masses, which also benefits from the anatomic flexibility and tissue characterization capabilities of this modality.

RC403B ● Cardiac PET/MRI: Clinical Applications

Pamela K Woodard MD (Presenter) *

LEARNING OBJECTIVES
1) Participants in this course will learn clinical applications of cardiac PET/MRI. 2) Participants in this course will learn potential workflows for the performance of a cardiac PET/MRI myocardial perfusion examination.

RC403C ● Cardiac PET Imaging: Perfusion and Viability

Fabio Esteves MD (Presenter)

LEARNING OBJECTIVES
1) Identify the current clinical applications of cardiac PET. 2) Compare advantages and disadvantages of myocardial perfusion PET versus SPECT. 3) Recognize image artifacts associated with cardiac PET/CT. 4) Demonstrate understanding of myocardial viability interpretation and its use in clinical practice.

ABSTRACT

RC403D ● The Promise of a Combined MRI/PET Scanner

Bruce E Hammer PhD (Presenter)

LEARNING OBJECTIVES
Basic concepts behind acquiring a MRI and a PET image will be reviewed. Inherent resolution capabilities of MRI and PET imaging modalities as stand-alone scanners will be compared to that of combined MRI/PET scanners. The effect of MRI hardware on PET image quality and that of PET hardware on MRI image fidelity will also be explored.

Minicourse: Current Topics in Medical Physics-Nuclear Cardiac Imaging for Physicists

Tuesday, 04:30 PM - 06:00 PM ● S403B

`PH` `NM` `CA`

RC423 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
Moderator
G. Donald Frey , PhD

LEARNING OBJECTIVES
1) The participant will understand the role of nuclear cariology in the diagnosis of cardiac disease. 2) The participant will understand the role of the medical physicist in PET imaging of the heart. 3) The participant will understand the role of SPECT imaging of the heart.

RC423A ● Introduction

G. Donald Frey PhD (Presenter)

LEARNING OBJECTIVES
1) The participant will have an overall orientation to the role of medical physics in nuclear cardiology.

ABSTRACT
This section of the course will provide and overall introduction

RC423B ● SPECT Imaging of the Heart

Mark T Madsen PhD (Presenter)

LEARNING OBJECTIVES
1) Understand how cardiac SPECT studies are acquired. 2) Understand how cardiac SPECT studies are reconstructed and what corrections are required. 3) Understand how cardiac SPECT studies are analyzed. 4) Become familiar with cardiac SPECT instrumentation.

ABSTRACT
Cardiac SPECT is the most common nuclear medicine procedure and it contributes nearly 85% of the radiation dose associated with nuclear medicine imaging. In this presentation, the instrumentation and algorithms associated with cardiac SPECT will be reviewed. We begin with conventional general purpose SPECT systems that rely on parallel collimation along with the associated special purpose cardiac SPECT systems that are based on the conventional approach. Recent advances in SPECT instrumentation have made avaiable cardiac systems that rely on novel collimation and detector systems and these will also be reviewed. SPECT reconstruction approaches will be discussed including methods for motion, scatter and attenuation correction. Commercially available resolution recovery software for improving image quality and potentially reducing patient dose will round out the presentation..

RC423C ● PET Imaging of the Heart

Sameer Tipnis PhD (Presenter)

LEARNING OBJECTIVES
1) To understand the basic physics of cardiac PET imaging and the differences with cardiac SPECT. 2) To learn the proper way of acquiring data, including ECG gating, choice of bins, list mode data acquisition. 3) To understand the factors that affect image quality. 4) To learn tips for acquiring good clinical images. 5) To understand the role of dynamic PET imaging for determination of coronary flow reserve (CFR).

ABSTRACT

Hot Topic Session: Indications for MRI versus Low Dose CT in Congenital Heart Disease

Wednesday, 07:15 AM - 08:15 AM ● E353A

`MR` `CT` `CA`

SPSH40 ● *AMA PRA Category 1 Credit* ™:1 ● ARRT Category A+ Credit:1
Moderator

Rajesh Krishnamurthy , MD *

LEARNING OBJECTIVES
1) Understand how new generation ultrafast wide array CT scanners with adaptive iterative reconstruction reduce radiation dose and decrease sedation rates in pediatric cardiac CT. 2) Learn about recent advances in use of MRI for evaluating morphology, function, flow and myocardial tissue properties in CHD. 3) Evaluate role of low-dose CT versus MRI for management decision-making in the pre-operative period in the following conditions: vascular rings and slings, pulmonary atresia, anomalous coronaries, single versus two ventricle repair, heterotaxy and aortopathies. 4) Evaluate role of low-dose CT versus MRI for management decision-making following palliation of CHD in the following conditions: Following coarctation repair, after two-ventricle repair of conotruncal anomalies, and single ventricle s/p Glenn and Fontan procedures.

SPSH40A ● Preoperative Evaluation of CHD

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH40B ● MRI

Shi-Joon Yoo MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH40C ● CT

Rajesh Krishnamurthy MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH40D ● Discussion

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH40E ● Postoperative Evaluation of CHD

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH40F ● MRI

Shi-Joon Yoo MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH40G ● CT

Rajesh Krishnamurthy MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH40H ● Discussion

LEARNING OBJECTIVES
View learning objectives under main course title.

Women and Cardiovascular Disease (In Conjunction with the American Association for Women Radiologists)

Wednesday, 08:30 AM - 10:00 AM ● S104A

CT VA CA
Back to Top

RC516 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
Moderator
Yoshimi Anzai , MD

RC516A ● The Utility of Coronary CTA for the Evaluation of Coronary Artery Disease

Jill E Jacobs MD (Presenter)

LEARNING OBJECTIVES
1) To understand the benefits and limitations of coronary CTA for the assessment of coronary artery disease.

RC516B ● Cardiac CT Perfusion for Coronary Artery Disease

U. Joseph Schoepf MD (Presenter) *

LEARNING OBJECTIVES
1) To describe the various image acquisition protocols that are available for measuring myocardial perfusion with CT. 2) To recognize findings of normal and pathologic myocardial perfusion patterns at CT. 3) To discuss specific advantages of CT based assessment of myocardial perfusion in women. 4) To identify potential future clinical applications involving CT myocardial perfusion imaging.

RC516C ● Cardiac MR for Myocardial Infarction

Gisela C Mueller MD (Presenter) *

LEARNING OBJECTIVES
1) To understand technique, imaging findings, and clinical application of MR for myocardial infarct.

ABSTRACT
1) To describe the MR technique for myocardial infarct
2) To discuss segmental anatomy, MR appearances, and appropriate reporting of myocardial infarction
3) To discuss differential diagnoses of myocardial infarct on MR images and diagnostic pitfalls
4) To discuss clinical indications, alternative diagnostic methods, and impact on patient management of MR for myocardial infarction

Cardiac Radiology Series: Transcatheter Aortic Valve Replacement (TAVR)

Wednesday, 08:30 AM - 12:00 PM ● S502AB

IR VA CA

VSCA41 ● *AMA PRA Category 1 Credit* ™:3.75 ● ARRT Category A+ Credit:4
Moderator
Dominik Fleischmann , MD *
Moderator
Jonathan A Leipsic , MD *

VSCA41-01 ● The Emerging Role of TAVR

James Min MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the use of cardiac CT in the setting of transcatheter aortic valve replacement.

VSCA41-02 ● CT-angiography Based Evaluation of the Aortic Valve Annulus for Prosthesis Sizing in Transcatheter Aortic Valve Implantation (TAVI) - Predictive Value and Optimal Thresholds for Major Anatomic Parameters

Florian Schwarz MD (Presenter) ; **Dominik Zinsser** BS ; **Philipp Lange** MD ; **Martin Greif** ; **Maximilian F Reiser** MD ; **Hans-Christoph R Becker** MD ; **Alexander Sterzik** ; **Christian Kupatt** MD, PhD ; **David Jochheim** MD

PURPOSE
To evaluate the predictive value of CT-measurements of the aortic annulus for prosthesis sizing in transcatheter aortic valve implantation (TAVI) and to calculate optimal cutoff values for the selection of the small, medium and large valve size for two manufacturers.

METHOD AND MATERIALS
In 351 TAVI-patients, optimal prosthesis size was determined during TAVI by inflation of a balloon catheter at the aortic annulus. The Corevalve Valve System (Medtronic; CV) and the Edward Sapien XT valve (Edwards Life Sciences; ES) were used in 235 and 116 patients, respectively. All patients had undergone CT-angiography of the bodytrunc prior to TAVI. Using the CT datasets, the length of the long and short axis as well as circumference and area of the aortic annulus were measured by two experienced observers. A 10-fold nested cross-validation approach was used to estimate the predictive power of different anatomical parameters for the prosthesis size ultimately implanted and to define optimal cut-off points.

RESULTS
There was excellent interobserver agreement (ICC's > 0.85), so average values were used for further analysis. Differences between patients who underwent implantation of the small, medium or large prosthesis were significant for all evaluated aortic root parameters and both manufactures (p�s
CONCLUSION
CT-based aortic root measurements permit good prediction of the prosthesis size considered optimal during TAVI. Applying the proposed parameter ranges, prosthesis size would have been chosen correctly in 87% of cases. Inclusion of the degree of calcification and/or the dimensions of the sinus of Valsalva into our model might further increase its predictive potential.

CLINICAL RELEVANCE/APPLICATION
The proposed cutoff-values for major anatomic parameters of the aortic annulus can serve as a guide for non-invasive prosthesis sizing for the most widely used TAVI prosthesis models

VSCA41-03 ● C-arm CT has Higher Interobserver Variability Compared to Multidetector CT (MDCT) for Transcatheter Aortic Valve Implantation/Replacement (TAVI/R) Planning

Suhny Abbara MD (Presenter) * ; **Lorenzo Azzalini** ; **Umesh C Sharma** MD, DPhil ; **Ignacio Inglessis** ; **Igor F Palacios** ; **Brian B Ghoshhajra** MD

PURPOSE
Accurate characterization of the aortic annulus and root is critical for guidance of prosthesis diameter choice in TAVI/R planning, and to accurately deploy the valve, and is usually performed by transesophageal echocardiography or MDCT. The same C-arm used for fluoroscopy during the procedure may also be utilized to acquire 3-D datasets that are similar to MDCT. However, this C-arm CT (CACT) is not currently used to perform measurements of the aortic root to guide the procedure. We aim to evaluate the interobserver variability of CACT aortic root measurements, as compared to MDCT.

METHOD AND MATERIALS
CACT and MDCT were performed in 20 patients. Multiplanar reconstructions were performed to determine aortic annulus area, circumference and diameters, sinus of Valsalva diameters and height, leaflet length, distance of the coronary ostia to annulus plane, sinotubular junction, ascending aortic diameters, and predicted perpendicular projection to annulus plane (Figure 1).
Each parameter was determined by two independent blinded cardiac imagers. Interobserver variability for CACT- and MDCT-derived measurements was determined using the intraclass correlation coefficient (ICC).

RESULTS
No significant interobserver variability was found for all variables derived from MDCT (ICC 0.45 to 0.93).
However, there was significant disagreement for the following measurements derived from CACT: aortic annulus short and long axis diameters, area and circumference (ICC

CONCLUSION
No significant interobserver variability was found with MDCT. Although, good agreement was found for the measurements above the aortic annulus with CACT, the measurements of the aortic annulus demonstrate greater variability compared to MDCT, possibly due to absence of contrast within the left ventricular outflow tract. Therefore sizing of TAVI/R valves may not reliably performed based on CACT measurements alone.

CLINICAL RELEVANCE/APPLICATION
CACT provides MDCT-like images, but measurements of aortic annulus are not reliable. Sizing of TAVI/R valves therefore continues to require MDCT or echocardiography.

VSCA41-04 ● Assessment of the Aortic Annulus with TransEsophageal Echocardiography, Multidetector Computed Tomography and Magnetic Resonance to Direct Surgical Sizing: Can We Rely on Imaging?

Leonardo Capitolo MD (Presenter) ; **Marco Gatti** MD ; **Claudio Maria Berzovini** ; **Riccardo Faletti** ; **Stefano Salizzoni** ; **Paolo Fonio** ; **Mauro Rinaldi** ; **Giovanni Gandini** MD

PURPOSE
Precise sizing of the aortic annulus is crucial in order to properly select type and size prosthesis to avoid complication during TAVI procedures. We Evaluate aortic annulus sizing performed by TransEsophageal Echocardiography (TEE), MultiDetector Computed Tomography (MDCT) and Magnetic Resonance (MR) and compares the results to direct intra-operative sizing.

METHOD AND MATERIALS

RESULTS
All imaging techniques yield results in satisfactory agreement with one another and with the Hegar (R=0.70 for TEE; R=0.81 for MDCT and R=0.81 for MR), even if with different behaviors: MDCT and TEE suffer from overestimation for smaller diameters changing into underestimation for larger ones; MR overestimate over the whole diameter range. The measurements within ±2 mm around the Hegar sizing result in 71% for TEE, 76% for MR and 80% for MDCT.

CONCLUSION
MDCT and MR seem to be more accurate in annulus measurements, with different advantages and drawbacks, than TEE.

CLINICAL RELEVANCE/APPLICATION
The imaging and the assessment of �virtual tube� could accurately size the aortic annulus in order to properly select the most appropriate valve size for transcatheter aortic valve implantation (TAVI)

VSCA41-05 ● Functional Anatomy and Measurements of the Aortic Root

Jonathan A Leipsic MD (Presenter) *

LEARNING OBJECTIVES
1) Discuss the most reproducible and accurate methods for annular assessment with CT with a focus on the dynamic changes throughout the cardiac cycle. 2) Provide a deeper understanding of proposed annular sizing strategies with MDCT with focus on recently published multicenter trial data. 3) Discuss the role of MDCT to identify potential adverse root features to help reduce the risk of annular injury.

VSCA41-06 ● Intentional Computed Tomography-based Oversizing in Balloon-expandable Transcatheter Aortic Valve Replacement - Incidence of Paravalvular Regurgitation and Post-deployment Geometry

Philipp Blanke MD (Presenter) ; **Eva Maria Spira** ; **Gregor Pache** MD ; **Mathias F Langer** MD, PhD

PURPOSE
To evaluate the incidence of paravalvular regurgitation and post-deployment geometry of intentional computed tomography (CT)-based oversizing of Transcatheter Heart Valves (THV) in Transcatheter Aortic Valve Replacement (TAVR) using pre- and post-deployment dual-source CT.

METHOD AND MATERIALS
115 patients with severe aortic stenosis (mean age 81±7 years, mean aortic valve area $0.68±0.18cm^2$) underwent retrospectively gated dual source CT for THV sizing prior to TAVR. Aortic annulus dimensions were quantified by means of planimetry and area-derived diameter calculation (D = 2 x v(area/?)) at the level of the basal attachment points of the aortic cusps during systole. THV selection was CT-diameter-based (EdwardSAPIEN XT 23mm THV for D 25mm). Post-deployment CT was performed in 95 patients. Stent-expansion was assessed planimetrically at the inlet, outlet and level of the native annulus. Relative oversizing and relative changes in annulus dimensions were calculated.

RESULTS
Average pre-deployment annulus diameter was 24.1±1.8mm, average post-deployment diameter was 23.9±1.5mm (p=n.s.). Average relative change in annulus diameter was -0.5±3.6%. Mean relative oversizing was 9.1±4.7%. Mean diameter at the THV outlet was significantly larger than at the THV inlet (24.3±1.8mm vs. 23.8±1.7mm, p
CONCLUSION
Intentional oversizing of the THV based on an area-derived annulus diameter in CT and an adapted incremental sizing scheme appears safe and is associated with a lower incidence of relevant paravalvular regurgitation, as compared to published landmark trial with echocardiography-based THV-sizing

CLINICAL RELEVANCE/APPLICATION
Planimetric assessment of the aortic annulus by CT allows for intentional prosthesis oversizing in trancatheter aortic valve replacement to reduce the occurrence of paravalvular regurgitation.

VSCA41-07 ● CT Angiography for Aortic Root Measurements in TAVR Patients: Comparison of High-pitch Dual-source CT Image Acquisition versus Retrospective ECG-Gating

Felix G Meinel MD (Presenter) ; **U. Joseph Schoepf** MD * ; **Carlo Nicola De Cecco** MD ; **Aleksander Krazinski** ; **Maximilian F Reiser** MD ; **Lucas L Geyer** MD * ; **Daniel H Steinberg** MD

PURPOSE
To compare the diagnostic value and robustness of high-pitch dual-source CT angiography versus retrospectively ECG-gated data acquisition for aortic root measurement during pre-procedural planning of transcatheter aortic valve replacement (TAVR).

METHOD AND MATERIALS
With IRB approval and in HIPAA compliance, data of 20 patients (77.5±12.8 years, 11 male, heart rate 69.4±15.5bpm) considered for TAVR were retrospectively analyzed. All patients had undergone both retrospectively ECG-gated cardiac CT (scan 1) as well as high-pitch dual-source CT angiography (scan 2) of the aorta. Scan 2 targeted the end-systolic phase at 35% of the RR�-cycle. A BMI-based contrast medium (CM) injection protocol was used with 70-144mL volume, injected at 3.0-5.5mL/s. For consistency, both scans were reconstructed with a section thickness of 1.5mm with 0.7mm increment. Image quality (IQ) was subjectively assessed. Aortic annulus dimensions were measured as area-derived diameters. Based on effective diameter, agreement for prosthesis selection between the high-pitch image acquisition (D_{FLASH}) was compared with standard reconstructions at 30%-80% ($D_{30}-D_{80}$) of the RR�-cycle.

RESULTS
All patient studies had at least 150 HU CM attenuation at the level of the aortic root. In scan group 1, aortic annulus measurements could be successfully performed in all patients. Scan 2 resulted in 7 studies with non-diagnostic IQ. Patients with non-diagnostic IQ had a significantly higher body-mass index ($38.5±10.1kg/m^2$ versus $27.4±4.2kg/m^2$, pFLASH 24.1±2.0mm, D_{30} 24.6±2.2mm, D_{40} 24.2±2.1mm, D_{50} 24.1±2.2mm, D_{60} 23.9±1.99mm, D_{70} 23.8±1.98mm, D_{80} 24.2±2.3mm. In patients with diagnostic IQ, the highest agreement in prosthesis sizing was found in 11 of 13 patients by D_{30} (?=0.65) and 13 of 13 patients by D_{70} (?=1.00) compared with D_{FLASH}.

CONCLUSION
For TAVR planning, the use of high-pitch dual-source CT angiography is feasible in the majority of patients. However, retrospectively ECG-gated cardiac CT should be considered in problematic scenarios, such as obese patients or cardiac arrhythmia.

CLINICAL RELEVANCE/APPLICATION
High-pitch dual-source CTA requires appropriate patient selection for reliable measurements of the aortic annulus in TAVR patients compared with the more robust retrospectively ECG-gated approach.

VSCA41-08 ● Accuracy of Aortic Root Annulus Assessment with Cardiac Magnetic Resonance in Patients referred for Transcatheter Aortic Valve Implantation: A Comparison with Multi-detector Computed Tomography

Gianluca Pontone MD (Presenter) ; **Daniele Andreini** MD ; **Erika Bertella** ; **Saima Mushtaq** ; **Paola Gripari** ; **Monica Loguercio** ; **Sarah Cortinovis** ; **Andrea Baggiano** ; **Edoardo Conte** ; **Andrea Daniele Annoni** MD ; **Alberto Formenti** ; **Mauro Pepi**

PURPOSE
Cardiac magnetic resonance (CMR) has distinct advantages over 2D echocardiography such as exceptional spatial resolution and does not need administration of contrast agents, provides similar 3D multi-slice images of the aortic root, so that it may be a valid alternative to MDCT. The aim of this study is to compare the accuracy of CMR evaluation of AoA as compared to MDCT in patients referred for TAVI.

METHOD AND MATERIALS
50 patients were studied with a 1.5-T scanner (Discovery MR450, GE Healthcare, Milwaukee, WI). Steady-state free precession cine acquisitions were acquired with following parameters: echo time 1.57 ms, repetition time 46 ms, slice thickness 8 mm, field of view 350mmx263mm, and pixel size 1.4mmx2.2 mm. Two long-axis view of the aortic root and ascending aorta were obtained. Thus, serial short-axis cines orthogonal to the AoA (3-mm thickness with 1.5-mm overlapping) were imaged. The following parameters were assessed with CMR and compared with those obtained with MDCT: AoA maximum diameter (AoA-Dmax), minimum diameter (AoADmin), and area (AoA-A), length of the left coronary, right coronary, and non-coronary aortic leaflets, degree (grades 1 to 4) of aortic leaflet calcification and distance between AoA and coronary artery ostia.

RESULTS
AoA-Dmax, AoA-Dmin and AoA-A were 26.45±2.83 mm, 20.17±2.20 mm, 444.88±84.61 mm2 and 26.45±2.76 mm, 20.59±2.35 mm and 449.78±86.22 mm2 bv MDCT and CMR. respectivelv. The length of left coronary, right coronary, and non-coronary leaflets were 14.02±2.27 mm, 13.33±2.33 mm, 13.39±1.97 mm, and 13.95±2.18 mm, 13.30±2.14 mm, 13.46±1.80 mm by MDCT and CMR, respectively, while the scores of aortic leaflet calcifications were 3.4.±0.7 vs. 2.97±0.77. Finally, the distance between AoA and left main and right coronary artery ostia was 16.21±3.07 mm, 16.02±4.29 mm and 16.14±2.83 mm, 16.14±4.36 mm by MDCT and CMR, respectively. There was close agreement between CMR and MDCT measurements, whereas aortic leaflet calcifications were underestimated by CMR.

CONCLUSION
Aortic root assessment with CMR including AoA size, aortic leaflet length and coronary artery ostia height is accurate in comparison to MDCT.

CLINICAL RELEVANCE/APPLICATION
CMR may be a valid imaging alternative in patients unsuitable for MDCT.

VSCA41-09 ● Access Vessel Assessment

Dominik Fleischmann MD (Presenter) *

LEARNING OBJECTIVES
1) Review the possible percutaneous access sites for patients undergoing TAVR: femoral, transapical, transaortic, subclavian/axillary. 2) Explain the techniques for accurate vessel visualization, diameter measurements and curvature assessment. 3) Present the current recommendations for minimum access vessel diameters with clinical examples.

ABSTRACT
Treatment planning for TAVR requires meticulous assessment of access vessels to assure safe device delivery. A high-quality CTA dataset with 0.6-1.25mm section thickness is a prerequisite for accurate vessel visualization and measurement. While transverse source images provide a reasonalby good 'first look', most patients require dedicated postprocessing with curved planar reformations and orthogonal images through the access vessels to determine the minimal vessel diameter, to assess for the presence of calcifications, and display the degree of tortuosity. The minimum arterial diameter necessary for TAVR depends on the valve type and size, as well as on the outer diameter of the delivery system. The outer diameter of the delivery system should not exceed 1.05 times the inner arterial diameter. If heavy calcifications are present, particularly circumferential or horse-shoe shaped, the delivery system should be smaller.
If periheral arterial access is inadequate, a direct transaortic route can be chosen through a mini-sternotomy, or right mini-thoracotomy (2nd interspace). It is important to exclude heaviy calcifications at a potential aortic access site (e.g. plaque of porcellain aorta), and to determine the distance between the aortic access and the valve plane to assure enough length for device delivery. Transapical access can be gained through a left lateral mini-thoracotomy (5th or 6th interspace).

VSCA41-10 ● Low Volume, Low Iodine Concentration Contrast Medium Protocol for Comprehensive CT Planning of Transcatheter Aortic Valve Replacement

Aleksander Krazinski ; **Philipp Blanke** MD ; **U. Joseph Schoepf** MD * ; **Justin R Silverman** ; **Carlo Nicola De Cecco** MD ; **Lucas L Geyer** MD (Presenter) * ; **Fabian Bamberg** MD, MPH * ; **Daniel H Steinberg** MD

PURPOSE
To investigate the feasibility of a dual-source CT angiography (CTA) protocol with a low volume of low iodine concentration contrast medium (CM) for comprehensive planning of transcatheter aortic valve replacement (TAVR) in a patient group with a high prevalence of chronic renal failure and atrial fibrillation.

METHOD AND MATERIALS
44 patients, considered for TAVR, underwent retrospectively ECG-gated CTA of the heart, immediately followed by high-pitch CTA of the femoro-ilio-aortic access route using two different injection protocols of low iodine concentration (320mgI/mL) iodixanol: group A, iodine delivery rate (IDR)-based (target, 1.28gI/s), CM volume 60mL, flow rate 4.0mL/s; group B, BMI-based (routine protocol), CM volume range 70◆144mL, flow rate range 3.0◆5.5mL/s. All injections were followed by a 50mL saline chaser. Aortic root complex and iliofemoral dimensions were measured. Mean arterial attenuation, signal-to-noise ratio (SNR), and contrast-to-noise ratio (CNR) were calculated. Subjective image quality was assessed at the level of the aortic root complex and the aortoiliac vasculature.

RESULTS
Gender distribution (12 female, 8 female, p=0.226), age (82.1±9.8 years, 80.0±11.5 years, p=0.520), body mass index (26.8±4.1kg/m², 29.1±4.7kg/m², p=0.098), and heart rate (69.3±10.3bpm, 70.0±14.5bpm, p=0.849) showed no significant differences between groups. Aortic root complex and iliofemoral dimensions could be analyzed in all cases. Mean attenuation at the level of the aortic root (272.5±100.3HU, 318.9±67.3HU, p=0.097), the aorta (214.7±70.0HU, 251.2±82.4HU, p=0.140), and the iliofemoral access route (264.1±87.2, 287.7±64.9, p=0.337) was non-significantly lower in group A. SNR and CNR were non-significantly higher in group B. Qualitative assessment of image quality did not result in significant differences.

CONCLUSION
The performance of a combined CTA protocol consisting of a retrospectively ECG-gated cardiac CTA immediately followed by a high-pitch scan of the femoro-ilio-aortic access route is feasible. With this approach, the amount of CM can be considerably reduced by using a single low volume CM bolus without substantial loss of image quality in fragile, multimorbid patients who are considered for the TAVR procedure.

CLINICAL RELEVANCE/APPLICATION
This comprehensive protocol facilitates the use of a low volume, low iodine concentration CM protocol, which is essential in this patient group who often presents with significant comorbidities.

VSCA41-11 ● Influence of Left Ventricular Geometry and Body-surface Area on Aortic Annulus Dimensions in Patients prior to

Transcatheter Aortic Valve Implantation - Assessment by Computed Tomography

Philipp Blanke MD (Presenter) ; **Eva Maria Spira** ; **Tobias Baumann** MD ; **Gregor Pache** MD ; **Mathias F Langer** MD, PhD

PURPOSE
To investigate the influence of left ventricular geometry, left ventricular function, body surface area (BSA), and gender on aortic annulus dimensions by computed tomography (CT) in patients with severe aortic stenosis.

METHOD AND MATERIALS
ECG-gated cardiac dual-source CT data of 289 consecutive patients with severe aortic stenosis (mean age 81±7 years, 121 males, mean aortic valve area 0.68±0.18cm2) was included. Aortic annulus dimensions were quantified by means of planimetry and area-derived diameter calculation (D = 2 x v(area/?)) at the level of the basal attachment points of the aortic cusps during systole. End-diastolic left ventricular volume (LVEDV), left ventricular ejection fraction (LVEF) and left ventricular myocardial mass (LVM) were assessed by multiphasic cine image reconstructions. Pearson correlation analysis and a step-wise multi-linear regression model were performed.

RESULTS
Mean aortic annulus diameter was 24.4±2.4mm, mean LVEF 59.1±16.1%, mean LVEDV 145.6±51.5ml, mean LVM 181.8±54.2g, and mean BSA 1.8±0.2m2. A positive and significant correlation (p
CONCLUSION
In patients with aortic stenosis, aortic annulus dimensions are influenced by gender, BSA and left ventricular geometry. A larger end-diastolic left ventricular volume, as present in left ventricular dilation, is associated with a larger annulus diameter.

CLINICAL RELEVANCE/APPLICATION
In patients undergoing transcatheter aortic valve replacement, aortic annulus dimensions are critical for prosthesis sizing. This study aids in understanding predictors of annulus dimension.

VSCA41-12 ● Anatomical and Procedural Features Associated with Annular Injury in Balloon Expandable Transcatheter Aortic Valve Replacement

Jonathan A Leipsic MD (Presenter) * ; **Marco Barbanti** MD ; **Philipp Blanke** MD ; **Gudrun Feuchtner** MD * ; **David Wood** MD, FRCPC * ; **James Min** MD * ; **John Webb** MD, FRCPC *

PURPOSE
Aortic root rupture is a major concern with balloon expandable TAVR. We sought to identify predictors of aortic root rupture during balloon-expandable TAVR using MDCT.

METHOD AND MATERIALS
Thirty seven consecutive patients with left ventricular outflow tract (LVOT)/annular rupture complicating balloon expandable TAVR were collected from 17 centers and 10 countries. Analysis was performed on an historical cohort of 150 consecutive TAVR patients without aortic root rupture who underwent pre-procedure MDCT at St Paul�s Hospital, Vancouver, to identify a comparable group. Matched case-control analysis was conducted where random 1 to 1 matching datasets were constructed on confounders which include gender, baseline aortic valve area, baseline mean transaortic gradient and annular area on CT. Conditional logistic regression was used on the matched data to assess study variables' association with root rupture. MDCT assessment included short and long axis diameters and cross sectional area of the sinotubular junction, annulus and LVOT, as well as the presence, location, and extent of LVOT calcification.

RESULTS
Mean age was 82.4±8.5 years and 74% of patients were females. There were no significant differences between the two groups in any preoperative clinical and echocardiographic variables. Aortic root rupture was identified in 20 patients and periaortic hematoma in 11. Patients with root rupture had a higher degree of LVOT calcification quantified by Agatston score (181.2±211.0 vs. 22.5±37.6, p
CONCLUSION
This study demonstrates that LVOT calcification and aggressive annular area oversizing are associated with an increased risk of aortic root rupture during TAVR with balloon-expandable prostheses. Larger studies are warranted to confirm these findings.

CLINICAL RELEVANCE/APPLICATION
We have identified an important anatomical factor and two procedural variables strongly associated with annular rupture which will allow for a deeper understanding of this important complication.

VSCA41-13 ● Complications and Incidental Findings

Gudrun Feuchtner MD (Presenter) *

LEARNING OBJECTIVES
1) To learn which imaging features are associated with complications related to TAVI procedure. 2) To understand morphology of aortic valve, annulus, calcifications and implications for procedure success. 3) To learn which incidental findings have impact on pre-procedural patient management and intraoperative complications.

ABSTRACT
Transcather aortic valve implantation (TAVI) is a modern innovative minimal invasive approach to treat patiens with severe aortic stenosis effectively. Imaging plays a key role to ensure procedure sucess and to avoid complications. During this course, imaging features associated with complications will be discussed:1) Major vascular complications accur at 15%. This rate can be cut when selecting patients carefully taking into account high.risk features on CT. 2)Aortic annular calcification are related to intraoperative complications, and high.risk characteristica will be shown. 3) incidental findings having impact on patients managments will be identified.

VSCA41-14 ● The Impact of Post-implant SAPIEN XTGeometry on Conduction Disturbances, Hemodynamic Performance and Paravalvular Regurgitation

Cameron J Hague MD (Presenter) ; **Jonathan A Leipsic** MD * ; **John Webb** MD, FRCPC * ; **Stefan Toggweiler** ; **Melanie Freeman** ; **Ronald Binder** ; **David Wood** MD, FRCPC * ; **Marco Barbanti** MD ; **Donya A Al-Hassan** MD

PURPOSE
To examined the relationship between post valve placement geometry and position of a percutaneously placed Edwards Sapien XT balloon expandable aortic valve and the presence of prosthetic valve dysfunction and post-implant conduction abnormalities.

METHOD AND MATERIALS
89 consecutive patients with symptomatic aortic stenosis undergoing transcatheter aortic valve replacement (TAVR) with a balloon expandable Sapien XT valve had pre and post valve assessments with multidetector computed tomography (MDCT) , transthoracicechocardiography (TTE) and pre and post procedure 12 lead ECG. MDCT measures included valve circularity, percent expansion, inflow/outflow valve areas, and implantation height. Chart review assessed for placement of a permanent pacemaker (PPM) in subjects post TAVR. Statistical analyses were performed using SPSS statistics software. A p-value below 0.05 was considered significant. IRB approval was obtained for this study. All subjects provided consent.

RESULTS
89 patients (age 82+/- 8 years, 54 male, 35 female) undergoing TAVR with an Edwards Sapien XT THV were analyzed. Analysis of post implant MDCTs demonstrate average THV stent frame placement as follows: outflow 0.3mm +/- 2.6mm below the left main ostium, and inflow (inferior aspect of stent) was 3.6 +/-2.2mm below the aortic annulus (basal insertion of the native aortic leaflets). Paravalvuar regurgitation (PAR) as assessed by TTE was absent in 24.7%, mild in 67.4%, moderate in 5.6% and moderate to severe in 2.2%. As assessed by MDCT stent frame inflow area in relation to the native annular area, and the difference of the stent frame long-axis diameter

to native annulus long axis diameter were the only measured parameters predictive of PAR (p=0.03 and p=0.023 respectively). 5.1% of subjects required a new PPM following TAVR. The MDCT derived THV inflow level to annular distance was the strongest predictor of PPM placement post TAVR. (3.5 +/-2.0mm versus 7.1 +/-2.5mm, p=0.001).

CONCLUSION
MDCT measures of THV implantation depth and relationship of inflow stent area to native annulus area are strong predictors of new onset conduction disturbances/PPM placement and PAR respectively, both important causes of morbidity and mortality post TAVR.

CLINICAL RELEVANCE/APPLICATION
MDCT measures of implantation depth and stent inflow area versus native annular area provide important predictors of complications TAVR (PPM placement and PAR respectively).

VSCA41-15 ● Contrast Induced Nephropathy after Contrast Enhanced Computed Tomography prior to Transcather Aortic Valve Implantation

Vera S Schneider BS (Presenter) ; **Florian Schwarz** MD ; **David Jochheim** MD ; **Christian Kupatt** MD, PhD ; **Maximilian F Reiser** MD ; **Hans-Christoph R Becker** MD ; **Philipp Lange** MD ; **Julinda Mehilli** MD ; **Frederik F Strobl** MD

PURPOSE
Contrast induced nephropathy (CIN) is a common complication after contrast enhanced computed tomography (CT). Particularly, patients with aortic valve stenosis (AS) are at increased risk for CIN due to their high prevalence of chronic kidney disease. The aim of this analysis is to determine the rate of CIN in patients with AS following contrast enhanced CT scans prior to transcatheter aortic valve implantation (TAVI).

METHOD AND MATERIALS

RESULTS
Rates for CIN in patients with GFR under 30, 30 to 60 and over 60 ml/min, were 13.6 %, 10.9 %, 6.8 %, respectively. Average contrast volume in patients who developed CIN was 101 ml vs. 92 ml in those who did not (p < 0.05), supporting a strong relation between the development of CIN and the volume of contrast administered.

CONCLUSION
The incidence of CIN in high risk patients with AS undergoing contrast enhanced CT depends on the baseline GFR. We found a close relation between the amount of administered contrast media and the development of CIN.

CLINICAL RELEVANCE/APPLICATION
Low dose contrast protocols for CT angiography may help reduce the risk of CIN � particularly in high risk patients with AS in whom baseline renal function frequently is impaired.

VSCA41-16 ● Fusion of Cardiac Computed Tomography Angiography and 18F-Fluorodesoxyglucose Positron Emission Tomography for the Detection of Prosthetic Heart Valve Endocarditis

Wilco Tanis (Presenter) ; **Asbjorn Scholtens** MD ; **Jesse Habets** MD ; **Renee B Van Den Brink** MD, PhD ; **Lex Van Herwerden** * ; **Steven Chamuleau** MD, PhD ; **Ricardo P Budde** MD, PhD

PURPOSE
In prosthetic heart valve (PHV) endocarditis transthoracic and transesophageal echocardiography (TTE and TEE) may fail to recognize vegetations and peri-annular extensions, which is an indication for urgent surgery. Moreover, abnormal peri-annular anatomy after PHV implantation is not uncommon and differentiation between active or absent inflammation is difficult. The purpose of this study is to investigate the additional value of imaging with fused Computed Tomography Angiography (CTA) and 18F Fluorodesoxyglucose Positron Emission Tomography including low dose CT (FDG-PET/CT) providing high resolution anatomical and functional information.

METHOD AND MATERIALS
In our hospital PHV patients suspected for endocarditis undergo additional CTA and sometimes also FDG-PET/CT imaging when TTE and TEE are inconclusive. All PHV patients that underwent FDG-PET/CT were selected from the hospital database and assigned as cases or controls. Surgical inspection was the reference standard for cases.

RESULTS
Twelve PHV endocarditis cases and six normal functioning PHV controls were identified, which all underwent TTE, TEE, CTA and FDG-PET/CT. On surgical inspection 11/12 cases had peri-annular extension and 4/12 had a vegetation. CTA alone detected all vegetations but missed one peri-annular extension. FDG-PET/CT alone missed all vegetations, however all peri-annular extensions were detected correctly. Combined FDG-PET/CT and CTA detected all peri-annular extensions and vegetations correctly. Controls were all free of significant FDG uptake. SUV ratios around the PHV ring were significantly (p
CONCLUSION
Fused FDG-PET and CTA imaging is a promising tool to correctly diagnose PHV endocarditis in patients with an inconclusive echocardiography. SUV ratios may be of additional help for correct detection of peri-annular extensions.

CLINICAL RELEVANCE/APPLICATION
PHV endocarditis sometimes remains difficult to diagnose with echocardiography due to acoustic shadowing of mechanical valves. In those cases hybrid imaging wit CTA and FDG-PET/CT may guide treatment.

VSCA41-17 ● Characteristics of Aortic Valvular Function and Ascending Aorta Dimensions According to Bicuspid Aortic Valve Morphology Using Dual-source Computed Tomography

Tae Hyung Kim (Presenter) ; **Sung Min Ko** ; **Meong Gun Song** ; **Hweung Gon Hwang** ; **Jung Ah Park**

PURPOSE
The bicuspid aortic valve (BAV) is associated with aortic valve dysfunction and ascending aorta dilatation. The relationship between BAV morphology and ascending aorta dimensions remains unclear. We sought to characterize the aortic valve function and the ascending aorta dimensions according to valve morphology using dual-source computed tomography (DSCT).

METHOD AND MATERIALS
Two hundred nine BAV patients who underwent DSCT and transthoracic echocardiography were retrospectively included. BAV was classified into type I (anterior-posterior orientation of cusps or raphe) and type II (lateral orientation of cusps or raphe), and divided into raphe + (presence of raphe) and raphe � (absence of raphe) using DSCT.

RESULTS
Type I was present in 129 patients (61.7%) and raphe + in 120 (57.4%) patients. BAV type I and II was more commonly in patients with raphe + (84%) and raphe - (69%), respectively. Aortic regurgitation was more common in patients with type I (45%) and raphe + (53%), and aortic stenosis in patients with type II (46%) and raphe - (56%). Type I patients had a larger aortic annulus and smaller tubular portion of ascending aorta (29.9±4.7 mm and 41.7±7.3 mm, respectively) compared to type II patients (26.7±3.5 mm and 44.3±8.3 mm, respectively, P
CONCLUSION
BAV morphology is helpful in predicting the type of aortic valve dysfunction and the location of ascending aorta dilatation

CLINICAL RELEVANCE/APPLICATION
BAV morphology is helpful in predicting the type of aortic valve dysfunction and the location of ascending aorta dilatation.

Cardiac (Coronary CT/MR IV)

Wednesday, 10:30 AM - 12:00 PM ● S504AB

IR CT CA

SSK03 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
Moderator
Gisela C Mueller , MD *
Moderator
Jacobo Kirsch , MD

SSK03-01 ● Feasibility of Calcium Image Subtraction Using Second-generation 320-detector Row Coronary CT Angiography

Andreas Fuchs (Presenter) ; **J. Tobias Kuhl** ; **Marco Razeto** * ; **Arakita Kazumasa** * ; **Steffen Helqvist** ; **Joanne Schuijf** * ; **Marcus Y Chen** MD ; **Andrew E Arai** MD ; **Klaus Kofoed** MD

PURPOSE
The reader confidence and diagnostic accuracy of Coronary CT angiography (CCTA) can be compromised by the presence of calcified plaques causing blooming artifacts. Compared to conventional invasive coronary angiography (CAG), this may cause an overestimation of stenosis severity leading to false positive results. We tested the feasibility of a new coronary calcium image subtraction algorithm in relation to reader confidence and diagnostic accuracy.

METHOD AND MATERIALS
Twenty-seven patients underwent both CAG and CCTA on clinical indication using a second-generation 320◇detector row CT. Median Agatston score was 345 (interquartile range 110-1328). Two datasets were reconstructed: a conventional CCTA (conCCTA) and a subtracted CCTA (subCCTA), where calcifications detected on non-contrast images were subtracted from the CCTA. Reader confidence (1=poor, 2=partially diagnostic, 3=diagnostic) and concordance with CAG for identification of >50% stenosis (17 segment model) were recorded. We defined study lesions on conCCTA as motion free coronary segments with calcified plaque. The impact of coronary calcium image subtraction was assessed in these coronary segments.

RESULTS
A total of 130 study lesions were identified. Out of these, low reader confidence (less than 3) was found in 41 due to severe coronary calcification or stents. The use of coronary calcium image subtraction improved the reader confidence in 36% (13/36) of the segments with severe calcification and in 60% (3/5) of the segments with coronary stents. In 31 of the study lesions CAG found stenosis >50%. With conCCTA the false positive rate in study lesions was 18% (24/130) compared to 14% (19/130) with subCCTA.

CONCLUSION
Our initial experience with coronary calcium image subtraction suggests that it is feasible, and could lead to an improvement in reader confidence and diagnostic accuracy for identification of significant coronary artery disease.

CLINICAL RELEVANCE/APPLICATION
Coronary calcium subtraction may improve reader confidence and diagnostic accuracy in the presence of calcified plaques and stents, and thus may possibly improve overall diagnostic strength of CCTA.

SSK03-02 ● Effect of Snapshot Freeze Motion Correction Algorithm on Image Quality of Prospective ECG-triggered Coronary CT Angiography

Lijuan Fan (Presenter) ; **Jiwang Zhang** ; **Donghai Fu** ; **Liren Zhang** MD

PURPOSE
We assessed Snapshot Freeze Motion Correction algorithm for its effect on image quality of coronary CT angiography (CCTA) with prospective ECG-triggered.

METHOD AND MATERIALS
Thirty consecutive patients undergoing coronary CTA with prospective ECG-triggered. We compared image quality and interpretability between standard (STD) and snapshot freeze motion correction (SSF) reconstructions. Coronary CTA images were interpreted with Likert 5-points score by two experienced radiologists. The image qualities and interpretability were respectively assessed on per-patient, per-artery and per-segment levels. Comparisons of variables were performed with Wilcoxon rank sum test and McNemar test.

RESULTS

CONCLUSION
The use of snapshot freeze motion correction algorithm improves image quality and interpretability in patients undergoing prospective ECG-triggered coronary CTA.

CLINICAL RELEVANCE/APPLICATION
The use of snapshot freeze motion correction algorithm improves image quality and interpretability in patients undergoing prospective ECG-triggered coronary CTA.

SSK03-03 ● Association of Calcium Score and Coronary Artery Disease on CCTA according to the Presence and the Degrees of Diabetic Retinopathy: Preliminary Results

Eun Young Kim (Presenter) ; **Joon-Won Kang** MD ; **Dong Hyun Yang** MD ; **Tae-Hwan Lim** MD, PhD

PURPOSE
To compare the difference of coronary artery calcium (CAC) score, plaque characterization and coronary artery disease in diabetes mellitus (DM) patients according to the presence and the type of retinopathy using coronary CT angiography (CCTA).

METHOD AND MATERIALS
From 1 February 2009 to 31 July 2011, 172 consecutive patients (89 men, 83 women mean age, 65.4±9.3 years) diagnosed with type 2 DM and CCTA taken were enrolled. The patients were categorized according to the presence of diabetic retinopathy (DR) and the types of DR. Differences in CAC score, plaque score, segment score and degree of stenosis were compared, simultaneously using Chi-square test and T-test.

RESULTS
The study patients were divided into 3 groups; no retinopathy (n=37), non-proliferative (NPDR, n=91) and proliferative DR (PDR, n=44). The average of HbA1c (8.3±1.4, p=0.003), total cholesterol (163.0±42.3, p=0.014) and DM duration (20.7±6.5, p=0.000) were significantly high in PDR patients among three groups. Of 172 DM patients, 137 (80 %) showed DR. There was statistically significant difference in CAC score (p=0.002) between the presence and absence of retinopathy. Segment score (p=0.01) and plaque score (p=0.04) was significantly higher in patients with DR as well. in patients with PDR, compared with NPDR, all of CAC score (p=0.012), the presence of significant stenosis (p=0.003) and multivessel disease (p=0.013), segment score (p=0.000) and plaque score (p=0.000) was significantly higher.

CONCLUSION
CAC score, plaque burden is significantly higher in DR and it becomes clear that in addition to that result, significant stenosis is more common in PDR patients. At least, proliferative diabetic retinopathy patients need to identify coronary artery disease with CCTA.

CLINICAL RELEVANCE/APPLICATION
This study suggested that PDR could be a predictor for CHD in asymptomatic type 2 diabetic patient and PDR patients need to start screening test for CHD through the CCTA.

SSK03-04 ● Combined Assessment of MR Flow Measurement of Coronary Artery Bypass Graft and Stress Perfusion MRI in Detecting Graft Stenoses

Tatsuro Ito MD (Presenter) ; Masaki Ishida MD, PhD ; Kakuya Kitagawa MD, PhD ; Hiroshi Nakajima MD ; Kaoru Dohi ; Shinji Kanemitsu ; Hideto Shimpo ; Masaaki Ito ; Hajime Sakuma MD *

PURPOSE
Stress myocardial perfusion MRI is useful for the detection of flow-limiting coronary stenosis. However, reduced sensitivity of stress myocardial perfusion MRI was reported in patients after coronary artery bypass grafts (CABG). MR flow measurement can provide functional assessment of CABG and permits noninvasive detection of significant graft stenoses. The purpose of this study was to evaluate the value of combined assessment of MR graft flow measurement and stress myocardial perfusion MRI for the detection of graft stenoses.

METHOD AND MATERIALS
Forty-eight patients (68±7 years) with CABG who had recurrent chest pain and underwent both coronary angiography and cardiac MRI including stress perfusion, late gadolinium enhancement (LGE) MRI and MR graft flow measurement within 3 months were studied. The observers recorded the presence or absence of myocardial ischemia using 4-point scale. The threshold of 24.8ml/min, determined by ROC analysis, was used for identifying functional abnormality of the graft. Stenoses >70% in bypass grafts were considered significant.

RESULTS
Ninety-nine grafts were eligible for the analysis. MR graft flow measurement was inconclusive due to metal artifact in 6 (6%) grafts, whereas stress perfusion MRI was diagnostic in all patients. When 93 areas with successful flow measurements were evaluated, the diagnostic performance assessed by the area under the ROC curve (AUC) was significantly higher with MR graft flow measurement (AUC 0.924; sensitivity 90%; specificity 85%) than with stress perfusion MRI (AUC 0.793; sensitivity 70%; specificity 74%) (p=0.040) (Figure 1). In the analysis of all 99 areas with bypass grafts, stress perfusion MRI yielded a sensitivity of 70% and a specificity of 75% in detecting significant graft stenoses. These values were improved to 87% and 86% by combining MR graft flow measurement and stress perfusion MRI, using MR flow measurement as a primary determinant.

CONCLUSION
MR graft flow measurement combined with stress perfusion MRI can provide excellent diagnostic accuracy for the detection of graft stenoses in patients after CABG.

CLINICAL RELEVANCE/APPLICATION
MR graft flow measurement combined with stress perfusion MRI is highly valuable for the accurate detection of graft stenoses in patients after CABG.

SSK03-05 ● Feasibility Study of the 100kVp and 400mA Coronary CTA

Kai Zhao (Presenter) ; Yuan Jiang ; Jian-Xing Qiu MD ; Xiaoying Wang MD

PURPOSE
To study the image quality and radiation dose of 100 kVp and 400 mA CT imaging in patients undergoing coronary CT angiography (CCTA).

METHOD AND MATERIALS
From september to december 2012, 101 patients suspected of coronary artery disease were scanned by GE CT 750HD with retrospectively ECG-gated reconstruct mode, whose weight was less than 80 kg. They were divided into 100 kVp group (n=65) and 120kVp group (n=36). The patients in 100 kVp group were scanned with 100 kVp and ECG modulation tube current (peak current 400 mA), while 120 kVp group were scanned with 120 kVp and ECG modulation tube current (peak current 500 mA). Contrast medium injection rate and volume were personalized by patients� weight (370 mgI/ml, mean 40ml). CT image raw data sets were reconstructed with ASiR-FBP composite at 30%. The effective radiation dose (ED) and size specific dose estimate (SSDE) of each patient were calculated. CT attenuation of the main vessels were measured and the image quality (noise, CNR, SNR) were estimated. Subjective evaluation was assessed by an experienced radiologist. Independent samples T test and Mann-Whitney U test were performed to compare the difference between the 2 groups.

RESULTS

CONCLUSION
To those whose body weight is less than 80 kg, CCTA obtained by 100 kVp, may obtain diagnostic image quality with more than half of the radiation dose reduction.

CLINICAL RELEVANCE/APPLICATION
High radiation exposure for CCTA is a concern and a limitation for its use, 100kVp and 400mA provide a feasible way to solve the problem for most people.

SSK03-06 ● Accuracy of Coronary Plaque Detection Using a Semiautomatic Plaque Analysis Software in Computed Tomography Coronary Angiography

Azien Laqmani (Presenter) ; Thorsten Klink MD ; Marcus Quitzke ; Domenique-Daniel Credner ; Gerhard B Adam MD ; Gunnar K Lund MD

PURPOSE
To assess the accuracy of coronary plaque detection with a semiautomatic plaque analysis software in computed tomography coronary angiography (CTCA) with a 256-MSCT scanner

METHOD AND MATERIALS

RESULTS
The software automatically identified 114 structures as plaques. 32 (28%) of the automatically marked lesions complied with plaques (true-positive). 82 (72 %) of the lesions did not correspond with visually detectable plaques (false-positive). 20 plaques were manually detected by observers but not by the software (false-negative). For 82 false-positive detected plaques the following potential reasons were noticed by the observers: high density in pericoronary fat (59%), vessel ramification (24%), contrast in adjacent veins (6%), artery kinking (4%) and falsely contured vessel (7%).

CONCLUSION
The evaluated semiautomatic plaque analysis software demonstrates a very high false-positive detection rate of coronary plaques.

CLINICAL RELEVANCE/APPLICATION
Detection of coronary plaques with a semiautomatic plaque analysis software is not reliable. A revision of the software marked lesions as plaques is indispensable.

SSK03-07 ● Restriction of Referral to CTCA by Clinical Evaluation Combined with Calcium Score

Anoeshka S Dharampal MD (Presenter) ; **Alexia Rossi** MD ; **Admir Dedic** MD ; **Annick C Weustink** MD, PhD ; **Mohamed Ouhlous** MD, PhD ; **Filippo Cademartiri** MD, PhD * ; **Eric H Boersma** PhD ; **Koen Nieman** MD ; **Pim Feyter** MD, PhD ; **Gabriel P Krestin** MD, PhD *

PURPOSE
To investigate the value of calcium score (CaSc) in addition to clinical evaluation to restrict referral to CTCA by reducing the number of patients with intermediate probability of CAD.

METHOD AND MATERIALS
We retrospectively included 2042 symptomatic stable patients who underwent clinical evaluation, unenhanced CT-scan for the calculation of CaSc and CTCA. Obstructive CAD (=50% lumen diameter narrowing) assessed by CTCA was the outcome. We investigated 2 models, first, clinical evaluation consisting of chest pain typicality, female sex, age, risk factors and ECG) and second model consisting of clinical evaluation with CaSc. The model discrimination of CAD was compared by using area under the receiver operating characteristic curves. We assessed the net reclassification improvement (NRI) that allows both models to reclassify patients into low (

RESULTS
Discriminiation of CAD was significantly improved by addition of CaSc to clinical evaluation (AUC: 0.80 vs. 0.90, p < 0.001). The NRI using both model to reclassify all patients was 56%. The clinical net reclassification improvement by model 2 of patients first classified by model 1 having intermediate risk was 66%. Unenhanced CT-scan and CTCA could be avoided in 12% using model 1 and an additional 32% of CTCA�s could be avoided using model 2 subsequently.

CONCLUSION
Calcium score provides incremental discrimination of CAD compared to clinical evaluation. Implementation of calcium score model can reduce referral to CT coronary angiography by 44%.

CLINICAL RELEVANCE/APPLICATION
Risk stratification of stable angina patients can be improved by using the calcium score model.

SSK03-08 ● Effect of a Novel Motion Correction Algorithm (SSF) on the Image Quality of Coronary CTA with Higher Heart Rates: In Comparison with Bi-sector Reconstruction

Qianwen Li (Presenter) ; **Xiangying Du** MD ; **Peng-Yu Li** ; **Xiaoguang Yang** ; **Kuncheng Li** MD

PURPOSE
SnapShotFreeze (SSF) is a novel vendor-specific motion correction algorithm based on non-rigid registration in coronary CTA. The purpose of this study is to assess the effect of SSF algorithm on image quality in comparison with bi-sector reconstruction in higher heart rates.

METHOD AND MATERIALS
Retrospective ECG-gated coronary CTA was performed on 15 patients with higher heart rates (65-75bpm,mean69.7±3.2bpm) using a 64-row CT scanner (GE Discovery CT750 HD). The optimal SSF images were generated following the reconstruction protocol for SSF. Multi-phase bi-sector images were reconstructed as well and the optimal phase was selected for comparison with SSF images. The images were interpreted in an intent-to-diagnose fashion by 2 experienced readers using a 5-point scale with 3 point as diagnostically acceptable.

RESULTS

CONCLUSION
SSF algorithm can provide superior image quality than bi-sector reconstruction in coronary CTA of patients with higher heart rates.

CLINICAL RELEVANCE/APPLICATION
For higher heart rates patients, bi-sector reconstruction may be neglected by using the motion-correction algorithm, avoiding the higher radiation dose related to small pitch required by bi-sector.

SSK03-09 ● Role of an Intracycle CT Motion Correction Algorithm in the Coronary CT Angiography Accuracy

Patricia M Carrascosa MD (Presenter) * ; **Carlos Capunay** MD ; **Alejandro Deviggiano** MD ; **Gaston Rodriguez Granillo** ; **Jorge M Carrascosa** MD

PURPOSE
The purpose of this study is to demonstrate that coronary CT angiography (CCTA) employing a novel intracycle motion compensation algorithm (SnapShot Freeze [SSF]) will be superior to CCTA without intracycle motion compensation algorithm (�conventional� CCTA) for diagnostic accuracy and image quality.

METHOD AND MATERIALS
Twenty patients with known or suspected coronary artery disease were studied with MSCT and ICA. CCTA were performed on a 128-slice CT scanner (Discovery CT750 HD, GE Medical Systems). Studies were done using prospective or retrospective ECG-gating depending on the heart rate of the patients. In the prospective scan a padding of 100 msec was used, while in the retrospective scans, cardiac x-ray modulation was performed (centered 45 % to 75% of the R-R interval).
First images were analyzed without the motion compensation algorithm and 2 weeks later in a random and blinded way with the algorithm.
The per-vessel and per-segment diagnostic interpretability and image quality of CCTA with and without motion compensation algorithm was calculated.

RESULTS
From the 20 patients studied, 299 segments were analyzed.
In 215 of 299 segments, the motion compensation algorithm showed similar evaluation than conventional CCTA. In 84 segments, the motion compensation algorithm allowed a better evaluation.
In relation to vessel analysis, SSF showed improvement of vessel viusalization in 30% of DA, 75% of CX and 40% of RCA.
SSF had only 1 segment non evaluable whereas conventional CCTA 15. The assessability was 99.6% versus 95 % for both modalities
WC had an average segment analysis of 3.1 versus 3.7 of SSF.

CONCLUSION
SSF allowed better visualization of the coronary arteries as well as lesser non evaluable segments in comparison to conventional CCTA.

CLINICAL RELEVANCE/APPLICATION
Correction of coronary arterial motion on coronary CTA using an Intracycle CT Motion Correction Algorithm would be of clinical significance.

Cardiac - Wednesday Posters and Exhibits (12:15pm - 12:45pm)

Wednesday, 12:15 PM - 12:45 PM ● Lakeside Learning Center

LL-CAS-WEA • *AMA PRA Category 1 Credit* ™:0.5
Host
Suhny Abbara , MD *
Host
Lisa Diethelm , MD

LL-CAS-WE1A ● Area at Risk and Infarct Core Visualized by 3.0T cMRI and Multifunctional Stainings in a Rabbit Model of Myocardial Infarction

Yuanbo Feng (Presenter) ; **Zhanlong Ma** MD ; **Feng Chen** MD, PhD ; **Marlein Miranda Cona** MSc ; **Raymond H Oyen** MD, PhD ; **Yicheng Ni** MD, PhD

PURPOSE
To identify the myocardial infarction (MI) core and salvageable zone (SZ) within the area at risk (AAR) after myocardial infarction (MI) is crucial for reperfusion therapies. In this article we have strived to set up a multiple function staining postmortem methodology to directly visualization and quantification MI core, AAR and SZ simultaneously and correlated it with 3.0T Cardiac magnetic resonance (cMR) on a rabbit model of acute reperfused MI.

METHOD AND MATERIALS
Rabbits (n=15) were surgically subjected to 90-min left anterior descending (LAD) coronary artery occlusion to induce reperfused MI that was then stained by intravenously injected Evens blue (EB). One-day later, 3.0T cMRI was performed for T2-weighted imaging (T2WI), first-pass perfusion weighted imaging (PWI) and delayed enhancement (DE) T1WI to determine AAR and MI-core before euthanasia. Afterwards, the excised heart with LAD re-ligated was infused via aorta with a red-iodized-oil (RIO) dye to delineate AAR. The heart was sliced into 3-mm sections for digital radiography (DR) and histology. DE-T1WI-discerned and EB-stained areas, RIO-unstained and DR-negative regions, and T2WI-hyperintense and first-pass-PWI-defect regions were planimetrically compared to define the SZ and calculate myocardial salvage indexes (MSI). The perfusion density rate (PDR) on DR was compared between AAR and normal myocardium and correlated with PWI-derived parameters.

RESULTS
There was no significant difference between MI-cores defined by DE-T1WI and EB-staining (31.20±14.87% vs 29.83±15.57%, p=0.74; r2=0.91). AAR was virtually equivalent (r2=0.99) by RIO (38.12±14.41%) and DR (38.67±15.98%). T2WI significantly (p
CONCLUSION
The introduced methodology with a rabbit model and new staining technique may contribute to translational cardiac imaging research and help in management of ischemic heart disease.

CLINICAL RELEVANCE/APPLICATION
The new multiple staining techniquei accurate identification of the salvageable zone within the area at risk is crucial to plan upcoming reperfusion therapies.

LL-CAS-WE2A ● Does Adaptive Statistical Iterative Reconstruction Technique Affect Coronary Artery Calcium Scoring Based on Filtered Back Projection Technique?

Fumiko Kimura MD, PhD (Presenter) * ; **Tatsuya Umezawa** RT ; **Masahiro Takahashi** MD ; **Yusuke Watanabe** MD

PURPOSE
Adaptive statistical iterative reconstruction (ASiR, GE Healthcare) has been used for coronary CT angiography to improve image quality and reduce radiation dose, but its influence on coronary artery calcium scores (CACS) is unknown. We compared CACS, coronary artery calcium volume (CACV), and image noise between FBP and ASiR to clarify if CACS differs significantly between the two.

METHOD AND MATERIALS
We retrospectively evaluated CACS, CACV, and image noise in 340 consecutive patients (average age 65.1 years; 213 men, 127 women) who underwent non-contrast cardiac CT between January 2012 and January 2013. We reconstructed images using FBP, ASiR 30, 50, 70, and 100%. Workstation software automatically calculated CACS (Agatston method) and CACV; we manually measured image noise of the left ventricle. We compared these values among reconstruction techniques (RTs) and evaluated changes by ASiR among the CACS groups (CACS scores 1-100, 101-400, and > 401) using Wilcoxon signed-rank test (Holm�s method). $P < 0.05$ was considered significant.

RESULTS
Of the 340 patients, 105 had CACS score of 0; 107, CACS 1-100; 85, CACS 101-400; and 43, CACS > 401 (mean CACS 197.5 ± 465.2; range 0 to 4468) on FBP. Of the 235 patients with CACS > 0, significant differences among RTs were observed in image noise ($P < 0.01$), total CACS ($P < 0.01$), and total CACV ($P < 0.01$), decreasing as ASiR percentage increased. Compared to FBP, CACS decreased 5.3% in ASiR 30%; 9.1% (ASiR 50%); 12.6% (ASiR 70%), and 17.7% (ASiR 100%). Reduction was larger by ASiR in patients with low CACS scores: CACS decreases by ASiR in CACS 1-100, 101-400, and > 400 groups were 10.1%, 7.8% and 4.3% (ASiR 30%); 15.9%, 13.1% and 7.0% (ASiR 50%); 21.2%, 17.3% and 10.1% (ASiR 70%); and 29.2%, 23.9% and 14.4% (ASiR 100%), respectively. Using ASiR, CACS became 0 in 7 patients (mean CACS 2.3 on FBP), though CACS 0 with FBP remained 0 in all patients.)

CONCLUSION
Image noise, CACS, and CACV decreased as ASiR percentage increased. Compared to FBP, a blend of no more than 50% ASiR limited CACS reduction to about 15% in all CACS groups; the same RT should be used to assess temporal changes in CACS.

CLINICAL RELEVANCE/APPLICATION
The use of high-percentage ASiR may lead to underestimation of risk in patients with low CACS. Therefore, we consider limiting ASiR to 50% for appropriate evaluation.

LL-CAS-WE3A ● MRI Demonstrates a Decrease in Myocardial Infarct Resorption and Increase in Compensatory Hypertrophy Following Coronary Embolization

Maythem Saeed DVM, PhD (Presenter) ; **Hisham Bajwa** MD ; **Loi Do** ; **Mohammed Suhail** MD ; **Steven W Hetts** MD * ; **Mark W Wilson** MD

PURPOSE
Purpose: To use cine and delayed contrast enhanced MRI (DE-MRI) in serially quantifying the effects of coronary microemboli on infarct resorption, LV mass and function in swine model with pre-existing myocardial infarct and poor collateral flow.

METHOD AND MATERIALS
Materials and Methods: Group I animals (n=8) were subjected to myocardial infarction by 90min LAD coronary artery occlusion followed by reperfusion, while group II (n=8) were subjected to 90min LAD occlusion followed by microemboli (32mm3 volume, 80�m diameter) delivery for mechanical obstruction of microvessels then reperfusion. Four animals served as control. All infarcts were imaged at 3 days and 5 weeks post coronary interventions. The studied animals have matching infarct size on DE-MRI at 3 days. The ±3SD threshold method was used to measure myocardial infarct and persistent MVO on images acquired at 10min post Gd-DTPA injection (1.5 mmol/kg). At 3 days, we selected animals in group I with matched infarct size in group II to eliminate the influence of infarct size difference on LV mass.

RESULTS
Results: DE-MRI illustrated myocardial infarct as hyperenhanced region and MVO as hypoenhanced region. Four animals in group I and all

animals in group II had persistent MVO, with significantly larger MVO zone size in group II. Five weeks later, group I animals showed significantly greater infarct resorption (31±2%) and less increase in compensatory LV mass (31±4%) compared with group II animals (23±2%, P

CONCLUSION
Conclusion: Mechanical obstruction of coronary microvessels impairs infarct resorption (healing), LV function and causes increased compensatory hypertrophy. This noninvasive MRI study indirectly confirms what was recently hypothesized that MVO limits delivery and transit of cellular components required for optimal infarct healing.

CLINICAL RELEVANCE/APPLICATION
MRI can show the deleterious effects of microemboli on LV function/remodeling. There is urgent need to develop new distal filtration devices that can capture microemboli during coronary interventions.

LL-CAS-WE5A ● Advanced Glycation Endproducts, as Measured by Skin Autofluorescence, Are Increased in Patients with Incremental Degrees of Atherosclerosis

Martijn A Den Dekker MD, MS ; **Gert Jan Pelgrim** MSc ; **Rozemarijn Vliegenthart** MD, PhD (Presenter) ; **Matthys Oudkerk** MD, PhD ; **Marjan Zwiers** MD ; **Andries J Smit** MD, PhD * ; **Clark J Zeebregts** MD, PhD ; **Joop D Lefrandt** MD, PhD ; **Douwe J Mulder** MD, PhD

PURPOSE
Studies in diabetes and renal disease patients show that advanced glycation endproducts (AGEs) may be linked to the development of atherosclerosis. AGE levels can be measured non-invasively by skin autofluorescence (AF). It is not yet known if skin AF is already increased in subclinical atherosclerosis. The purpose of this study was to evaluate whether skin AF is associated with increasing degrees of atherosclerosis, independent of diabetes and renal function.

METHOD AND MATERIALS
In this study, we included 223 patients who were referred for primary (n=163) or secondary (n=60) prevention between 2006 and 2012. The study was approved by the local medical ethical board. The AGE-Reader was used for skin AF measurements. Degree of atherosclerosis was assessed based on ultrasonographically detected plaques in carotid and femoral arteries (in primary prevention only), and computed tomography derived coronary calcium score. Primary prevention patients were classified into a group with subclinical atherosclerosis defined as >1 carotid or femoral plaque, or calcium score >100 (n=67; age 53 years [interquartile range 48-56]; 49% male) and without (controls; n=96; 43 [38-51]; 55%). For secondary prevention, patients with proven peripheral arterial disease were chosen (n=60 [58-70]; 73%).

RESULTS
Skin AF was higher in patients with subclinical and clinical atherosclerosis compared to controls (skin AF 2.11 [1.83-2.46] and 2.71 [2.15-3.27] vs. 1.87 [1.68-2.12] respectively; PP=0.92).

CONCLUSION
Skin AF is increased in subclinical and clinical atherosclerosis, independent of known risk factors such as diabetes and renal disease. These data suggest that AGE levels are associated with the burden of atherosclerosis.

CLINICAL RELEVANCE/APPLICATION
AGEs levels, as measured by skin AF, are related to atherosclerosis, also in persons without diabetes or renal disease. Skin AF may be useful to detect persons at higher risk of atherosclerosis.

LL-CAS-WE6A ● Feasibility Study of the 100kVp and 400mA Coronary CTA

Kai Zhao (Presenter) ; **Yuan Jiang** ; **Jian-Xing Qiu** MD ; **Xiaoying Wang** MD

PURPOSE
To study the image quality and radiation dose of 100 kVp and 400 mA CT imaging in patients undergoing coronary CT angiography (CCTA).

METHOD AND MATERIALS
From september to december 2012, 101 patients suspected of coronary artery disease were scanned by GE CT 750HD with retrospectively ECG-gated reconstruct mode, whose weight was less than 80 kg. They were divided into 100 kVp group (n=65) and 120kVp group (n=36). The patients in 100 kVp group were scanned with 100 kVp and ECG modulation tube current (peak current 400 mA), while 120 kVp group were scanned with 120 kVp and ECG modulation tube current (peak current 500 mA). Contrast medium injection rate and volume were personalized by patients◻ weight (370 mgI/ml, mean 40ml). CT image raw data sets were reconstructed with ASiR-FBP composite at 30%. The effective radiation dose (ED) and size specific dose estimate (SSDE) of each patient were calculated. CT attenuation of the main vessels were measured and the image quality (noise, CNR, SNR) were estimated. Subjective evaluation was assessed by an experienced radiologist. Independent samples T test and Mann-Whitney U test were performed to compare the difference between the 2 groups.

RESULTS

CONCLUSION
To those whose body weight is less than 80 kg, CCTA obtained by 100 kVp, may obtain diagnostic image quality with more than half of the radiation dose reduction.

CLINICAL RELEVANCE/APPLICATION
High radiation exposure for CCTA is a concern and a limitation for its use, 100kVp and 400mA provide a feasible way to solve the problem for most people.

LL-CAS-WE7A ● Non-contrast MRI T1P Images Can Identify Chronic Myocardial Infarction

Jiayu Sun (Presenter) ; **Rui Xia** ; **Yucheng Chen** MD, PhD ; **Jie Zheng** PhD ; **Fabao Gao** MD, PhD

PURPOSE
Recent study using a porcine model of chronic myocardial infarction (MI) reveals capability of non-contrast spin-lock T1?-weighted imaging to correctly identify location and extension of MI. However, this approach has yet been revaluated in clinical patients with MI.

METHOD AND MATERIALS
Twelve patients (male 7, female 5) with suspected myocardial ischemia and/or MI were scanned in a Siemens 3T Trio system., The protocol included 4-slice pre-contrast T1? imaging and multi-slice post-contrast late gadolinium enhancement (LGE). The T1? sequence was newly developed for the 3T system to reduce inhomogeneity effects and to obtain single-slice absolute T1? map within one breath-hold. The later was created by acquiring three different spin-lock times (10, 30, and 50 ms) with a spin-lock frequency of 255 ◻ 340 Hz. By comparing with corresponding LGE images, the T1? values in normal and infarcted tissue areas can be obtained. The size of enhanced infarction area in LGE images were compared to the size of increased T1? areas (infarction increases T1p value).

RESULTS
Seven patients had evidence of MI as detected by LGE. The normal (in the myocardial tissue of patients without MI) and infarcted tissues had T1p of 46.3 ± 4.1 and 87.3 ± 8.9 ms, respectively, which agreed with the values in the animal study. The size of infarcted area measured by T1? map strongly correlate with the size in the LGE image (r2 = 0.998). Figure 1 shows one example of LGE and T1? map with arrows pointed to the infarcted tissue areas.

CONCLUSION
This is the first time that non-contrast T1? method was used to assess MI in a clinical setting. Although it is warranted further vigorous validation, non-contrast T1? method appears to provide a simple alternative mean to diagnose chronic MI, particularly for patients with renal insufficiency.

CLINICAL RELEVANCE/APPLICATION
For MI patients who are allergy to MR contrast agent, this approach allows for a fast diagnostic screen of the location and extent of the MI.

LL-CAE-WE8A ● Cardiac MR of Partial Anomalous Pulmonary Venous Return and Its Association with Sinus Venosus Atrial Septal Defect in Adults

Lancia L Guo MD (Presenter) ; **Conrad Crofts** ; **Naeem Merchant** MD

PURPOSE
1) To determine the lobar distribution of PAPVR in the adult population using cardiac MR (CMR). 2) To determine specific CMR findings of PAPVR that are predictive of a co-existing sinus venosus type ASD (SV-ASD).

METHOD AND MATERIALS
With institutional ethics review board approval, we retrospectively reviewed 36 patients (21 females, 15 males), mean age 46 year old (18 to 76), who underwent CMR for congenital heart disease. Using a 1.5 Tesla magnet, the following sequences were obtained: 1) Multiple long and short axis SSFP images. 2) Cine phase contrast images through the aorta and main pulmonary artery. 3) 3-dimensional MRA images with gadolinium.

RESULTS
1) PAPVR most often occurs in the right upper lobe (64%). A significant portion of PAPVR occurs in more than one pulmonary lobes, and the most common combination is the right upper lobe (RUL) and right middle lobe (RML) (42%). 2) 14 out of the 36 patients (39%) with PAPVR have a co-exisiting SV-ASD. Among these patients, 12 patients (86%) have PAPVR draining both RUL and RML. 3) The height of drainage of right-sided PAPVR into SVC is associated with co-existing SV-ASD: In PAPVR patients with co-existing SV-ASD, the height of draining is 4.5 (+/-4.4) mm, while in patients without co-existing SV-ASD, the height of drainage is 38.9 (+/-3.7) mm.

CONCLUSION
1) RUL is the most common location for PAPVR. 2) PAPVR involving both RUL and RML are most commonly associated with the presence of SV-ASD. 3) The height of PAPVR draining into the SVC in relation to the atriocaval junction is significantly lower in patients with SV-ASD than those without. A drainage height < 30mm is predictive of the presence of co-existing SV-ASD.

CLINICAL RELEVANCE/APPLICATION
1) PAPVR often occurs in multiplicity - when you find one, look for others. 2) A height of PAPVR draining into the SVC < 30mm is predictive of the presence of a co-existing SV-ASD - look for it!

LL-CAE-WE9A ● MR Myocardial Perfusion: Insights on Techniques, Analysis, Interpretation and Findings

Monda L Shehata MD (Presenter) ; **Dagmar Hartung** MD ; **Oleg Teytelboym** MD ; **Jens Vogel-Claussen** MD

PURPOSE/AIM
Myocardial Perfusion using cardiac MRI (CMR) has currently evolved as a reliable tool for diagnosis of coronary stenosis with great accuracy. Recent implementation of high strength magnetic fields and 3D volume acquisition has moved CMR perfusion from traditional applications to novel applications such as right ventricular perfusion imaging.

CONTENT ORGANIZATION
1. Understanding the myocardial circulation at rest and stress 2. Understanding principles of myocardial perfusion imaging using CMR 3. Pulse sequences, pitfalls and how to avoid them 4. Myocardial Perfusion post processing and analysis tools. 5. Image interpretation and caveats 6. Clinical applications including traditional coronary artery disease (CAD) applications as well as novel applications 7. Limitations of CMR perfusion.

SUMMARY
Cardiac MRI perfusion imaging is a powerful diagnostic tool aiding clinical diagnosis, understanding and management of various clinical conditions at high in space resolution and in absence of ionizing radiation.

Cardiac - Wednesday Posters and Exhibits (12:45pm - 1:15pm)

Wednesday, 12:45 PM - 01:15 PM ● Lakeside Learning Center

CA

LL-CAS-WEB ● *AMA PRA Category 1 Credit* ™:0.5

LL-CAS-WE1B ● Quantification of Aortic Pressure Characteristics in Patients with Repaired Aortic Coarctation by Noninvasive 4D Pressure Difference Mapping Derived from 4D Flow MRI

Fabian Rengier MD (Presenter) ; **Michael Delles** DiplEng ; **Joachim Eichhorn** MD ; **Hendrik Von Tengg-Kobligk** MD * ; **Hans-Ulrich Kauczor** MD * ; **Roland Unterhinninghofen** PhD ; **Sebastian Ley** MD

PURPOSE
Identification of abnormal pressure characteristics that might underlie complications after aortic coarctation repair such as aneurysm formation or premature atherosclerosis may improve clinical management and risk stratification. Purpose of this study was to assess aortic pressure characteristics in patients with repaired aortic coarctation compared to young healthy volunteers using 4D flow MRI and derived 4D pressure difference maps.

METHOD AND MATERIALS
13 patients after aortic coarctation repair without recoarctation (mean age 18.8 years, 5 female, 8 male) and 13 healthy volunteers (mean age 22.9 years, 4 female, 9 male) underwent 4D flow MRI of the thoracic aorta at 1.5T. Spatial/temporal resolution was 1.6x1.6x2.1mm³/28ms. 4D pressure difference maps were computed based on the Navier-Stokes equation using published algorithms and in-house developed image processing software. Eight positions were analyzed: P1, mid ascending aorta; P2, proximal to first branch of aortic arch; P3, mid aortic arch; P4, distal to left subclavian artery; P5-P8, at equal distances in descending aorta. For each position, pressure difference amplitude and peak pressure difference to a reference position in the proximal ascending aorta were calculated.

RESULTS
Mean pressure difference amplitude (in mmHg) was for patients/volunteers: P1 2.3/2.0 (p=ns), P2 4.9/3.7 (p=0.026), P3 8.4/4.7 (p=0.002), P4 13.2/5.9 (p=0.001), P5 19.7/10.1 (p
CONCLUSION
Noninvasive 4D pressure difference mapping derived from 4D flow MRI showed significant increase of pressure difference amplitudes and peak pressure differences in patients with repaired aortic coarctation compared to young healthy volunteers, mainly in the aortic arch and the proximal descending aorta. The technique enables quantification of abnormal aortic pressure characteristics that might help to identify pathophysiological conditions after aortic coarctation repair.

CLINICAL RELEVANCE/APPLICATION
Quantification of abnormal aortic pressure characteristics by noninvasive 4D pressure difference mapping may help to guide imaging surveillance intervals as well as medical and surgical therapy.

LL-CAS-WE2B ● Combined Assessment of Coronary CT Angiography and Adenosine Triphosphate Stress Dynamic Myocardial Perfusion CT Using 256-slice Multi-detector CT in the Detection of Coronary Artery Disease

Naoto Kawaguchi MD (Presenter) ; **Teruhito Kido** ; **Yuki Tanabe** ; **Rami Yokoyama** ; **Masashi Nakamura** ; **Takuya Matsuda** ; **Yoshiko Nishiyama** MD ; **Tomoyuki Kido** ; **Akira Kurata** ; **Masao Miyagawa** MD, PhD ; **Akiyoshi Ogimoto** ; **Teruhito Mochizuki** MD

PURPOSE
Coronary CT angiography (CTA) has been wide spread in the clinical practice to assess coronary stenosis. But the assessment of CTA actually had uncertain segments because of severe calcification, motion artifacts and stent placement. The purpose of this study was to assess the usefulness of combined assessment of CTA and adenosine triphosphate (ATP) stress dynamic myocardial CT perfusion (CTP) in the detection of coronary artery disease (CAD).

METHOD AND MATERIALS

RESULTS

CONCLUSION
Combined assessment of CTA and CTP improves the detection of significant CAD.

CLINICAL RELEVANCE/APPLICATION
Combined assessment of coronary CT angiography and adenosine triphosphate stress dynamic myocardial CT perfusion is useful in the detection of coronary artery disease.

LL-CAS-WE3B ● Quantitative CT Coronary Angiography: Does It Predict Functionally Significant Coronary Lesions?

Alexia Rossi MD (Presenter) ; **Francesca Pugliese** MD, PhD ; **Stella-Lida Papadopoulou** DMD ; **Brunella Russo** MD ; **Anoeshka S Dharampal** MD ; **Pieter Kitslar** ; **Robert J Van Geuns** MD ; **Steffen E Petersen** ; **Pim J De Feyter** MD, PhD ; **Gabriel P Krestin** MD, PhD *

PURPOSE
Studies using intravascular ultrasound (IVUS) have demonstrated that cross-sectional measurements of coronary artery stenosis are correlated well with fractional flow reserve (FFR). Similarly to IVUS, CT coronary angiography (CTCA), using automated border lumen detection algorithms, allows assessment of quantitative cross-sectional parameters. The aim of our study was to compare the diagnostic performance of quantitative CTCA-derived cross-sectional parameters with visual CTCA in the detection of functionally significant coronary lesions as determined by FFR.

METHOD AND MATERIALS
CTCA and FFR measurements were obtained in 99 patients with stable chest pain. In total, 144 coronary lesions detected on CTCA were visually graded for stenosis severity. Coronary lesions with lumen narrowing >50% were considered as obstructive. Quantitative CTCA-derived cross-sectional parameters were obtained by using semi-automated plaque analysis software and included lesion minimal lumen area (MLA), percentage area stenosis (%AS) and plaque burden [((vessel area ◆ lumen area)/vessel area)*100]. Optimal cut-off values of quantitative CTCA-derived cross-sectional parameters were determined and their diagnostic accuracy to detect flow-limiting coronary lesions (FFR =0.80) was compared to visual CTCA.

RESULTS
FFR was =0.80 in 54/144 (38%) coronary lesions. Receiver operating characteristic (ROC) curve analysis yielded an area under the curve (AUC) of 0.82 (0.75-0.89) for MLA, 0.83 (0.75-0.90) for %AS and 0.80 (0.73-0.87) for plaque burden. Optimal cut-off values to predict the functional significance of coronary lesions were 1.8 mm^2 for MLA, 73% for %AS, and 76% for plaque burden. Specificity of visual CTCA (42%; 95%CI: 32-52) was lower than that of MLA (68%; 95%CI: 57-77; p=0.001), %AS (76%, 95%CI: 65-84; p0.05).

CONCLUSION
Quantitative CTCA has higher specificity than visual CTCA to detect functionally significant coronary lesions but remains insufficient for clinical routine.

CLINICAL RELEVANCE/APPLICATION
Quantitative CTCA improves the prediction of functionally significant coronary lesions compared to visual CTCA but remains insufficient. Functional assessment is still needed for patient management.

LL-CAS-WE4B ● Using Recursive Partitioning Modeling to Develop Classification Trees to Predict Progression of Aortic Stiffness: Results from the Dallas Heart Study

Akshay Goel BS (Presenter) ; **Kevin S King** MD ; **Christopher Maroules** MD ; **Colby Ayers** MS ; **Roderick McColl** PhD ; **Ronald M Peshock** MD

PURPOSE
Aortic pulse wave velocity (APWV) is a non-invasive measure of aortic stiffness, independently associated with end organ damage and mortality. We used recursive partitioning modeling (RPM) to predict the progression of aortic stiffness in a large, multi-ethnic population based cohort and compared it to standard Backward Elimination Logistic Regression (BELR) analysis.

METHOD AND MATERIALS

RESULTS
BELR showed significance in DHS1-APWV (p < .0001), age (p < .0001), waist circumference (p < .0001), SBP (p = 0.065), and smoking status (p = 0.013). The c-statistic for this model was 0.873. RPM identified DHS1-APWV, age, and SBP as necessary features in the pruned classification tree. The prediction accuracy based on cross-validation for this model was 0.812.

CONCLUSION
RPM produces a decision tree that predicts an increase in APWV with a comparable accuracy to BERL. Such decision trees are particularly applicable in routine clinical management, as they do not require explicit calculations.

CLINICAL RELEVANCE/APPLICATION
Recursive partitioning modeling can be used to develop classification trees to predict a change in APWV. Such models may aid in routine clinical management.

LL-CAS-WE5B ● Comparison of Plaque Characteristics between 256-MSCT Based on the Diluted Test Injection Protocol and IB-IVUS

Masashi Nakamura (Presenter) ; **Teruhito Kido** ; **Yuki Tanabe** ; **Rami Yokoyama** ; **Takuya Matsuda** ; **Naoto Kawaguchi** MD ; **Yoshiko Nishiyama** MD ; **Tomoyuki Kido** ; **Masao Miyagawa** MD, PhD ; **Teruhito Mochizuki** MD

PURPOSE

Primary aim of this study was to evaluate whether 256-MSCT can assess plaque characteristics (amount of lipid component), by comparing plaque characteristics by IB-IVUS. Secondary aim was to make a comparison plaque CT density value obtained by 256-MSCT with that of 64-sliced MDCT in previous study.

METHOD AND MATERIALS
Since coronary plaque density (HU) depends on lumen density, we uniformed coronary lumen density (enhancement) using diluted test injection protocol. Then, average plaque CT density value (HU) at the minimum coronary diameter was compared with %lipid area of IB-IVUS in 21 patients who performed both 256-MSCT and IB-IVUS. We evaluated plaques without calcification.

RESULTS

CONCLUSION
When uniforming the coronary enhancement (HU), CT could assess high risk coronary plaques as well as IB-IVUS. In addition, plaque CT density value could be measured more correctly by 256-MSCT than 64-sliced MDCT.

CLINICAL RELEVANCE/APPLICATION
By 256-MSCT, We could measure plaque CT density value correctly and could assess plaque characteristics more precisely with high temporal resolution.

LL-CAS-WE6B ● Prognostic Value of CT Angiography in Coronary Bypass Patients: A 73 Months Follow-up Study

Daniele Andreini MD ; Gianluca Pontone MD (Presenter) ; Saima Mushtaq ; Erika Bertella ; Edoardo Conte ; Andrea Baggiano ; Andrea Daniele Annoni MD ; Alberto Formenti ; Mauro Pepi

PURPOSE
Multidetector computed tomography coronary angiography (MDCT-CA) is a non-invasive and accurate tool for the detection of obstructive coronary artery disease and for the evaluation of coronary artery bypass graft (CABG) patency and MDCT-CA appears to have prognostic value in patients without previous revascularization. However, the prognostic value of MDCT-CA in CABG patients is still unclear. Aim of the present study is to investigate the long-term prognostic value of MDCT-CA in a large population of CABG patients

METHOD AND MATERIALS
Between March 2005 and April 2009, 721 CABG patients (mean age 66.8±8.4, 577 males) were enrolled in our study. Patients were classified by unprotected coronary territory (UCTs) or a summary of native vessel disease and graft patency: the coronary artery protection score (CAPS). The composite rate of hard cardiac events (cardiac death, non-fatal myocardial infarction, unstable angina) and all cardiac events (including revascularization) were end points of the study

RESULTS
10 patients were excluded because MDCT-CA data set was uninterpretable. Of the remaining 711, clinical follow up (mean 73.5±14 months) was obtained in 698 patients. By univariate analysis, the strongest MDCT-CA predictors of hard and all events were UCT 2 and 3 and CAPS 4 and 8. Cumulative event-free survival was 85% for hard events and 75% for all events in patients with UCT 0, 75% for hard events and 50% for all events in patients with UCT 1, 30% for hard events and 8% for all events in patients with UCT 2 and 10% for hard events and 2% for all events in patients with UCT 3. Cumulative event-free survival by CAPS ranging from 95% for hard events and 90% for all events in patients with CAPS 2 and 3% for hard events and 2% for all events in patients with CAPS 4.

CONCLUSION
MDCT-CA appears to be a promising tool for long-term risk stratification of CABG patients. Particularly, assessing prognosis by UCTs appears to have prognostic value in CABG patients more than CAPS score.

CLINICAL RELEVANCE/APPLICATION
MDCT-CA appears to be a promising tool for long-term risk stratification of CABG patients

LL-CAS-WE7B ● The Prevalence of Coronary Artery Disease in Liver Cirrhosis: Is Screening Cardiac CT Necessary before Liver Transplantation?

Hyun Jung Koo MD (Presenter) ; Joon-Won Kang MD ; Hwa Jung Kim ; Dong Hyun Yang MD ; Tae-Hwan Lim MD, PhD

PURPOSE
To investigate whether liver cirrhosis (LC) is associated with coronary artery disease (CAD) compared to general population

METHOD AND MATERIALS
Between 2008 and 2012, 716 patients (M:F=548:168) patients with LC underwent cardiac CT for preoperative evaluation of CAD before liver transplantation. Among them, 688 patients (M:F=528:160) were matched (1:1) to controls by Framingham risk score, and the presence of CAD was individually compared in males and females. As a control group, a total of 2,652 patients (M:F=1810:842) with cardiac CT who visited our hospital health screening center between 2008 and 2009 enrolled without known liver disease or a history of ischemic heart disease. To obtain the Framingham risk score, age, gender, lipid profile (LDL, cholesterol, HDL), blood pressure, presence of diabetes and smoking history were graded in the two groups. Agatston scores in the two groups were also compared. For subgroup analysis, the causes of liver cirrhosis were subdivided in two types, alcoholic LC versus non-alcoholic LC.

RESULTS
The initial distributions of the Framingham risk score in liver cirrhosis and controls were different (p
CONCLUSION
The risk of CAD in LC patients is not increased compared to general population. Routine preoperative cardiac CT before liver transplantation might be not necessary, and cardiac CT could be recommended for only high risk CAD patients.

CLINICAL RELEVANCE/APPLICATION
There was no significant prevalence of CAD in patient with liver cirrhosis, and this finding suggests that the controversy of the relationship between CAD and LC could be ended.

LL-CAE-WE8B ● Demonstration of Mechanical Deformity in Coronary Stent Using Cardiac Computed Tomography

Mi Sun Chung MD (Presenter) ; Dong Hyun Yang MD ; Joon-Won Kang MD ; Young-Hak Kim ; Tae-Hwan Lim MD, PhD

PURPOSE/AIM
1- To describe imaging findings of mechanical deformity in coronary stent and its complication on cardiac CT
2- To learn technical tips for optimal CT imaging of coronary stent and diagnostic clues to differentiate mechanical deformities and normal post-procedure findings.

CONTENT ORGANIZATION
1. Tips for good image quality of coronary stent on CT
- Image acquisition
- Image reconstruction 2. Mechanical deformity and its complication
A. Mechanical deformities of coronary stents
- Stent fracture: partial fracture, complete fracture
- Longitudinal compression of stent
- Radial stent compression by coronary plaque
B. Normal post-procedure finding mimicking pathology
- Stent overlap

- Two stents in bifurcation lesion: crushed stent in the bifurcation lesion
- Side branch ballooning
C. Complication of deformed coronary stent
- Aneurysm
- In stent restenosis (ISR)
- Jailed braches
- Edge stenosis 3. Pitfall and remedy of cardiac CT
A. Technical pitfalls in evaluating coronary stents
- Small stents
- Calcified plaque
- Motion artifact and metal artifact
B. Remedy

SUMMARY
We described various imaging findings of mechanical deformity in coronary stent and its complication on cardiac CT. Cardiac CT may be used as noninvasive imaging modality to evaluate a mechanical deformity of coronary stent as well as stent patency.

LL-CAE1175-WEB ● Single Ventricle Physiology and the Role of Imaging

Rachael M Edwards MD (Presenter) ; **Demetrius L Dicks** MD ; **Daniel Ocazionez** MD ; **Gregory Kicska** MD, PhD * ; **Mark R Ferguson** MD ; **Randolph K Otto** MD ; **Gautham P Reddy** MD

PURPOSE/AIM
1. To discuss the spectrum of congenital cardiac conditions representing a functional single ventricle.
2. To describe the imaging of common operative therapies.
3. To describe the role of imaging in evaluation and management of a functional single ventricle.

CONTENT ORGANIZATION
1.Overview
a.Physiology
b.Clinical presentation
2.Single Ventricle Anomalies
a.Dominant Left Ventricle
-Mitral valve atresia
-Aortic atresia
-Double inlet left ventricle
-Unbalanced atrioventricular canal(AVC)
-Hypoplastic right ventricle
b.Dominant Right Ventricle
-Hypoplastic left ventricle
-Tricuspid atresia
-Double inlet/outlet right ventricle
-Unbalanced AVC
3.Operative procedures
a.Three stage palliation
b.Pre-operative evaluation
c.Common surgical procedures
-Norwood
-Pulmonary artery banding
-Bidirectional cavopulmonary anastomosis
-Fontan
-Conduits
4.Imaging modalities
a.MRI
b.CT
c.Echo
d.Angiography

SUMMARY
1. Numerous cardiac anomalies present with single ventricle physiology. Knowledge of the underlying anatomy, physiology, and surgical interventions is necessary to effectively contribute to the complex evaluation of these disorders.
2. MRI, CT, and other imaging modalities can be utilized to evaluate the anatomy and functionality of single ventricle lesions and assist in management.

Cardiac (Experimental and Animal)

Wednesday, 03:00 PM - 04:00 PM ● S502AB

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MR CT CA

SSM03 ● *AMA PRA Category 1 Credit* ™:1 ● ARRT Category A+ Credit:1
Moderator
Vincent B Ho , MD, MBA *
Moderator
E. Kent Yucel , MD
Moderator
Pamela K Woodard , MD *

SSM03-01 ● Phase-contrast Computed Tomography of Coronary Atherosclerotic Plaque: Characterization of Plaque Components Based on Quantitative Phase-contrast Hounsfield Units

Holger Hetterich MD (Presenter) ; **Marian Willner** ; **Christopher Habbel** ; **Julia Herzen** ; **Michael Chabior** ; **Fabian Bamberg** MD, MPH * ; **Franz Pfeiffer** ; **Maximilian F Reiser** MD ; **Tobias Saam** MD *

PURPOSE
Atherosclerotic plaque imaging by absorption-contrast computed tomography (ACT) is limited due to poor contrast in low absorbing materials like soft plaque. Phase-contrast CT (PCT) is an experimental technique relying on X-ray phase-shift rather than absorption, yielding a higher contrast in biological soft tissue. Phase-contrast Hounsfield units (HU-P) can be calculated in analogy to absorption-contrast HU (HU-A) using the refraction index. We hypothesized that plaque components including fibrous (Fib), lipid-rich (Lip) and calcified tissue (Cal) can be differentiated based on HU-P.

METHOD AND MATERIALS
Ten ex-vivo human coronary arteries were imaged at a laboratory-based set-up using a conventional X-ray tube (35kV) and grating-interferometer to obtain the phase- and absorption-signal simultaneously. Tomographic images were reconstructed with an effective pixel size of 100�m and correlated with histopathology sections. In both ACT- and PCT-data, regions corresponding to Fib, Lip or

Cal based on histopathology as well as reference regions in surrounding formalin were manually traced. Mean HU-A, HU-P and signal-to-noise ratios (SNR) were calculated for all analyzed regions.

RESULTS
A total number of 276 cross-sections with 206 Fib, 113 Lip and 115 Cal containing regions were assessed. Fib, Lip and Cal were associated with significant different mean HU-P (57.5±9.3, 28.9±5.8 and 325.0±113.0; p 0.01) although there was no difference for Cal (p=0.72).

CONCLUSION
In an ex-vivo experimental set-up PCT can reliably differentiate important components of atherosclerotic coronary lesions based on quantitative HU-P, indicating its high potential for improved assessment of coronary artery disease.

CLINICAL RELEVANCE/APPLICATION
Phase-contrast computed tomography might improve characterization of coronary atherosclerotic plaque morphology compared to conventional absorption CT.

SSM03-02 ● Non Contrast T2-mapping Detects Area at Risk in Acute Myocardial Ischemia Rats

Rui Xia (Presenter) ; Xi Lu ; Jichun Liao ; Jie Zheng PhD ; Fabao Gao MD, PhD

PURPOSE
To compare the area at risk in rats with myocardial infarction and reperfused myocardial ischemia with a T2-mapping method on 7.0T MR.

METHOD AND MATERIALS
Two groups(7 each group) of reperfused myocardial ischemia(MI30) and myocardial infarction(MI) rats were investigated. For MI30, the left anterior descending coronary artery was occluded for 30 minutes while MI was induced by permanent ligation of the left anterior descending coronary artery. MRI scans were taken at 24 hours after the occlusion.
The T2-mapping was optimized on 7.0T MR(BRUKER BIOSPEC 70/30). Multiple single-slice turbo spin-echo T2-weighted images were acquired on the short axis slices during mid-diastolic phase and end-inspiratory period using both ECG and respiratory gating systems(TR/TE=1500ms/10,20,30ms,MTX=192×192,FOV=50×50mm,slice thickness=1.5mm).Then late gadolinium enhancement(LGE) imaging was performed by FISP(TR/TE=5.2ms/1.8ms,FA=25�,MTX=256×256,FOV=50×50mm,slice thickness=1.5mm) after an injection of Gd-DTPA. After MRI scan, rat hearts were cut into transverse slices for TTC staining.
The T2-maps were calculated using a custom-made software. Area at risk were defined as the difference between edema areas with high T2 values(> mean ± 2SD in remote normal tissue areas) and positive enhanced area in LGE images. The T2 values in edema regions were normalized by the T2 values in the remote normal tissue regions. All areas were expressed as a percentage of the whole myocardial tissue of left ventricle.

RESULTS
There was no significant difference between two groups (MI 1.62±0.27, MI30 1.59±0.16, p>0.05) in normalized mean T2 values of myocardial edema areas. The total size of infarction regions in MI(23.2±4.7%) was significantly higher than MI30(16.3±4.2%, p0.05). No significant difference was found for the edema area (MI 26.9±4.4%, MI30 21.1±7.2%, p>0.05). No significant difference was found for the infarcted area defined by LGE and TTC staining for MI30(17.5±2 vs. 15.2±4, n=3, p>0.05) and MI(22.5±3 vs. 21.2±2, n=3, p>0.05).

CONCLUSION
After 30 min myocardial ischemia in rats, reperfusion can reduce myocardial infarction, but not area at risk and edema.

CLINICAL RELEVANCE/APPLICATION
Area at risk may not always be the target of therapy for patients who undergo reperfusion after acute myocardial infarction.

SSM03-03 ● Beam Hardening Correction in Quantitative Myocardial CT Perfusion with Rapid kV Switching Dual Energy CT: A Validation Study with Microspheres

Aaron So PhD (Presenter) ; Jiang Hsieh PhD * ; Yasuhiro Imai MS * ; Jean-Baptiste Thibault * ; Kelley Branch MD * ; Ting-Yim Lee MSc, PhD * ; Suresh Narayanan MS * ; Sandeep Dutta PhD *

PURPOSE
We validated the usefulness of beam hardening (BH) reduction with a rapid kV switching dual energy CT (DECT) protocol in quantitative myocardial perfusion (MP) imaging against microspheres measurement of MP.

METHOD AND MATERIALS
Normal pigs were scanned using a Discovery 750HD scanner (GE Healthcare (GE)) with a DECT protocol: 140/80 kilovolts (kV) alternating at 0.2 ms intervals, 640 mA and 0.35 s gantry period. In each study, 22 axial scans covering 40 mm of the heart were triggered under normal physiologic conditions every 1-2 heart beat at mid-diastole together with contrast injection contrast at 4 ml/s. Single energy CT (SECT) and DECT monochromatic 70 keV images were reconstructed with 140 kV and both 80 and 140 kV projections respectively. The SECT images were also corrected for BH using an image-based correction algorithm (iBHC). Each image set was analyzed using CT Perfusion (GE) to derive MP functional maps. Fluorescent microspheres were injected into the left atrial appendage of the heart after the CT perfusion studies to measure MP. Mean MP in the lateral, apical and septal segments over 4 to 6 consecutive 5-mm-thick slices measured by microspheres and from the three CT image sets were compared using linear regression and Bland-Altman analysis. A total of 57 segments in 19 slices in four pigs were analyzed in this study.

RESULTS
DECT exhibited the highest correlation with microspheres (R=0.77) compared to SECT with (R=0.56) and without (R=0.49) iBHC. DECT also had the smallest difference in mean MP from microspheres (2.2 ml/min/100g) compared to SECT without iBHC (29.2). Despite a comparable mean difference from microspheres (-2.0), SECT with iBHC showed a wider limits of agreement (-45.0 to 41.0 ml/min/100g) than DECT (-30.7 to 35.2).

CONCLUSION
DECT provided better BH correction and the most accurate and smallest variation of MP measurements compared to microspheres MP gold standard. In SECT MP imaging, iBHC reduced the spatially inconsistent overestimation of MP in myocardial segments but did not outperform DECT.

CLINICAL RELEVANCE/APPLICATION
DECT minimizes beam hardening in contrast-enhanced cardiac images which leads to a more accurate MP measurement with CT Perfusion to facilitate reliable assessment of ischemic heart disease.

SSM03-04 ● A Computational Algorithm for the Automated Detection of the Napkin-ring Sign: A High-risk Plaque Feature in Coronary CT Angiography

Christopher L Schlett MD, MPH (Presenter) ; Nabeel Ali BS ; Maros Ferencik MD ; Hans-Ulrich Kauczor MD * ; Udo Hoffmann MD

PURPOSE
To develop a fully automated computational algorithm which allows highly efficient, accurate and reproducible detection of the �Napkin-Ring Sign� (NRS), which has been validated as a highly specific marker for vulnerable plaque in coronary CT angiography (CCTA). NRS is characterized by a center of lower CT attenuation representing a lipid-rich/necrotic core in histology surrounded by a rim-like area of higher CT attenuation representing fibrous tissue (figure). So far, NRS detection is limited to a manual and time-intensive reading by CCTA experts.

METHOD AND MATERIALS
The algorithm was developed utilizing MATLAB (Mathworks, Natick, MA), which employs computational image-analysis techniques. A database of cross-sectional CCTA images of coronary arteries from ex-vivo human cadaver hearts co-registered with histology was used. Presence of NRS for each CCTA cross-section was evaluated by a manual reading of a CCTA expert. The vulnerable status of the plaques was confirmed based on the co-registered histology images. Images were randomly split into a training and validation sets, each containing 15 NRS-positive and 45 NRS-negative CCTA cross-sections. The algorithm was developed with iterative steps based on the training set and the performance of the algorithm was verified based on the validation sets.

RESULTS
The algorithm analyzes each cross-sectional image by establishing �Line Density Profiles� (LDP) at the lumen centre in fixed intervals of rotation. Based on the training set, the following decision rule was established. A LDP was �positive� if it had a bi-peak curve with its first peak (labelled as X) at a minimum of 0-100 Hounsfield Units (HU) and second peak (labelled as Y) >0 HU and Y>X regarding HU values. If =4 consecutive LPDs were �positive�, the algorithm considered the entire CCTA cross-section as NRS positive. Applying this algorithm in the validation set, the accuracy was 72% with 94% sensitivity and 67% specificity to detect NRS fully automated. Adjunct structures such as vessel branches led to a false-positive results.

CONCLUSION
We have developed a novel computational algorithm that automatically detects the presence of the NRS in cross-sectional coronary CTA images with a good accuracy.

CLINICAL RELEVANCE/APPLICATION
If our NRS algorithm is combined with vessel segmentation software, a routine detection of high-risk plaques should be feasible even in larger cohorts and a treatment possible before the event occurs.

SSM03-05 • Cardiac Magnetic Resonance Elastography of the Right Ventricle in Canines with Congenital Pulmonary Valve Stenosis

Juliana S Da Silveira MD (Presenter) ; **Brian A Scansen** ; **Peter Wassenaar** MS * ; **Brian Raterman** ; **Ning Jin** * ; **Richard D White** MD ; **John D Bonagura** ; **Arunark Kolipaka** PhD

PURPOSE
To demonstrate the feasibility of quantitating right ventricular (RV) stiffness using cardiac magnetic resonance elastography (CMRE) and correlate it against RV thickness and mass in dogs with severe congenital pulmonary valve stenosis causing RV hypertrophy (RVH).

METHOD AND MATERIALS

RESULTS
Figure 1 shows a short-axis magnitude image (A), snap shots of wave propagation (B-E) and the corresponding stiffness map (F) with a mean RVFW stiffness value of 6.8kPa from one dog. Figure 2A shows poor inverse correlation between normalized RV mass and RVFW stiffness during ED (R2=0.05) and ES (R2=0.40). Figure 2B shows a poor inverse correlation between RVFW stiffness and thickness during ED (R2=0.19), but a good inverse correlation during ES (R2=0.81).

CONCLUSION
It is known that wall thickness has been used as a surrogate for estimating myocardial stiffness. However, our results do not show an increase in stiffness with an increase in wall thickness or mass; suggesting that thickness or mass do not reflect changes in the intrinsic mechanical property of the RVH myocardium.

CLINICAL RELEVANCE/APPLICATION
CMRE is a noninvasive method to estimate myocardial stiffness and can potentially facilitate better understanding of the impact of RVH.

SSM03-06 • Evaluating Myofibre Architecture of Rhesus Monkey with Myocardial Infarction Using DT-MRI

Yuqing Wang (Presenter) ; **Lei Wang** ; **Rui Xia** ; **Fabao Gao** MD, PhD

PURPOSE
For more accurately deducing and better understanding the microstructural progress of myocardial infarction in human being, we developed a rhesus monkey model of myocardial infarction for studying myocardial fibers on 7.0T MR.

METHOD AND MATERIALS
Infarction had been produced by permanent suture ligation of the left anterior descending coronary artery for 12 weeks. Both infracted and healthy monkeys were sacrificed under deep surgical anesthesia with pentobarbital for excising heart. The excised heart was immediately perfusion-fixed by and stored in a 4% paraformaldehyde solution. All experiments were performed in accordance with regulations for the humane care of laboratory animals at Sichuan university.
The diffusion tensor imaging (DTI) of each excised heart was performed on 7.0T MR (Bruker BioSpec 70/30, Germany). Each DTI dataset consisted of a single non-weighted and 30 diffusion-weighted 3D spin echo scans (TR/TE=12000/32ms, MTX=100×100, FOV=50×50mm, slice thickness=0.8mm) encoded in 30 gradient directions. The scan time for each DTI dataset was the same, approximately 20 hrs. All DTI datasets were analyzed to calculate the diffusion parameters such as fractional anisotropy (FA) and apparent diffusion coefficient (ADC) using Diffusion Toolkit package and the myocardial fiber tractography was performed by using Trackvis software.

RESULTS
The figure.1 A and B revealed respectively the myocardial fibers in healthy monkey and in infarcted monkey. In the infarcted heart, the decreased FA (0.2457) and increased ADC (0.00048) in infarcted area (red arrow) than in remote area (FA: 0.817, ADC: 0.00019) indicated damaged completeness of myocardial fibers in infarcted area. In contrast, the healthy heart revealed homogeneous FA and ADC in whole heart. Moreover, the myocardial fibers were intermittent (=2500 track/ml) in infarcted area but holonomic (=4977 track/ml) in remote area.

CONCLUSION
Higher similarity of fibers architecture with the ex-vivo human�s heart made us to accurately deduce and interpret the human's myocardial infarction using infarcted monkey�s hearts. To the best of our knowledge, this study is a first in monkeys for myocardial fiber imaging using 7.0T MR.

CLINICAL RELEVANCE/APPLICATION
The monkey model enable us to deduce and understand the human's myocardial infarction in more accurate manner.

ISP: Cardiac (Clinical Trials and Population Studies)

Wednesday, 03:00 PM - 04:00 PM • S504AB

CA

SSM04 • *AMA PRA Category 1 Credit* ™:1 • ARRT Category A+ Credit:1
   Moderator
   W. Brian Hyslop , MD, PhD
   Moderator

U. Joseph Schoepf , MD *

SSM04-01 ● Cardiac Keynote Speaker: MagnaSafe Registry
Robert J Russo MD, PhD (Presenter)

SSM04-03 ● The Diversion of Outpatient Echocardiography from Private Offices to Higher Cost Hospital Facilities: An Unanticipated Effect of Code Bundling

David C Levin MD (Presenter) * ; **Vijay M Rao** MD ; **Laurence Parker** PhD ; **Ethan J Halpern** MD

PURPOSE
In 2009, the add-on codes for spectral Doppler and color flow Doppler echocardiography (echo) were bundled into the primary transthoracic echo (TTE) code. The relative value units for the new single code were substantially lower than the previous sum for the 3 codes that were usually done together. Our purpose was to see what effect this had on Medicare echo utilization rates and on the distribution of outpatient echos between cardiology offices and hospital outpatient departments (HOPDs). This is important because the costs to Medicare of echos done in HOPDs are substantially higher than of those done in offices.

METHOD AND MATERIALS
The nationwide Medicare Part B databases for 2005-2011 were used. All echo CPT codes were selected. Specialty codes were used to identify echos done by cardiologists (who do most echos). Place-of-service codes were used to identify echos done in offices and HOPDs. Procedure volumes and utilization rates per 1000 were determined, and trends were evaluated before and after bundling occurred in 2009.

RESULTS
Cardiologists� office echo utilization rate rose from 219.5 per 1000 in 2005 to 257.1 in 2008, then dropped to 100.0 in 2009 (-61%). Their HOPD echo rate rose from 72.2 in 2005 to 76.5 in 2008, then dropped to 35.0 in 2009 (-54%). From 2009 to 2011, cardiologists� office echo rate dropped again from 100.0 to 88.8 (-11%), while their HOPD echo rate increased from 35.0 to 46.1 (+32%). In 2008 (the last year before bundling), 23% of all outpatient echo was done in HOPDs; this increased to 34% by 2011.

CONCLUSION
Echo code bundling produced a sharp drop in outpatient claims from cardiologists. After bundling, office echo rates continued to drop but HOPD echo rates increased. This was likely due to migration of cardiology office practices into hospitals. The technical component national fee for office TTE is $148 vs $393 for HOPD echo. It appears that in this instance, code bundling (which also occurred with cardiac nuclear scans) led to closure of many cardiology offices and a resultant shift of echos from that lower cost setting to the much higher cost HOPD setting. From the perspective of Medicare and other payers, this is a drawback of code bundling.

CLINICAL RELEVANCE/APPLICATION
not applicable

SSM04-04 ● Extent and Distribution of Left Atrial Delayed Enhancement at MRI in Patients with and without Atrial Fibrillation

Hubert Cochet MD (Presenter) ; **Amaury Mouries** ; **Delphine Elbes** ; **Mathilde Merle** ; **Bruno Quesson** ; **Jatin Relan** ; **Maxime Sermesant** ; **Nicholas Ayache** PhD ; **Pierre Jais** ; **Michel Montaudon** MD ; **Francois H Laurent** MD

PURPOSE
Atrial delayed enhancement (aDE) at MRI has mostly been reported in patients with atrial fibrillation (AF). Additionally, the 3-dimensional distribution of aDE has not been thoroughly studied. We aimed to study the extent and distribution of aDE in patients with and without AF.

METHOD AND MATERIALS
190 patients referred for cardiac MRI underwent aDE imaging. The population was composed of 60 AF patients (26 persistent), and 130 patients without AF, including 75 with structural heart disease (SHD). Imaging was performed using a 3-dimensional respiratory-navigated inversion-recovery prepared TurboFLASH method with fat saturation (voxel size 1.25x1.25x2.5mm). Acquisition was initiated 15 minutes after contrast media injection. After left atrial segmentation aDE was quantified using an adaptative thresholding algorithm and expressed in % of the left atrial wall. Regression analysis was performed to identify predictors of aDE extent. Areas of aDE were registered to an atrial template to study aDE distribution in sub-populations.

RESULTS

CONCLUSION
In addition to age, AF and its persistence are major determinants of aDE extent. However, aDE is also related to female gender and SHD. The distribution of aDE is highly variable between patients but a stereotyped pattern is found, regardless of the underlying condition. aDE is more frequent in the posterior wall around left inferior pulmonary vein ostium.

CLINICAL RELEVANCE/APPLICATION
The determinants of atrial delayed enhancement at MRI are consistent with atrial remodeling. Age, atrial fibrillation and structural heart disease are associated with a higher extent of enhancement.

SSM04-05 ● Standard Weight-based Gadolinium Dosing over Corrects for Body Size in Obese Individuals when Evaluating the Myocardium: The Multi-Ethnic Study of Atherosclerosis (MESA)

Songtao Liu MD (Presenter) ; **Chia-Ying Liu** ; **Jing Han** ; **Evrim B Turkbey** MD ; **Bharath Venkatesh** ; **Diane Bild** ; **Andrew E Arai** MD ; **Robyn McClelland** ; **William Hundley** ; **Antoinette S Gomes** MD * ; **Russell Tracy** ; **Richard Kronmal** ; **Joao A Lima** MD * ; **David A Bluemke** MD, PhD *

PURPOSE
Gadolinium-based contrast agents (GBCAs) are administered in direct proportion to body weight according to FDA approval. However, body fat is less vascular than either visceral organs or muscle and has a lower contribution to the extravascular fluid space. The purpose of this study was to evaluate the impact of body weight based GBCA dosing on myocardial T1 time in a large multi-center study.

METHOD AND MATERIALS
1231 study participants (mean age 67±9 years) free of clinical cardiovascular disease at enrollment (2000) in the Multi-Ethnic Study of Atherosclerosis (MESA) underwent gadolinium enhanced CMR. GBCA (Magnevist,0.15mmol/kg) was administrated and T1 mapping was performed at the mid-ventricular level before and after GBCA using a MOLLI sequence. Study participants with focal late gadolinium enhancement were excluded. The associations of myocardial T1 time with body weight and body mass index (BMI) were evaluated by a linear model adjusting for age, ethnicity, traditional risk factors and creatinine.

RESULTS
The mean BMI was 28.4±5.6 for women and 27.9±4.2 for men. The mean post-contrast myocardial T1 times were 440±39 ms (@12min), and 504±38 ms (@25min) for women. For men, the corresponding values were slightly higher, 469±31 ms (@12min), and 532±33 ms (@25min). Pre-gadolinium T1 times were not associated with either body weight or BMI. Post-gadolinium T1 times were significantly related to both weight and BMI (women, weight, r:-0.43; BMI, r:-0.41; men, weight, r:-0.25; BMI, r:-0.23; all r^2, men -1.3 msec/kg/m^2, p=0.001). For an individual with BMI of 35 kg/m^2, weight-based GBCA administration resulted in a 38 msec lower T1 time for women, and a 20 msec lower T1 time for men relative to an individual with a BMI of 20 kg/m^2. Similar results were obtained when considering waist circumference as a measure of obesity.

CONCLUSION

For myocardial T1 evaluation, standard body weight based administration of GBCA �overdoses� individuals with elevated BMI, this effect is slightly greater for women compared to men.

CLINICAL RELEVANCE/APPLICATION
Standard weight based dosing of a GBCA may result in overcorrection in obese subjects, lowering myocardial T1 time, potentially confounding interpretation of T1 results.

SSM04-06 ● Ethnic Differences in Aortic Stiffening across the Adult Life Span: Results from MRI Aortic Pulse Wave Velocity Measurements in the Dallas Heart Study

Akshay Goel BS (Presenter) ; **Ronald M Peshock** MD ; **Christopher Maroules** MD ; **Colby Ayers** MS ; **Roderick McColl** PhD ; **Kevin S King** MD

PURPOSE
Aortic pulse wave velocity (APWV) is a non-invasive measure of aortic stiffness, independently associated with end organ damage and mortality. The purpose of this study was to assess ethnic differences in aortic stiffness across the adult life span using MRI measured APWV in a large population based study.

METHOD AND MATERIALS
The study consisted of 1197 participants from the Dallas Heart Study-1 (DHS-1), a multiethnic, population-based study of cardiovascular health. APWV was measured across the thoracic aortic arch using phase contrast (PC) cardiac gated MRI, expressed as velocity in m/s. APWV measurements were log transformed to normalize the distribution. Linear regression was used to model the age-related increase in APWV stratified by Black ethnicity and Non-Black ethnicity.

RESULTS

CONCLUSION
In the DHS-1 Blacks demonstrated increased age related aortic stiffening across the adult life span relative to Non-Blacks.

CLINICAL RELEVANCE/APPLICATION
Ethnic differences in aortic stiffness across the adult life span can be demonstrated by MRI measures of APWV, and may account for ethnic differences in cardiovascular events.

Controversy Session: The Heart of the Matter: Nuclear Stress Test vs CTA for Low to Intermediate Risk Cardiac Patients with Chest Pain

Wednesday, 04:30 PM - 06:00 PM ● S404CD

ER | NM | IR | CT | CA

SPSC45 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
Suhny Abbara , MD *
Sharmila Dorbala , MBBS *

LEARNING OBJECTIVES
1) To review the current literature on cardiac CT in the setting of chest pain with low to intermediate risk. 2)To review the current literature on radionuclide myocardial perfusion imaging in the setting of chest pain with low to intermediate risk. 3) To understand the strengths and weaknesses of radionuclide imaging and MDCT in this particular situation.
ABSTRACT
URL
http://www.mgh-cardiovascimages.org/

Advances in Cardiac Nuclear Imaging: SPECT/CT and PET/CT

Thursday, 08:30 AM - 10:00 AM ● S505AB

NM | CT | CA

RC611 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
1) Understand the technical advancements associated with new scintillation cameras and SPECT-CT and PET-CT cameras. 2) Appreciate the benefits of CT attenuation correction. 3) Appreciate the adjunctive benefits of anatomic definition provided with CT and physiologic/function information provided by SPECT and PET. 4) Improve interpretive skills related to SPECT and PET-CT.
ABSTRACT
Camera and software technology recently has rapidly advanced, providing improved SPECT image resolution and increased counting statistics. These advancements in turn have provided the possibility of reduced-time and reduced radiopharmaceutical dose image acquisitions. Moreover, increased flexibility in imaging protocols has been realized. Future development of these methods hold promise in increasing diagnostic accuracy and expanding diagnostic applications. The addition of CT to SPECT and PET has afforded the ability to perform attenuation correction, thereby minizing attenuation artifacts and increasing diagnostic specificity. With CT acquisitions of sufficient resolution, complementary anatomic diagnostic information is provided. In addition, more precise anatomic localization of SPECT and PET abnormalities significantly increases clinical applicability.

RC611A ● Advances in Cardiac SPECT

E. Gordon Depuey MD (Presenter) *

LEARNING OBJECTIVES
1) Understand software methods to cope with lower SPECT counting statistics in order to reduce scan acquisition time and/or radiopharmaceutical injected activity and their clinical impact. 2) Understand instrumentation advances that allow new cameras to perform SPECT with markedly reduced acquisition times and/or less radiopharmaceutical activity and their clinical impact. 3) Implement protocols that facilitate patient-centered imaging and that reduce patient radiation exposure. 4) Recognize new software methods to select appropriate patients for cardiac resynchronization therapy (CRT).

ABSTRACT
A long-standing limitation of radionuclide myocardial perfusion SPECT is its relatively lengthy acquisition time, as compared to stress echocardiography and cardiac CT. New software methods and new innovative hardware, however, now allow for significantly shortened SPECT acquisition times without a decrease in image quality. Advancements include iterative reconstruction, resolution recovery, and noise reduction software, and focused collimation and solid state detectors incorporated into new camera designs.
More recently the media, the public, and the medical community have drawn attention to patient radiation exposure associated with radiographic, nuclear medicine, and nuclear cardiology procedures and the potential associated patient risk . The radiology and nuclear imaging communities have responded rapidly and definitively by implementing a variety of guidelines to decrease patient radiation exposure and to avoid exposure in higher risk patient populations. The American society of Nuclear Cardiology has set a goal to decrease patient radiation exposure associated with myocardial perfusion SPECT to less than 9 mSv per entire study in 50% of patients by 2014,

and the ACR Image Wisely Guidelines encourage reduced radiation doses. New software and hardware methods described in this presentation will help us achieve this goal by providing the ability to maintain or improve SPECT image quality with the lower image counting statistics associated with significantly decreased injected radiopharmaceutical doses. There has been an intersocietal effort to promote patient-centered imaging with a focus on appropriateness guidelines, cost-containment, radiation dose reduction, and the selection of the most appropriate imaging test and protocol to suit particular patient needs. The technical advancements described above facilitate implementation of patient-centered imaging.

RC611B ● Advances in Cardiac PET

Sharmila Dorbala MBBS (Presenter) *

LEARNING OBJECTIVES
1) Review the advantages and disadvantages of myocardial perfusion PET compared to SPECT for evaluation of coronary artery disease. 2) Learn the added value of absolute quantitative parameters derived from PET for assessment of cardiovascular disease. 3) Update of current and future clinical applications of cardiac PET imaging in cardiovascular medicine.

ABSTRACT

Cardiac Radiology Series: Cardiac Dual Energy CT

Thursday, 08:30 AM - 12:00 PM ● S404CD

QA | CT | CA

VSCA51 ● *AMA PRA Category 1 Credit* ™:3.75 ● ARRT Category A+ Credit:4
Moderator
U. Joseph Schoepf , MD *
Moderator
James P Earls , MD *

VSCA51-01 ● Technique

Willi A Kalender PhD (Presenter) *

LEARNING OBJECTIVES
1) To learn about the basic principles and data acquisition strategies of dual energy CT. 2) To understand the different acquisition strategies for cardiac CT. 3) To learn about dose implications in cardiac dual energy CT.

ABSTRACT
Dual-energy cardiac CT represents the combination of two of the most demanding CT applications; special hardware, scan protocols and dedicated data processing algorithms are demanded for both, high scan speed is an additional prerequisite.
Dual energy CT (DECT) data acquisition can be achieved by taking two separate scans at different voltages, by rapid kV-switching, or by using dual-source CT operating with different voltages and pre-filtrations. These concepts and the resulting options to determine tissue parameters will be explained.
Cardiac CT requires data acquisition in time intervals as short as possible based on either prospective triggering or retrospective gating. The technical options available allow either single or dual source spiral CT or stepwise sequential acquisition and will also be explained.
Dose levels for cardiac dual energy CT are moderate in general. Details and examples are given in the following lectures.

VSCA51-02 ● Dose Levels and Image Quality of Second-generation 128-slice Dual-source Coronary CT Angiography - Comparison of High-pitch Spiral, Sequential, Retrospectively ECG-gated Spiral and Dual-energy Acquisition Mode

Julian L Wichmann MD (Presenter) ; **Xiaohan Hu** MD ; **Alexander Engler** MD ; **Ralf W Bauer** MD * ; **Claudia Frellesen** ; **Boris Bodelle** MD ; **Thomas Lehnert** MD ; **Martin Beeres** MD ; **Thomas J Vogl** MD, PhD ; **Josef Matthias Kerl** MD *

PURPOSE
To compare the radiation exposure and image quality of coronary CT angiography (cCTA) protocols on a second generation 128-slice dual-source CT (DSCT) scanner.

METHOD AND MATERIALS
We prospectively included 100 patients referred for cCTA. Patients with a heart rate below 65 bpm were randomized between prospectively ECG-gated high-pitch spiral (group 1) and narrow-window sequential (group 2) acquisition. Patients with a heart rate above 65 bpm were randomly assigned to a retrospectively ECG-gated spiral acquisition protocol in either dual-source (group 3) or dual-energy (group 4) mode. CT dose index volume, dose length product, effective dose, contrast-to-noise and signal-to-noise ratio were compared. Subjective image quality was rated by two observers blinded to the used protocol.

RESULTS
High-pitch spiral cCTA showed a mean estimated radiation dose of 1.27±0.64 mSv, significantly (p0.05), ranging from 16.03±6.3 (group 1) to 19.3±9.5 (group 4) and 20.1±16.5 (group 2) up to 26.4±23.0 (group 3). Each protocol showed diagnostic image quality in at least 98.4% of evaluated coronary segments.

CONCLUSION
Prospectively ECG-gated DSCT protocols allow cCTA with significant dose reduction. High-pitch spiral mode generates less than 1/2 of the estimated radiation exposure of sequential acquisition mode. In patients with a heart rate above 65 bpm, dual-energy mode should be preferred over spiral DSCT as it significantly decreases estimated dose without compromising diagnostic image quality.

CLINICAL RELEVANCE/APPLICATION
Second-generation DSCT scanners allow cCTA in patients with normo- or arrhythmia that result in significant dose reduction while maintaining diagnostic image quality.

VSCA51-03 ● Diagnostic Performance of Dual Energy Computed Tomography Stress Myocardial Perfusion Imaging: A Direct Comparison to Cardiac Magnetic Resonance

Sung Min Ko (Presenter) ; **Jin-Woo Choi** ; **Hweung Kgon Hwang** ; **Meong Gun Song**

PURPOSE
This study aimed to determine the diagnostic performance of stress testing by dual-energy computed tomography (DECT) for identification and exclusion of hemodynamically significant stenoses when compared to combined conventional coronary angiography (CCA) and stress perfusion cardiac magnetic resonance (SP-CMR) as reference standards.

METHOD AND MATERIALS
One hundred patients without prior known coronary artery disease without chronic myocardial infarction detected by coronary CT angiography (CCTA) were included and underwent SP-DECT, SP-CMR, and CCA. All CT examinations were performed using a Somatom Definition scanner. DECT-based iodine maps were used for detecting myocardial perfusion defects (MPDs) (per-vessel and per-segment) and compared with SP-CMR. The assessment of MPDs was based on visual analysis instead of quantitative analysis because DECT-based iodine map highlights areas of decreased iodine in the left ventricular myocardium. SP-CMR exams were performed on a Signa HDxt

1.5-T system with an 8-element phased array surface coil or a Magnetom Skyla 3.0-T system with a 32-channel body coil after SP-DECT. Diagnostic values of CCTA for detecting hemodynamically significant stenosis were assessed before and after SP-DECT on a per-vessel basis compared with CCA/SP-CMR as the reference standard.

RESULTS
The performance of SP-DECT for detecting MPDs compared with SP-CMR was sensitivity, 89%; specificity, 74%; positive predictive value (PPV), 73%; negative predictive value (NPV), 90% (per-vessel). Compared to the combined CCA/SP-CMR for identifying hemodynamically significant stenosis, per-vessel territory sensitivity, specificity, PPV, and NPV of CCTA were 95%, 61%, 61%, and 95%, respectively, those by using SP-DECT were 92%, 72%, 68%, and 94%, respectively, and those by using CCTA/SP-DECT were 88%, 79%, 73%, and 91%, respectively. The area under the receiver operating characteristic curve increased from 0.78 to 0.84 (p=0.02) using CCTA/SP-DECT compared with CCTA.

CONCLUSION
SP-DECT can play a complimentary role to enhance the accuracy of CCTA for identifying hemodynamically significant stenosis.

CLINICAL RELEVANCE/APPLICATION
SP-DECT has the potential to become a robust clinical tool for the detection of myocardial ischemia and can be used as an alternative to other perfusion imaging techniques such as SP-CMR and SPECT.

VSCA51-04 ● Diagnostic Value of Dual-energy Computed Tomography (DECT) Combined CT Perfusion and CT Angiography in Patients after Coronary Stent Implantation

Lingyan Kong MD (Presenter) ; **Zhengyu Jin** MD ; **Yining Wang** MD

PURPOSE
To evaluate the diagnostic value of dual-energy computed tomography (DECT) combined CT perfusion (CTP) and CT angiography (CTA) in patients after coronary stent implantation, in compare with quantitative coronary angiography (QCA).

METHOD AND MATERIALS

RESULTS
Using QCA as a reference standard, the sensitivity and specificity of DE-CTA for detecting in-stent stenosis was 75.0% and 100%, respectively. The accuracy was 94.3%. For detecting non-stent stenosis on the vessel-based analysis, DE-CTA showed sensitivity of 87.5%, specificity of 100%, and accuracy of 93.3%, while the combination of CTA and CTP showed accuracy of 100%.

CONCLUSION
DECT has a high diagnostic accuracy for the detection of in-stent restenosis. CTA combined with CTP may improve the diagnostic accuracy for detecting non-stent significant coronary stenosis.

CLINICAL RELEVANCE/APPLICATION
DECT may evaluate both stenosis of coronary artery and myocardiac perfusion in the assessment of coronary artery disease, and shows value in follow up of coronary stent inplantation.

VSCA51-05 ● Reduced Contrast Medium in 100kVp Coronary Artery Angiography with Dual-source CT

Dan Han MD (Presenter) ; **Jun Zhang**

PURPOSE
To evaluate the image quality of 100kVp dual-source CT coronary angiography using three different contrast media (CM) injection protocols.

METHOD AND MATERIALS
In this IRB approved study, dual-source CT coronary angiography scans were performed in 120 patients, who were randomly divided into three groups using contrast medium with concentration of 370 mg I/mL, 320 mg I/mL and 270 mg I/mL at the same injection rate(5.0 mL/s,14 s). The CT scan protocol was the same in three groups (prospective scan, 100kVp, reference mAs: 400 mAs) with automatic tube current modulation activated. Two observers evaluated the visibility of 4 main branches of coronary arteries. The mean CT values in coronary artery, image noise, signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), radiation dose, patient BMI were recorded and compared using one way ANOVA test among three groups.

RESULTS
The three groups all had an average body mass index (BMI) value of 22 kg/m^2. The assigned CM volume was 60 mL in 370 group, 65 mL in 320 group and 65 mL in 270 group.The visibility of 4 main branches of coronary arteries are all 100% in three groups by two observers. The mean CT value in 270 group (390.65 +/- 50.34 HU) was lower than 320 group (466.76 +/- 45.65 HU) and 370 group (710.32 +/- 45.65 HU), where the difference was statistically significant (p < 0.05). The SNRs and CNRs were 27.42 +/- 4.21 and 21.7 +/- 4.4 for 370 group; 27.68 +/- 4.09 and 20.1 +/- 5.2 for 320 group; 26.12 +/- 4.13 and 21.2 +/- 5.7 for 270 group. There was no statistical difference were found in image noise, SNR, CNR and radiation dose (p > 0.05).

CONCLUSION
Using 270 mg I/mL iodine Contrast Medium and 100 kVp tube voltage scan protocol with dual-source CT coronary angiography is feasible in patients with normal BMI. This scan protocol can substantially reduce iodine intakes for patients while preserve good diagnostic image quality.

CLINICAL RELEVANCE/APPLICATION
Using 270 mg I/mL iodine Contrast Medium with dual-source CT coronary angiography is equal to 370 mg I/mL in detecting plaque of coronary.

VSCA51-06 ● Multiple Vulnerable Plaque Characteristic Factors Co-existing in Single Non-obstructive Non Calcified or Mixed Plaques in Coronary Arteries are Higher Risk Predictors of Major Cardiac Events on CT

Hiroyuki Takaoka MD, PhD (Presenter) ; **Nobusada Funabashi** MD, PhD ; **Masae Uehara** MD ; **Koya Ozawa** MD ; **Yoshihide Fujimoto** ; **Yoshio Kobayashi**

PURPOSE
To evaluate significance of presence of three vulnerable plaque characteristics (VPC) co-existing in single non calcified plaques (NCP) or mixed plaques (MP) in non obstructed coronary arteries on CT: 1) low attenuation (LA) (< 30HU), 2) positive remodeling (PR) and 3) spotty calcification (SC), for the risk of major adverse cardiac events (MACE).

METHOD AND MATERIALS
166 consecutive subjects with suspected coronary artery disease (81 male; 62 ± 13 years; hypertension, 61%; diabetes mellitus, 21%; dyslipidemia, 56%; smokers, 45%; obese, 49%) underwent cardiac CT (Light speed Ultra 16, GE Healthcare) from 2003 to 2004. On CT no significant stenosis (> 50%) of coronary arteries was observed; subjects were retrospectively followed for a median of 103 months after CT and incidence of MACE was compared. Subjects with old myocardial infarction or myocardial diseases were excluded from the analysis. MACE included cardiac death, acute coronary syndromes, new onset of angina pectoris, and cardiac failure.

RESULTS
39 subjects had NCP (17) or MP (22), of whom 8, 29, and 14 subjects had LA, PR, and SC in NCP or MP, respectively. These were classified into 4 groups, 1) 128 who did not have NCP or MP with any VPCs, 2) 20 who had NCP or MP with one VPC, 3) 14 who had NCP

or MP with two VPCs and 4) 2 who had NCP or MP with three VPCs. 6 subjects (4%) had MACE. Subjects who had NCP or MP with = two VPCs (n=16) had a higher risk of MACE than subjects with = one VPC (n=150) (P < 0.05) during the observation period. Significant differences between subjects with NCP or MP with = two VPCs and others (zero, one VPC groups) were observed at each time point when the whole period of follow-up was compared by Kaplan Meier analysis and log rank test (P < 0.001). A Cox proportional hazard model revealed that presence of NCP or MP with = two VPCs on coronary arteries on CT was a greater predictor of MACE (Hazard ratio 7.5, 95% confidential interval 1.0-55.4, P < 0.05 than other factors.

CONCLUSION
Presence of NCP or MP with = two VPCs in non obstructed coronary arteries on CT were critical factors for the prediction of MACE in subjects with normal myocardium on follow-up for a median of 103 months.

CLINICAL RELEVANCE/APPLICATION
Even in subjects without significant stenosis in coronary arteries on CT, if NCP or MP with = two VPCs are observed on CT, careful follow-up with control of risk factors is desired.

VSCA51-07 ● Radiation Dose

James P Earls MD (Presenter) *

LEARNING OBJECTIVES
1) Understand how the use of dual energy technique affects radiation dose from CT exams. 2) Identify which parameters can be changed to reduce the dose of dual energy exams. 3) Discuss the relative differences in radiation dose of dual energy and single energy CT exams.

ABSTRACT
Dual energy techniques have been developed and are now available for imaging the heart with CT. This course will discuss how different techiques, dual source and single source fast kV switching, can effect the dose of the exams. We will review how the scan protocols can be manipulated to minimize the dose to the patient. We will also compare doses from dual energy and single energy exams.

VSCA51-08 ● Dual Energy versus Single Energy CT in the Evaluation of Myocardial Perfusion in Correlation with SPECT Studies

Patricia M Carrascosa MD (Presenter) * ; **Carlos Capunay** MD ; **Alejandro Deviggiano** MD ; **Javier Vallejos** MD ; **Roxana Campisi** ; **Maria Munain** ; **Carlos Tajer** ; **Jorge M Carrascosa** MD

PURPOSE
A mainchallenge of myocardial CT perfusion (CTP) is beam hardening. With the developments of dual-energy CT (DECT) scanning, the beam hardening artifact could be reduced with the generation of monochromatic images. The objective of this paper is to determine the usefulness of Stress-Rest DECT versus Single Energy CT (SECT) in the evaluation of myocardial perfusion in correlation with SPECT findings.

METHOD AND MATERIALS
Forty patients with known or suspected coronary artery disease who had a positive stress test for ischemia or had an indication of SPECT study were included. Twenty patients were scanned using a DECT scanner and the other 20 using a SECT scanner. Demographic data was similar in both groups. In all patients, a stress CT scan was carried out first, and 30 minutes later a rest CT scan was complemented. Dipiridamol was used for stress myocardial perfusion imaging in both CT and SPECT studies.
A 17 segmental-model analysis was done to determine myocardial segments with perfusion defects. Monochromatic images at different keV from the DECT data and SECT images were evaluated for the detection of myocardial perfusion defects based on Hounsfield units. CT analysis was carried out blinded to SPECT results, considered as the gold standard. Statistical analysis: The 95% confidence interval of the proportions was calculated by the exact binomial method to determine the presence of myocardial perfusion defects. Correlation between DECT, SECT and SPECT studies was measured by the kappa coefficient.

RESULTS
The mean radiation dose for each patient was 7.1 +/- 1.2 mSv on DECT exams and 8.1 +/-1.1 mSv on SECT scans. For detection of the presence of myocardial perfusion defects, DECT showed a sensitivity of 82.1%; specificity 96.7%; PPV 85.5%; NPV 96%, with a k=0.77. SECT showed a sensitivity of 70.3%; specificity 90.7%; PPV 79.3%; NPV 85.7%, with a k=0.62.

CONCLUSION
Stress-Rest DECT myocardial perfusion demonstrated higher sensitivity and specificity than SECT in correlation with SPECT for the detection of myocardial perfusion defects using similar radiation dose. More studies have to be done to validate these results.

CLINICAL RELEVANCE/APPLICATION
Quantitative myocardial CT perfusion for the assessment of coronary artery disease may have a significant effect on patient care, giving a functional significance to a coronary stenosis.

VSCA51-09 ● One-step Dual-energy Cardiac CT Scan for Diagnostic and Prognostic Evaluation of Coronary Artery Disease

Patricia M Carrascosa MD (Presenter) * ; **Carlos Capunay** MD ; **Alejandro Deviggiano** MD ; **Javier Vallejos** MD ; **Jorge M Carrascosa** MD

PURPOSE
Coronary artery calcium score (CCS) is used for risk stratification and early detection of coronary atherosclerosis. It is well known that CCS is an independent predictor of cardiovascular events and it adds value to the Framingham risk score. The objective of this study is to evaluate the possibility of obtaining the information given by CCS from a contrast enhanced dual energy coronary CT angiography (DE-CCTA).

METHOD AND MATERIALS
Twenty five patients were evaluated with a 128 slice CT scanner (Discovery CT750 HD; GE Medical Systems). All patients underwent a non-contrast calcium score and then a contrast enhanced DE-CCTA. First the non contrast CCS scan was evaluated with a dedicated special software (Smart score; GE Medical Systems) in order to quantify the calcium score of each patient. Additionally, mass and volume of burden calcium plaque were obtained from the same software.
The contrast enhanced DE-CCTA data was decomposed into monochromatic images at 140 keV obtaining a virtual non-contrast serie and calcium [iodine] material images. The volume of burden calcium plaque was obtained by using a 3-D voxel quantification method. Correlation between results of calcium volumes from CCS software and DE-CCTA data was performed by the intra-class correlation coefficient.

RESULTS
By coronary calcium score software, the median of Agatston score was 208 (range: 0-2045), the median coronary calcium mass was 36 mg (range: 0-264 mg), and the median of calcium plaque volume was 92 mm3 (range: 0-778 mm3), while the median of calcium volume by 3-D quantification from the DE-CCTA data was 98 mm3 (range: 0-771 mm3), without significant differences between both methods (p >0.05). Correlation between CCS and DE-CCTA in calcium volume quantification was r: 0.98.

CONCLUSION
There was a linear relationship with excellent correlation between the amounts of calcium measured by coronary calcium score software and those by the 3-D quantification obtained from contrast enhanced DE-CCTA. In this way, prognostic as well diagnostic information could be obtained from a single scan reducing the total radiation dose and costs.

CLINICAL RELEVANCE/APPLICATION

Coronary artery is an independent predictor of cardiovascular events and it adds value to the Framingham risk score. Having its information from a dual energy coronary CT angiography is feasible.

VSCA51-10 ● A Randomized Trial of Low Contrast Volume vs. Standard Contrast Volume CT Angiography Using Rapid kVp Switching Dual Energy CT

Sasi R Gangaraju MBChB (Presenter) ; **Angus G Thompson** PhD, MBBS ; **Kristy Lee** MD ; **Giang Nguyen** MD ; **Carolyn Taylor** MD ; **Jonathan A Leipsic** MD * ; **Brett Heilbron** MD, FRCPC ; **Tae-Hyun Yang** ; **James P Earls** MD * ; **James K Min** * ; **Jennifer D Ellis** MD ; **Cameron J Hague** MD

PURPOSE
CCTA is a robust tool for evaluating CAD. Its application is limited in those with borderline renal function out of concern for contrast-induced nephropathy (CIN). We evaluated qualitative and quantitative measures of image quality and diagnostic efficacy of a reduced iodine contrast volume Dual Energy CCTA(DE) vs the standard iodine contrast volume CCTA(STD).

METHOD AND MATERIALS
A prospective single centre double-blind trial recruited 77 consecutive outpatients who were then randomised to 2 cohorts; STD with BMI based tube potential selection (100-120 kVp)(n=41) or DE with rapid kVp switching (n=35). STD protocol used 110cc iodinated contrast via a triple phase injection and the DE protocol used 55cc of iodinated contrast with the reduced volume being substituted with saline. Demographics and cardiac history was obtained via a questionnaire at the time of CCTA. 2 readers measured signal and noise in the left main, left anterior descending, circumflex and right coronary artery, and SNR and CNR was calculated. A 5-point Likert scale subjectively evaluated vascular enhancement, noise and overall image quality (5:excellent, 1:non-diagnostic, scores
RESULTS

CONCLUSION
DE CCTA results in inferior image quality scores, but demonstrates comparable SNR and CNR and rate of diagnostic interpretability with no radiation dose penalty, while allowing for a 50% reduction in contrast volume compared to standard CCTA.

CLINICAL RELEVANCE/APPLICATION
DE reduced contrast volume CCTA may be considered a viable imaging option in patients at higher risk for CIN.

VSCA51-11 ● Feasibility of Low Concentration Contrast Medium in Dual Energy Spectral Coronary CT Angiography

Xinhuai Wu (Presenter) ; **Wei Han** ; **Junliang Lu**

PURPOSE
To investigate the utility of low concentration contrast medium in coronary CT angiography with dual energy spectral imaging mode for overweight patient.

METHOD AND MATERIALS

RESULTS
The mean CT values of LAD, LCX and RCA (389.6±54.3, 421±61.3, 415.3±58.4) in group B had no significant difference with those in group A (LAD (379.4±48.3, 356.7±55.8, 402.9±77.2) (each p>0.05). The image noise of group A (21.43±7.69) was lower than that of group B (27.28±7.14). The mean CNR of LAD, LCX and RCA in group B (23.44±8.23) was higher than that in group A (17.69±7.95) (p=0.023). Effective radiation dose was similar between group A and group B (2.75±0.43 mSv vs 2.49±0.57mSv, p=0.17)

CONCLUSION
Dual energy spectral CCTA (70keV monochromatic images) provides better image quality than conventional CCTA and reduces the contrast medium demand.

CLINICAL RELEVANCE/APPLICATION
Dual energy spectral CCTA provides better image quality, and should better choice for elder patients who have impaired renal function.

VSCA51-12 ● Applications

U. Joseph Schoepf MD (Presenter) *

LEARNING OBJECTIVES
1) To select suitable clinical image acquisition protocols for cardiac dual-energy CT. 2) To discuss the role of pharmacological stress for dual-energy CT imaging of myocardial ischemia. 3) To identify potential future applications of cardiac dual-energy CT in the diagnostic algorithm of coronary heart disease.

VSCA51-13 ● Dual Energy Subtraction Radiography in the Evaluation of Calcific Valve Disease

Calen Frolkis BA (Presenter) ; **Robert C Gilkeson** MD * ; **Alan H Markowitz** MD

PURPOSE
This retrospective study investigates the diagnostic implications of Dual Energy Subtraction Radiography (DES) in the work up of cardiovascular disease.

METHOD AND MATERIALS
Four hundred patients who underwent Aortic and/or Mitral valve replacement and/or repair from February 2010 to November 2012 were identified. Of those, 222 patients met inclusion criteria: record of both pre-operative DES chest radiography, and Chest CT or CT Angiography.Dual Energy Subtraction protocol included an initial 60kV acquisition, 150msec delay, followed by 140kV acquisition. The subtracted low energy bone algorithm was evaluated, and compared to standard 140kV CXR for visualization of cardiovascular calcification. Those cases where cardiovascular disease was better visualized on bone window were then further screened, and disease confirmed with correlative CT images. Primary findings were coronary artery calcification (CAC), valvular calcification (both mitral and aortic), Mitral annual calcification (MAC), and aortic arch or descending aorta disease.The final patient cohort was 47, with 29 women (61.7%), and 18 men (38.2%). The age range was 38-92, with an average age of 74.4yrs. Of these patients, 21 underwent subsequent AVR. Twelve patients underwent Aortic Root Reconstruction with valve conduit enlargement. Eight patients underwent AVR and MVR. Three patients underwent subsequent MVR, 2 patients underwent AV-repair with MVR, and 1 patient had AV-repair with MVR

RESULTS
Of the 47 patients with significant findings on DES radiography, the most common finding was Mitral Annular Calcification with 31 cases (65.9%). Coronary Artery Calcification was the next most common finding, seen in 23 cases (48.9%). Calcific aortic valve (CAV) was seen in 22 patients (46.8%). MV disease was seen in 8 cases, and aortic disease in 5 patients.

CONCLUSION
Dual Energy Subtraction improves visualization of calcified cardiovascular structures. The use of both CT and DES offers an intriguing clinical correlation in the evaluation of cardiovascular calcification. Further prospective studies are warranted.

CLINICAL RELEVANCE/APPLICATION
Dual Energy Radiography enables an enhanced detection of cardiovascular disease compared to standard radiographic techniques.

VSCA51-15 ● Direct Comparison of Stress- and Rest-dual-Energy Computed Tomography with Cardiac Magnetic Resonance for Detection of Myocardial Perfusion Defect

Sung Min Ko (Presenter) ; **Jin-Woo Choi** ; **Hweung Kgon Hwang** ; **Meong Gun Song**

PURPOSE
We assessed the diagnostic performance of stress- and rest-dual-energy computed tomography (DECT) and their incremental value when used with coronary CT angiography (CCTA) for detecting hemodynamically significant stenosis causing myocardial perfusion defect (MPD) compared with combined conventional coronary angiography (CCA)/cardiac magnetic resonance (CMR).

METHOD AND MATERIALS
Seventy-one patients with known coronary artery disease (CAD) detected by CCTA underwent stress-DECT followed by rest-DECT. Among those, 46 patients underwent CMR and 62 underwent CCA. DECT-based iodine maps were compared with CMR. Diagnostic value of CCTA for detecting hemodynamically significant stenosis was assessed before and after stress- and rest-DECT, respectively, on a per-vessel basis, compared with CCA/CMR.

RESULTS
Forty (56%) patients completed all the protocol. Compared to CMR (n=46), sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of stress-DECT for detecting segment (vessel)-based MPDs were 73 (94)%, 85 (78)%, 70(72)%, and 87 (96)%, respectively, and those by using rest-DECT were 29 (47)%, 89 (80)%, 54 (59)%, and 74 (72)%, respectively. There was moderate (?=0.45) agreement between stress- and rest-DECT iodine maps in identifying segments with MPDs. Compared with the CCA/CMR (n=40) for identifying hemodynamically significant stenosis, per-vessel territory sensitivity, specificity, PPV, and NPV of CCTA were 91%, 56%, 55%, and 91%, respectively, those by using CCTA/stress-DECT were 87%, 79%, 71%, and 91%, respectively, and those by using CCTA/rest-DECT were 42%, 83%, 59%, and 70%, respectively. The area under the receiver operating characteristic curve increased from 0.74 to 0.83 (p=0.02) but decreased to 0.62 (p=0.06), respectively, if using CCTA/stress-DECT and CCTA/rest-DECT, respectively.

CONCLUSION
Stress-DECT has superior performance for detection of MPDs and incremental value when used with CCTA for detecting hemodynamically significant stenoses compared with rest-DECT.

CLINICAL RELEVANCE/APPLICATION
The use of combined coronary CT angiography and stress-dual-energy CT may provide accurate assessment of hemodynamically significant coronary stenosis inducing myocardial perfusion defect.

VSCA51-16 ● Relation between Stenosis Severity, CT-derived Myocardial Blood Flow, and CT-derived Myocardial Flow Reserve in Patients with Stable Chest Pain

Alexia Rossi MD (Presenter) ; **Andrew Wragg** ; **Ernst Klotz** DiplPhys * ; **Maria A Cova** MD ; **Steffen E Petersen** ; **Francesca Pugliese** MD, PhD

PURPOSE
The functional significance of coronary stenosis of intermediate severity is often difficult to determine from anatomical information alone derived from coronary angiography. Therefore, the aim of our study was to assess the relationship between hyperaemic myocardial blood flow (MBF) and flow reserve measured by dynamic CT perfusion imaging and stenosis severity on invasive coronary angiography (ICA) in patients with stable chest pain.

METHOD AND MATERIALS
Fourty-seven patients with stable chest pain referred to ICA and invasive fractional flow reserve (FFR) were included in the study. All patients underwent stress and rest dynamic CT perfusion imaging using a second generation dual source CT. Hyperaemic stress was induced by continuous infusion of adenosine (140�g/kg body weight) for 3 to 5 minutes. Hyperaemic and rest MBF (ml/100ml/min) were computed using a model-based parametric deconvolution method. Hyperaemic and rest MBF were obtained from regions of interest following a standard 16-segment model. Individual myocardial segments supplied by the same coronary vessel were considered as parts of the same territory. Myocardial flow reserve was calculated as the ratio of hyperaemic MBF and rest MBF. Stenosis severity in each coronary vessel was classified from ICA as mild (=30% lumen narrowing), intermediate non-functionally significant (INFS, 30%-85% and FFR>0.80), intermediate functionally significant (IFS, 30%-85% and FFR=0.80), and severe (=85%).

RESULTS
A total of 133 coronary vessels and myocardial territories were analysed. Rest MBF was similar in all groups of coronary stenosis (p>0.05). Hyperaemic MBF and myocardial flow reserve progressively decreased with increasing coronary stenosis severity following a non-linear relationship (all p-values
CONCLUSION
CT-derived hyperaemic MBF and myocardial flow reserve are inversely and non-linearly related to stenosis severity as defined by ICA and FFR. In intermediate lesions, hyperaemic MBF can discriminate IFS from INFS coronary stenoses.

CLINICAL RELEVANCE/APPLICATION
CT-derived measurements of hyperaemic MBF and myocardial flow reserve provide functional characterization of anatomically defined coronary stenoses.

VSCA51-17 ● Comparison of ECG-gated Coronary CT Angiography with Stress Nuclear Imaging for Evaluation of Myocardial Perfusion

Jacob P Deutsch ; **Ethan J Halpern** MD (Presenter)

PURPOSE
To compare myocardial perfusion data obtained during coronary CT angiography (cCTA) with stress nuclear imaging.

METHOD AND MATERIALS
We retrospectively identified 53 patients with ECG-gated cCTA and stress nuclear perfusion imaging performed within 30 days. Among these patients, 37 had helical cCTA with both diastolic and systolic imaging; 16 had only diastolic imaging. cCTA was performed with the iCT 256 slice scanner (Philips Medical Systems), and myocardial perfusion was evaluated with the comprehensive cardiac analysis application (Philips Intellispace Portal version 5.0). Areas of perfusion abnormality were identified by subjective evaluation of a binary polar map based upon the American Heart Association standardized 16 myocardial segment model. cCTA perfusion abnormalities were also identified automatically by quantitative analysis of a defect probability map using a cutoff probability of 15%.

RESULTS
Fifteen of 53 patients demonstrated perfusion defects on nuclear imaging, including 11 fixed defects and 15 reversible defects. There was complete agreement between the subjective assessment of cCTA polar maps and the automated quantitative cCTA analysis on location of defects, although the size of one defect was larger by subjective assessment while two defects were judged to be larger by quantitative assessment. Eleven of these 15 patients had cCTA imaging in both systole and diastole. In a by-patient analysis, true positive perfusion defects were identified on cCTA in 10/15 (67%) by diastolic imaging and in 9/11(82%) by systolic imaging (p=0.17). False positive perfusion defects were identified in 37/53 (70%) of patients by diastolic cCTA imaging and in 36/37 (97%) of patients by systolic cCTA imaging. Furthermore, among true positive cases, cCTA overestimated defect size in 10/10 (100%) of cases.

CONCLUSION
Systolic phase cCTA imaging of the myocardium may be more sensitive for detection of perfusion defects as compared to diastolic phase imaging. Although the majority of myocardial perfusion defects found by nuclear imaging are detected on cCTA with the comprehensive cardiac analysis application, this technique is unlikely to be clinically useful, given the high rate of false positive perfusion cCTA defects.

CLINICAL RELEVANCE/APPLICATION
A majority of myocardial perfusion can be identified by cCTA, but many of the apparent myocardial defects found during cCTA do not correspond with perfusion defects on nuclear imaging.

VSCA51-18 ● Prognostic Value of SYNTAX Score Based on Coronary Computed Tomography Angiography

Young Joo Suh MD (Presenter) ; **Sae Rom Hong** MD ; **Yoo Jin Hong** MD ; **Hye-Jeong Lee** MD ; **Jin Hur** MD ; **Young Jin Kim** MD ; **Byoung Wook Choi** MD

PURPOSE
The SYNTAX score is an angiographic score to quantify the complexity of coronary artery disease (CAD). It has been reported as an independent predictor of major adverse cardiac events (MACEs) in populations with a varying extent of CAD. Computed tomography angiography (CTA) can be a useful modality to score non-invasively estimate SYNTAX score. The aim of our study was to investigate the prognostic value of CT-based SYNTAX for prediction of MACEs.

METHOD AND MATERIALS
Institutional review board approval was obtained. We included 375 patients (mean age, 60.9 years; 224 men and 151 women) with a suspicion of CAD who underwent coronary CTA. The SYNTAX scores were obtained based on CTA. Follow-up clinical outcome data regarding composite MACEs were procured. Cumulative event rates were obtained by using the Kaplan-Meier method for coronary CTA-diagnosed CAD and CT-based SYNTAX score (threshold level >22), respectively. Cox proportional hazards model was developed to predict MACE.

RESULTS
During the mean follow-up of 1070 days ± 121, there were 12 MACEs, for and event rate of 3.2%. The presence of obstructive CAD at coronary CTA showed a positive correlation with CT-based SYNTAX score (P
CONCLUSION
The SYNTAX score based on coronary CTA can be a useful method for noninvasively predicting MACEs.

CLINICAL RELEVANCE/APPLICATION
The SYNTAX score based on coronary CTA can be a useful method for noninvasively predicting MACEs.

Cardiac (Myocardial Ischemia and Viability)

Thursday, 10:30 AM - 12:00 PM ● S504AB

`MR` `CT` `CA`

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SSQ03 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
    Moderator
    Richard D White , MD
    Moderator
    Hajime Sakuma , MD *
    Moderator
    Konstantin Nikolaou , MD *

SSQ03-01 ● Dynamic CT Myocardial Perfusion Imaging: Performance of 3D Semi-automated Evaluation Software

Ullrich Ebersberger MD (Presenter) ; **Roy Marcus** BS ; **Lucas L Geyer** MD * ; **Gladys G Lo** MD ; **Christian Canstein** * ; **U. Joseph Schoepf** MD * ; **Yining Wang** MD ; **Fabian Bamberg** MD, MPH * ; **Andrew D McQuiston** BS

PURPOSE
To determine the performance and accuracy of dedicated 3D semi-automated evaluation software for the assessment of myocardial blood flow (MBF) and blood volume (MBV) at dynamic CT myocardial perfusion imaging.

METHOD AND MATERIALS
In an IRB-approved study, 37 dynamic, time-resolved myocardial perfusion CT datasets acquired using a 2nd-generation dual-source CT system (Definition Flash, Siemens) were assessed both manually and by use of the semi-automated prototype for MBF and MBV, based on the AHA segmental model. The prototype software employs an automatic 3D heart chamber segmentation system and a surface-based four-chamber heart model. For automated segmentation, a series of anatomical landmarks in the heart are detected followed by delineation of chambers. Marginal space learning is applied for automatic localization of anatomical structures. Subsequently, the 3D shape of the cardiac chambers is determined using a probabilistic boosting tree-based contour fitting. The resulting segmentation consequently allows for both manual placement of ROIs and calculation of a polar map employing the modified 17-segment AHA myocardial model. Time required for each assessment was recorded. Results were compared to SPECT as the standard of reference.

RESULTS
592 segments were evaluated. 19 (3.21%) were excluded due to insufficient coverage. Based on the results at SPECT, 42 segments in 17 patients were classified as showing pathologic myocardial perfusion (prevalence: 45.9% patient-based). Overall, both approaches yielded higher negative predictive value than positive predictive value, with NPV: 0.99 vs. 0.98 and PPV: 0.65 vs. 0.65 for the manual as compared with the 3D evaluation tool. A comparison of MBF and MBV measurements using the prototype versus manual assessment showed high correlation (Spearman rank correlation coefficient = 0.85/0.83, p
CONCLUSION
The performance of 3D semi-automated evaluation software for dynamic CT myocardial perfusion imaging correlates highly with manual assessment of MBF/MBV values in good agreement with SPECT. Use of such software substantially decreases post-processing and interpretation times.

CLINICAL RELEVANCE/APPLICATION
These results show promise for fostering the integration of dynamic CT myocardial perfusion imaging in actual clinical workflows.

SSQ03-02 ● Non-concordant Results by Myocardial CT Perfusion Imaging and SPECT Perfusion Imaging Compared with Invasive Coronary Angiography: A Post-hoc Analysis from the CORE320 Trial

Vishal C Mehra MD, PhD (Presenter) ; **Marcelo F Di Carli** MD * ; **Andrew E Arai** MD ; **Kakuya Kitagawa** MD, PhD ; **Armin Arbab-Zadeh** MD ; **Julie Miller** MD * ; **Andrea L Vavere** ; **Klaus Kofoed** MD ; **Carlos E Rochitte** MD, PhD ; **Marc Dewey** MD * ; **Swee Yaw Tan** MBBCh, MRCP ; **Hiroyuki Niinuma** ; **Christopher Cox** * ; **Melvin E Clouse** MD ; **Joao A Lima** MD * ; **Richard T George** MD *

PURPOSE
The conventional form of non-invasive testing by stress single photon emission computed tomography (SPECT) perfusion imaging is known to be less reliable in the presence of clinical situations associated with balanced ischemia. The international, multicenter CORE320 trial was designed to test a non invasive risk stratification approach using combined computed tomography angiography (CTA) and adenosine stress CT perfusion (CTP) imaging compared to the reference standards of combined stress SPECT perfusion imaging and invasive coronary angiography (ICA). This design allows for the head-to-head comparison of the two forms of stress perfusion imaging (CTP and SPECT) vs. the reference standard of ICA in a post-hoc manner. The purpose of this analysis was to examine the non-concordance of CTP and SPECT perfusion imaging among participants of the CORE320 trial and compare to percent stenosis by ICA.

METHOD AND MATERIALS

The international, multicenter CORE320 study enrolled 381 symptomatic patients referred for ICA. Prior to ICA, patients underwent rest CTA and adenosine stress CTP as well as SPECT perfusion imaging. CTA, CTP, ICA, and SPECT were all analyzed using parallel methods in blinded independent laboratories. As part of this post-hoc analysis, when SPECT and CTP showed discordant results, we compared these results to the reference standard ICA. ICA was defined as abnormal at the = 50% diameter stenosis threshold.

RESULTS

A positive CTP with a negative SPECT study occurred in 113 of the 381 enrolled subjects. Compared to ICA, 62% (70 of 113) of these had single vessel disease or greater and 33% (36 of 113) had multi-vessel (= 2 vessels) or left main disease. Conversely, a negative CTP with a positive SPECT study occurred in 33 subjects Only 27% (9/33) of these had single vessel disease or greater and 15% (7/33) had multi-vessel disease (P=0.004).

CONCLUSION

These data suggest that in patients with discordant findings in CTP and SPECT, CTP imaging is more sensitive than SPECT imaging for the detection of anatomic coronary stenosis. The majority of positive CTP studies without concordant SPECT defects do, in fact, demonstrate single, multi-vessel or left main coronary artery disease.

CLINICAL RELEVANCE/APPLICATION

CT perfusion imaging is more accurate than SPECT perfusion in predicting significant coronary stenosis, by ICA.

SSQ03-03 • Cardiac Troponin I Predicts the Development of Unrecognized Myocardial Infarctions Detected with Magnetic Resonance Imaging

Charlotte Ebeling Barbier MD (Presenter) ; **Raquel E Themudo** MD ; **Tomas Bjerner** MD, PhD * ; **Lars O Johansson** PhD * ; **Bertil Lindahl** * ; **Lars Lind** MD, PhD ; **Hakan K Ahlstrom** MD, PhD

PURPOSE

To investigate whether plasma levels of cardiac troponin I measured with a high-sensitivity assay (hs-cTnI) could predict the development of unrecognized myocardial infarctions (UMIs) detected with late enhancement magnetic resonance imaging (LE-MRI).

METHOD AND MATERIALS

LE-MRI was performed on 248 randomly selected community-living 70-year-old subjects and hs-cTnI was determined with a highly sensitive premarket assay. Five years later the subjects were invited to a second LE-MRI, and 143 of them (68 women, 75 men) who were free from myocardial scars at 70 years of age and did not have a hospital diagnosis of MI, constitute the present study population. LE involving the subendocardial layer was considered an MI scar.

RESULTS

New UMIs were detected in 37 subjects during follow-up. Plasma levels of hs-cTnI at 70 years of age, which were mainly within what is considered to be the normal range, were related to new UMIs at 75 years of age with an adjusted Odds Ratio (OR) of 1.78 for 1 SD increase in hs-cTnI (95%CI 1.13-2.81; p=0.014). In the third and fourth quartiles of hs-cTnI the adjusted ORs were 5.63 (95%CI 1.08-29.38; p=0.041) and 10.11 (95%CI 1.89-54.22; p=0.007) respectively compared to the first quartile. Plasma levels of hs-cTnI at 70 years of age were associated with the volumes of the UMIs detected at 75 years of age (p=0.022).

CONCLUSION

hs-cTnI in 70-year-old community-living women and men predicted the development of MRI-detected UMIs within five years.

CLINICAL RELEVANCE/APPLICATION

It is debated whether MRI-detected UMIs constitute real MIs. These results may be helpful in understanding the constitution and potential prognostic impact and of these UMIs.

SSQ03-04 • T1 and T2 Mapping for the Detection of Myocardial Edema in Acute Myocardial Infarction by Cardiac Magnetic Resonance

Jerome Caudron MD (Presenter) ; **Valentin Lefebvre** ; **Benjamin Dubourg** ; **Jeannette Fares** MD ; **Jean-Nicolas Dacher** MD *

PURPOSE

To evaluate quantitative T1 and T2 mapping sequences in assessing myocardial edema in patients with acute myocardial infarction (AMI)

METHOD AND MATERIALS

Single center study involving 24 patients referred for AMI (STEMI) and 24 healthy volunteers who served as controls to determine normal T1 and T2 values of the myocardium. Cardiac MRI was performed between day 2 and day 7 after acute event (Avanto 1.5T, Siemens, Germany). Standard protocol included CINE, T2w STIR, first pass and delayed enhancement (PSIR) sequences. In addition, steady state free precession T2 mapping sequences (3 echoes) and modified Look Locker inversion recovery T1 mapping sequences (11 inversion times) were performed on short axis views at basal, mid and apical levels of the left ventricle. Analysis was performed using the 16 left ventricular segments model, excluding the apex. Quantitative T1 and T2 values (in ms) were obtained from regions of interest encompassing each segment. Segments were therefore divided in 3 areas: infarct, peri-infarct and remote. Diagnostic accuracy of T1 and T2 mapping sequences was therefore calculated for detecting infarct area as defined by late gadolinium enhancement.

RESULTS

T1 and T2 maps were interpretable in all patients and controls. Mean T1 and T2 values in infarct areas (respectively 1135±69 ms and 69.8±8.7ms) were significantly longer than T1 and T2 values in peri-infarct (respectively 1018±36ms and 56.7±4.7ms) and remote areas (respectively 988±26ms and 53.5±3.9ms) (p-T2 maps AUC=0.922, Se=82.1, Spe=92.9, optimal threshold=61.4 ms
-T1 maps AUC=0.893, Se=80.3, Spe=89.6, optimal threshold=1053 ms
Difference was almost significant between T2 and T1 maps (p=0.05).

CONCLUSION

T1 and T2 mapping are effective methods for quantifying myocardial edema in patients referred for AMI. Interestingly, T1 and T2 values of the remote areas in patients are longer than those measured in controls.

CLINICAL RELEVANCE/APPLICATION

Quantification of T1 and T2 values could be relevant in the evaluation of area at risk in AMI but also for the evaluation of new treatments, prognostic stratification and patients follow-up

SSQ03-05 • Myocardial CT Delayed Enhancement Using Targeted Spatial Frequency Filtration: Comparison with Conventional Half Scan and MR Delayed Enhancement

Yusuke Kurobe MD (Presenter) ; **Kakuya Kitagawa** MD, PhD ; **Tatsuro Ito** MD ; **Yoshie Kurita** MD ; **Yasuyuki Shiraishi** ; **Makiko Fujita** ; **Motonori Nagata** MD, PhD ; **Masaki Ishida** MD, PhD ; **Hajime Sakuma** MD *

PURPOSE

CT assessment of myocardial delayed enhancement (DE) is feasible but is not widely used due to relatively poor contrast-to-noise ratio (CNR) and artifacts associated with half scan reconstruction. Targeted spatial frequency filtration (TSFF) developed for dynamic myocardial perfusion imaging is a hybrid algorithm of half and full scan reconstruction that can achieve both high temporal resolution and improved stability of CT Hounsfield unit of the myocardium. The purpose of this study was to evaluate the feasibility and image quality of CTDE using TSFF in comparison with conventional half scan (CHS) reconstruction.

METHOD AND MATERIALS

Forty patients with suspected CAD underwent CTDE 7 minutes after administration of 120ml of contrast medium using dual-source CT. Images were reconstructed with TSFF and CHS. Two blinded readers independently determined the presence and size of DE. Signal-to-noise ratio (SNR) and CNR of DE lesions were also determined. Image artifact was assessed by a three-point scale (3=minimal, 2=not interfering with interpretation, and 1=substantial). The presence of DE was compared between CT and CMR in 12 patients.

RESULTS
TSFF demonstrated significantly reduced artifact on CTDE images compared with CHS (2.4±0.7 vs 3.0±0.0, P
CONCLUSION
TSFF algorithm is highly effective in reducing artifacts on myocardial CTDE images and considerably improves inter-observer reproducibility of infarct sizing. Myocardial CTDE using TSFF allows for accurate infarct detection and reproducible infarct sizing in patients with known or suspected myocardial infarction.

CLINICAL RELEVANCE/APPLICATION
Myocardial CT delayed enhancement using TSFF algorithm markedly improves infarct detection and sizing, and is recommended for comprehensive assessment of CAD and myocardial infarction.

SSQ03-06 ● Age-related Increase and Regional Difference of Extracellular Fraction of Myocardium in Subjects without Coronary Artery Disease: A Cardiac CT Study

Yoshie Kurita MD (Presenter) ; Kakuya Kitagawa MD, PhD ; Tatsuro Ito MD ; Naoki Nagasawa RT, PhD ; Hiroshi Nakajima MD ; Shiro Nakamori MD ; Masaki Ishida MD, PhD ; Hajime Sakuma MD *

PURPOSE
Assessment of extracellular fraction by CT is a new approach toward the evaluation of diffuse myocardial fibrosis. The purpose of this study was to describe the normal pattern of age-related and regional variation of extracellular fraction in subjects without coronary artery disease (CAD).

METHOD AND MATERIALS
Among 82 patients with known or suspected CAD who underwent comprehensive cardiac CT study consisting of non-contrast CT, stress CT perfusion, coronary CTA and myocardial CT delayed enhancement, we retrospectively identified 27 subjects without any of coronary artery stenosis, LV hypertrophy, stress perfusion deficits and delayed enhancement. After exclusion of subjects with calcium score of >100 (n=5), poor image quality (n=1), and without hematocrit measurement (n=5), 16 subjects (ages 45-80, median 65 years, 5 females) comprise the study population. CT delayed enhancement was acquired 7 minutes after coronary CTA with a total of 120ml of contrast medium. Based on the 16-segment model, extracellular fraction was calculated as a ratio of the change in Hounsfield unit of the myocardium and the LV blood before and after contrast administration, multiplied by (1- hematocrit). Twenty-two segments (22/256, 8.6%) affected by streak artifacts were excluded from analysis.

RESULTS
Mean extracellular fraction for each subject by CT was 25.7%±2.2 (range 23.2-29.7%), showing excellent agreement with the previously reported extracellular fraction values determined by MRI using T1 mapping method (mean extracellular fraction of 24.8-26.6%), and was strongly related to age (r=0.806, p
CONCLUSION
Extracellular fraction values determined by CT in this study are in excellent agreement with previous reports using MRI. Strong linear correlation between extracellular fraction and age may indicate the ability of CT to demonstrate increasing diffuse fibrosis associated with normal aging.

CLINICAL RELEVANCE/APPLICATION
In the evaluation of diffuse myocardial fibrosis, age-related increase and regional variation of extracellular fraction of LV myocardium demonstrated in this study should be taken into consideration.

SSQ03-07 ● Age- and Gender-based Performance of Non-invasive Fractional Flow Reserve Computed from Coronary CT Angiography: Results from a Prospective International Multicenter Trial

Jonathan A Leipsic MD (Presenter) * ; Gilat Grunau PhD ; Rekha Raju ; Carolyn Taylor MD ; Ryo Nakazato ; Daniel S Berman MD * ; Matthew J Budoff MD * ; Cameron J Hague MD ; James Min MD *

PURPOSE
Fractional flow reserve (FFR) at the time of invasive coronary angiography (ICA) is the gold standard for determining lesion-specific ischemia. Non-invasive FFR computed from a resting coronary CT angiogram (FFRCT) enables measurement of lesion-specific ischemia with high concordance to invasive FFR. To date, the performance of FFRCT when stratified by age and gender, has not been examined.

METHOD AND MATERIALS
407 vessels from 252 patients (17 centers in 5 countries) underwent CT, FFRCT, ICA and invasive FFR, with all studies interpreted in blinded fashion by independent core laboratories. FFRCT and FFR =0.80 were considered hemodynamically significant, while CT stenosis =50% was considered anatomically obstructive. Stratified by age and gender, discrimination and diagnostic accuracy of FFRCT was assessed against FFR on a per-patient basis by area under the receiver-operating-characteristics curve (AUC) and accuracy.

RESULTS
Median age of the study population was 63 + 9 years (71% male). By FFR, ischemia was identified in 151 of 407 lesions (37%). FFRCT demonstrated similar per-patient discrimination for subjects >65 versus versus
CONCLUSION
When compared to invasive FFR, FFRCT yields similar discrimination and accuracy for diagnosis of lesion-specific ischemia in older and younger patients, as well as in men and women.

CLINICAL RELEVANCE/APPLICATION
There is preserved discriminatory capacity and diagnostic accuracy of FFRCT as compared to measured FFR when stratified by age and sex.

SSQ03-08 ● Evaluation of Accuracy for Detection and Extent of Occult Myocardial Scars Using Delayed-enhancement CT in Patients with Asymptomatic Diabetes: Results from the ACCREDIT Study

Sung Min Ko (Presenter) ; Joon-Won Kang MD ; Sang Il Choi MD ; Tae-Hwan Lim MD, PhD

PURPOSE
To evaluate through an exploratory sub-study the accuracy of delayed-enhancement CT (DE-CT) for detecting occult myocardial scars (OMS) and to evaluate the transmurality of OMS using DE-CT compared with delayed enhancement MRI (DE-MRI) in asymptomatic patients with type 2 Diabetes.

METHOD AND MATERIALS
In this prospective, multicenter, and open-label study, 347 patients with type 2 DM were included with 2 or more risk factors of coronary artery disease. DE-MRI and DE-CT were respectively performed with Gadoterate Meglumine (Dotarem�) and Iobitridol (Xenetix�350) on 167 patients. Image quality of DE-CT was evaluated using 4-grading system, good, adequate, poor and null. The prevalence and the transmurality of OMS on both DE-MRI and DE-CT were evaluated at patient and segment levels. The sensitivity, specificity, positive and negative predictive values of DE-CT for detecting OMS was evaluated in comparison with DE-MRI both at patient and segment levels. The transmurality of OMS in DE-CT and DE-MRI for each scar was assessed in terms of over- or underestimation of DE-CT using 6-grade system, 0%, 1-25%, 26-50%, 51-75%, 76-99%, and 100% at segment level.

RESULTS
The image quality of DE-CT was good and adequate in 165 (98.8%) patients. The OMS was detected in 12 (7.3%) by DE-MRI and 7 (4.3%) by DE-CT of the 164 patients for whom a valid assessment was available. Of the 2788 segments, OMS was detected in 24 segments on DE-MRI and in 12 segments on DE-CT. The sensitivity of DE-CT for detecting OMS was 58.3%, specificity was 100%, positive predictive value was 100% and the negative predictive value was 96.8% at patient level. At segment level, the sensitivity, specificity, positive and negative predictive value of DE-CT for detecting OMS were 50%, 100%, 100%, and 99.6% respectively. The grade for transmurality of OMS between DE-CT and DE-MRI was matching at segment level in 41.7%, under-evaluation of transmurality on DE-CT was in 54.2%, and overestimation on DE-CT was 4.2%.

CONCLUSION
The sensitivity of DE-CT for detecting OMS is moderate, but the specificity is high. Under-evaluation of the transmurality of OMS is common using DE-CT.

CLINICAL RELEVANCE/APPLICATION
(dealing with delayed-enhancement CT (DE-CT) for detecting occult myocardial scars), the sensitivity of DE-CT for detecting OMS is moderate, but the specificity is high.

SSQ03-09 ● Relationship between Hyperaemic Myocardial Blood Flow on Dynamic Dual-source Computed Tomography and Myocardial Perfusion Reserve Index on Magnetic Resonance Imaging

Federica Pirro (Presenter) ; **Ermanno Capuano** MD ; **Alexia Rossi** MD ; **Steffen E Petersen** ; **Lorenzo Bonomo** MD ; **Francesca Pugliese** MD, PhD

PURPOSE
To evaluate the relationship between regional hyperaemic myocardial blood flow (MBF) estimated in absolute terms by computed tomography, and perfusion reserve index (PRI) on adenosine stress first-pass magnetic resonance imaging (MRI; reference standard) in a population of patients with stable chest pain.

METHOD AND MATERIALS

RESULTS
In total 102 vascular territories were available for comparison. On MRI, perfusion defects were found in 32/102 (31%) vessels in 16/34 (47%) patients. The mean (sd) MBF was 84 (36) ml/100g/min in myocardial segments with perfusion defects, whereas MBF was 120 (35) ml/100g/min in the remote myocardium (p
CONCLUSION
Regional hyperhaemic MBF estimated in absolute terms by dynamic dual-source computed tomography decreased significantly as PRI decreased.

CLINICAL RELEVANCE/APPLICATION
MBF is quantitative parameter obviating the need of rest perfusion imaging, which may have clinical implications on availability, scan time and cost.

Imaging the Tips of the Ventricles: A Systematic Approach to Apical Pathology

Thursday, 12:15 PM - 12:45 PM

LL-CAE1176-THA
  Kate Hanneman , MD
  Bernd J Wintersperger , MD *
  Andrew M Crean , MD
  Elsie Nguyen , MD

PURPOSE/AIM
1. To describe the spectrum of echocardiographic, CT and MRI findings of apical ventricular aneurysms and other pathology
2. To outline an approach to the differential diagnosis of ventricular apical pathology based on imaging findings combined with clinical and biochemical data
CONTENT ORGANIZATION
� Ventricular apical aneurysms may be true or false aneurysms and are often secondary to myocardial infarction
� Other conditions that may cause ventricular apical aneurysmal dilatation and pathology not mediated through epicardial coronary atherosclerosis include Tako-tsubo cardiomyopathy, apical hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy, Loeffler myocarditis, endomyocardial fibrosis, Maroteaux-Lamy syndrome, ventricular non-compaction, as well as iatrogenic and congenital aneurysms
� Distinguishing imaging features include location, size, dimensions, enhancement characteristics and associated complications such as thrombus formation
SUMMARY
While the majority of pathologic conditions at the ventricular apices involve apical aneurysms secondary to myocardial infarction, other etiologies should be considered, especially when there is no documented coronary atherosclerosis. We recommend taking into account imaging findings and clinical data as presented in our algorithm outlining an approach to the differential diagnosis.

Cardiac - Thursday Posters and Exhibits (12:15pm - 12:45pm)

Thursday, 12:15 PM - 12:45 PM ● Lakeside Learning Center

CA

LL-CAS-THA ● *AMA PRA Category 1 Credit* ™:0.5
  Host
  Antoinette S Gomes , MD *
  Host
  E. Kent Yucel , MD

LL-CAS-TH1A ● Knowledge-based Iterative Model Reconstruction: Improved Image Quality of Low-tube-Voltage Prospective ECG-gated Coronary Computed Tomography Angiography at 256-Slice CT

Seitaro Oda MD (Presenter) ; **Gaby Weissman** ; **Mani Vembar** MS * ; **Daisuke Utsunomiya** MD ; **Yasuyuki Yamashita** MD * ; **Wm. Guy Weigold** ; **Hideaki Yuki** MD ; **Sadahiro Yamamura**

PURPOSE
To investigate the effects of a knowledge-based iterative model reconstruction (IMR) on the quantitative and qualitative image quality of prospectively-gated coronary computed tomography angiography (coronary CTA) acquired at low-tube-voltage in comparison with filtered back projection (FBP) and a hybrid iterative reconstruction (HIR).

METHOD AND MATERIALS

Thirty patients (16 men, 14 women; mean age 52.2±13.2 years, mean body weight 79.4±11.6 kg) underwent prospective cardiac CT at 100-kVp on a 256-slice CT unit. Paired image sets were created using 3 types of reconstruction, i.e. FBP, HIR, and IMR. Two observers independently reviewed CT images from each patient. Quantitative parameters including CT-attenuation, image noise, and contrast-to-noise ratio (CNR) were for all coronary artery segments. The visual image quality, i.e. graininess, streak artifact, vessel sharpness, and overall image quality, was scored on a 5-point scale and each coronary segment was also evaluated using a 4-point scale to investigate the effect of noise on the assessability of each segment.

RESULTS
There was no significant difference in coronary arterial CT attenuation among the 3 reconstruction methods. The mean image noise of FBP, HIR, and IMR images was 81.3±26.7, 53.3±19.1, and 20.2±5.1 Hounsfield units (HU), respectively; there were significant differences for all comparison combinations among the 3 methods (p
CONCLUSION
Knowledge-based iterative model reconstruction (IMR) can provide significantly improved qualitative and quantitative image quality in prospective ECG-gated coronary CTA using a low-tube-voltage.

CLINICAL RELEVANCE/APPLICATION
Low-tube-voltage prospectively-gated coronary CT with the IMR algorithm can provide significantly improved image quality at low radiation dose.

LL-CAS-TH2A ● Effects of Cardiac Phase and Heart Rate on Accuracy of Delayed Cardiac Computed Tomography for Detection of Myocardial Scarring on SPECT Myocardial Perfusion Scintigraphy

James Stirrup MBBS, MRCP (Presenter) ; **Ed D Nicol** ; **Eliana Reyes** ; **Elly Castellano** PhD ; **Michael B Rubens** MBBS ; **Simon P Padley** MBBS ; **S. Richard Underwood**

PURPOSE
Myocardial scarring may be seen as hyperenhancement on delayed cardiac computed tomography (dCCT). Although the end-diastolic phase is used typically when quantifying depth of myocardial scar on cardiac magnetic resonance imaging, the optimal phase for assessing enhancement patterns on 64-slice dCCT is uncertain and, given its poorer temporal resolution, may depend on heart rate.

METHOD AND MATERIALS
50 patients (39 male, age 66±8.8 years) with previous myocardial infarction (MI) underwent ^{99m}Tc-tetrofosmin myocardial perfusion scintigraphy (MPS) and 64-slice dCCT. Median heart rate (HR) during dCCT acquisition was 63 beats per minute (bpm) [IQR 56◆66bpm]; 15/50 (30%) had heart rates =65bpm. Images were analysed using the AHA 17-segment model. End-systolic and end-diastolic images were analysed for segmental hyperenhancement, which was characterised as absent, non-transmural or transmural (0%,
RESULTS
There were no differences in accuracy of dCCT between end-systolic and end-diastolic phases for discrimination of normal from abnormal myocardium (AUC 0.83 [95%CI 0.80-0.85] vs. 0.85 [95%CI 0.82-0.87] respectively, p=0.10) or non-transmural from transmural MI (AUC 0.82 [95%CI 0.79-0.85] vs. 0.84 [95%CI 0.81-0.86] respectively, p=0.37) on MPS. Similarly, there were no differences in agreement between end-systolic and end-diastolic phases (?=0.76 [95%CI 0.72-0.81] vs. 0.79 [95%CI 0.75-0.83] respectively). When analysed according to heart rate, highest agreement was seen in end-diastole with heart rates
CONCLUSION
Choice of cardiac phase for evaluation of MI on dCCT is relatively unimportant clinically. Heart rate seems to be a more dominant factor, with the best segmental agreement seen in end-diastole with heart rates
CLINICAL RELEVANCE/APPLICATION
In patients with chronic myocardial infarction, delayed hyperenhancement on cardiac computed tomography is seen most accurately in the end-diastolic phase with heart rates

LL-CAS-TH3A ● Adaptive Noise Reduction of Cardiac CT Data by a Partial Temporal Profile Non-local Means (PATEN) Filter

Zhoubo Li (Presenter) ; **Shuai Leng** PhD ; **Lifeng Yu** PhD ; **Armando Manduca** PhD * ; **Eric E Williamson** MD * ; **Cynthia H McCollough** PhD *

PURPOSE
To develop an image-space filter for cardiac CT images that can reduce image noise in a given image, without affecting spatial resolution, using other images within the same cardiac cycle but acquired at different cardiac phases.

METHOD AND MATERIALS
A modified non-local means (PATEN) filter was developed that uses redundant information to reduce image noise. The pixel value in the reduced noise image is a weighted average of similar pixels and the weight is calculated by comparing their partial temporal profiles. The filter strength is adapted to the estimated noise level for each cardiac phase. This approach can successfully reduce noise in a series of cardiac images, even when there is significant anatomic motion between images from different phases. Feasibility testing was performed using data from 9 patient scans acquired using ECG-gated tube current modulation. The noise level for images at different phases was estimated from the acquired images and the adaptive PATEN filter applied. The mean and standard deviation of CT numbers in the ascending aorta and qualitative image quality were assessed and compared between the PATEN and original images.

RESULTS
Between the original and PATEN images, the mean decreases in noise values (standard deviation of CT numbers in the ascending aorta) were 3.7 and 28.1 HU respectively, for images acquired within the full dose portion of the cardiac cycle and images acquired within the portion of the cardiac cycle where the ECG-based tube current modulation reduced dose to approximately 20% of the full dose. Radiologist evaluation revealed no spatial or motion blurring in the PATEN images.

CONCLUSION
In cardiac CT data sets, use of the PATEN filter resulted in a 21.7% and 70.0% decrease in image noise for the full and reduced dose phases of the cardiac cycle, respectively, without loss of spatial or temporal resolution.

CLINICAL RELEVANCE/APPLICATION
Noise reduction in cardiac CT by the PATEN filter will improve image quality throughout the cardiac cycle, but most strongly during the low-dose phases used for functional assessment.

LL-CAS-TH4A ● Comparison of Image Quality for Coronary CT Angiography Using Adaptive Iterative Dose Reduction 3D versus Filtered Back Projection

David Tso MD (Presenter) ; **Andrew Van Der Westhuizen** MD ; **Patrick McLaughlin** FFRRCSI ; **Darra T Murphy** FFRRCSI ; **John R Mayo** MD * ; **Savvas Nicolaou** MD

PURPOSE
The purpose of this study was to compare image quality of a Cardiac CT angiography (CCTA) utilizing Adaptive Iterative Dose Reduction 3D (AIDR 3D), an iterative reconstruction technology on a Toshiba CT scanner, and compare it with standard filtered back projections (FBP).

METHOD AND MATERIALS
59 consecutive patients were scanned with the Toshiba Aquilion ONE 320-slice MDCT scanner using a low-dose CCTA protocol. Two datasets for each patient were generated, one with iterative reconstruction (AIDR 3D) applied to the original dataset, and the other was unaltered as a FBP dataset. The two datasets were compared with respects to signal and noise measures of cardiac vascular structures. Qualitative image quality of the cardiac structures and coronary segments were assessed using a 4-point scale (3-clear, 2-minor motion, 1-signifciant motion, 0-non-diagnostic).

RESULTS
The mean effective radiation dose for the CCTA was 1.97 mSv. When comparing FBP vs. AIDR 3D, there was higher signal in the FBP dataset vs. AIDR 3D in the aorta and coronary arteries (677.33 HU vs. 657.33 HU; p

CONCLUSION
AIDR 3D improves qualitative visualization of cardiac anatomy in CCTA through iterative reconstruction in both raw and image data space. This enables CCTA scans to be performed at reduced radiation exposure to patients while producing images that are of diagnostic quality.

CLINICAL RELEVANCE/APPLICATION
AIDR 3D improves qualitative visualization of cardiac anatomy in CCTA through iterative reconstruction process which can allow scans to be performed at much lower radiation doses.

LL-CAS-TH5A ● Delayed Enhancement versus First-pass Perfusion Imaging at Rest: A Coincidentally Found Discrepancy between Two Validated Methods of Detecting Myocardial Infarction by Cardiac Magnetic Resonance Imaging with Adenosine Stress Perfusion

Laurens Swart BSc (Presenter) ; **Kenneth Koster** MD ; **Rob Jaspers** MD ; **Erik Badings** MD ; **Jan Van Wijngaarden** MD, PhD ; **Fabrice Martens** MD, PhD ; **Ruben Uijlings** MD

PURPOSE
The assessment of previous myocardial infarction (MI) in adenosine stress perfusion CMR imaging (AP-CMRi) has always been based on two different, but both equally validated principles: the detection of deficits on first-pass perfusion at rest (RP) and the rendition of delayed enhancement (DE). A logical and generally accepted inference is that an area of MI will show up as both a dark area of reduced RP, and a hyperintense area of DE. Although an excellent correlation has previously been reported[1], we coincidentally found a large discrepancy between these two findings during our recent study of the diagnostic value of out-patient AP-CMRi[2].

METHOD AND MATERIALS
We revised 110 AP-CMR scans that were performed between Feb. 2011 and Oct. 2012. All 28 AP-CMR scans that initially reported either RP deficits or areas of DE were selected and revisited by two specialized radiologists to assess the correlation between both methods of detecting previous MI. Both radiologists reviewed the RP and DE images separately and blinded to the initial report, while re-assessing the location and extent of either the RP deficit or hyperintense area of DE. These reports were cross-referenced and the inter-test agreeability between both imaging modalities, adjusted for location and transmurality, was determined.

RESULTS
Areas of DE were found in all 28 included scans (100%). RP imaging however showed scarcely any deficits, even in patients with evident scarring on DE imaging. Only 2 RP deficits (7.1%) were found with locations matching the reported area of DE. Analysis of the revision by both radiologists resulted in a very weak correlation between the two imaging modalities (?=0.06), even when comparing only the transmural (>50%) areas of DE with RP deficits (?=0.10).

CONCLUSION
The two methods which AP-CMRi provides for the detection of MI, do not correspond as well as previously reported. This could be attributed to RP imaging not being as reliable as we thought for the detection of MI[3], or to the idea that (even transmural) myocardial scars can, after some time, become reperfused. We are currently planning a prospective trial in which all future patients with proven MI on DE imaging will also undergo first-pass RP imaging series.

CLINICAL RELEVANCE/APPLICATION
In the assessment of previous MI with AP-CMRi, deficits on RP imaging do not correlate well with areas of DE. RP imaging alone might not be a reliable test for the detection of previous MI.

LL-CAS-TH6A ● Pre-operative Evaluation of Intracardiac Septal Defects by ECG-gated Cardiac CT: Comparison with Echocardiography and Operative Findings

Ethan J Halpern MD (Presenter)

PURPOSE
Percutaneous therapies for closure of atrial septal defects (ASD�s), patent foramen ovales (PFO�s) and ventricular septal defects (VSD's) require careful pre-operative planning. Although transesophageal echocardiography is routinely used, ECG-gated cardiac CT can provide additional 3D detail. We review our experience with ECG-gated CT of intracardiac septal defects prior to attempted repair, with echocardiographic and surgical correlation.

METHOD AND MATERIALS
A retrospective review of ECG-gated cardiac CT studies identified studies performed for pre-operative evaluation of ASD, PFO and VSD defects. Ten cases of ASD, 5 cases of PFO and 2 cases of VSD were identified. Each defect was evaluated in multiple projections using a CT workstation. CT results were compared to transthoracic/transesophageal echocardiography and with subsequent operative findings/decisions to determine whether CT imaging was helpful in these cases.

RESULTS
Septal defects were identified in all cases by the presence of shunting of contrast between the more densely opacified left heart and less densely opacified right heart. Definite enlargement of the right heart was identified in 7 patients. CT measurements of ASD size correlated well with echocardiography and operative reports. CT was most useful for measuring the tissue rim around an ASD to determine whether a sufficient rim was present for percutaneous closure. In three patients CT identified findings that were not suggested by transesophageal echocardiography and that changed the operative approach: one patient with an additional septal defect (2 ASD�s), one patient with an absent tissue rim along the antero-superior aspect of an ASD adjacent to the aortic root, and one patient with tricuspid chordal structures along a VSD. CT clearly defined the length of the interatrial tunnel in patients with PFO�s. In one patient with a PFO, the CT demonstrated a right to left shunt.

CONCLUSION
Defects in the atrial or ventricular septum are clearly defined by ECG-gated cardiac CT, and the defect location is defined relative to adjacent structures (SVC, IVC, aortic root, chordal structures). The size of the defect and its associated tissue rim are easily quantified by 3-dimensional analysis of CT data. The presence and direction of intracardiac shunts may also be demonstrated.

CLINICAL RELEVANCE/APPLICATION
Cardiac CTA is a useful adjunct to echocardiography in the pre-operative assessment of intracardiac septal defects.

LL-CAS-TH7A ● CT-derived Hyperaemic Myocardial Blood Flow: Does It Predict Functionally Significant Coronary Lesions?

Alexia Rossi MD (Presenter) ; **Anoeshka S Dharampal** MD ; **Steffen E Petersen** ; **Gabriel P Krestin** MD, PhD * ; **Pim J De Feyter** MD, PhD ; **Francesca Pugliese** MD, PhD

PURPOSE
CT coronary angiography (CTCA) is an anatomical modality and it is often insufficient to predict functional significance of coronary stenosis. According to the current guidelines the treatment of patients with coronary artery disease should be based on the combination of anatomical and functional significance of coronary stenosis. Therefore, the aim of our study was to evaluate the diagnostic performance of hyperaemic myocardial blood flow (MBF) derived from stress computed tomography perfusion (CTP) imaging compared to visual CTCA and semi-automatic quantitative computed tomography (QCT) in the detection of functionally significant coronary lesions in patients with stable angina.

METHOD AND MATERIALS
CTCA and CTP were performed in 80 patients (210 analyzable coronary vessels) referred to invasive coronary angiography (ICA). MBF (ml/100ml/min) was computed using a model-based parametric deconvolution method. The diagnostic performance of MBF in detecting functionally significant coronary lesions was compared to visual CTCA and QCT. In addition, the incremental value of MBF in predicting functionally significant coronary lesions over visual CTCA and QCT was evaluated in intermediate coronary lesions (30% to 70% diameter narrowing on visual CTCA). Coronary lesions with invasive fractional flow reserve (FFR) =0.75 were defined as functionally significant.

RESULTS
Functionally significant coronary lesions were found in 56/210 (27%) vessels. The optimal cut-off value of MBF to detect functionally significant coronary lesions was 78 ml/100ml/min. On a vessel-territory level, MBF had a larger area under the curve (0.95; 95% CI: 0.92-0.98) compared to visual CTCA (0.85; 95% CI, 0.79-0.91) and QCT (0.89; 95% CI, 0.84-0.93) (both p-values
CONCLUSION
MBF performed better than visual CTCA and QCT in identifying functionally significant coronary lesions. MBF had additional value beyond CT anatomy in intermediate coronary lesions.

CLINICAL RELEVANCE/APPLICATION
The CT evaluation of coronary artery anatomy and hyperaemic MBF performs well as an integrated diagnostic tool to detect functionally significant coronary lesions in patients with stable angina.

LL-CAE-TH8A ● Subprosthetic Soft Tissue in Patients with Aortic Valve Replacement: Cardiac Computed Tomography Findings and Clinical Features

Kichang Han MD ; **Dong Hyun Yang** MD (Presenter) ; **Joon-Won Kang** MD ; **Tae-Hwan Lim** MD, PhD

PURPOSE
To investigate the cardiac computed tomography (CT) findings and clinical features in patients with subprosthetic soft tissue after aortic valve replacement.

METHOD AND MATERIALS
Eighty eight patients (mean age, 63 years; 45 males) with prosthetic aortic valve (mechanical valve, 55) who underwent cardiac CT during 1 year were consecutively enrolled in this retrospective study. Multiphase cardiac CT data were retrospectively reconstructed at every 10% interval and analyzed using multiplanar reformatted images by two readers in consensus manner. The presence or absence of subprosthetic tissue and the circular angle of subvalvular tissue were evaluated at cardiac CT. By using customized software, the geometric orifice area (GOA) of each prosthetic valve was measured to analyze the encroachment ratio by subprosthetic soft tissue. The parameters for echocardiography such as mean transaortic pressure gradient (MTPG) and peak transaortic velocity were also reviewed.

RESULTS
Seventeen patients (19%) showed subprosthetic soft tissue on cardiac CT. In patients with subprosthetic soft tissue, MTPG, peak pressure gradient, AV peak velocity and LV ejection fraction were significantly higher than in patients without subprosthetic soft tissue(p 40mmHg) was noted in four patients on echocardiography and subprosthetic soft tissues were identified at CT in all of them. In patients with increased MTPG, the encroachment ratio of GOA by subprosthetic soft tissue, AV peak velocity, peak pressure gradient were significantly higher in patients with MTPG less than 40 (p
CONCLUSION
Subprosthetic soft tissue is not uncommon in patients with aortic valve replacement and can lead to flow limitation through the prosthesis. Cardiac CT may serve as a useful tool for evaluating subprosthetic soft tissue which otherwise would not be able to be assessed with conventional echocardiography.

CLINICAL RELEVANCE/APPLICATION
MDCT can also help to differentiate subprosthetic soft tissue causing flow limitation from subclinical lesions by analzying the encroachment ratio on CT.

LL-CAE-TH9A ● Novel Cardiac CT Imaging Techniques and Strategies for Assessing Ischemic Heart Disease: What the Radiologist Should Know

Haruhiko Machida MD (Presenter) ; **Isao Tanaka** ; **Rika Fukui** ; **Yun Shen** PhD * ; **Yue Dong** ; **Eiko Ueno** MD ; **Takuya Nishino** ; **Etsuko Tate**

PURPOSE/AIM

1. To review standard cardiac computed tomography (CCT) and its limitations for assessing ischemic heart disease (IHD)
2. To illustrate novel CCT imaging techniques for assessing IHD
3. To demonstrate optimal strategies using these techniques by presenting experimental data and clinical images

CONTENT ORGANIZATION
1. Standard CCT and its limitations

- limited spatial/temporal resolution/plaque composition analysis
- radiation/contrast medium (CM) dose
- beam-hardening (BH) effect/calcification/stent/indeterminate lesion

2. Novel CCT imaging techniques

- high definition CT (HDCT)
- motion correction algorithm
- iterative reconstruction (IR)
- dual-energy CT (DECT): BH correction/monochromatic imaging/material density imaging/effective Z analysis/myocardial perfusion/late enhancement CT

3. Optimal CCT strategies

SUMMARY
Compared to standard CCT, HDCT can improve spatial resolution and, with IR, in-stent delineation, and motion correction algorithm can improve temporal resolution and, with IR, reduce radiation dose. DECT can reduce CM dose/BH effect, remove vessel calcification, improve image contrast/vessel delineation, and provide accurate information about plaque composition/myocardial ischemia/infarction. Optimal strategies using these techniques are essential for appropriate IHD assessment.

Cardiac - Thursday Posters and Exhibits (12:45pm - 1:15pm)

Thursday, 12:45 PM - 01:15 PM ● Lakeside Learning Center

CA

LL-CAS-THB ● *AMA PRA Category 1 Credit* ™:0.5

LL-CAS-TH1B ● Dynamic Four Dimensional CT Imaging for Re-Entry Risk Assessment in Re-do Sternotomy

Harish Narayanan FRANZCR, MBBS (Presenter) ; **John M Troupis** MBBS, FRANZCR ; **Fabiano Viana**

PURPOSE
Re-do cardiac surgery can be associated with an increased risk of morbidity and mortality related to intraoperative injury. Adequate pre operative imaging is essential and while conventional CT is optimal for anatomical detail, it is of limited use in assessment of functional tethering of structures. Our aim was to assess the role of respiratory dynamic 4D CT for re-entry risk assessment in re-do sternotomy.

METHOD AND MATERIALS
18 patients who were being considered for re-do cardiac surgery underwent 4D CT assessment using wide field of view 320-slice MDCT (Aquilion ONE, Toshiba Medical Systems, Tochigi, Japan) with 16cm of superior to inferior coverage in one tube rotation. Without table movement, volume acquisition of anterior chest was initiated at full expiration and continued for two respiratory cycles. A radiologist assessed the data as cine loops in multiple planes for the presence of differential motion between the sternum and subjacent structures with respiration, to determine tethering. The imaging findings were compared to intra-operative evidence

RESULTS
3 of the 18 subjects were later deemed unfit for surgery hence where excluded from the study. Of the remaining subjects, surgical correlation was available for 12 whereas 3 subjects were awaiting surgery at the time of writing. We correctly excluded significant adhesions in 9 patients. Significant tethering was detected in 3 subjects, all of which were surgically confirmed. Overall there was excellent correlation between preoperative imaging and intraoperative findings. The technique enabled our surgeons to meticulously plan the procedures and to avoid re-entry related injuries. The average radiation exposure endured by the subjects was 8.3mSv.

CONCLUSION
This initial experience shows that respiratory dynamic 4D CT to evaluate functional tethering in re-do sternotomy improves pre-operative imaging accuracy and allows improved risk stratification and planning of surgical strategy, thus reducing the potential re-entry risk in patients.

CLINICAL RELEVANCE/APPLICATION
Respiratory dynamic 4D CT is useful in determining functional tethering of sternum to subjacent structures before re-do sternotomy and assists in pre-operative planning and risk stratification.

LL-CAS-TH2B ● Radiation Dose Reduction for Coronary Artery Calcium Scoring at 320-detector CT with Iterative Reconstruction: Preliminary Clinical Study

Fuminari Tatsugami (Presenter) ; **Toru Higaki** PhD ; **Masao Kiguchi** RT ; **Shuji Date** ; **Akira Taniguchi** RT * ; **Kazuo Awai** MD *

PURPOSE
The purpose of this study was to compare the accuracy of coronary artery calcium scoring (CACS) on cardiac CT images acquired at a normal tube current and reconstructed with filtered back projection (FBP) with images acquired at a low tube current and reconstructed with iterative reconstruction (IR), for the assessment of the possibility of reducing the radiation dose for CACS on a 320-detector CT scanner.

METHOD AND MATERIALS
Thirty patients (9 women, mean age 68.1 ± 8.3 years) who suspected of having coronary artery disease underwent two consecutive CT examinations for CACS. All scans were performed using a 320-detector CT scanner (Aquilion One, Toshiba) with prospective ECG-triggering at the tube voltage of 120 kV. At the first examination, tube current was determined as if standard deviation (noise level) at the level of the heart would be obtained at 23 HU and reconstructed with FBP. At the second examination, CT was performed at one third of the tube current of the first examination and reconstructed with high level IR (adaptive iterative dose reduction 3D: AIDR-3D; Toshiba). For each examination, we measured image noise, CACS calculated using the Agatston algorithm and mass scores. We assessed agreement between calcium scores obtained with FBP and with IR using Bland-Altman analysis.

RESULTS
The mean tube current and effective radiation dose for CACS at normal tube current with FBP and at low tube current with IR were 308.1 ± 118.7 and 100.3 ± 39.8 mA, 2.0 ± 0.9 and 0.6 ± 0.3 mSv, respectively (k = 0.014). The mean image noise at normal tube current with FBP and at low tube current with IR was 21.1 ± 1.8 and 21.5 ± 1.8, respectively (p = 0.29). The mean Agatston- and mass scores at normal tube current with FBP and at low tube current with IR were 296.8 ± 279.3 and 51.5 ± 46.7, 287.0 ± 276.6.8 and 49.8 ± 46.2, respectively. Bland-Altman analysis for the Agatston- and mass score revealed that there were no systemic biases. The Bland-Altman limits of agreement for the Agatston- and mass score were -27.4 to 40.6 and -19.6 to 33.5 %, respectively, which suggested IR was a good alternative to FBP.

CONCLUSION
The use of high-level AIDR 3D made it possible to reduce the radiation dose by 66% for CACS without impairing the quantification of coronary calcification.

CLINICAL RELEVANCE/APPLICATION
We suggest that with high-level AIDR-3D a radiation dose reduction by 66% is possible for CACS using 320-detector CT.

LL-CAS-TH3B ● Coronary Flow Reserve Quantified with 320-row Multi-detector CT Perfusion Image: Clinical Usefulness for Detection of Coronary Artery Disease

Yasuka Kikuchi MD (Presenter) ; **Noriko Oyama-Manabe** MD, PhD ; **Masanao Naya** ; **Osamu Manabe** ; **Yuuki Tomiyama** ; **Kohsuke Kudo** MD ; **Chietsugu Katoh** MD ; **Tsukasa Sasaki** ; **Nagara Tamaki** MD ; **Hiroki Shirato** MD, PhD

PURPOSE
We established a new method of low dose dynamic CT perfusion (CTP) scan with a 320-row multi-detector CT (MDCT) for comparison of whole myocardial blood flow (MBF) between rest and stress to calculate coronary flow reserve (CFR). The aim of this study was to investigate the usefulness of MDCT based CFR for detection of coronary artery disease (CAD).

METHOD AND MATERIALS

RESULTS
Increase in heart rate during stress was 19% in patients and 16% in controls, which was not significantly different (p=0.40).
The average CFR of patients was 2.37±0.81, which was significantly lower than that of controls (5.11±1.77, p

CONCLUSION
CFR measurement quantified by low dose CTP and Renkin-Crone model algorithm with 320-row MDCT is clinically feasible. It can be used for detection of CAD with high specificity.

CLINICAL RELEVANCE/APPLICATION
The coronary flow reserve quantified by low dose CT perfusion and Renkin-Crone model algorithm with 320-row MDCT is clinically feasible for detection of coronary artery disease with high specificity.

LL-CAS-TH4B ● What Is the Lowest Volume of Contrast Material with a Body Weight-adapted Injection Protocol for 320-detector Row CT Coronary Angiography?

Wen-Cai Yang (Presenter) ; **Zhao-Hui Xian** ; **Xiang-Ran Cai** ; **Xu-Kai Mo** ; **Chun-Liu Luo** ; **Xiao-Bai Wang**

PURPOSE
To investigate the lowest volume of contrast material (CM) to achieve sufficient and credible evaluation of the coronary arteries for 320-detector row computed tomography coronary angiography (CTCA).

METHOD AND MATERIALS
A total of 98 patients who underwent 320-detector row CTCA were divided into three groups: group A, receiving 0.7 mL/kg of CM injected during 9 seconds (n=34); group B, receiving 0.6 mL/kg of CM injected during 8 seconds (n=34); group C, receiving 0.5 mL/kg of CM injected during 6 seconds (n=30). The concentration of CM was 350 mg of iodine per milliliter. Each patient then received 30 mL of saline chaser with the same injection rate as the administration of CM. The groups were compared with respect to the attenuation values of the left ventricle (LV), ascending aorta (AA), descending aorta (DA), coronary sinus (CS) and the main coronary arterial segments (vessel diameters >2.0 mm). Image quality was evaluated using a 5-point grading scale.

RESULTS
The mean injection rate was 5.36 ± 0.64mL/s in group A, 5.06 ± 0.83mL/s in group B and 5.39 ± 0.72mL/s in group C (p=0.23). The mean attenuation values in the LV, AA and DA for group C were lower than those for group A and group B ($p<0.05$). Similar statistical results were found in the proportion of attenuation values >250 Hounsfield units in the main coronary arterial segments. Also, the image quality evaluation for group C was worse than that for group A and group B ($p<0.05$). There were no significant differences in the mean attenuation value of the CS and the image noise among the groups (p>0.05).

CONCLUSION
In order to achieve sufficient and credible evaluation of the coronary arteries for CTCA using 320-detector row CT scanner, a total of at least 0.6 mL/kg with 350 mg I/mL of CM injected during 8 seconds was required.

CLINICAL RELEVANCE/APPLICATION
The morbidity of dose-dependent contrast-induced nephropathy will be reduced, if the lowest volume of contrast material is used in 320-detector row CTCA.

LL-CAS-TH5B ● Reduced Contrast Medium in 100kVp Coronary Artery Angiography with Dual-Source CT

Dan Han MD (Presenter) ; **Jun Zhang**

PURPOSE
To evaluate the image quality of 100kVp dual-source CT coronary angiography using three different contrast media (CM) injection protocols.

METHOD AND MATERIALS
In this IRB approved study, dual-source CT coronary angiography scans were performed in 120 patients, who were randomly divided into three groups using contrast medium with concentration of 370 mg I/mL, 320 mg I/mL and 270 mg I/mL at the same injection rate(5.0 mL/s,14 s). The CT scan protocol was the same in three groups (prospective scan, 100kVp, reference mAs: 400 mAs) with automatic tube current modulation activated. Two observers evaluated the visibility of 4 main branches of coronary arteries. The mean CT values in coronary artery, image noise, signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), radiation dose, patient BMI were recorded and compared using one way ANOVA test among three groups.

RESULTS
The three groups all had an average body mass index (BMI) value of 22 kg/m^2. The assigned CM volume was 60 mL in 370 group, 65 mL in 320 group and 65 mL in 270 group.The visibility of 4 main branches of coronary arteries are all 100% in three groups by two observers. The mean CT value in 270 group (390.65 +/- 50.34 HU) was lower than 320 group (466.76 +/- 45.65 HU) and 370 group (710.32 +/- 45.65 HU), where the difference was statistically significant (p < 0.05). The SNRs and CNRs were 27.42 +/- 4.21 and 21.7 +/- 4.4 for 370 group; 27.68 +/- 4.09 and 20.1 +/- 5.2 for 320 group; 26.12 +/- 4.13 and 21.2 +/- 5.7 for 270 group. There was no statistical difference were found in image noise, SNR, CNR and radiation dose (p > 0.05).

CONCLUSION
Using 270 mg I/mL iodine Contrast Medium and 100 kVp tube voltage scan protocol with dual-source CT coronary angiography is feasible in patients with normal BMI. This scan protocol can substantially reduce iodine intakes for patients while preserve good diagnostic image quality.

CLINICAL RELEVANCE/APPLICATION
Using 270 mg I/mL iodine Contrast Medium with dual-source CT coronary angiography is equal to 370 mg I/mL in detecting plaque of coronary.

LL-CAS-TH6B ● Undersampled Real Time Cine SSFP with Through-Time Radial GRAPPA: Analysis of Global LV Function and Ventricular Mass

Vikram M Raju MBBS, FRCR (Presenter) ; **Marshall S Sussman** PhD ; **Aaron Pellow** ; **Mark A Griswold** PhD * ; **Nicole Seiberlich** PhD * ; **Bernd J Wintersperger** MD *

PURPOSE
To evaluate real-time imaging using through-time Radial GRAPPA reconstruction in analysis of global left ventricular (LV) functional parameters.

METHOD AND MATERIALS
20 patients underwent evaluation of the LV function on 1.5T (Magnetom Avanto) employing a 32-element coil. Acquisition was performed using a real-time radial SSFP sequence (16 projections) in a multislice breath-hold setting with a spatial resolution of 2x2mm^2 (matrix 128; slice 6mm) and a temporal resolution of 46ms (TR 2.9ms). Through-time radial GRAPPA reconstruction was performed off-line (MATLAB) incorporating fully-sampled (128 projections; 40 phases) calibration data acquired prior to the undersampled datasets. Segmented Cartesian cine SSFP was acquired at identical slice positions in multiple consecutive breath-holds with a spatial resolution of 1.3-1.5x1.3-1.5mm, 6mm slices and 35ms temporal resolution (TR 3ms). Breath-hold real-time datasets were evaluated for end-diastolic volume (EDV), end-systolic volume (ESV), ejection fraction (EV) and myocardial mass (MASS) and results compared to segmented cine SSFP with appropriate correction for multiple pair-wise testing (P
RESULTS
Results of real-time cine imaging did correlate significantly with segmented cine imaging for EDV (r=0.996; P
CONCLUSION
Real-time imaging using through-time radial GRAPPA allows for adequate temporal and spatial resolution to ensure adequate volumetric analysis of the LV.

CLINICAL RELEVANCE/APPLICATION
Radial through-time GRAPPA enables accurate high-resolution real-time cine imaging for potential application in heart rhythm disturbances.

LL-CAS-TH7B ● Multiple Vulnerable Plaque Characteristic Factors Co-existing in Single Non-Obstructive Non Calcified or Mixed Plaques in Coronary Arteries Are Higher Risk Predictors of Major Cardiac Events on CT

Naoko Mizuno (Presenter) ; **Hiroyuki Takaoka** MD, PhD ; **Nobusada Funabashi** MD, PhD ; **Masae Uehara** MD ; **Koya Ozawa** MD ; **Yoshihide Fujimoto** ; **Yoshio Kobayashi**

PURPOSE
To evaluate significance of presence of three vulnerable plaque characteristics (VPC) co-existing in single non calcified plaques (NCP) or

mixed plaques (MP) in non obstructed coronary arteries on CT: 1) low attenuation (LA) (< 30HU), 2) positive remodeling (PR) and 3) spotty calcification (SC), for the risk of major adverse cardiac events (MACE).

METHOD AND MATERIALS
166 consecutive subjects with suspected coronary artery disease (81 male; 62 ± 13 years; hypertension, 61%; diabetes mellitus, 21%; dyslipidemia, 56%; smokers, 45%; obese, 49%) underwent cardiac CT (Light speed Ultra 16, GE Healthcare) from 2003 to 2004. On CT no significant stenosis (> 50%) of coronary arteries was observed; subjects were retrospectively followed for a median of 103 months after CT and incidence of MACE was compared. Subjects with old myocardial infarction or myocardial diseases were excluded from the analysis. MACE included cardiac death, acute coronary syndromes, new onset of angina pectoris, and cardiac failure.

RESULTS
39 subjects had NCP (17) or MP (22), of whom 8, 29, and 14 subjects had LA, PR, and SC in NCP or MP, respectively. These were classified into 4 groups, 1) 128 who did not have NCP or MP with any VPCs, 2) 20 who had NCP or MP with one VPC, 3) 14 who had NCP or MP with two VPCs and 4) 2 who had NCP or MP with three VPCs. 6 subjects (4%) had MACE. Subjects who had NCP or MP with = two VPCs (n=16) had a higher risk of MACE than subjects with = one VPC (n=150) (P < 0.05) during the observation period. Significant differences between subjects with NCP or MP with = two VPCs and others (zero, one VPC groups) were observed at each time point when the whole period of follow-up was compared by Kaplan Meier analysis and log rank test (P < 0.001). A Cox proportional hazard model revealed that presence of NCP or MP with = two VPCs on coronary arteries on CT was a greater predictor of MACE (Hazard ratio 7.5, 95% confidential interval 1.0-55.4, P < 0.05 than other factors.

CONCLUSION
Presence of NCP or MP with = two VPCs in non obstructed coronary arteries on CT were critical factors for the prediction of MACE in subjects with normal myocardium on follow-up for a median of 103 months.

CLINICAL RELEVANCE/APPLICATION
Even in subjects without significant stenosis in coronary arteries on CT, if NCP or MP with = two VPCs are observed on CT, careful follow-up with control of risk factors is desired.

LL-CAE-TH8B ● Demonstration of Various Morphologic Findings in Patients with Infective Endocarditis by Cardiac Computed Tomography: Comparison with Surgical Findings

Hyun Jung Koo MD (Presenter) ; **Dong Hyun Yang** MD ; **Joon-Won Kang** MD ; **Tae-Hwan Lim** MD, PhD

PURPOSE
To assess the diagnostic value of cardiac computed tomography (CT) for demonstrating detailed morphology of infective endocarditis (IE) comparing transesophageal echocardiography (TEE) with standard reference of surgical findings.

METHOD AND MATERIALS
Between May 2011 and December 2012, 86 consecutive patients with IE who underwent cardiac surgery were included in this study. Seven patients who had delayed operation after using antibiotics, and 28 patients who did not perform cardiac CT were excluded. In the 51 patients (M:F = 38:13, mean age of 54 years) who finally enrolled, the mean interval between CT and TEE was 1.5 ± 3.7 days, and all patients underwent operation within 7 days after CT scan. The morphology of IE was classified as 4 categories as follows: vegetation, abscess/pseudoaneurysm, leaflet perforation, and valvular dehiscence. With the standard reference of surgical inspection, the findings of TEE and CT were compared.

RESULTS
The most common site of IE was aortic valve (AV) (n=27), followed by mitral valve (MV) (n=16), both AV and MV (n=6), tricuspid valve (n=1), and ventricular septal defect patch (n=1). Correct detection rate of the all specific morphologies per patient in CT and TEE were 62.7% (32/51) and 74.5% (38/51), respectively. Using both modalities, correct detection rate increased to 90.2% (46/51). TEE detected 5 cases with leaflet perforation that could not be expected using cardiac CT. However, valvular dehiscence was over-diagnosed with TEE in 3 patients. On the other hand, the presence of abscess/pseudoaneurysm could be found by CT more than that of TEE in two patients. For evaluating prostatic valve involvement in 17 patients, CT could suggest correct findings of IE than TEE in one patient. In seven patients, significant coronary artery disease (stenosis >50% in one patient, and >70% in 6 patients) were detected by CT.

CONCLUSION
In patients with infective endocarditis, cardiac CT may have an incremental value over TEE for demonstrating specific findings such as abscess/pseudoaneurysm and involvement of prosthetic valve.

CLINICAL RELEVANCE/APPLICATION
Preoperative Cardiac CT is useful to demonstrate the detailed findings of IE which might be valuable information to make surgical planning, and to detect coexisting coronary artery disease.

Cardiomyopathy

Thursday, 04:30 PM - 06:00 PM ● N227

MR CT CA

RC703 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5

RC703A ● CT

Hans-Christoph R Becker MD (Presenter)

LEARNING OBJECTIVES
1) To understand the different forms of cardiomyopathy and how they present in CT. 2) To learn about the best imaging strategy for cardiomyopathy in CT.

RC703B ● MRI

Hajime Sakuma MD (Presenter) *

LEARNING OBJECTIVES
1) To understand study protocols and CMR findings in patients with various cardiomyopathies. 2) To recognize the value of CMR in risk stratification of patients with non-ischemic cardiomyopathies.

RC703C ● Clinical Perspective

Daniel Lee (Presenter) *

LEARNING OBJECTIVES
1) Understand the role of CT/MR in determining the etiology of cardiomyopathy. 2) Understand the role of CT/MR in selecting patients for revascularization. 3) Understand the role of CT/MR in selecting patients for device therapy.

Interactive Game: Read with the Experts (Cardiac Radiology)

Friday, 08:30 AM - 10:00 AM ● E353A

CA

RC803 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
  Moderator
  Jill E Jacobs , MD
  Frank J Rybicki , MD, PhD *
  Satinder P Singh , MD
  Sanjeev Bhalla , MD
  Jacobo Kirsch , MD

LEARNING OBJECTIVES
1) To illusrtrate common cardiac pathologies encountered in noninvasive imaging. 2) To review imaging protocols designed to best depict cardiac pathology. 3) To review image post-processing tools to render cardiac imaging findings for interpretation and communication with referring clinicians. This interactive session will use RSNA Diagnosis Live◆. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.
ABSTRACT
This session will include live reads with experts in cardiac radiology to meet the learning objectives. Specific cases and clinical scenatios will be presented to best demonstrate the pathology and the strategies for imaging and image interpretation.

Cardiac (Coronary CT/MR V)

Friday, 10:30 AM - 12:00 PM ● S502AB

CT CA

SST02 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
  Moderator
  Karin E Dill , MD
  Moderator
  Robert R Edelman , MD *

SST02-01 ● Comparison of Image Quality for Coronary CT Angiography Using Adaptive Iterative Dose Reduction 3D versus Filtered Back Projection

  David Tso MD (Presenter) ; **Andrew Van Der Westhuizen** MD ; **Patrick McLaughlin** FFRRCSI ; **Darra T Murphy** FFRRCSI ; **John R Mayo** MD * ; **Savvas Nicolaou** MD

PURPOSE
The purpose of this study was to compare image quality of a Cardiac CT angiography (CCTA) utilizing Adaptive Iterative Dose Reduction 3D (AIDR 3D), an iterative reconstruction technology on a Toshiba CT scanner, and compare it with standard filtered back projections (FBP).

METHOD AND MATERIALS
59 consecutive patients were scanned with the Toshiba Aquilion ONE 320-slice MDCT scanner using a low-dose CCTA protocol. Two datasets for each patient were generated, one with iterative reconstruction (AIDR 3D) applied to the original dataset, and the other was unaltered as a FBP dataset. The two datasets were compared with respects to signal and noise measures of cardiac vascular structures. Qualitative image quality of the cardiac structures and coronary segments were assessed using a 4-point scale (3-clear, 2-minor motion, 1-signifciant motion, 0-non-diagnostic).

RESULTS
The mean effective radiation dose for the CCTA was 1.97 mSv. When comparing FBP vs. AIDR 3D, there was higher signal in the FBP dataset vs. AIDR 3D in the aorta and coronary arteries (677.33 HU vs. 657.33 HU; p
CONCLUSION
AIDR 3D improves qualitative visualization of cardiac anatomy in CCTA through iterative reconstruction in both raw and image data space. This enables CCTA scans to be performed at reduced radiation exposure to patients while producing images that are of diagnostic quality.

CLINICAL RELEVANCE/APPLICATION
AIDR 3D improves qualitative visualization of cardiac anatomy in CCTA through iterative reconstruction process which can allow scans to be performed at much lower radiation doses.

SST02-02 ● High-pitch Coronary CT Angiography in Dual-source CT during Free Breathing vs. Breath Holding

  Bernhard Bischoff MD (Presenter) ; **Felix G Meinel** MD ; **Maximilian F Reiser** MD ; **Hans-Christoph R Becker** MD

PURPOSE
Usually, coronary CT angiography (CCTA) is performed during breath hold to reduce motion artifacts caused by respiration. However, some patients are not able to follow the breathing command sufficiently due to deafness, hearing impairment, agitation or pulmonary diseases. The aim of this study was to evaluate the potential of high-pitch CCTA in free breathing patients when compared to breath holding patients.

METHOD AND MATERIALS
In this study we evaluated 40 patients with a heart rate of 60 bpm or below referred for CCTA for ruling out coronary artery disease who were examined on a 2nd generation dual-source CT system. The first consecutive 20 patients were examined using a prospectively ECG-triggered high-pitch scan protocol during breath holding in inspiration (scan delay 8 seconds, 70 ml contrast agent at 6 ml/s) while the second group of 20 consecutive patients was examined during free breathing (scan delay 4 seconds, 45 ml contrast agent at 6 ml/s). Heart rate prior to and during image acquisition was monitored. Image quality of each coronary artery segment according to the AHA 15-segment model was rated by two experienced readers who were blinded to the patients breathing status using a 4-point grading scale (1: non diagnostic - 4: excellent).

RESULTS
Patient and scan characteristics did not differ significantly between both study groups. Mean heart rate during image acquisition was 52 ±5 bpm in both groups. There was no significant difference in mean image quality, slightly favoring image acquisition during breath holding (see figure). Due to a smaller amount of injected contrast medium signal intensity was little but not significantly lower in free breathing patients (435 ±123 HU vs. 473 ±117 HU; p=0.648). Mean effective radiation dose was 0.92 ±0.42 mSv in breath holding patients and 0.94 ±0.41 mSv in free breathing patients (p=0.741).

CONCLUSION
In patients with a low heart rate who are not able to hold their breath adequately during CCTA images might also be acquired during free breathing without substantial loss of image quality when using a high pitch scan mode in 2nd generation dual-source CT. Furthermore, free breathing CCTA may allow to reduce the amount of injected contrast medium due to a shorter scan delay.

CLINICAL RELEVANCE/APPLICATION
High-pitch CCTA may be performed during free breathing without substantial loss of image quality.

SST02-03 ● The Effect of Iterative Reconstruction on Quantitative CT Analysis of Coronary Plaque Composition

Richard A Takx MD (Presenter) ; **Martin J Willemink** MD ; **Ricardo P Budde** MD, PhD ; **Arnold Schilham** PhD ; **Pim A De Jong** MD, PhD ; **Tim Leiner** MD, PhD *

PURPOSE
To compare CT assessment of coronary plaque volume and composition using three levels of iterative reconstruction (IR) and filtered back projection (FBP) as the reference reconstruction.

METHOD AND MATERIALS

RESULTS

CONCLUSION
Application of IR to CCTA exams significantly improves objective image quality, and does not alter quantitative analysis of coronary plaque volume, composition and luminal area.

CLINICAL RELEVANCE/APPLICATION
Iterative reconstruction has the potential to reduce radiation exposure without affecting analysis of coronary plaque composition.

SST02-04 ● Interobserver Variability of Coronary Atherosclerotic Plaque Characteristics Using a Semiautomatic Plaque Analysis Software

Azien Laqmani (Presenter) ; **Thorsten Klink** MD ; **Marcus Quitzke** ; **Gerhard B Adam** MD ; **Gunnar K Lund** MD

PURPOSE
To evaluate the interobserver variability (IOV) of a dedicated semiautomatic plaque analysis software for the characterization of coronary atherosclerotic plaques.

METHOD AND MATERIALS

RESULTS

CONCLUSION
The dedicated semiautomatic plaque analysis software allows for a reproducible characterization of coronary atherosclerotic plaques. However, the IOV significantly deteriorates when the observers adjust the plaque segmentation based on individual experience.

CLINICAL RELEVANCE/APPLICATION
A standardized concept is essential for coronary plaque analysis in order to maintain reproducible plaque dimensions.

SST02-05 ● Image Quality and Radiation Dose of Coronary Computed Tomography Angiography with Automatic Tube Potential Selection Technique

Ying Wang MD (Presenter) ; **Huishu Yuan** MD

PURPOSE
To investigate the image quality and the radiation dose of automatic tube potential selection technique (ATPS) in dual-source computed tomography (DSCT) coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS
325 patients (153 men and 172 women) consecutively enrolled in CCTA were randomly assigned into group A (n = 172) and group B (n = 153). The group A used ATPS (Care kV), and group B used conventional tube current modulation at 120 kV. All patients were scanned with prospectively ECG-triggered high-pitch helical mode or sequential mode according to the heart rate. The mean image quality score, attenuation, image noise, signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), volume CT dose index ($CTDI_{vol}$), and effective dose (ED) were compared between the two groups with the 2-tailed Student t test or Mann-Whitney U test., A P-value < 0.05 was considered statistically significant. The interobserver variability of image quality scoring was determined by $Kappa$ statistics.

RESULTS
The mean image quality score was not significantly different between group A and B (3.86 ± 0.23 vs. 3.85 ± 0.20, P>0.05). Imaging noise was significantly higher in group A than group B (25.6 ± 7.6 vs. 15.8 ± 4.0 HU, PPvol and ED were both significantly lower in group A than group B ($CTDI_{vol}$: 5.82 ± 6.85 vs. 10.32 ± 10.05 mGy; ED: 1.25 ± 1.24 vs. 2.19 ± 1.77 mSv, PKappa=0.59).

CONCLUSION
The use of ATPS for CCTA significantly reduced radiation dose while maintaining image quality.

CLINICAL RELEVANCE/APPLICATION
Automatic tube potential selection technique can maintain diagnostic image quality of coronary CTA as well as reduce radiation dose.

SST02-06 ● Multi-detector Computed Tomography Angiography (MDCTA) in Asymptomatic Adults with Low and Intermediate Coronary Artery Disease Risk: Atherosclerotic Plaques Features

Radwa A Noureldin MD, MSc (Presenter) ; **Riham H El Khouli** MD, PhD ; **Roderic I Pettigrew** MD, PhD ; **Ahmed M Gharib** MBChB

PURPOSE
MDCTA has a developing role in evaluating coronary artery disease (CAD) & ruling out significant stenosis non-invasively, yet it is not recommended for cardiovascular risk assessment in asymptomatic adult regardless of their risk score. We conducted this prospective study to evaluate the value of MDCTA examination in asymptomatic patients with low & intermediate risk for CAD.

METHOD AND MATERIALS
For our IRB approved study, we scanned 129 consecutive asymptomatic adults scanned with at least 64 detectors MDCTA scanner. Coronary arteries were categorized according to AHA 17-segment model. Number, size, quality of plaques & the degree of stenosis in each segment were assessed. Cardiac risk factors were evaluated & correlated to coronary arteries findings. Logistic regression & ROC curve analysis were performed.

RESULTS
Of 119 asymptomatic adults, 113 were included in the study (58 were females & 55 males), with mean age of 55+11. 73% (82/113) have low risk, 19.5% (22/113) intermediate risk, & only 5% (6/113) had high risk for CAD according to Framingham risk score (FrSc). Only 10 (8.8%) asymptomatic adults had completely normal CT scan with no plaques, all with low risk by FrSc. In 91.2% of cases, there were plaques with variable extent and in 22% of cases plaques caused moderate to severe stenosis. The best model to predict the total number of plaques in asymptomatic adults combined the age, gender, HbA1c level, C-reactive protein (CRP) level, calcium score (CaSc), & Framingham score (FrSc). For predicting the total number of large plaques, combining age, gender, & CaSc was the best model resulting in an AUC of 0.9. For predicting the total number of non-calcified plaques, combining the Tri-glyceride & CRP levels was the best model resulting in an AUC of 0.65. For the number plaques causing moderate to severe stenosis, combining age, gender, HbA1c, FrSc, & CaSc was the best model resulting in an AUC of 0.92.

CONCLUSION
MDCTA is useful in identifying coronary plaques in asymptomatic subjects with low or intermediate 10 years risk for CAD. We identified risk factors combined together enables the prediction of the risk of atherosclerosis in this specific population with good accuracy.

CLINICAL RELEVANCE/APPLICATION
MDCTA facilitated identification of multiple risk factors when combined that can predict the presence of coronary plaques in a group of asymptomatic adults with low & intermediate risk for CAD.

SST02-07 ● Reduction of the Total Injection Volume of Contrast Material at Half Flow Rate in the First Four Seconds for 320-detector Row CT Coronary Angiography

Zhao-Hui Xian (Presenter) ; **Xiang-Ran Cai** ; **Wen-Cai Yang** ; **Xu-Kai Mo** ; **Xiao-Bai Wang**

PURPOSE
To investigate the feasibility of half flow rate in the first 4 seconds to reduce the total injection volume of contrast material (CM) for 320-detector row computed tomography coronary angiography (CTCA).

METHOD AND MATERIALS
Ninety patients who underwent 320-detector row CTCA with heart rate =70 bpm and body weight =80 kg were recruited consecutively. They were randomly divided into two groups with a fixed injection of CM duration of 10 seconds: receiving 0.8 mL/kg body weight at a single flow rate (group 1; n=45), or receiving half flow rate in the first 4 seconds to reduce the total injection volume of CM by 20% (group 2; n=45). The concentration of CM was 350 mg of iodine per milliliter. All patients then received 30 ml of saline chaser with the same flow rate as the administration of CM. The groups were compared with respect to the attenuation values of the pulmonary truck (PT), ascending aorta (AA), proximal and middle segments (vessel diameters >2.0 mm) of three coronary arteries and coronary sinus (CS).

RESULTS
The mean attenuation values of the PT and AA decreased slightly from group 1 to group 2, but did not achieve statistically significant differences (p>0.05). Also, there were no significant differences between the mean attenuation values at the proximal and middle segments of the right coronary artery, left anterior descending artery and left circumflex artery (p>0.05). However, the mean attenuation value in the CS for group 1 was higher than that for group 2 (p<0.05).

CONCLUSION
It was feasible to achieve sufficient and reliable evaluation of the coronary arteries in 320-detector row CTCA using half flow rate in the first 4 seconds, which could reduce the injection volume of CM by 20% compared to the single flow rate for 10 seconds.

CLINICAL RELEVANCE/APPLICATION
Variable flow rate of CM injection protocol contributes to achieving sufficient and credible evaluation of the coronary arteries, while reducing possible confounding of the coronary vein.

SST02-08 ● Expanding the Role of 256-row Multidetector CT Coronary Angiography with Prospective ECG-gating and Iterative Reconstruction Algorithm in the Assessment of Coronary Artery Bypass: Evaluation of Dose Reduction and Image Quality

Davide Fior MD (Presenter) ; **Davide Ippolito** MD ; **Pietro A Bonaffini** MD ; **Cammillo R Talei Franzesi** ; **Orazio Minutolo** MD ; **Sandro Sironi** MD

PURPOSE
To evaluate the diagnostic performance of high speed 256-row computed tomography coronary angiography (CTCA) in the follow-up of patients with coronary artery bypass grafting (CABG), using low-kV CT angiography protocol combined with prospective ecg-gating technique and iterative reconstruction algorithm (iDose4) compared with standard retrospective protocol.

METHOD AND MATERIALS
Thirty-seven non obese patients with known advanced coronary disease treated with artery bypass grafting were prospectively enrolled in our study. All the patients underwent 256MDCT (Brilliance iCT, Philips) CTCA using low-dose protocol (100kV; automated tube current modulation; rotation time: 0,375s) combined with prospective ECG-triggering acquisition protocol and 4th generation iterative reconstruction technique (Idose4; Philips,Best,Netherlands), and all the length of the bypass graft was included in the evaluation. A total of 21 similar patients were enrolled in the control group and evaluated with a standard retrospective ECG-gated CTCA (120kV; 350mAs). Dose-length product (DLP) was directly provided by the scanners. On both CT scans regions of interest (ROIs) were placed in coronary arteries, in order to calculate standard deviation (SD) of pixel values and intravessel density (HU). Diagnostic quality was also evaluated using a 4-point scale (4 excellent, 3 good, 2 acceptable, 1 low).

RESULTS
Two radiologists performed a �double blind� reading of the exams (all considered diagnostic) and maximum intensity projection, curved planar reformatted images and volume rendering reconstructions were generated in both groups.
Despite the statistically significant reduction of radiation dose (51% lower in the study group with a P-value Qualitative analysis did not reveal any significant difference in diagnostic quality of the two groups.

CONCLUSION
The development of high-speed multidetector CT scans combined with modern iterative reconstruction allows the use of low dose prospective CTCA protocols also in patients with CABG, maintaining high diagnostic performance despite the significant reduction in radiation dose.

CLINICAL RELEVANCE/APPLICATION
High speed CT scans combined with Idose4 allow an accurate evaluation of CABG with prospective ECG-gating protocols in a single breath-hold, obtaining a significant reduction in radiation dose.

SST02-09 ● Resident Interpretation of On-Call "Triple-Rule-Out�? CT Studies in Patients with Acute Chest Pain

Kevin G Garrett MD (Presenter) ; **Justin R Silverman** ; **Aleksander Krazinski** ; **Lucas L Geyer** MD * ; **Carlo Nicola De Cecco** MD ; **U. Joseph Schoepf** MD * ; **Gary F Headden** ; **Philip Costello** MD ; **Felix G Meinel** MD ; **Pal Suranyi** MD, PhD ; **James G Ravenel** MD

PURPOSE
To evaluate the agreement between preliminary Radiology resident and final subspecialty attending interpretation of on-call, emergency �Triple-Rule-Out� (TRO) CT studies in patients with acute chest pain.

METHOD AND MATERIALS
Our department uses �peerVue� to track agreement between preliminary trainee and final subspecialty attending interpretation of on-call emergent imaging studies. This system enables grading preliminary resident reports as �Concur�, �Minor Discrepancy� (not affecting patient management), and �Major Discrepancy� (affecting patient management). During a 24 month sampling period from April 2011 through March of 2013, 617 TRO studies were performed in an on-call setting, were initially evaluated by the on-call upper level resident and had �peerVue� data available. �peerVue� TRO grades were analyzed and compared with resident performance on 609 emergent non ECG-synchronized routine chest CT cases from the same period. In cases of flagged discrepancies, patient records were reviewed to determine eventual patient management and outcome.

RESULTS

There was agreement (�Concur�) between preliminary Radiology resident and final subspecialty attending interpretation in 88.5% (n=546) of TRO cases. 10.4% (n=64) were graded as �Minor Discrepancy� and 1.1% (n=7) as �Major Discrepancy�, with possible significance for patient management. In the interpretation of non ECG-synchronized routine chest CT cases (89.8% [n=547] �Concur�-rate), there were significantly (p

CONCLUSION
On-call resident interpretation of TRO CT studies in patients with acute chest pain is congruent with final subspecialty attending interpretation in the overwhelming majority of cases. Discrepancies are rare and did not affect patient management or outcome in our cohort. Resident performance in this domain is similar to performance in the interpretation of emergent non ECG-synchronized routine chest CT.

CLINICAL RELEVANCE/APPLICATION
With appropriate training, on-call resident interpretation of ECG-synchronized TRO CT studies is safe and trainee performance does not differ from more traditional interpretative tasks.

Cardiac (Anatomy and Function II)

Friday, 10:30 AM - 12:00 PM ● S504AB

`CT` `CA`   Back to Top

SST03 ● *AMA PRA Category 1 Credit* ™:1.5 ● ARRT Category A+ Credit:1.5
   Moderator
   James C Carr , MD *
   Moderator
   Jeremy D Collins , MD *

SST03-01 ● Should All Patients Undergoing Pulmonary Vein Isolation Have a Trans-esophageal Echocardiogram to Rule out Thrombus in the Left Atrial Appendage?

Saurabh Jha MD (Presenter) ; **Sahar J Farahani** MBBS

PURPOSE
Patients with atrial fibrillation (AF) undergoing pulmonary vein isolation (PVI) for catheter-guided ablation nearly always have a pre-procedural cardiac CT for 3 D guidance. These patients are at increased risk for thrombus in the left atrial appendage (LAAT), which results in cancellation of the procedure. This is a cost analysis to determine the optimal method of excluding LAAT, with the assumption that for patient convenience imaging is performed on the same day as the PVI.

METHOD AND MATERIALS
A simple diagnostic model was constructed on Tree Age Pro (2012). Patients with AF undergoing PVI were assumed to require pre-procedural cardiac CT. Two diagnostic strategies were explored for the detection of LAAT. The first was intracardiac US for LAAT flagged on cardiac CT. The second was TEE for all patients. Both TEE and intracardiac US were assumed to be perfect tests. If the patient had a positive TEE or a positive intracardiac US for LAAT the procedure would be abandoned. The outcomes included costs from a payer's perspective, number of cases of missed LAAT and number of procedures cancelled. The data were abstracted from published meta-analysis and varied with sensitivity analysis. Medicare fee for schedule was used for the costs of procedures.

RESULTS
Assuming a prevalence of LAAT in AF of 9 % and sensitivity and specificity of cardiac CT of 96 % and 92 %, the selective intracardiac US strategy was cheaper ($417.93) than the strategey of TEE for all patients ($503.20). In a cohort of 10, 000 patients with AF requiring PVI there would be 36 missed cases of LAAT using the cheaper strategy. The incremental cost incurred in detecting an additional case of LAAT was $23, 686. If efficiency is desired such that patients must have imaging on the same day as the procedure then in a cohort of 10,000 patients there will be 864 cancellations with the cheaper strategy and 900 cancellations with the more expensive strategy.

CONCLUSION
In patients with AF undergoing PVI and same day imaging the strategy of selective intracardiac US on patients with cardiac CT positive for LAAT costs $85.27 less than subjecting all patients to TEE; at the expense of missed LAAT such that the incremental cost of picking up an additional patient with LAAT is $23, 686.

CLINICAL RELEVANCE/APPLICATION
LAAT has a high prevalence in patients with AF and this affects the management of the condition.

SST03-02 ● The Myocardial Cut-off Sign: A Finding of Left Ventricular Pseudoaneurysm

Clinton E Jokerst MD (Presenter) ; **Travis S Henry** MD * ; **Constantine A Raptis** MD ; **Cylen Javidan-Nejad** MD ; **Fernando R Gutierrez** MD ; **Pamela K Woodard** MD *

PURPOSE
The purpose of this study is to describe/define the 'myocardial cut-off' sign and compare its sensitivity and specificity to other imaging findings which help distinguish left ventricular pseudo-aneurysms (LV PSA) from left ventricular true aneurysms (LV aneurysm).

METHOD AND MATERIALS
Retrospective chart review of patients who had undergone left ventricular repair at our institution was performed. Patients who had pre-operative cardiac imaging with either CT or MRI were identified and divided into 2 groups, those with surgically or pathologically proven LV aneurysms (n=15) and those with surgically or pathologically proven LV PSAs (n=15). The thickness of the sac wall was measured at the aneurysm neck and 1 and 2 cm distal to the neck. A decrease of 50% or more between the neck measurement and sac wall measurement was called a positive myocardial cut-off sign; a decrease of less than 50% was called negative. These measurements were made during diastole (when applicable) on images oriented in a plane perpendicular to the axis of the aneurysm/PSA in an effort to quantify how quickly the wall of the sac tapered. 2 measurements were obtained for each patient, one on either side of the neck. In addition, other imaging findings associated with LV aneurysms and PSAs were evaluated. Some of these included location, presence of pericardial enhancement, presence of thrombus, ratio of neck diameter to maximum sac diameter, and ratio of neck diameter to maximum sac depth. Sensitivities and specificities for these signs and findings were calculated.

RESULTS
The sensitivity and specificity of the myocardial cut-off sign measured 1 cm from the sac neck was 90% and 96.4% respectively. Apical location was 66.6% sensitive and 80% specific for LV aneurysms. Pericardial enhancement was 77.8% sensitive and 88.9% specific for LV PSAs. Thrombus was 93.3% sensitive and 73.3% specific for LV PSAs. The mean ratio of neck diameter to maximum sac diameter and to maximum sac depth was 1:1.1 and 1:0.7 for LV aneusyrms; 1:2.3 and 1:1.9 for LV PSAs.

CONCLUSION
The myocardial cut-off sign is a sensitive and specific sign of LV PSA when measured at 1 cm from the sac neck. * more in-depth statistical evaluation will occur prior to presentation!

CLINICAL RELEVANCE/APPLICATION
The myocardial cut-off sign is sensitive and specific for LV PSA. This is an important diagnosis to make as LV PSA is a surgical emergency and can be difficult to distinguish from LV aneurysm.

SST03-03 • Systematic Comparison of CT Scan and Retrograde Venography for Depicting the Cardiac Venous System Prior to Cardiac Resynchronisation Therapy

Marie-Michele Theriault MD (Presenter) ; **Maria De La Paz Ricapito** MD ; **Felix paredes** MD ; **Patricia Diez Martinez** MD ; **Paul Farand** ; **Gerald Gahide** MD, PhD

PURPOSE
To assess the value of cardiac CT in comparison to retrograde venography for depicting the presence of a cardiac vein suitable to implant a left ventricular lead for Cardiac Resynchronization Therapy.

METHOD AND MATERIALS
Cardiac CT was performed in 41 consecutive patients (75.6% men) prior to Cardiac Resynchronisation Therapy procedure. Cardiac veins were systematically described by two readers (Inferior Interventricular Vein, Posterior Vein(s), Lateral Vein(s)) and compared to retrograde venography findings. The coronary sinus diameters, atrium area and distance between coronary sinus ostium and right atrium lateral wall were measured.

RESULTS
An inferior interventricular vein was demonstrated in all patients (41) on CT scan and in 41.5% patients (17) on venography. A posterior vein was demonstrated in 73.2% (n=30) of patients on CT scan and in 61% (n=25) on venography. A lateral vein was observed in 56.1% (n=23) on CT scan and in 51.2% (n=21) on venography. In comparison to venography, CT scan sensitivity for detecting cardiac veins was 100%. CT scan demonstrated significantly more veins than retrograde venography (p2 (IQR: 17.5 � 26.9 cm^2). There was a good inter-observer agreement for the measures of coronary sinus ostium antero-posterior diameters (r: 0.83 ; p
CONCLUSION
Cardiac CT is an efficient tool for non-invasively depicting cardiac venous system tributaries suitable for Cardiac Resynchronisation Therapy. Its sensitivity for depicting those veins is significantly higher than retrograde venography.

CLINICAL RELEVANCE/APPLICATION
Cardiac CT could non-invasively help choosing patients with suitable veins for Cardiac Resynchronisation Therapy.

SST03-04 • Comparison of Rapid Left Atrial Volume Determination: Gated Multidetector CT vs. Transthoracic Echo

Daniel A Moses MBBS, FRANZCR (Presenter) ; **Minh Truong** MBBS, FRANZCR ; **Liza Thomas** MBBS, PhD ; **Suzanne Eshoo** MBBS, PhD

PURPOSE
As CCTA become more ubiquitous, rapid LA volume estimation is desirable. We compared multidetector CT rapid volume estimation with transthoracic echo measurements.

METHOD AND MATERIALS
Retrospective study examining 51 patients undergoing retrospectively gated CCTA evaluation. Gated MDCT and TTE assessments were performed within 48 hours when there was no change in the patients clinical status. The CT images were reconstructed to reflect standard views from the TTE. The following measurements were obtained from the CT images (radiologists) and TTE (cardiologists), both at left ventricular end-systole and end-diastole.
1. Parasternal long axis view (PLAX): AP LA diameter.
2. AP-4 chamber view: maximum LA length and width, maximum and minimum left atrial area.
Measurements were compared using Pearson's correlation and Bland-Altman analysis.
Left atrial volume was calculated by the area-length and prolate ellipse methods (and indexed to BSA).

RESULTS
Comparison measurements were as follows: PLAX: TTE 3.7 ± 0.51 cm; MDCT 3.94 ± 0.56 cm 4-CH max length: TTE 5.22 ± 0.59 cm; MDCT 5.38 ± 0.54 cm 4-CH area-length: TTE 55.43 ± 19.12 cm^3; MDCT 76.823 ± 27.2 cm^3 4-CH min area: TTE 11.33 ± 3.65 cm^2; MDCT 17.04 ± 3.87 cm^2 4-CH max area: TTE 18.27 ± 3.81 cm^2; MDCT 21.85 ± 4.46 cm^2 Prolate ellipse volume: TTE 41.12 ± 12.79 cm^3; MDCT 52.52 ± 17.37 cm^3 When adjusted for surface area: 4-CH area-length: TTE 29 ± 10 mL/m^2; MDCT 40 ± 14 mL/cm^2 Prolate ellipse volume: TTE 21 ± 6 mL/m^2; MDCT 27± 9 mL/cm^2 There was modest correlation between measurements on MDCT and TTE: PLAX r = 0.57; max area r = 0.54; area length r=0.55; prolate ellipse r = 0.53.TTE measurements were systematically less than CT for all methods. Bland-Altman plots demonstrate there was less agreement on larger LA sizes.

CONCLUSION
The systematically lower volume estimates by TTE likely relate to the reduced image spatial resolution and foreshortening on TTE when compared to gated MDCT. Anatomical landmarks (including the precise location of the LA wall and mitral valve) are much more easily appreciated on MDCT. Also the ability to manipulated the data set and achieve the desired imaging view is easier on MDCT.

CLINICAL RELEVANCE/APPLICATION
TTE is the most common modality for estimate of LA volume. Knowing how these relate to similar estimations of LA size on gated MDCT scan is important clinical information.

SST03-05 • Presence of Myocardial Fibrosis in Right Ventricle Detected on ECG Gated 320 Slice CT Might Be a Predictor of a Short Term Poor Prognosis in Subjects with Pulmonary Hypertension

Koya Ozawa MD (Presenter) ; **Nobusada Funabashi** MD, PhD ; **Akihisa Kataoka** MD ; **Noriyuki Yanagawa** MD ; **Nobuhiro Tanabe** ; **Koichiro Tatsumi** ; **Yoshio Kobayashi**

PURPOSE
To evaluate significance of presence of myocardial fibrosis (MF), as represented by abnormal late enhancement on CT, in right ventricle (RV) in subjects with pulmonary hypertension (PH), we undertook ECG gated enhanced 320 slice CT.

METHOD AND MATERIALS
A total of 56 PH subjects confirmed on right heart catheterization (RHC) (15 males, mean age 57 ± 15 years, 33 chronic thromboembolic PH (CTEPH), 21 pulmonary arterial hypertension (PAH), and 2 others) underwent ECG gated 320 slice CT (Aquilion one, Toshiba Medical) to evaluate pulmonary artery, RHC and transthoracic echocardiogram (TTE) within 3 months without any clinical incident. Prospective ECG gating was added and if there was abnormal enhancement in RV myocardium, we regarded this as MF. Subjects were followed for a median of 17 months.

RESULTS
Adverse events (AE) occurred in 11 subjects (5 males, mean age 60 ± 10 years); cardiac death (3), heart failure (6), cerebral hemorrhage (2). MF in RV was detected in 16 subjects (5 males, mean age 56 ± 2 years, 9 CTEPH, 6 PAH and 1 other). Comparing subjects with and without MF, only cardiac output (l/min) calculated on TTE was significantly lower in subject with than without MF (P < 0.05). However, there were no significant differences between groups in other factors, especially hemodynamic state parameters, on CT, TTE and RHC. Significant differences between subjects with and without MF were seen at each time point when whole follow up period was compared by further Kaplan Meier analysis and log rank test (P = 0.031).

CONCLUSION
Presence of MF in RV detected on ECG gated 320 slice CT may have a short term poor prognosis in PH subjects, even though there were no significant differences in hemodynamic state parameters acquired from CT, TTE and RHC (except cardiac output) on TTE between subjects with and without MF. In contrast to hemodynamic state parameters, which tend to change, presence of MF in RV is a permanent morphological parameter which may be useful for accurately predicting prognosis of PH subjects.

SST03-06 ● Volumetric and Flow Measurements in Patients with Repaired Tetralogy of Fallot: Comparison of Transverse versus Short-axis Cine-MRI and Echocardiography

Juliane Schelhorn MD (Presenter) ; **Ulrich Neudorf** ; **Kai Nassenstein** ; **Thomas W Schlosser** MD

PURPOSE
Patients with corrected tetralogy of Fallot (TOF) are prone to develop dilatation and dysfunction of the right ventricle resulting in long-term complications. For right ventricular (RV) volumetry MRI is the gold standard but it remains controversial whether axial or short-axis (SA) planes should be used for RV analysis. The aim of this study was to compare both algorithms for the assessment of RV function. Additionally we compared volumetric and flow data in MRI and echocardiography (Echo).

METHOD AND MATERIALS
31 MRI studies of 27 patients with TOF were retrospectively studied. End-systolic volume (ESV), end-diastolic volume (EDV), stroke volume (SV) and ejection fraction (EF) of the left and right ventricle and left myocardial mass were measured in axial and SA planes. Furthermore the inner diastolic right ventricular diameter (R VIDdiast) in Echo and pulmonary valve peak velocity (PVPV) were acquired in MRI and Echo.

RESULTS
Good correlation between axial and SA orientation was found for left ventricular ESV, EDV, myocardial mass and SV and for right ventricular ESV, EDV and SV in MRI (p=0.001). For right ventricular volumetry no systematic difference between both stack orientations was found. R VIDdiast in Echo and right EDV in SA and in axial orientation in MRI correlated well (p=0.001). Good correlation was found between PVPV in MRI and Echo (p=0.001).

CONCLUSION
For right ventricular volumetry in MRI axial and SA slices provide comparable results with no systematic error. Due to its good correlation with right EDV in MRI the R VIDdiast in Echo can be recommended as practicable follow-up tool in clinical routine.

CLINICAL RELEVANCE/APPLICATION
We wanted to evaluate whether axial or short-axis planes for right ventricular volumetry in MRI in patients with corrected tetralogy of Fallot are more appropriate.

SST03-07 ● Fusion of Body Surface Mapping and Imaging for the Assessment of Cardiac Arrhythmias

Hubert Cochet MD (Presenter) ; **Frederic Sacher** ; **Meleze Hocini** ; **Bruno Quesson** ; **Pierre Jais** ; **Michel Montaudon** MD ; **Michel Haissaguerre** ; **Francois H Laurent** MD

PURPOSE
Non-invasive imaging with cardiac MDCT and delayed-enhanced (DE) MRI gives access to cardiac anatomy and myocardial substrate. Body surface mapping (BSM) enables a non-invasive assessment of cardiac activation. We evaluated the feasibility of BSM/imaging fusion for the assessment of cardiac arrhythmias.

METHOD AND MATERIALS
24 patients referred for electrophysiological procedure in the context of ventricular tachycardia (VT, N=10), Wolf-Parkinson-White syndrome (WPW, N=2), atrial fibrillation (AF, N=10) and scar-related ventricular fibrillation (VF, N=2) were studied. All patients underwent BSM and non-invasive imaging with MDCT (N=9) and/or DEMRI (N=18). When both MDCT and DEMRI had been performed, datasets were fused using landmark registration. BSM was performed using a 252-electrode vest enabling the computation of epicardial electrograms from body surface potentials. The epicardial geometry on which electrical activation was calculated from BSM acquisition was then registered to the geometry segmented from imaging, using an iterative coupled points algorithm. The output was a 3-dimensional cardiac model integrating cardiac anatomy (cardiac chambers, epicardium, coronary vessels, phrenic nerve), myocardial substrate (fibrosis from DEMRI, myocardial hypodensity or wall thinning from MDCT), and epicardial activation from BSM.

RESULTS
Acquisition, segmentation, and registration was feasible in all patients. In patients referred for VT, this enabled a non-invasive assessment of the earliest epicardial exit of the VT circuit, and its location with respect to myocardial substrate, coronary vessels, or phrenic nerve. In WPW patients, this helped understanding accessory pathways of unusual location, or resistant to prior ablation. In AF and VF patients this enabled a non-invasive analysis of rotor trajectories with respect to myocardial substrate. In 14 patients (10 VT, 1 WPW, 3 AF), 3-dimensional models were successfully integrated in navigation systems and used to guide mapping/ablation.

CONCLUSION
By combining information on anatomy, substrate and electrical activation, BSM and imaging fusion enables a comprehensive non-invasive assessment of cardiac electrical disorders. This might have applications for diagnosis, prognosis, or ablation targeting.

CLINICAL RELEVANCE/APPLICATION
Body surface mapping can be fused with other non-invasive cardiac imaging modalities to provide a comprehensive assessment of cardiac arrhythmias.

SST03-08 ● Biventricular Myocardial Strain Analysis in Patients with Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC) Using Cardiac Magnetic Resonance Feature Tracking

Philipp Heermann (Presenter) ; **Dennis Hedderich** MD ; **Walter L Heindel** MD ; **Matthias Paul** MD ; **David C Maintz** MD ; **Alexander C Bunck**

PURPOSE
Fibrofatty degeneration of myocardium in ARVC causes detectable wall motion abnormalities. The aim of this study was to examine whether cardiac magnetic resonance (CMR) based strain analysis using feature tracking (FT) can serve as an observer-independent and quantifiable measure to confirm global and regional ventricular dysfunction in ARVC patients and support the detection of early forms of ARVC.

METHOD AND MATERIALS
We enrolled 20 patients diagnosed with ARVC, 30 with boderline-ARVC and 22 subjects with a positive family history but no signs of a manifest ARVC. 10 healthy volunteers (HV) served as controls. 15 ARVC patients received genotyping for placophilin-2 mutation (PKP-2), of which 8 were found to be positive. Cine MR datasets of all subjects were assessed for myocardial strain using FT (TomTec Diogenes Software). Global and segmental strain in radial, circumferential and longitudinal mode were assessed.

RESULTS

CONCLUSION
CMR based strain analysis using FT is an objective and useful measure for quantification of wall motion abnormalities in ARVC. It allows differentiation between manifest or boderline-ARVC and HV, even if ejection fraction is still normal.

CLINICAL RELEVANCE/APPLICATION
Importance of quantitative parameters in ARVC diagnosis is underlined by the modification of the Task Force Criteria 2010 and CMR-based strain promises to be a powerful measure to objectify diagnosis.

SST03-09 • Morphological and Functional Evaluation of Right Ventricle on ECG-Gated 320 Slice CT Can Predict a Short Term Poor Prognosis in Subjects with Pulmonary Hypertension

Koya Ozawa MD (Presenter) ; **Nobusada Funabashi** MD, PhD ; **Akihisa Kataoka** MD ; **Noriyuki Yanagawa** MD ; **Nobuhiro Tanabe** ; **Koichiro Tatsumi** ; **Yoshio Kobayashi**

PURPOSE
To evaluate the morphological and functional parameters of right ventricle (RV) in subjects with pulmonary hypertension (PH) by electrocardiogram (ECG)-gated enhanced 320 slice computed tomography (CT).

METHOD AND MATERIALS
56 PH subjects (15 males, mean age 57 ± 15 years, 33 chronic thromboembolic PH, 21 pulmonary arterial (PA) hypertension and 2 others) underwent retrospective ECG-gated 320 slice CT (Aquilion one, Toshiba Medical). To obtain not only images of the whole heart including RV and coronary arteries, but also images of the PA, all CT scans were obtained using a double volume conventional scan with retrospective ECG-gating with a 0.5 mm slice thickness with a downward direction. Tube voltage was set at 120 kV and tube current was set at 580 mA with tube current dose modulation. We injected 60 ml of contrast material (350 mgI/ml) at 3.5 ml/s, followed by injection of a saline-to-contrast material mixture (40 ml contrast material at 2.0 ml/s and 30 ml saline at 1.5 ml/s), followed by injection of 20 ml pure saline at 1.5 ml/s. CT images were reconstructed every 5% from 0-95% of ECG R-to-R interval and 4 dimensional (4D) images were obtained. Subjects were followed for a median of 17 months.

RESULTS
Adverse events (AE) occurred in 11 subjects (5 males, mean age 60 ± 10 years); Cardiac death (3), heart failure (6), cerebral hemorrhage (2). Receiver operating characteristic (ROC) curves of RV end-diastolic volume (RVEDV) and end-systolic volume (RVESV) on CT showed area under curve (AUC) of 0.646 and 0.590, respectively, and best cutoff points of 125.2 mm3 (sensitivity 72.7%, specificity 60%) and 113.5 mm3 (sensitivity 54.5%, specificity 80%), respectively, to distinguish subjects with and without AEs. By Kaplan Meier analysis, there was significant differences in incidence of AEs between = and < 113.5 mm3 of RVESV on CT (P=0.032). In a similar analysis, there was not significant differences in incidence of AEs between = and < 125.2 mm3 of RVEDV on CT (P = 0.051).

CONCLUSION
Quantitative and qualitative morphological and functional evaluation of RV on 4D images of ECG gated 320 slice CT showing RVESV can predict short term poor prognosis in PH subjects.

CLINICAL RELEVANCE/APPLICATION
Presence of RVESV dilation on ECG-gated 320 slice CT should be considered for poor prognosis in PH subjects.

Disclosure Index

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