Cardiac Radiology
The Assessment of Complex Flow in Pulmonary Venous Pathologies with the Use of 4D Flow Imaging

All Day Room: CA Community, Learning Center

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TEACHING POINTS
The purpose of this exhibit is to: Review the diagnostic assessment of patients with partial Anomalous venous return, focusing on the role of transthoracic echocardiography, 2D phase contrast imaging, and 4D flow MRI. Review 4D flow MRI pulse sequences and steps for data processing. Detail the emerging role of qualitative and quantitative analysis of 4D flow MRI data in the assessment of pulmonary venous pathology.

TABLE OF CONTENTS/OUTLINE
Anomalous Venous Return: Types, Spectrum, Epidemiology Role of echocardiography Role of cardiac MRI Role of cardiac CT Role of cardiac MRI with 4D flow MRI 4D flow MRI: Technical considerations Pulse sequences Processing methods Display methods Analytical assessment: Quantitative and qualitative approaches Current and emerging applications Case based assessment of 4D flow in Partial Anomalous Pulmonary Venous Return Qualitative imaging analysis Quantitative analysis: \( I_e Q_p:Q_s \) ratio, valvular assessments, peak velocity, net flow, regurgitation fractions Assessment of pulmonary veins: Future directions and limitations
Strain-Encoding MRI for Real-Time Myocardial Regional Functional Analysis: Principles and Applications

All Day Room: CA Community, Learning Center

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TEACHING POINTS
1. Review the principles of MRI strain-encoding (SENC) for fast and high-resolution myocardial regional functional analysis, and explain the measured parameters.
2. Illustrate complementary information provided by SENC in relation to other MRI techniques, e.g. cine functional imaging, flow imaging, and tissue fat quantification.
3. Describe different SENC clinical applications, including heart failure, congenital heart disease, pulmonary hypertension, and heart tissue characterization.

TABLE OF CONTENTS/OUTLINE

Strain-encoding (SENC) MRI gained large popularity as a unique tool for measuring myocardial regional function with high resolution in as short as one heartbeat without breath-hold or contrast injection. The resulting color-coded strain maps and curves provide important markers of subclinical cardiac dysfunction before the development of global dysfunction (e.g. reduced EF) and progress to heart failure. Herein, we review SENC basic principles, imaging parameters, and protocol optimization, as well as its advantages compared to conventional MRI tagging. We then describe different measures obtained by SENC and their relation with information from other MRI techniques in different clinical applications, including heart failure, congenital heart disease, pulmonary hypertension, and heart tissue characterization.
Magnetic Resonance Imaging for Evaluating Heart Mechanics: Overview of Different Techniques

All Day Room: CA Community, Learning Center

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TEACHING POINTS
1. Review the technical principles of different MRI techniques for evaluating heart mechanics, including HARP, SENC, SinMod, feature tracking, tissue phase mapping, and DENSE.
2. Discuss advantages, limitations, and tips for optimization of each technique.
3. Illustrate potential clinical applications of each technique.

TABLE OF CONTENTS/OUTLINE
Magnetic resonance imaging provided unprecedented capabilities for evaluating heart mechanics and myocardial deformation patterns in both health and disease. Throughout the past 25 years, a large number of techniques have been developed to address this issue and assess regional heart function by measuring different mechanical parameters, e.g. myocardial displacement, velocity, strain, strain rate, and torsion. The developed techniques include conventional myocardial tagging, harmonic phase (HARP) analysis, strain encoding (SENC), sinusoidal modulation (SinMod) analysis, cine feature tracking, tissue phase mapping, and displacement encoding with stimulated echo (DENSE). Herein, we provide an overview of these different techniques by describing their technical principles, advantages, limitations, parameter optimization, and potential clinical applications. Future trends in the field will be also discussed.
Understanding the Coronary Artery Disease Reporting and Data System (CAD-RADS): A Primer for Radiologists

All Day Room: CA Community, Learning Center

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TEACHING POINTS
The Coronary Artery Disease Reporting and Data System (CAD-RADS) is a standardized reporting system for patients undergoing coronary CT angiography, designed to improve the communication of results to referring physicians and standardize management recommendations based on imaging findings. The purposes of this exhibit are: To review evidence supporting coronary CT angiography for the evaluation of acute chest pain and chronic stable chest pain To discuss CAD-RADS categories for patients with acute chest pain To discuss CAD-RADS categories for patients with stable chest To illustrate the imaging appearance of CAD-RADS categories, including modifiers for plaque vulnerability and prior coronary revascularization

TABLE OF CONTENTS/OUTLINE
Introduction to CAD-RADS: a multidisciplinary expert consensus reporting system Coronary CT angiography in acute chest pain Coronary CT angiography in chronic stable chest pain CAD-RADS Reporting and Data System for patients with acute chest pain CAD-RADS Reporting and Data System for patients with stable chest pain CAD-RADS Modifiers Illustration of CAD-RADS cases for each assessment category Recommended standardized reporting template Inter-observer reproducibility Opportunities for research and quality improvement

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

Suhny Abbara, MD - 2014 Honored Educator
How to Achieve Uniform CT Enhancement of the Fontan Pathway

Participants
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TEACHING POINTS
Imaging of the Fontan circulation is not easy. Because the flow through the Fontan circulation is passive from the systemic venous system to the pulmonary arteries, homogeneous enhancement of the Fontan pathway cannot be obtained until the venous phase of contrast administration is reached. Dual injection technique, performing a delayed second-phase CT scan and using a bolus tracking method is the best way to achieve uniform CT enhancement in the Fontan patient.

TABLE OF CONTENTS/OUTLINE
I. The Fontan Procedure: Type and Complications
II. Difficulty in optimal CT enhancement
III. Various MDCT techniques
IV. Cases
Myofiber Visualization System for Micro CT Volumes of Left Ventricle

All Day Room: CA Community, Learning Center

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TEACHING POINTS
The purpose of this exhibit is:
1. To show how micro CT can be utilized for cardiac imaging
2. To demonstrate myofiber orientation visualization system based on cardiac micro CT volumes

TABLE OF CONTENTS/OUTLINE
Basic anatomical structure of the and the left ventricle (LV)
• Myofiber structures
• Myofiber orientations
• Myofiber analysis on DTI-MR and X-ray CTCardiac imaging with micro-focus X-ray CT (micro CT)
• What is micro CT?
• Comparison and relationship with other modalities
• How is resolution of micro CT?
• How can myofiber be observed on micro CT volumes of LV?Myofiber visualization system and its result
• Automated myofiber extraction technique using structure tensor analysis
• Overview of structure tensor
• Structure-based myofiber tracking rather than DTI
• Myofiber segmentation based on fiber directions
• Visualization scheme of myofiber extracted from micro CT volumes
• Direction-by-direction visualization of myofibersDemonstration and trial of our system
• On-site demonstration of myofiber analysis results using 3D visualization system
• Viewpoint and magnification scale can be changed easily by mouse
• Enabling intuitive understanding of the positional and directional relationShow possible application
• Cardiac function estimation from myofiber directions
• Future radiology focusing on micro structure
Multimodality Imaging for Guiding Cardiac Ablation Procedures for Arrhythmia

All Day Room: CA Community, Learning Center

FDA Discussions may include off-label uses.

Participants
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TEACHING POINTS
Foci responsible for the generation of cardiac arrhythmia are intimately related to areas of myocardial scar. There has been extensive advances in the imaging of myocardial scar by MRI and by voltage mapping. Scar maps by MRI and by voltage maps are often intimately related, and the former can simplify the acquisition of the latter. Extensive progress has been made to integrate imaging data into systems used for cardiac ablation therapy, and imaging is now an integral part of most cardiac ablation procedures.

TABLE OF CONTENTS/OUTLINE
EA mapping systems for ablation Image integration into EA maps Imaging vs EA maps Atrial ablation Pre-procedural imaging LA and PV anatomy thrombus adjacent structures LA scar Intra-procedural imaging integrated imaging (CT, MRI, ICE) Post-procedural imaging New technology to visualize gaps complications Ventricular ablation Pre-procedural imaging LV ablation guided by EA maps MRI: Scar detection, location, thickness, heterogeneity T1 mapping, ECV mapping MRI in subjects with devices Scar and denervation: SPECT, PET Intra-procedural imaging ICE and scar real time MRI guided Post procedure imaging MRI DE-MRI, T1 mapping Future aspects
Resident Primer for Pericardial Disease: A Multi-Modality Approach

All Day Room: CA Community, Learning Center

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TEACHING POINTS
The purposes of this exhibit are: To review imaging techniques in the assessment of pericardial disease To review a broad spectrum of pericardial diseases To discuss differential diagnosis of pericardial diseases based on specific imaging features

TABLE OF CONTENTS/OUTLINE
Table of Contents/Outline: Normal anatomy of the pericardium Review of imaging techniques: Radiography Echocardiography CT MRI Review of pericardial diseases: Congenital absence of pericardium Acute, calcific, and constrictive pericarditis Pericardial effusion and tamponade Pericardial mass Review of imaging features key to differential diagnosis Review treatment of pericardial diseases

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

Elliot K. Fishman, MD - 2012 Honored Educator
Elliot K. Fishman, MD - 2014 Honored Educator
Elliot K. Fishman, MD - 2016 Honored Educator
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Tube Current Modulation in Coronary CT Angiography with Wide Coverage Detector: Factors Affecting Image Quality and Dose Reduction

All Day Room: CA Community, Learning Center

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Han Wang, MD, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
To demonstrate ways to acquire anatomic and/or functional information in prospective coronary CT angiography using ECG-triggered tube current (mA) modulated CT scan with wide coverage detector To point out factors affecting dose reduction potential in such application To demonstrate strategies in prospective CCTA to maximize dose reduction

TABLE OF CONTENTS/OUTLINE
1) Prospective cardiac CT imaging prospective CCTA significantly reduces CT dose compared with retrospective CCTA ECG-triggered mA modulation further reduces dose multiple scans may be possible within 1 heart beat for best phase selection and functional information2) Factors in CCTA affecting dose reduction how higher heart rate and variation affect the ability for dose reduction how higher rotation speed and innovative mA modulation methods improve dose reduction ability advantages of 2 scans in 1 heart beat for image quality over using extended cardiac phases for challenge patients3) Strategies in prospective CCTA to maximize dose reduction reduce patient heart rate and variation for maximum dose reduction optimize scan protocols and cardiac phase selection based on imaging tasks and patient condition to optimize image quality and radiation dose use advanced reconstruction algorithms to reduce phase margin requirement and overall tube power
Computed Fractional Flow Reserve derived from Coronary CT Angiography (FFRct): A Pictorial Review of the New Technique and its Clinical Impact Due to Improved Patient Selection for Invasive Coronary Angiography

All Day Room: CA Community, Learning Center

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TEACHING POINTS
The purpose of this exhibit is: 1. To emphasize that haemodynamic or functional significance of coronary stenoses is often poorly evaluated on coronary CT angiography (CCA) alone 2. To learn about the concept of measuring fractional flow reserve derived from coronary CT angiography (FFRct) as a useful non-invasive test to quantify both coronary lesion severity and associated ischaemia 2. To review the use of FFRct to guide lesion-specific decisions on invasive coronary angiography and revascularization in patients with stable coronary artery disease 4. To guide optimization of CCA technique to allow accurate FFRct analysis 5. To show that through careful patient selection, FFRct can significantly reduce "over-calling" of coronary stenoses at CCA and accurately determine which patients will benefit from ICA.

TABLE OF CONTENTS/OUTLINE
Introduction to the FFRct technique and its clinical relevance to the investigation of coronary artery disease Patient selection and CCA protocols for FFRct Interpreting the results from FFRct analysis Pictorial review of 20 patients with coronary artery stenoses suspected to be flow-limiting on initial CCA who then underwent FFRct and ICA (including invasive measurements of FFR) Corresponding images for CCA, FFRct and ICA presented to illustrate the clinical and economic impact of FFRct on our cardiac service
Teaching Points

To explain the utility of MRI for assessment of hemodynamics in pulmonary hypertension (PH)
To learn how to evaluate the treatment effect using MRI
To discuss the new insights of 4D flow MRI in PH

Table of Contents/Outline

- Pulmonary hypertension is a life-threatening condition that gets worse over time. Cardiac MRI is a promising technique in assessment of right ventricular volume. Meanwhile, Cardiac MRI can assess not only right ventricular volume but also ventricular pressure, ventricular synchronicity, myocardial fibrosis, and pulmonary vascular resistance with its ability to assess vascular flow pattern and ventricular wall motion. It provides useful information in pulmonary hypertension. Therefore, the purpose of our presentation is to show various MRI methods to evaluate pulmonary hemodynamics and compare with invasive catheterization. In addition, we show the utility of cardiac MRI to evaluate the therapeutic effect of balloon pulmonary angioplasty in chronic thromboembolic pulmonary hypertension.
Role of Delayed Enhancement at MR imaging (MRI) in Acute Coronary Syndrome with Non-obstructed Coronary Arteries

Participants
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María Marinela Chaparro Muno, Sevilla, Spain (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
Patients with acute coronary syndrome without obstruction of the coronary arteries represent a clinical challenge since management will depend on the underlying pathology that will, in turn, determine the prognosis and treatment. The purposes of this exhibit is:
- To explain the utility of MRI, in particular delayed enhancement imaging, to detect the underlying pathology in patients with acute coronary syndrome without obstruction of the coronary arteries
- To identify the distribution and enhancement patterns of each pathology

TABLE OF CONTENTS/OUTLINE
- Definition and state of art of acute coronary syndrome with normal coronary arteries, emphasizing the crucial value of etiologic diagnosis on final therapeutic strategy
- Utility of delayed enhancement imaging in the diagnosis
- Description of MRI protocol and delayed enhancement imaging technique
- Cases report highlighting the imaging findings and differential diagnostic key points
- Conclusions and summary
TEACHING POINTS

Ventricular assist devices have emerged as an effective treatment option other than medical therapy for patients with end-stage heart failure. Presently, total artificial heart (TAH) implantation is being performed as a bridge to heart transplantation in end-stage heart failure patients who are eligible to receive an orthotopic heart and are at risk of imminent death because of irreversible biventricular heart failure. Diagnostic imaging plays a pivotal role in the assessment of TAH implantation patients. We would like to share the experience of imaging TAH implantation patients at our centre. The purpose of our exhibit is: 1) To review indications and contraindications for Total Artificial Heart 2) To describe the TAH device and its components 3) To understand the expected imaging appearances after TAH implantation 4) To share our experience about radiological appearance of complications associated with TAH implantation.

TABLE OF CONTENTS/OUTLINE

Outline of the presentation: Introduction Indications and contraindications of TAH Description of TAH device and its components Implantation Procedure and explanation of expected postoperative appearances after TAH implantation Radiological appearance of complications associated with TAH implantation through our cases Summary.
T2-Weighted Imaging of the Heart - Tips and Tricks

All Day Room: CA Community, Learning Center

Participants
Suzanne Byrne, MD, Rochester, MN (Presenter) Nothing to Disclose
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TEACHING POINTS
The purpose of this exhibit is:
1. To review T2-weighted imaging techniques in cardiac MRI.
2. To illustrate the clinical utility of T2-weighted cardiac imaging using cases examples.
3. To discuss challenges of T2-weighted cardiac imaging and troubleshooting tips.

TABLE OF CONTENTS/OUTLINE
Review T2-weighted imaging techniques in cardiac MRI, including use of T2 mapping and low b-value diffusion weighted sequences
Illustrate the utility of T2-weighted cardiac imaging using case examples including:
   - Ischemic heart disease
   - Nonischemic heart disease
   - Myocardial masses
   - Pericardial disease
Discuss challenges and artifacts of T2-weighted cardiac imaging and how to troubleshoot
Summary and future directions of T2-weighted cardiac imaging
CT Coronary Angiography Fractional Flow Reserve as a Tool in the Diagnosis and Treatment of Coronary Artery Disease

All Day Room: CA Community, Learning Center

Participants
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TEACHING POINTS
To highlight the use of calculation of fractional flow reserves through critical coronary artery stenoses. To show the first clinical experiences with this technique in determining prognosis and treatment from our center, the first clinical site to use fractional flow reserve calculation software in the US. To show the importance of calculating fractional flow reserves and how CT can be used to determine treatment options for patients presenting with chest pain. To show the use of CT as a tool in the treatment of significant coronary artery disease and how it can be used to decrease the use of invasive coronary angiography.

TABLE OF CONTENTS/OUTLINE
1) Introduction to coronary artery disease flow dynamics and fractional flow reserve 
   a. Need for noninvasive markers and the risks of catheterization
2) Introduction to HeartFlow and FFR calculation 
   a. Protocol technique for CT of the coronary arteries
3) Case examples of use of HeartFlow 
   a. Correlation with coronary angiography
4) Limitations of fractional flow reserve analysis 
   a. False negatives
   b. False positives
5) Role of CTA in evaluation of chest pain 
   a. Effect on reduction of coronary catheterization
6) Economics of CTA use in the management of chest pain 
   a. Significant reduction in expensive workups for patients without coronary artery disease
What's in the Bag: Multimodality Imaging of the Pericardium

All Day Room: CA Community, Learning Center

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TEACHING POINTS
- To understand normal pericardial anatomy.
- To identify congenital pericardial conditions.
- To discuss the multimodality appearance and physiology of acquired pericardial disorders.

TABLE OF CONTENTS/OUTLINE
1. Overview of normal pericardial anatomy.
   a. Embryology.
   b. Pericardial recesses.
      i. Superior and inferior aortic recesses.
      ii. Right and left pulmonic recesses.
      iii. Postcaval recess.
      iv. Pulmonic venous recesses.
      v. Oblique sinus.
2. Congenital pericardial anomalies:
   a. Congenital absence of the pericardium.
   b. Pericardial cyst.
      i. Typical locations.
      ii. Atypical locations.
3. Acquired disorders of the pericardium on radiography, CT and MRI:
   a. Pericardial effusion.
   b. Pericarditis.
      i. Etiologies: Viral, neoplastic, tuberculous.
   c. Pericardial masses:
      i. Primary tumors of the pericardium:
         1. Mesothelioma.
         2. Sarcoma.
      ii. Metastatic disease of the pericardium.
Cardiovascular CT and MR Imaging in Adult Congenital Heart Disease: A Practical Approach to the Current State of the Art

All Day Room: CA Community, Learning Center

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TEACHING POINTS
To discuss the methods to assess complex anatomy and hemodynamics in adult congenital heart disease using cardiovascular CT and MRITo show the current state of art in assessment of adult congenital heart disease

TABLE OF CONTENTS/OUTLINE
TABLE OF CONTENTS
1. The clinical role of cardiovascular CT and MR imaging methods in adult congenital heart disease (ACHD)
2. Review of imaging findings in each disease
3. The current state of the art of non-invasive imaging in the setting of ACHD
4. Future directions and summary

OUTLINE
Advances in medical treatment have led to enormous worldwide growth in the number of adults with congenital heart disease. Today, adult congenital heart disease (ACHD) is not uncommon. Non invasive technique to assess complex morphology and hemodynamics is important in ACHD. Cardiovascular CT is useful with its ability of evaluate detailed anatomy, and provides crucial information before percutaneous treatment (e.g. atrial septal occluder for atrial septal defect) and surgery. Cardiovascular MRI can assess ventricular volume and vascular flow non-invasively (e.g. right ventricular function and pulmonary regurgitant fraction in repaired tetralogy of Fallot). In addition, we show 4D flow MRI as the current state of the art imaging and its clinical utility in assessment of ACHD.
Transposition of the great arteries (TGA) is the most common newborn cyanotic congenital heart disease, and is fatal without surgical repair. Since the introduction of Senning/Mustard atrial switch and Jatene arterial switch procedures, patients are living longer with reported survival rates of 70-80% and >90% at 25 years, respectively. It is important to recognize the spectrum of imaging findings and role of imaging in the management of TGA as the surviving adult population continues to grow. Four-dimensional phase-contrast MRI (4D Flow MRI) is a validated imaging technique which provides temporal hemodynamic information for an imaging volume. This presentation will review, using 4D Flow MRI: (1) segmental analysis of TGA, (2) types of surgical repair, and (3) common post-repair complications.

**TEACHING POINTS**

Transposition of the great arteries (TGA) is the most common newborn cyanotic congenital heart disease, and is fatal without surgical repair. Since the introduction of Senning/Mustard atrial switch and Jatene arterial switch procedures, patients are living longer with reported survival rates of 70-80% and >90% at 25 years, respectively. It is important to recognize the spectrum of imaging findings and role of imaging in the management of TGA as the surviving adult population continues to grow. Four-dimensional phase-contrast MRI (4D Flow MRI) is a validated imaging technique which provides temporal hemodynamic information for an imaging volume. This presentation will review, using 4D Flow MRI: (1) segmental analysis of TGA, (2) types of surgical repair, and (3) common post-repair complications.

**TABLE OF CONTENTS/OUTLINE**

Introduction to 4D Flow MRI  
Segmental Analysis of TGA using 4D Flow MRI  
D-TGA  
L-TGA  
Common Types of Surgical Repair and Complications as demonstrated by 4D-MRI  
Atrial Switch  
Atrial baffle leak/stenosis  
Right ventricular hypertrophy and systolic dysfunction  
Atrioventricular valve regurgitation  
Arterial Switch  
Right ventricular outflow tract obstruction  
Supravalvular neopulmonary artery stenosis  
Branch pulmonary artery stenosis  
Summary
A Nobel Visualization Method of Preoperative Cardiac CT for Atrial Septal Occlusion: Minimum Intensity Projection and Fusion Volume Rendering Images

All Day Room: CA Community, Learning Center

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TEACHING POINTS
Minimum Intensity Projection (MinIP) has high accuracy and high reliability for measuring a atrial septal defect (ASD). MinIP and multi Volume Rendering (mVR) are useful technique for the pre-procedural assessment of adult type the ASD

TABLE OF CONTENTS/OUTLINE
1. Background. Pre-procedural imaging for the ASD
2. Analysis process for measuring the ASD size
   3-1. Phantom study; Accuracy of MinIP to measure the ASD size
   3-2. Clinical study; Reliability of MinIP to measure the ASD size
3. Usefulness of pre-procedural assessment of the ASD using fusion VR
4. Advantages and limitations

OUTLINE
The most valuable clinical benefit of percutaneous closure of atrial septal defect is the significant improvement in symptoms, without thoracotomy. To perform safely and achieve good procedure success, pre-procedural cardiac CT plays an important role. Cardiac CT provides high quality imaging for anatomical evaluation including defect size, and the relationship between defect and other cardiac structures. MinIP can determine the ASD size with high accuracy and reliability than MPR. MinIP is able to demonstrate the entire defect in the frontal view. And, MinIP is able to decrease artifacts by high-contrast agent. In addition, Fusion VR can provide clinically useful visualization.
Comprehensive Assessment of Hypertrophic Cardiomyopathy (HCM) by Cardiac Magnetic Resonance (CMR): Risk Stratification for Sudden Cardiac Death

All Day Room: CA Community, Learning Center

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Clerio F. Azevedo, MD, PhD, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
HCM is the most common of the genetic cardiovascular diseases, with a prevalence of about 0.2% in the general population. It is the most common cause of SCD in the young. At present, the main risk markers for SCD are: (1) Massive LV hypertrophy (wall thickness ≥ 30 mm). (2) Prior cardiac arrest or sustained VT; (3) Family history of one or more premature HCM-related deaths; (4) Syncope, especially in the young and related to exertion; (5) Hypotensive or attenuated blood pressure response to exercise; (6) Multiple, repetitive nonsustained VT on serial ambulatory monitoring. CMR is the most accurate modality for the assessment of biventricular volumes, function and mass. Moreover, CMR allows for the accurate quantification of hypertrophied segments and of regional myocardial scarring. These parameters have been demonstrated to be associated with the risk of SCD.

TABLE OF CONTENTS/OUTLINE
A quick review of HCM epidemiology. Assessment of morphological and functional parameters by cardiac MRI: the gold standard. Differential diagnosis of aortic valve stenosis, systemic hypertension, and some expressions of athlete’s heart. Characterization of chronic myocardial injury in patients with severe HCM: quantitative assessment of myocardial fibrosis by the late gadolinium enhancement (LGE) and T1 mapping techniques.
Repaired Tetralogy of Fallot: What the Clinician Wants to Know

All Day Room: CA Community, Learning Center

Participants
Madhukar S. Kollengode, MD, Aurora, CO (Abstract Co-Author) Nothing to Disclose
Kate Hanneman, MD, FRCPC, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Lorna Browne, MD, FRCR, Aurora, CO (Abstract Co-Author) Nothing to Disclose
Carlos S. Restrepo, MD, San Antonio, TX (Abstract Co-Author) Nothing to Disclose
Daniel Vargas, MD, Denver, CO (Presenter) Nothing to Disclose

TEACHING POINTS
Knowledge of post-operative anatomy, post-operative complications and anomalies associated with Tetralogy of Fallot (ToF) is crucial when evaluating patients with history of prior surgical repair. Importantly, the radiologist must be aware of the parameters and findings that will have an impact on the clinical or surgical management of these patients, such as thresholds for re-intervention. 1. Review the clinically significant parameters and criteria in the imaging evaluation of patients with repaired tetralogy of Fallot. 2. Discuss the value of cardiac MR and CT in the assessment of associated findings that have clinical, surgical or interventional implications.

TABLE OF CONTENTS/OUTLINE

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Carlos S. Restrepo, MD - 2012 Honored Educator
Carlos S. Restrepo, MD - 2014 Honored Educator
Atrio-esophageal Fistula: Radiographic Diagnosis of Dreaded Left Atrial Ablation Complication

All Day Room: CA Community, Learning Center

Participants
David T. Wymer, MD, Miami Beach, FL (Presenter) Nothing to Disclose
Kunal P. Patel, MD, Miami Beach, FL (Abstract Co-Author) Nothing to Disclose
David C. Wymer, MD, Archer, FL (Abstract Co-Author) Nothing to Disclose
William F. Burke III, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
- To discuss the etiology and natural history of atrio-esophageal fistula - To emphasize the risk of delayed or misdiagnosis, and that the most frequent presentation is related to air emboli as opposed to bleeding - To emphasize the importance of early chest CT in post-ablation patients with unexplained chest symptoms, and especially in the setting of stroke or neurologic symptoms - To discuss appropriate management, and emphasize urgency of surgical consult

TABLE OF CONTENTS/OUTLINE
- Background of atrial-esophageal fistula with discussion of high mortality rates exacerbated by delayed or misdiagnosis - Details of left atrial ablation and pathophysiology of fistula development - Discussion of patient presentation with focus on air embolism and role of imaging as the only means of diagnosis, with emphasis on seeking emergent chest imaging in stroke/transient ischemic attack patient in the setting of recent ablation - Specific discussion of imaging findings including trace pneumomediastinum, left atrial air, atrial diverticulum, effusion, and brain imaging for stroke - Discussion of treatment options and compare conservative approach versus aggressive surgical management
TEACHING POINTS

The purpose of this exhibit is as follows: Define normal origin and insertion of two frequently used ventricular assist devices (VAD) including anomalous or alternative inflow and outflow attachment sites. Present baseline imaging in patients without complication following VAD placement. Describe and categorize subsequent imaging (both radiographs and CT angiography) with identified complications (VAD thrombosis, mediastinal hematoma, etc.). Review indications for obtaining CT angiography in context of previous VAD placement.

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CA122-ED-X

Cardiovascular Disease Associated with HIV Infection in the Era of Antiretroviral Therapy

All Day Room: CA Community, Learning Center

Participants
Harold Goerne Ortiz, Guadalajara, Mexico (Abstract Co-Author) Nothing to Disclose
Deepali Saxena, MD, Bangalore, India (Abstract Co-Author) Nothing to Disclose
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Prabhakar Rajiah, MD, FRCR, Dallas, TX (Presenter) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

TEACHING POINTS
The purpose of this exhibit is To review the cardiovascular manifestations of HIV infection To recognize the changing patterns of disease with anti-retroviral therapy To understand the role of imaging modalities in the evaluation of cardiovascular disease in a HIV infected patient. To illustrate the imaging appearances of cardiovascular disease in HIV. To recognize that with the longer survival of patients with HIV, atherosclerosis is becoming a common problem.

TABLE OF CONTENTS/OUTLINE
Introduction HIV infection- Current trends with anti-retroviral therapy Cardiovascular involvement in HIV Role of Imaging- X-ray, calcium score, CT, MRI, echo, PET Review and illustration with case examples of the following cardiovascular manifestations of HIV Atherosclerosis Coronary artery disease Vasculitis Aneurysm Thrombus, Embolism Myocarditis (cytomegalovirus, tuberculosis, cryptococcus, histoplasma) Pericarditis Pericardial effusion Endocarditis- Nonbacterial thrombotic, infective (Staphylococcus aureus, Streptococcus pneumoniae, Candida, Aspergillus, Cryptococcus) Dilated cardiomyopathy Drug induced cardiotoxicity (Zidovudine, didanosine) Pulmonary hypertension Malignancy- Non-Hodgkin lymphoma, Kaposi sarcoma Immune reconstitution syndrome Cardiovascular risk factor profiles of HIV patients

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Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
Be Still My Heart! An Implantable Heart Failure Monitor

All Day Room: CA Community, Learning Center

Participants
Taara S. Hassan, MD, Fort Sam Houston, TX (Abstract Co-Author) Nothing to Disclose
Brittany Ritchie, MD, San Antonio, TX (Abstract Co-Author) Nothing to Disclose
Christopher J. Lisanti, MD, Schertz, TX (Abstract Co-Author) Royalties, Wolters Kluwer nv
Jennifer Schwantes, Fort Sam Houston, TX (Presenter) Nothing to Disclose
Emilio Fentanes, San Antonio, TX (Abstract Co-Author) Nothing to Disclose
James Watts, Fort Sam Houston, TX (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
At the end of this exhibit, participants will be able to: List the indications for CardioMEMS placement. Know the expected radiologic appearance of CardioMEMS. List the reported and potential complications of CardioMEMS and radiologic safety. Discuss the imaging appearance of intrathoracic objects that may mimic CardioMEMS.

TABLE OF CONTENTS/OUTLINE
CardioMEMS (Micro-Electro-Mechanical Systems, St. Jude Medical) is the only FDA-approved, wireless implantable hemodynamic monitoring system for patients with congestive heart failure that allows for continual and precise hemodynamic measurements. Review New York Heart Association (NYHA) heart failure classification CardioMEMS is indicated for NYHA class III patients who have been hospitalized in the last year. Hemodynamics of heart failure and the importance of pulmonary artery pressures CardioMEMS provides continuous pulmonary artery pressure monitoring. Pulmonary vascular anatomy as it relates to CardioMEMS deployment Expected appearance of CardioMEMS on radiologic imaging A metallic density in a lower lobe pulmonary artery in a heart failure patient may be a CardioMEMS device. Review of reported and potential complications related to CardioMEMS device Intrathoracic mimics of CardioMEMS Summary
Pericarditis: Multimodality Imaging Overview

All Day Room: CA Community, Learning Center

Participants
Jessica R. Cox, DO, Aurora, CO (Presenter) Nothing to Disclose
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Carlos S. Restrepo, MD, San Antonio, TX (Abstract Co-Author) Nothing to Disclose
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Gautham P. Reddy, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Daniel Vargas, MD, Denver, CO (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. Review the clinical findings and imaging appearance of the different presentations of pericarditis. 2. Discuss the role of CT, MR, echocardiography and nuclear medicine studies in the evaluation of patients with pericarditis. 3. Familiarize the radiologist with some of the common complications of pericarditis. 4. Recognize diastolic septal bounce on MR for assessment of constrictive physiology

TABLE OF CONTENTS/OUTLINE
Brief overview of pericardial anatomy and normal imaging appearance. Clinical presentation Acute pericarditis Infectious, including tuberculous Non-infectious Post-traumatic/post surgical Radiation induced Connective tissue disorders Drug/toxin induced Metabolic Idiopathic Post-myocardial infarction Constrictive pericarditis LVAD-associated pericarditis Role of different imaging modalities, including: MR for evaluation of constrictive physiology Evaluation for fibrinopurulent pericarditis Imaging myopericarditis Other complications (such as cardiac tamponade)

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Carlos S. Restrepo, MD - 2012 Honored Educator
Carlos S. Restrepo, MD - 2014 Honored Educator
Gautham P. Reddy, MD - 2014 Honored Educator
Congenital heart disease (CHD) is most often discovered via prenatal screen or symptomatic presentation early in life. Alternatively, it may present later in life due to complications or discovered incidentally. The advancement of surgical procedures affords patients with CHD better survival outcomes but also requires additional follow up to evaluate procedural success and potential complications. Also, a selective population cannot undergo MRI for multitude of contraindication; in this subset of patients CT is an excellent alternative for evaluation of CHD. Additionally the significant improvement of CT temporal resolution, dose reduction, and short exam duration has made CT a suitable exam for the evaluation of CHD and its complications. Illustrate the most common imaging findings of congenital heart diseases and their associated complications. Review the currently utilized surgical procedures and their complications.

TABLE OF CONTENTS/OUTLINE

Intro: The role of CT imaging in adults with CHD
Review of CT imaging findings of cardiac shunts & their complications
Discuss the complex CT imaging findings of uncorrected and repaired TOF, APVR, D-TGA, Hypoplastic RV, Double Inlet LV with L-TGA, ASD, VSD, and Ebstein's anomaly
Illustrate postsurgical imaging findings and potential complications
Correlate CT imaging findings with echocardiography and MRI
TEACHING POINTS

While the imaging findings of anomalous coronary artery origins have been extensively reviewed in the literature, a comprehensive review of other pathologies affecting the pediatric coronary arteries has not been assembled. Goals of this exhibit include: Offer a review of the differential diagnosis, imaging appearance, and pathology of both congenital and acquired disease processes other than anomalous origins which may involve the coronary arteries of the pediatric patient. Provide insight for differentiating these disease entities, which may appear similarly in children, including important patient history points and surgical techniques applicable to coronary artery pathology. Discuss the preferred imaging modality and techniques for each diagnosis.

TABLE OF CONTENTS/OUTLINE

Immune-mediated processes: Patient history and additional sites of involvement are key in diagnosis. Kawasaki disease Takayasu arteritis Polyarteritis nodosa Cardiac allograft vasculopathyPrior surgical manipulation: Correlating with history and operative report are helpful. Coronary artery reimplantation Iatrogenic transectionGenetic Familial hyperlipidemia Familial supravalvular aortic stenosisCongenital Myocardial bridge Hypoplasia FistulaTraumatic injury: Typically a feature of blunt trauma. Dissection

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Sanjeev Bhalla, MD - 2014 Honored Educator
Sanjeev Bhalla, MD - 2016 Honored Educator
TEACHING POINTS

1. Myocardial strain imaging by cardiac magnetic resonance (CMR) has been established as an essential technique for measuring regional myocardial function. It allows quantification of local intramyocardial motion measures called myocardial strain.  
2. The most diagnostically significant finding of myocardial strain is the early identification of contractile dysfunction in patients with apparently preserved systolic function, and it appears to be a sensitive and promising marker of subclinical disease, with the potential for improving patient management.

TABLE OF CONTENTS/OUTLINE

1. What is myocardial stain? - Basis of myocardial stain
   - Components of myocardial stain
   - Quantification of regional myocardial deformation
2. MR myocardial stain imaging techniques - Complementary spatial modulation of magnetization (cSPAMM)
   - Strain-encoded imaging (SENC)
   - Displacement-encoded with stimulated-echo (DENSE)
   - MR feature tracking
3. Physiologic heterogeneity of the strain
4. Normal MR strain values
5. Clinical applications of MR myocardial strain - Cardiac dyssynchrony
   - Coronary artery disease
   - Cardiomyopathy
   - Other disorders
   - Potential future applications
Nonatherosclerotic Disease of Coronary Arteries: Developmental Basis, Imaging Appearance and Clinical Implications

All Day Room: CA Community, Learning Center

Participants
Nagina Malguria, MBBS, MD, Dallas, TX (Presenter) Nothing to Disclose
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Mina F. Hanna, MBBC, MSc, Houston, TX (Abstract Co-Author) Nothing to Disclose
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Linda C. Chu, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Elliot K. Fishman, MD, Baltimore, MD (Abstract Co-Author) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company;

TEACHING POINTS
1. Embryology and development of coronary arteries
2. Identification of spectrum of nonatherosclerotic disease involving the coronary arteries
3. Clinical implication of distinguishing nonatherosclerotic coronary artery disease from atherosclerotic disease

TABLE OF CONTENTS/OUTLINE

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Suhny Abbara, MD - 2014 Honored Educator
Stefan L. Zimmerman, MD - 2012 Honored Educator
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Elliot K. Fishman, MD - 2012 Honored Educator
Elliot K. Fishman, MD - 2014 Honored Educator
Elliot K. Fishman, MD - 2016 Honored Educator
Teaching Points

The purpose of this exhibit is:

- Review the morphological classifications and anatomical changes after surgery
- Review characteristic imaging findings of clinically relevant abnormalities

Table of Contents/Outline

- Normal embryology and anatomy of the Transposition of the great arteries (TGA)
- Developmental considerations
- Imaging characteristics in different groups d-TGA
- Congenitally corrected transposition of the great arteries (ccTGA), L-TGA
- Others
- Post surgical TGA image findings
- Intra atrial baffle, arterial switch, Complications after surgery after atrial switch baffle stenosis
- Baffle leaks
- Other complications after arterial switch
- Conversion to arterial switch
- Anatomic variability of coronary vessels (arteries and veins)
- CT study of the baffle and RV function
- MR techniques for function analysis
- Systemic right ventricular dysfunction
- TGA and RV function
- Systemic RV in congenitally corrected transposition of the great arteries (ccTGA)

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Farhood Saremi, MD - 2015 Honored Educator
Biventricular Strain and Torsion in Adults with Corrected Transposition of the Great Arteries Analyzed by Feature Tracking Cine MRI

All Day Room: CA Community, Learning Center

Participants
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Michinobu Nagao, MD, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
Anatomical right ventricle (RV) in congenitally corrected transposition of the great artery (ccTGA) has a similar strain pattern to normal left ventricle (LV). To correspond to systemic circulation, circumferential strain of anatomical RV increases and approaches that of normal left ventricle. Torsion that is seen in LV contraction disappears in anatomical RV. Longitudinal strain of anatomical LV increases and is almost equal to normal RV.

TABLE OF CONTENTS/OUTLINE
In adult phase of ccTGA, the anatomical RV that corresponds to systemic circulation fails into dysfunction due to pressure overload during long-term. Our developed software using feature tracking cine magnetic resonance imaging (FT-MRI) enables to assess biventricular strain with standard steady-state free precession images. Moreover, ventricular torsion can be calculated from coordinates of the tracked points on MR images. In systole, LV apex rotates counterclockwise, whereas LV base rotates clockwise. Circumferential strain in anatomical RV of ccTGA is greater than that of normal RV. Torsion of anatomical RV is not seen in ccTGA. Longitudinal strain of anatomical LV in ccTGA is almost equal to that of normal RV. In representation of ccTGA case, circumferential strain of anatomical RV is -14.7% and torsion is 0.0 degree. Longitudinal strain of anatomical LV is -17.7%.
Closing the Gap- What Radiologists Should Know About PFO

All Day Room: CA Community, Learning Center

Participants
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Linda B. Haramati, MD, MS, Bronx, NY (Abstract Co-Author) Spouse, Board Member, Bio Protect Ltd; Spouse, Board Member, OrthoSpace Ltd; Spouse, Board Member, Kryon Systems Ltd

TEACHING POINTS
Embryology of the atrial septum with emphasis on the development, physiology and closure of the foramen ovale after birth. 25% of adults have a patent foramen ovale (PFO); hence understanding the imaging of the normal appearances of the fossa ovale including patent foramen ovale (PFO), an open channel and a fused fossa ovale is valuable. Key points that distinguish PFO from an atrial septal defect will be highlighted. A myriad of illnesses have been attributed to PFO- a normal variant. We will explore the quality of evidence for these associations and their treatment as well as potential physiological advantages of PFO.

TABLE OF CONTENTS/OUTLINE
ANATOMY Prevalence and pathophysiology Spectrum of foramen ovale: closed septum, blind-ending channels, patent foramen ovale
CLINICAL RELEVANCE PFO in the setting of stroke PFO in the setting of PE Other clinical manifestations of PFO: migraines, platypnea-orthodeoxia, sleep apnea, decompression sickness, high altitude pulmonary edema Physiologic advantage of PFO in pulmonary hypertension Using the PFO to cross the septum for EP procedures
IMAGING Echocardiogram, gated and non-gated MDCT, MRI Pertinent findings to convey to the clinicians Differentiating PFO from ASD and atrial septal aneurysm
TREATMENT Controversies and exploring the evidence
Muscular Dystrophies: Role of Cardiac MRI in its Management

All Day Room: CA Community, Learning Center

Participants
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Suhny Abbara, MD, Dallas, TX (Abstract Co-Author) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

TEACHING POINTS
Review the genetics and clinical features of various types of muscular dystrophies affecting the heart
Review the role of cardiac MRI in evaluation of these muscular dystrophies
Illustrate the imaging features of cardiac involvement in muscular dystrophies
Demonstrate that MRI is the most sensitive modality for detecting early cardiac involvement
Highlight that early treatment can prevent development of heart failure

TABLE OF CONTENTS/OUTLINE
1. Introduction
2. Classification of muscular dystrophies
3. Genetic background of the commonest types of the muscular dystrophies involving the heart (e.g. Duchenne, and Becker)
4. Clinical presentations of various cardiac abnormalities in patients with muscular dystrophy
5. Role of cardiac MRI in detecting various cardiac abnormalities
6. MRI sequences – Cine SSFP, strain imaging, velocity encoded imaging, first-pass dynamic perfusion, late gadolinium enhancement, T1 and T2 mapping
7. Cardiac MRI findings in various muscular dystrophy patients along with example case presentations. Duchenne dystrophy, Becker dystrophy, Emery- Dreifuss Limb-girdle muscle dystrophy, Myotonic dystrophy, X-linked dilated cardiomyopathy
8. Role of other imaging modalities like MDCT and Echocardiogram
9. Imaging follow up and response to therapy

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Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
Suhny Abbara, MD - 2014 Honored Educator
Introduction to the Total Artificial Heart

All Day Room: CA Community, Learning Center

Participants
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Lea Azour, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
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Matthew D. Cham, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
What is a total artificial heart & how does it work? What are the indications/contraindications? The basics to imaging—what do you need to know? What are common complications? What is the outlook for patients?

TABLE OF CONTENTS/OUTLINE
1. Introduction
   A. Indications/Contraindications
2. Device basics
   A. History
   B. Intrathoracic/extrathoracic components
   3. Function
      A. Changes in normal physiology
      B. Benefit of organ perfusion
      4. Imaging basics
         A. Normal plain film appearance
         B. CTA imaging technique
         5. Normal CT appearance
            A. Device components
               i. Inflow/outflow ports
               ii. Tissue expander
               iii. Valves
               iv. Drivelines
               v. Neopericardium
               vi. Normal appearance of native artery/graft conduit anastomosis
         C. Imaging of common complications
            A. Thromboembolism
            B. Intrathoracic hemorrhage
               i. Hemothorax
               ii. Hemomediatinum
               iii. Hemopericardium
            C. Extrathoracic hemorrhage
               i. Infection
3. Outcomes
   A. Survival
      • Survival to transplantation
      • Survival after transplantation
   B. Quality of life
TEACHING POINTS

To know the different phenotypes of hypertrophic cardiomyopathy (HCM) and their significance. To recognize those MRI findings that establish the differential diagnosis between HCM and its phenocopies.

TABLE OF CONTENTS/OUTLINE

Introduction. Cardiac MRI for morpho-functional characterization of the LV in patients with positive genotype/negative phenotype for HCM, classic phenotypical presentation, adverse remodeling of the LV and end-stage disease. HCM phenocopies: physiologic LV remodeling in athlete's heart, increased LV afterload due to systemic arterial hypertension or aortic stenosis, LV non-compaction, infiltrative diseases (cardiac amyloidosis and other storage diseases) and endomyocardial disease. Conclusion.
**TEACHING POINTS**

It is important for radiologists to be aware of the spectrum of CHD in adults, the context in which these anomalies occur and the most effective methods of imaging. Help radiologist to have extensive knowledge of cardiovascular anatomy, physiology and surgical techniques. Evaluate two important patient populations through a comprehensive case based pictorial approach: adults with surgically palliated CHD and adults with previously undiagnosed CHD.

**TABLE OF CONTENTS/OUTLINE**

Extraordinary advances in cardiac surgery, intensive care and noninvasive diagnosis have led to an enormous growth in the number of adults with CHD and an increasing utilization of cross-sectional imaging in those patients. Approximately 85% of babies born with cardiovascular anomalies can expect to reach adulthood and currently more adults than children have these malformations.

It is now possible to perform palliative or corrective surgery on almost all congenital cardiac anomalies. Survival cardiac patterns are affected, often profoundly. We are therefore confronted with a changing population of CHD and are obliged to look beyond the present.

Because many patients with treated CHD are being followed up into the 4th and 5th decades of life, this information does not exclusively fall within the domain of the pediatric radiologists but is instead vital to all radiologists.
Differentiating the Common from the Uncommon: Cardiac MRI Findings of Rare Non-Ischemic Cardiomyopathies

All Day Room: CA Community, Learning Center

Participants
Madhusudan S. Paravasthu, MBBS, FRCR, Toronto, ON (Presenter) Nothing to Disclose
Gianta Wong, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
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Daniel Vargas, MD, Denver, CO (Abstract Co-Author) Nothing to Disclose
Kate Hanneman, MD, FRCPC, Toronto, ON (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. Non-ischemic cardiomyopathies can be classified into morphologic phenotypes, including hypertrophic, dilated, arrhythmogenic, restrictive and unclassified. Each group can also be divided into familial and non-familial forms.2. Anderson Fabry disease is an uncommon cardiomyopathy characterized by hypertrophy with specific imaging features including reduced non-contrast T1 values and late gadolinium enhancement (LGE) at the basal inferolateral wall.3. Mutations in the dystrophin gene can result in an uncommon dilated phenotype of cardiomyopathy characterized by reduced function and LGE.4. Hyper-esosinophilia is an uncommon cardiomyopathy characterized by restriction and subendocardial LGE.5. Arrhythmogenic cardiomyopathy was originally described as a right ventricular disease but is now recognized to include biventricular and left-dominant forms less commonly.6. Left ventricular non-compaction is an example of an unclassified cardiomyopathy, characterized by a thick trabeculated non-compacted myocardial layer which can be complicated by thrombus formation and LV dysfunction.

TABLE OF CONTENTS/OUTLINE
1. Overview of current classification of cardiomyopathies2. Review of cardiac MRI techniques to assess function and myocardial tissue characterization3. Examples of rare cardiomyopathies highlighting unique and differentiating imaging features
Anatomic Pitfalls and Anomalies on ECG-gated CT

All Day Room: CA Community, Learning Center

Participants
Takashi Norikane, Kita-gun, Japan (Presenter) Nothing to Disclose
Yuka Yamamoto, MD, PhD, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose
Yoshihiro Nishiyama, MD, Kagawa, Japan (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

The major teaching points of this exhibit are: 1 Knowledge of the normal cardiac structures and variants will avoid misinterpretation for pathologic processes. 2 Knowledge of cardiac diseases on ECG-gated CT and clinical significance is important for radiologists to diagnose accurately.

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25 Tips for Performing Successful 320-row Cardiac CT

All Day Room: CA Community, Learning Center

Participants
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Kuni Ohtomo, MD, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
To learn how to extract maximal information from calcium scoring scan
To master techniques to overcome difficult situations in cardiac CT
To understand the relationship between time density curve and 320-row scan

TABLE OF CONTENTS/OUTLINE
Tips on calcium score scan
Look for extracardiac findings
Find elements that hamper further scan
Do not hesitate to abort further scan
Check the degree of artifact
Check the motion artifact of RCA and LAD
Tips on scanning parameter setting for cardiac CT
Diagonal patient positioning for long hearts
Widen acquisition window coronary arteries are moving on calcium score scan
Prediction of scan heart rate (HR)
Decreased HR with breathhold
Increased HR with breathhold "Phase shift"
Find static phase for Target CTA
Classify atrial fibrillation (Af) into 4 groups
Slow Af with nonfrequent fast beat
Slow Af without fast beat
Fast Af
Unpredictable Af
Frequent PACs
Frequent PVCs
Scan 2-3 beats under free breathing HR and breath cycle
Tips on the use of contrast material
Set the bolus tracking ROI within the scan range of diagnostic scan
Increase the amount of contrast material if there is aortic aneurysm
The meaning of time density curve in 320-row CT
Use biphasic contrast injection
Value Added Tool of T1 Mapping and ECV of Myocardium—What a Resident Needs to Know?

All Day Room: CA Community, Learning Center

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TEACHING POINTS
1. To understand pathophysiology of diffuse myocardial fibrosis.
2. To review basic physics behind T1 mapping sequence and ECV (extracellular volume).
3. How to apply understanding of T1 value and ECV for clinical purpose.

TABLE OF CONTENTS/OUTLINE
1. Pathophysiology – Increase in collagen volume fraction of myocardial tissue causes myocardial fibrosis.
2. Methods to detect fibrosis – a. Traditional: LGE – often subjective (with inter-observer variability) and diffuse fibrosis may be missed.
   b. Advanced: T1 mapping and ECV quantification.
3. Basic physics of T1 mapping and ECV – T1 maps are generated by acquiring a series of images with variable T1 weighting (example MOLLI: Modified Look-Locker inversion recovery). Each pixel in the map has a T1 value and this can be assessed by quantitative means or by color display. The reliability of T1 mapping is increased when hematocrit is taken into consideration which helps in computing the ECV.
4. Clinical use – Fibrosis is an independent predictor for outcome of different cardiac and systemic diseases. T1 mapping and ECV quantifies amount of fibrosis.
5. We will describe conditions with case examples where quantification of myocardial fibrosis helps in the diagnosis, prognostication, targeting biopsy and assessing treatment response.
Myocardial T1 Mapping-A Case Based Review

All Day Room: CA Community, Learning Center

Participants
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Prabhakar Rajiah, MD, FRCR, Dallas, TX (Presenter) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

TEACHING POINTS

Myocardial T1 mapping is emerging as an important non-invasive tissue characterization tool. The purpose of this exhibit is to review the physics and principles of myocardial T1 mapping. To understand the normal and abnormal myocardial T1 values. To illustrate the T1 mapping abnormalities in several myocardial pathologies. To understand the clinical significance of abnormal T1 values in several disorders. To discuss the pitfalls in T1 mapping.

TABLE OF CONTENTS/OUTLINE

1. Introduction
2. Physics and principles of T1 mapping
3. T1 mapping sequences (MOLLI, ShMOLLI, SASHA, SARC, SAPPHIRE), emphasizing pros and cons of each sequence in clinical practice
4. Techniques- Native non-contrast, Post-contrast, ECV fraction
5. Normal T1 values
6. Clinical Applications- Discussion, current evidence, and illustration of the following cases
   - Myocardial infarction-acute and chronic
   - Myocarditis
   - Amyloidosis
   - Hypertrophic cardiomyopathy
   - Dilated cardiomyopathy
   - Sarcoidosis
   - Hypertension
   - Aortic stenosis
   - Iron overload
   - Anderson-Fabry disease
   - Takotsubo cardiomyopathy
   - Pulmonary hypertension
   - Chemotherapy toxicity
   - Congenital disorders
7. Pitfalls
8. Future directions

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Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
Comprehensive Review of Coronary Artery Fistula from Beginning to End: Pathophysiology, Spectrum of Imaging Findings and Management

Awards
Certificate of Merit
Identified for RadioGraphics

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Eun Ju Chun, MD, PhD, Seongnam-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. To understand pathophysiology and clinical manifestations according to the various connection in coronary artery fistula (CAF).2. ECG-gated Coronary CT angiography (CCTA) is very effective for non-invasive evaluation of various connection from origin to drainage of CAF.3. CCTA is a promising tool to guide the treatment plan and to assess the post-procedural complication.

TABLE OF CONTENTS/OUTLINE
The 'Burning Heart': Cardiac Vasculitis

All Day Room: CA Community, Learning Center

Awards
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TEACHING POINTS

To review the physiopathological, clinical and imaging findings of vasculitis and other systemic diseases with vasculitic component. To analyze the differential diagnosis regarding different spectrum of cardiac involvement (pericarditis, myocarditis, valvulopathy and coronary vasculitis) with special focus on derived cardiac imaging biomarkers.

TABLE OF CONTENTS/OUTLINE

1. Introduction
2. Imaging modalities in vasculitis
   2.2. Cardiac CT
   2.2. Cardiac MRI
   2.2. 18FDG-PET/CT
4. Cardiac vasculitis: general classification and spectrum of cardiac involvement
   4.1. Large vessel vasculitis- Takayasu arteritis- Giant cell arteritis
   4.2. Medium vessel vasculitis- Polyarteritis nodosa
   4.3. Small – vessel vasculitis- Eosinophilic granulomatosis with polyangiitis- Granulomatosis with polyangiitis and microscopic polyangiitis- Cryoglobulinemic vasculitis
   4.4. Variable – vessel vasculitis: Bheçet’s disease
   4.5. Other entities with vasculitic component- Rheumatoid vasculitis- Systemic Lupus erythematosus- IgG4 related disease
5. Conclusion

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Sanjeev Bhalla, MD - 2014 Honored Educator
Sanjeev Bhalla, MD - 2016 Honored Educator
Update on Cardiovascular Applications of Spectral CT

All Day Room: CA Community, Learning Center

Awards
Identified for RadioGraphics

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Prabhakar Rajiah, MD, FRCR, Dallas, TX (Presenter) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

TEACHING POINTS
1. To review the different implementations of spectral CT technology
2. To discuss updates on the utility of spectral CT in cardiovascular imaging.
3. To highlight the applications of spectral CT utilizing several case examples.
4. To demonstrate the pitfalls of spectral CT.

TABLE OF CONTENTS/OUTLINE
Physics of spectral CT
Different technologies of spectral CT - Dual source, rapid kV switching, dual layer, dual spin, split beam, photon counting
Comparison of different technologies, advantages, limitations
Spectral images - Iodine, Virtual non contrast, effective Z, virtual monochromatic
Cardiovascular applications of spectral CT with clinical case example
- Myocardial perfusion
- Delayed enhancement for scar
- Plaque characterization
- Artifact reduction - Stent
- Artifact reduction - Other metals
- Artifact reduction - Calcium blooming
- Artifact reduction - beam hardening
- Low contrast dose studies
- Salvage of suboptimal enhanced studies
- Quantification of myocardial iron
- Pulmonary perfusion
- Pulmonary embolism and others
- Virtual non contrast - Radiation dose savings
- Virtual calcium score
- Characterization of incidental lesions

Updates on utility of spectral CT in cardiovascular system
Future directions

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Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
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TEACHING POINTS
MSCT Technique for Inferior Vena Cava Imaging Imaging appearances of various congenital anomalies and pathologies of Inferior Vena Cava

TABLE OF CONTENTS/OUTLINE
Inferior Vena Cava – Anatomy, congenital anomalies and pathologiesMSCT technique & Pitfalls MSCT imaging appearances of various congenital anomalies and pathologies of Inferior Vena CavaSummary
Multimodality Imaging of Cardiovascular Infections

All Day Room: CA Community, Learning Center

Awards
Certificate of Merit

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TEACHING POINTS

To review the different infections that affect the cardiovascular system. To discuss the role of different imaging modalities in the evaluation of cardiovascular infections. To illustrate the imaging appearances of several cardiovascular infections. To review the role of hybrid modalities like PET/CT and PET/MR in providing both anatomic and metabolic information.

TABLE OF CONTENTS/OUTLINE

Introduction
Role of imaging modalities- CT, MRI, echo, PET/CT, PET/MRI
Advantages and disadvantages of each modality
Echocardiography- Easily available, operator dependent, limited FOV
CT- Good spatial, temporal resolutions, MPR capabilities, wide FOV, radiation, contrast MRI- Good spatial, temporal resolution, multiplanar imaging capabilities, wide FOV, NSF, contraindications
PET/CT and PET/MRI- Metabolic information

4. Review of several infections, with imaging appearances of the following.
Myocarditis- Viral- PBV-16, HHV-6, etc
Myocarditis- Tuberculous, bacterial Chagas disease
Pericarditis- Viral Pericarditis- Tuberculous
 Infective endocarditis
Prosthetic valve endocarditis
Rheumatic fever
Syphilis
Loeffler endocarditis
Graft infection-
Staphylococcus Hydatid disease
Infectious aortitis
Mycotic aneurysm of thoracic aorta
Mycotic aneurysm of the pulmonary artery
Infected vascular grafts.

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Prabhakar Rajiah, MD, FCR - 2014 Honored Educator
Comprehensive Role of MRI in Multimodality Evaluation of the Right Ventricle: A Case-based Review of Algorithmic Approach

All Day Room: CA Community, Learning Center

Awards
Certificate of Merit

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TEACHING POINTS
To review the common and uncommon causes of right ventricular (RV) dilation. To discuss the role of several imaging modalities in evaluation of RV dilation. To discuss the comprehensive role of MRI in the evaluation of RV dilation. To illustrate the imaging appearances of various causes of RV dilation

TABLE OF CONTENTS/OUTLINE
Introduction Definition of RV dilation- Normal and abnormal RV Causes of RV dilation- Volume overload, Shunts, Pressure overload, cardiomyopathies, congenital Role of imaging modalities- Echo, CT, angiography, PET/CT Advantages of MRI MRI sequences- Black blood- Morphology; Cine SSFP- Systolic septal flattening, ventricular volumes, function, myocardial mass, morphology, TAPSE; Strain imaging- Regional myocardial function; Flow imaging- Pulmonary, systemic flow, shunt quantification, arterial stiffness, cardiac output; MR angiography- Vascular anatomy, pulmonary perfusion; Late gadolinium enhancement- Tissue characterization; T1 mapping- Tissue characterization, prognosis Illustration of common causes of RV dilation with sample cases- Tricuspid regurgitation, pulmonic regurgitation, ASD, VSD, PDA, PAPVR, pulmonary hypertension (arterial, venous), Ebstein anomaly, Uhl anomaly, Double chamber RV, ARVD, RV infarction, dilated CMP, non-compaction, sarcoidosis Multimodality imaging algorithm for evaluation of RV dilation

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Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
CA155-ED-X

Contrast Dose Reduction Strategies in Pre-TAVR CTA: Matching the Appropriate Dose to the Correct Patient

All Day Room: CA Community, Learning Center

Awards
Certificate of Merit

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TEACHING POINTS
The presence of multiple comorbidities in pre TAVR patients, along with the need for an accurate assessment of vascular anatomy, necessitates an in-depth triaging system to ensure accurate pre-procedural CT evaluation of the aortic root, thoracoabdominal aorta, and iliac arterial system. Discuss radiologist and CT technologist specific tasks and considerations Present a comprehensive triaging system for patient selection and scanning

TABLE OF CONTENTS/OUTLINE
Until recently, we offered two options for these patients: Routine full-dose and Non-contrast Pre TAVR exams. With recent advances in CT scanning technology, we have been able to do two things, reduce the total amount of iodinated IV contrast and reduce the amount of radiation. However, this is not a "one-size fits all" answer. We have developed a triaging system to help guide radiologists to a decision. Pre-TAVR Triage Exam Type Scanning Technique Scanner Technology IV Contrast Patient Considerations Additional Considerations Advantages & Disadvantages Routine Clinical Cases Full, low & ultra-low IV contrast dose
A New Method of Coronary Analysis Using Computational Fluid Dynamics (CFD). ~ Evaluation of Collateral Channels in Chronic Total Occlusion (CTO) ~

All Day Room: CA Community, Learning Center

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Daisuke Kittaka, RT, tokyo, Japan (Presenter) Nothing to Disclose
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TEACHING POINTS
1. To explain principle of CFD analysis
2. To evaluate the collateral channels from coronary CT using CFD analysis
3. To learn a problem of retrograde approach in CTO cases
4. To introduce a new method of the collateral channels using CFD analysis

TABLE OF CONTENTS/OUTLINE
1. Introduction (Principle of CFD analysis)
2. Basic examination using the simulated blood vessel phantom
3. Evaluation of the collateral channels using CFD analysis in clinical cases
4. Summary and future prospect of a new method by posture
Participants
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Cardiac Sunday Case of the Day

Sunday, Nov. 27 7:00AM - 11:59PM Room: Case of Day, Learning Center

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TEACHING POINTS

1) Identify pertinent findings and generate differential diagnosis for cardiac imaging studies. 2) Develop differential diagnoses based on the clinical information and imaging findings. 3) Recommend appropriate management for patients based on imaging findings.

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Rahul D. Renapurkar, MD - 2016 Honored Educator
Suhny Abbara, MD - 2014 Honored Educator
Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
Cardiac (Anatomy and Function)

SSA03-01 Imaging of Pericardiophrenic Bundles Using Multislice Spiral Computed Tomography for Phrenic Nerve Anatomy

Participants
Hong Zeng, MD, PhD, Changchun, China (Presenter) Nothing to Disclose
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Lin Liu, Changchun, China (Abstract Co-Author) Nothing to Disclose

PurPOSE
Phrenic nerve injury and diaphragmatic stimulation are common complications following arrhythmia ablation and cardiac pacing therapies. This study aimed to investigate the feasibility of utilizing non-invasive multi-slice spiral CT imaging to assess the phrenic nerve anatomy pre-operatively to reduce the electrophysiological procedure related complications both intra-operatively and post-operatively.

METHOD AND MATERIALS
Coronary CT angiography data of 121 consecutive patients was collected. Imaging of left and right pericardiophrenic bundles was performed with volume rendering and multi-planar reformation techniques. The shortest spatial distances between phrenic nerves and key anatomical structures likely to be at risk during interventional electrophysiological procedures were determined. The frequency of the spatial shortest distances ≤ 5 mm, > 5 mm, and direct contact or intersection between phrenic nerves and adjacent structures were calculated.

RESULTS
Left and right phrenic nerves were identified in 86.8% and 51.2% of the enrolled patients, respectively (P < 0.001). The right phrenic nerve was < 5 mm from right superior pulmonary vein ostium and main branches, and right inferior pulmonary vein ostium and main branches in 12.9%, 92.0%, 0% and 3.2% of the patients, respectively. The percentage of left phrenic nerve, < 5 mm from right atrium, superior caval vein, and superior caval vein-right atrium junction was 87.1%, 100% and 3.2%, respectively. Left phrenic nerve was < 5 mm from left atrial appendage, great cardiac vein, anterior interventricular vein, middle cardiac vein, and left ventricular posterior vein in 81.9%, 0.0%, 39.1%, 28.6% and 91.4% of the patients, respectively. Merely 0.06% left phrenic nerves had a distance < 5 mm with left superior pulmonary vein main branches, and none left phrenic nerve (0%) showed a distance < 5 mm with left superior pulmonary vein ostium, or left inferior pulmonary vein ostium and main branches.

CONCLUSION
One-stop enhanced coronary CT angiography enabled detection of phrenic nerve courses and their anatomical relationship with adjacent structures, which might be a promising method to apply clinically before interventional procedures in cardiac electrophysiology.

CLINICAL RELEVANCE/APPLICATION
Preoperative comprehension of phrenic nerve anatomy via non-invasive CT imaging may help to minimize the complications of phrenic nerve injury and diaphragmatic stimulation in interventional electrophysiology.

SSA03-02 Multiparametric Structure-Function Cardiac MR in the Assessment of Cardiotoxicity in Breast Cancer Patients Receiving Chemotherapy

Participants
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James C. Carr, MD, Chicago, IL (Abstract Co-Author) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

PurPOSE
Cardiotoxicity following chemotherapy affects 10-20% of patients receiving chemotherapy and may lead to acute or chronic heart failure. Newer tissue characterization/functional cardiac magnetic resonance (CMR) techniques may allow earlier detection of toxicity thereby facilitating earlier intervention. Here, we aimed to assess whether CMR techniques can detect early myocardial abnormalities in patients with suspected cardiotoxicity.

METHOD AND MATERIALS
18 healthy subjects (age: 51.66±16.09 y) and 12 patients (age: 54.15±11.18 y) with recent history of breast cancer and chemotherapy, who presented with more than 5% drop in LV ejection fraction (LVEF) by echocardiography were recruited. Tissue phase mapping (TPM) and T1 mapping pre and post contrast images were acquired in short axis and long axis orientations on a 1.5 T MRI scanner. T1 values were measured segmentally from TPM images.
RESULTS
Native T1 values were significantly higher in patients compared with controls (1046±32 vs. 974±40 ms, p<0.001). TPM analyses showed that global systolic radial and long axis velocities were significantly lower in patients compared with controls [(2.340.5 vs. 2.940.5 cm/s, p=0.004), and (3.4±1.4 vs. 4.9±1.8 cm/s, p=0.025), respectively]. Diastolic velocities were also lower in patients than controls, but the difference was not statistically significant (p=0.05). There was a strong association between EF (i.e. lowest EF% recorded during course of treatment) and radial systolic and diastolic velocities [(r=0.66, p=0.017) and (r=0.52, p=0.028), respectively] and also calculated ECV (r=0.72, p=0.016).

CONCLUSION
Preliminary CMR results show lower TPM-derived myocardial velocities in patients with suspected cardiotoxicity compared to controls. T1 and ECV were higher in patients vs controls and global EF correlated with both regional myocardial velocities and ECV. Work is ongoing to assess the value of multiparametric structure-function CMR for early detection of myocardial abnormalities in patients receiving potentially cardiotoxic chemotherapy agents.

CLINICAL RELEVANCE/APPLICATION
Multiparametric structure-function CMR may act as a surrogate for early detection of myocardial abnormalities in patients receiving potentially cardiotoxic chemotherapy agents.

SSA03-03  Myocardial Strain Evaluation in Thalassemia Major: Use of Tagging Sequence

PURPOSE
To measure the range of endocardial fractional shortening obtained with CT SQUEEZ in the normal human left ventricle (LV).

METHOD AND MATERIALS
Regional myocardial function was measured at 20 time points over the entire LV endocardium in 13 humans with normal LV function (ejection fractions between 60% and 80%) using coronary CT imaging protocols from two vendors (Siemens and Toshiba). Regional endocardial contraction was quantified by average SQUEEZ values in 16 standard AHA segments of the LV. CT Fractional Shortening (FScet) was computed as FScet=(1-SQUEEZ). Mean and standard deviation of Fractional Shortening values were computed in each segment to estimate the range of values expected in the normal LV as derived from SQUEEZ.
RESULTS
Calculating each SQUEEZ time frame over the entire left ventricle endocardium required ~30 seconds of compute time on a 2.8 GHz Intel Core i7 computer. The curves describing SQUEEZ vs. time were very consistent between hearts, and segments within each heart. There was a slight gradient of decreasing minimum SQUEEZ value (increased Fractional Shortening) from the base to the apex of the heart. The mean values, and standard deviations of FSct computed at end-systole over the segments were: Base = 33% ± 1%, Mid = 34% ± 1.5%, Apex = 37% ± 1%. The standard deviation of the maximum systolic FSct in each segment over the 13 hearts was 5%. This suggests a very tight guideline for calling a segment normal.

CONCLUSION
CT SQUEEZ is a simple, robust, operator independent method for measuring regional wall function over the entire left ventricle. SQUEEZ can be rapidly obtained in humans from standard cardiac gated CT protocols independent of vendor. A normal range of values of Fractional Shortening derived from SQUEEZ can be used to characterize normal local LV function: we estimate that 95 percent of normal LV end-systolic FSct values will fall between 33% and 47%. Therefore, FSct values lower than 33% indicate hypokinetic segments in the human heart.

CLINICAL RELEVANCE/APPLICATION
CT SQUEEZ is a simple, robust, operator independent method to measure quantitative regional LV function in the human heart using currently available coronary CTA protocols in as few as one heartbeat.

SSA03-05
Ventricular Deformation Assessed on Cardiac MRI Cine Images Correlated with Haemodynamics with Patients with Connective Tissue Disease Associated Pulmonary Artery Hypertension

Participants
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PURPOSE
To identify the correlation of cardiac function and ventricular strain assessed on cardiac MRI cine images with hemodynamics of right heart catheterization in patients with connective tissue disease associated pulmonary artery hypertension.

METHOD AND MATERIALS
After informed consent, 25 patients (age, 35.1±11.0years; male/female=2/23) with right heart catheterization proved connective tissue disease associated pulmonary artery hypertension (SLE/pSS/SSc/overlap=12/2/1/10; mPAP, 45.0±16.1mmHg) were included. Cardiac MRI (3.0T, Magnetom Skyra Siemens, Germany) was performed before treatment was given. Cardiac function was measured on cine images using Argus software (Siemens, Germany). Ventricular deformation was measured as the average total peak systolic strain in longitudinal, radial and circumferential direction on cine images using cvi42 software (version 5.3, Circle Cardiovascular Imaging, Canada). Spearman correlation was used.

RESULTS
Longitudinal strain of the RV correlated with sPAP (r=0.635, P=0.020), dPAP (r=0.718, P=0.006), mPAP (r=0.718, P=0.003) and PVR (r=0.693, P=0.001). Radial strain of the RV correlated with sPAP (r=0.682, P=0.010), dPAP (r=0.753, P=0.003), mPAP (r=0.685, P=0.001) and PVR (r=0.680, P=0.002). Circumferential strain of the RV correlated with sPAP (r=0.559, P=0.047) and dPAP (r=0.555, P=0.049). There was no significant correlation between right heart catheterization results with strain of the left ventricle. There was no significant correlation between right heart catheterization results with EDV or EF of the LV or RV.

CONCLUSION
RV strain measured on cardiac MRI cine images correlates with right heart catheterization results in patients with connective tissue disease associated pulmonary artery hypertension, and is promising to reflect the degree of RV afterload and identify early cardiac dysfunction.

SSA03-06
Submillisievert Median Radiation Dose for 4D Functional Cine Cardiac CT with a Third-generation Dual-source CT Scanner

Participants
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Hajime Sakuma, MD, Tsu, Japan (Abstract Co-Author) Departmental Research Grant, Siemens AG; Departmental Research Grant, Bayer AG; Departmental Research Grant, Queret SA; Departmental Research Grant, DAIICHI SANKYO Group; Departmental Research Grant, FUJIFILM Holdings Corporation; Departmental Research Grant, Nihon Medi-Physics Co, Ltd

PURPOSE
Continuous retrospectively ECG-gated multislice volume scanning allows 4D functional ( cine) cardiac CT imaging with 3D reconstruction of the heart volume. However, its clinical use is limited due to high radiation (~20mSv). In this study, we propose a new data acquisition/post-processing scheme for cine CT assessment of cardiac function with less than 1mSv. Its accuracy was evaluated by comparing with standard cine CT.

METHOD AND MATERIALS
This study was performed in ten consecutive patients (4 men, mean age: 82 years) who were referred for cine cardiac CT before transcatheter aortic valve implantation planning. Retrospective ECG-gating low tube voltage (70kV) scan was acquired 20 seconds after the end of acquisition of standard retrospective ECG-gating cine CT at 120kV using 3rd generation dual-source CT ( SOMATOM Force; Siemens, Forchheim, Germany). Delay of 20 seconds was set so that the low-dose cine CT can capture the recirculation of contrast medium injected for standard cine CT scan. Twenty axial image series were reconstructed every 5% (0-95%) of the RR-interval. Then, low-dose images were post-processed with the non-rigid registration-based noise reduction algorithm (PhyZiodynamics; Ziosoft, Tokyo, Japan).

RESULTS
Mean DLP of low-dose CT was significantly lower compared to standard scan (63.6±26.3mGy-cm vs 1472.2±527.5mGy-cm, p=0.005). End-systolic volume, end-diastolic volume, ejection fraction and left ventricular (LV) mass by low-dose CT agreed well with standard scan (bias±SD, -8.6±7.7mL, r=0.98; -4.5±3.9mL, r=0.99; 0.7±4.2%, r=0.99; 1.2±12.5g, r=0.98) in spite of lower contrast-to-noise ratio of LV cavity to myocardium (3.9±1.4 vs 23.7±9.3, p=0.005). Contrast-to-noise ratio of right-ventricular cavity to myocardium was higher with low-dose scan (3.4±1.4 vs 1.9±1.6, p=0.007).

CONCLUSION
Proposed low-dose cine cardiac CT scheme allows for accurate assessment of LV function with less than 1 mSv. By exploiting the recirculation of contrast medium used for coronary CT angiography, this method can be combined with any coronary CT acquisition protocol without additional contrast injection.

CLINICAL RELEVANCE/APPLICATION
Routine implementation of cine cardiac CT assessment of LV and RV function in coronary CT examinations may become feasible with the proposed ultralow-dose method.

SSA03-07 Cardiac Function and Ventricular Deformation Assessed on Cardiac MRI Cine Images are Impaired in Connective Tissue Disease Associated Pulmonary Artery Hypertension Patients Without Late Gadolinium Enhancement

Sunday, Nov. 27 11:45AM - 11:55AM Room: S502AB

Participants
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PURPOSE
To assess the cardiac function and ventricular deformation on cardiac MRI cine images in patients with connective tissue disease associated pulmonary artery hypertension, and in subgroup patients without late gadolinium enhancement (LGE).

METHOD AND MATERIALS
After informed consent, 25 patients (age, 35.1±11.0years; male/female=2/23) with right heart catheterization proved connective tissue disease associated pulmonary artery hypertension (SLE/pSS/SSc/overlap=12/2/1/10; mPAP, 45.0±16.1mmHg) and 10 healthy control subjects (age, 27.3±6.0years; male/female=1/9) were included. Cardiac MRI (3.0T, Magnetom Skyra Siemens, Germany) was performed before treatment was given. Patients were further divided into two subgroups with LGE or without LGE. Cardiac function was measured on cine images using Argus software (Siemens, Germany). Ventricular deformation was measured as the average total peak systolic strain in longitudinal, radial and circumferential direction on cine images using cvi42 software (version 5.3, Circle Cardiovascular Imaging, Canada). Mann-Whitney U test was used.

RESULTS
There were significant differences of RVEF (34.6±12.74% vs. 56.7±4.93%, p=0.002) and RV radial strain (25.50±10.89% vs. 45.04±18.85%, p=0.024) between all patients and healthy subjects. There were 18 patients with LGE, which mainly located in the ventricular insertion point of the inter-ventricular septum, and 7 patients without LGE. There was significant difference of RVEF (32.07±6.26% vs. 56.7±4.93%, p=0.003) and RV radial strain (20.5±46.10% vs. 45.04±18.84%, p=0.018) between patients without LGE and healthy subjects. There was no significant difference of RV strain, RVEF or RVEDV between subgroups.

CONCLUSION
In connective tissue disease associated pulmonary artery hypertension patients, RVEF and radial strain assessed on cardiac MRI cine images are significantly impaired, and help identify the early cardiac dysfunction in patients without LGE.

CLINICAL RELEVANCE/APPLICATION
In CTD associated PAH patients, RVEF and radial strain assessed on cardiac MRI cine images are significantly impaired, and help identify the early cardiac dysfunction in patients without LGE.

SSA03-08 Visualization Method of Myofiber Structure of the Left Ventricle Apex from Micro CT Volumes

Sunday, Nov. 27 11:55AM - 12:05PM Room: S502AB

Participants
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PURPOSE
Understanding the myofiber structure of the left ventricular apex is a challenging task due to high complexity of the underlying structures, as well as the restriction imposed because of the thickness of fiber bundles. In this study, we propose a visualization method for understanding each distinct layer.

METHOD AND MATERIALS
We create a specimen of the left ventricular apex from a dog's heart infiltrated with paraffin wax. We obtain a micro CT volume of the specimen by using a micro-focus X-ray CT scanner, inspeXio SMX-90CT, Shimadzu (Japan). The micro CT volume consists of 1024×1024×545 voxels, and the size of each voxel is 51.6×51.6×51.6 μm. The set the initial points as grid pattern on a micro CT volume. For each initial point, fiber tracking is performed. The eigenvector corresponding to the smallest eigenvalue of Structure Tensor (ST) is then assumed to represent the myofiber direction. Short tracking trajectories are eliminated. We utilize a visualization tool, Paraview, for flexible viewing setting. It is possible to show only some part of the result, only one range of the direction, etc. We define the axis and utilize it to compute the myofiber direction. Color scheme is defined for representing the myofiber direction at each point: -60° with red, 0° with blue, and +60° with green.

RESULTS
Myofiber around the left ventricular apex was extracted. Considering only one axial part, three layers were clearly identified by colors: endocardium with red, myocardium with blue, and epicardium with green. However, there were several wrong trajectories at each layer, so we should improve tracking accuracy. For viewing each layer, we looked at myofiber in a limited range of directions: around -60°, 0°, and +60°. Rough flow of each layer and location of singular point of each layer could be highlighted. Basically, due to the fact that there exists a high similarity
between the dog's cardiac anatomy and the human's, this approach could also be applicable to the human's heart.

CONCLUSION

We proposed a method for visualizing the myofiber structure of the separability of the left ventricular apex. Future work will involve improving both the accuracy of the fiber tracking approach and separability of each individual layer and addressing how to utilize micro CT volumes of the human heart for diagnostic purposes.

CLINICAL RELEVANCE/APPLICATION

This approach enables medical students to learn anatomical structure of the myofiber.

SSA03-09 Validation of CMR 4D Flow against Cardiac CT for Left Ventricular Function Quantification

Sunday, Nov. 27 12:05PM - 12:15PM Room: S502AB

Participants
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PURPOSE

4D MR flow is a rapidly evolving technique, offering both anatomical and functional information in just a single acquisition. The purpose of this study was to use the anatomical information from the 4D flow sequence, assess the global left ventricular function and compare the results with the functional cardiac CT acquisitions.

METHOD AND MATERIALS

Between November 2015 and February 2016, we prospectively included 10 consecutive adult patients (4 females, mean age 35 yo) known with bicuspid aortic valve. The MR and CT scan were performed in the same day. The 4D flow raw data sets were uploaded to a dedicated web-based software application (Arterys Inc., San Francisco, CA, USA). Images were reconstructed in 20 cardiac temporal phases separately with a compressed sensing algorithm. The end-diastolic, end-systolic and stroke volumes and ejection fractions were measured by CMR 4D flow. Cardiac CT was also reconstrucite in 20 cardiac phases and measurements were performed in a similar method as used for 4D flow. In both modalities papillary muscles were included in the left ventricle cavity.

RESULTS

The mean end-diastolic, end-systolic stroke volumes and ejection fraction were 164(±34) ml, 69(±18) ml, 94 (±19) ml and 58 (±4)% respectively for CMR 4D flow and 183 (±43) ml, 67 (±21) ml, 117 (±25) ml, 64 (±5)% respectively for cardiac CT. The Pearson's correlations between CMR 4D flow and CT were 0.91, 0.86, 0.94 and 0.83 for end-diastolic, end-systolic, stroke volumes and ejection fraction respectively.

CONCLUSION

In this study we showed that global left ventricular function can be quantified accurately using CMR 4D flow imaging analysed using a cloud based software

CLINICAL RELEVANCE/APPLICATION

CMR 4D flow may replace the standard CMR acquisition.
PURPOSE
The objectives of this study were to compare the prevalence and extent of coronary atherosclerosis as detected by coronary computed tomography angiography (CCTA) in African-American women with and without a history of prior pregnancy complications.

METHOD AND MATERIALS
We retrospectively evaluated patient characteristics and CCTA findings in groups of African-American women with a prior history of preterm delivery (n=154), preeclampsia (n=137), or gestational diabetes (n=148), and a matched control group of African-American women who gave birth without such complications (n=445). Univariate and multivariate analyses were performed to assess predictors of coronary atherosclerosis.

RESULTS
Average age at delivery and CCTA, number of pregnancies, body-mass-index, smoking history, and prevalence of hypertension or hyperlipidemia were similar between groups (all P>0.2). All groups with prior pregnancy complications showed higher rates of any (≥20% luminal narrowing) and obstructive (≥50% luminal narrowing) coronary atherosclerosis (preterm delivery: 29.2% and 9.1%; preeclampsia: 29.2% and 7.3%; gestational diabetes: 47.3% and 15.5%) compared to control women (23.8% and 5.4%). After accounting for confounding factors at multivariate analysis, gestational diabetes remained a strong predictor of any (OR 3.26; 95% confidence interval 2.03-5.22; P<0.001) and obstructive coronary atherosclerosis (OR 3.00; 95% confidence interval 1.55-5.80; P<0.001) on CCTA.

CONCLUSION
African-American women with a history of pregnancy complications have a higher prevalence of coronary atherosclerosis on CCTA while only a history of gestational diabetes was an independent predictor of any and obstructive coronary atherosclerosis on CCTA in our study.

CLINICAL RELEVANCE/APPLICATION
Healthcare providers should consider pregnancy complications a risk factor for future coronary atherosclerosis, especially in African-American women, and monitor affected women more aggressively for coronary risk factors for premature atherosclerosis.
SSA04-06  

Pattern of Coronary Calcifications as an Independent Predictor of Obstructive Coronary Stenosis in Patients with Suspected Coronary Heart Disease

Jae Wook Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this study is to evaluate that the non-ECG gated low dose chest CT (LDCT) for lung cancer screening can be used to predict the coronary atherosclerosis in asymptomatic population by measuring epicardial adipose fat tissue (EAT) area.

METHOD AND MATERIALS

Among 2,036 self-referred subjects who underwent LDCT for lung cancer screening and simultaneously took the coronary CT angiography (CCTA) for detecting the coronary artery disease from January 2010 to December 2015, we included adults aged 55-80 with a history of smoking who were considered for lung cancer screening by LDCT. LDCT_EAT shows very strong correlation with CCTA_EAT and has independent statistical significance to predict atherosclerosis.

CLINICAL RELEVANCE/APPLICATION

Radiologists will be able to predict the coronary atherosclerosis by measuring EAT area in those who take LDCT for lung cancer screening.

SSA04-04  

Potential Impact of Noninvasive FFRct to Guide Therapy in Chest Pain Patients with Intermediate (50-70%) CTA Stenosis: Can It Reduce Cost, Risk and Radiation Exposure?

Sunday, Nov. 27 11:15AM - 11:25AM Room: SS04AB

Participants

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PURPOSE

Can utilization of FFRct reduce cost, risk and radiation exposure in symptomatic patients with 50-70% CTA stenosis by reducing the number of “unnecessary” ICA-FFR examinations?

METHOD AND MATERIALS

Retrospective analysis of 48 patients with stable chest pain, positive exercise ECG and intermediate (50-70%) CTA stenosis who were referred for ICA and FFR examination. Blinded FFRct analysis. Determination of diagnostic accuracy of FFRct vs CTA using FFR as reference standard. Evaluation of potential impact of clinical adoption of FFRct to guide clinical decision making; “unnecessary” ICA-FFR examinations defined as FFR in all vessels >0.80.

RESULTS

FFRct had higher diagnostic accuracy than CTA (83% vs 29%) with higher PPV (69% vs 29%) and a sixfold reduction in false positives. Using invasive FFR-guided therapy, 34/48 patients (71%) had nonobstructive CAD (FFR >0.80) and were treated medically; 14 (29%) had FFR ≤0.80 and were revascularized (8 PCI, 6 CABG). There were no major adverse cardiac events. Use of a FFRct-guided strategy would have reduced “unnecessary” ICA-FFR procedures by 85%, thereby reducing the inherent risk of an invasive procedure. Assuming a cost of 1000€ per FFRct analysis, an overall cost reduction of 30% would have been achieved. Furthermore, radiation dose exposure would have been reduced by 63%, assuming an average dose of 2.1 mSv for CTA and 4.8 mSv for ICA.

CONCLUSION

Utilization of FFRct analysis in the evaluation of symptomatic patients with intermediate CTA stenosis may result in fewer “unnecessary” invasive ICA-FFR examinations with reduced costs, risks and radiation dose exposure.

CLINICAL RELEVANCE/APPLICATION

Utilization of FFRct analysis in the evaluation of symptomatic patients with intermediate CTA stenosis may result in fewer “unnecessary” invasive ICA-FFR examinations with significantly reduced costs, risks and radiation dose exposure.
Coronary calcium scores have poor correlation with absence of CAD in this population. The prevalence of CAD in South Asian subjects with cardiac chest pain is high, as defined by CCTA. Unlike Western countries, low CLINICAL RELEVANCE/APPLICATION subjects, where 53% of those with CCS=0 AU and 82% of those with CCS 1-100 AU already have ≥ 70% stenosis, respectively. A coronary calcium score =0, thought to represent a low burden of CAD, has limited utility in low to intermediate risk South Asian CONCLUSION presence of CAD (r=-0.1,p=0.6). We enrolled a total of 100 subjects (52±9 years; 71% males). The mean CCS was 94±166 AU, and 83% had a low risk FRS. 72% of subjects with a low CCS (<100 AU), there was a weak correlation with CCS and the absence of CAD (r=0.23, p=0.74). CAD was present on CCTA in 53% of subjects with CCS=0 AU (n=20), 82% of subjects with CCS 1-100 AU (n=27), and 86% of subjects with CCS>100 AU (n=25). There was no correlation between FRS and presence of CAD (r=−0.1, p=0.6). CONCLUSION Clustered coronary calcium, represented by type III pattern, has higher than expected incidence of OCS. This pattern may be a predictor of OCS independent of CS. CLINICAL RELEVANCE/APPLICATION Incorporation of CAC pattern information to CS may enhance prediction of clinically significant OCS. RESULTS A total of 369 patients were evaluated. The distribution by CAC types were type I: 101 (27.4%), type II: 86 (23.3%), type III: 40 (10.8%), type IV: 57 (15.5%), and type V: 85 (23.0%). As expected, CS significantly increases from type I to V (P < 0.001). A greater proportion of OCS cases are found in type III (33, 85.0%) and type V (65, 76.5%) relative to other types (P < 0.001). In particular, a greater incidence of OCS is found in type III than predicted by CS. The diagnostic performance of CS for detecting OCS for all patients, expressed as the area under the ROC curve, was 0.86 (95% CI: 0.81, 0.90; P < 0.001). By removing patients with type III pattern, the area increases to 0.93 (95% CI: 0.89, 0.96; P < 0.001).

CONCLUSION
Clustered coronary calcium, represented by type III pattern, has higher than expected incidence of OCS. This pattern may be a predictor of OCS independent of CS.

METHOD AND MATERIALS
With retrospective IRB approval, patients who underwent coronary calcium scan and coronary CTA between 2009 and 2015 and found to have CAC were identified. Patterns of CAC were classified into five types, from I to V, generally with increasing calcium burden. Type I is characterized by single calcification, type II by a few sparsely distributed calcifications, type III by focal cluster of calcification, type IV by diffusely distributed calcifications without clustering, and type V by heavy burden of diffuse calcifications with or without clustering. OCS is defined as one or more greater than 50% stenosis found anywhere in a coronary CTA. Incidence of OCS is correlated with CAC types and CS. Area under the ROC curve is calculated for CS as a predictor of OCS.

RESULTS
A total of 369 patients were evaluated. The distribution by CAC types were type I: 101 (27.4%), type II: 86 (23.3%), type III: 40 (10.8%), type IV: 57 (15.5%), and type V: 85 (23.0%). As expected, CS significantly increases from type I to V (P < 0.001). A greater proportion of OCS cases are found in type III (33, 85.0%) and type V (65, 76.5%) relative to other types (P < 0.001). In particular, a greater incidence of OCS is found in type III than predicted by CS. The diagnostic performance of CS for detecting OCS for all patients, expressed as the area under the ROC curve, was 0.86 (95% CI: 0.81, 0.90; P < 0.001). By removing patients with type III pattern, the area increases to 0.93 (95% CI: 0.89, 0.96; P < 0.001).

CONCLUSION
Clustered coronary calcium, represented by type III pattern, has higher than expected incidence of OCS. This pattern may be a predictor of OCS independent of CS.

CLINICAL RELEVANCE/APPLICATION
Incorporation of CAC pattern information to CS may enhance prediction of clinically significant OCS.

METHOD AND MATERIALS
We performed a prospective study at two centers involving subjects without known CAD referred for CCTA due to cardiac chest pain. Patients were excluded if they had a high pre-test likelihood of CAD (as determined by guideline based risk calculators) or if ejection fraction was <50%. Scans were performed on a 128-slice MDCT according to contemporary protocols. CCS and CAD severity were classified as per current guidelines. FRS was calculated to predict long term risk of CAD.

RESULTS
We enrolled a total of 100 subjects (52±9 years; 71% males). The mean CCS was 94±166 AU, and 83% had a low risk FRS. 72% of the study population had ≥ 1 vessel with ≥ 70% stenosis. In subjects with a low CCS (<100 AU), there was a weak correlation with CCS and the absence of CAD (r=0.23, p=0.74). CAD was present on CCTA in 53% of subjects with CCS=0 AU (n=20), 82% of subjects with CCS 1-100 AU (n=27), and 86% of subjects with CCS>100 AU (n=25). There was no correlation between FRS and presence of CAD (r=−0.1, p=0.6).

CONCLUSION
A coronary calcium score =0, thought to represent a low burden of CAD, has limited utility in low to intermediate risk South Asian subjects, where 53% of those with CCS=0 AU and 82% of those with CCS 1-100 AU already have ≥ 70% stenosis, respectively. There is no relation between FRS and presence of CAD.

CLINICAL RELEVANCE/APPLICATION
The prevalence of CAD in South Asian subjects with cardiac chest pain is high, as defined by CCTA. Unlike Western countries, low coronary calcium scores have poor correlation with absence of CAD in this population.
To investigate the progression of coronary atherosclerosis burden by coronary CT angiography (CCTA) and demonstrate the incidence of major adverse cardiac events (MACE) in patients with and without plaque burden progression.

METHOD AND MATERIALS

The retrospective study was approved by the institutional review board, and the requirement to obtain informed consent was waived. Two hundred ninety four patients with suspected coronary artery disease (CAD) underwent repeat CCTA examinations due to new/worsening symptoms were enrolled. Quantitative plaque burden categorized as lipid, fibrous, calcified and total plaque burden were analyzed using a semi-automated image workstation. Patients were follow-up for the incidence of MACE was defined as cardiac death, coronary revascularization (PCI and CABG) and occurrence of cardiac death and hospitalization due to unstable angina. Cumulative event rates of MACE were estimated by using the Kaplan-Meier method and log-rank test. The association between all the clinical characteristics and MACE were estimated by using Cox proportional hazard model. Logistic regression was used to analyze the associated factors with plaque progression.

RESULTS

Among 294 patients, 268 patients (mean age 52.9 years ± 9.8, male 71.0%) were follow-up with the mean period of 4.6 years ± 0.9. 26 patients were lost. Compared with patients with plaque progression, those with lipid, calcified and total plaque progression have a significantly higher incidence of MACE (all p < 0.05). The progression of lipid plaque burden (hazard ratio = 3.226, p = 0.048), calcified plaque burden (hazard ratio = 5.062, p = 0.007) and total plaque (hazard ratio = 8.022, p = 0.031) were considered as independent predictors of MACE. Baseline dyslipidemia, statin therapy and low-density lipoprotein cholesterol (LDL-C) were associated with progression of lipid plaque burden (p < 0.05 for all).

CONCLUSION

In patients with new/worsening symptoms after a prior CCTA, lipid, calcified and total plaque burden were progressed in patients who underwent MACE.

CLINICAL RELEVANCE/APPLICATION

Assessment of coronary atherosclerosis burden progression by repeat CCTA could predict MACE and provide risk stratification of patients with suspected CAD.

SSA04-09  Coronary CT Angiography-Derived Quantitative Markers for Predicting In-Stent Restenosis

Participants

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PURPOSE

To evaluate lesion-related quantitative markers derived from coronary CT angiography (CCTA) performed prior to percutaneous coronary intervention (PCI) with stent placement for predicting in-stent restenosis (ISR) as defined by quantitative coronary angiography (QCA).

METHOD AND MATERIALS

We retrospectively analyzed data of 74 patients (60±12 years, 72% male) who had undergone dual-source CCTA within 3 months prior to PCI with stent placement. Several quantitative analysis of the target atheromatous plaque were derived from CCTA: total plaque volume (TPV), calcified and non-calcified plaque volumes (CPV and NCPV), plaque burden (PB in %), remodeling index (RI), and lesion length (LL). The performance of these markers for the prediction of ISR, as defined by clinically indicated QCA on follow-up, were assessed.

RESULTS

Among 74 lesions with stent placement, 21 showed ISR on angiographic follow-up (mean 616.9±447.4 days). There was a trend towards insufficient coverage of the target lesion by the stent, when comparing stent length and LL in ISR versus non-ISR patients (17 vs 4, p=0.068). Odds ratios (ORs) in multivariate analysis were as follows: TPV (OR 1.02 per mm³, p=0.065), CPV (OR 0.66 per mm³, p=0.002), NCPV (OR 1.85 per mm³, p=0.037), LL (OR 1.23 per mm, p=0.002), and RI (OR 1.06 per mm², p=0.007). Sensitivity and specificity for detecting ISR were as follows: CPV 39% and 93%, NCPV 65% and 80%, LL 74% and 74%, and RI 71% and 78%, respectively. At receiver operating characteristics analysis these markers showed discriminatory power for predicting ISR: CPV (AUC 0.67, p=0.012), NCPV (0.72, p=0.001), LL (0.77, p<0.0001), and RI (0.79, p<0.0001).
CONCLUSION

CPV, NCPV, LL, and RI derived from CCTA as quantitative markers of target plaque lesion anatomy and disease activity portend predictive value for ISR. Obtaining these markers prior to PCI may guide selection of an appropriate revascularization and follow-up strategy.

CLINICAL RELEVANCE/APPLICATION

Coronary CT angiography-derived quantitative markers may be used to identify patients at increased risk for in-stent restenosis. Evaluation of these markers for informing percutaneous coronary intervention may improve procedural outcomes and enhance long-term stent patency.
PURPOSE
Oxygen consumption is rate-limiting step of myocardial metabolism, and links to exercise tolerance. In vivo, the imaging technique that can quantify myocardial oxygen consumption is not established. We propose a novel imaging technique to quantify oxygen consumption using the blood-oxygenation-level-dependent (BOLD) effect on T2-star cardiac magnetic resonance (T2* CMR), and investigate the relation to exercise tolerance on cardiopulmonary exercise test (CPX) in heart failure (HF).

METHOD AND MATERIALS
Thirty non-ischemic refractory HF patients who underwent CMR and CPX for heart transplant were enrolled (mean age, 46 year-old). In addition, 24 patients with suspected cardiomyopathy who had normal left ventricular function (LVEF>50%) on CMR were enrolled as control (mean age, 54 year-old). Myocardial T2* (M-T2*) imaging was accomplished using 3-Tesla scanner and multi-echo gradient-echo sequence. M-T2* was calculated by fitting the signal intensity data for the mid-left ventricular septum to a decay curve. During 10 minutes inhalation of oxygen at the flow rate of 10 l/min, M-T2* was measured under room-air and oxygen inhalation. Oxygen consumption (ΔT2*, ms) was defined as the difference between the two conditions. Changes in T2* between room-air and O2 inhalation was analyzed by paired t-test. Comparison of ΔT2* between HF and controls was analyzed by Mann-Whitney u-test. Correlations between ΔT2* and CPX tests (peak VO2, O2 pulse) was analyzed by Pearson coefficient.

RESULTS
M-T2* was significantly greater under oxygen inhalation than room-air in HF (29.9±7.3ms vs. 26.7±6.0ms, p<0.001), whereas there was no difference in controls (25.5±4.0ms vs. 25.4±4.4ms). ΔT2* was significantly greater for HF than controls (3.2±4.5ms vs. -0.1±1.3ms, p<0.001). Significant correlations between ΔT2* and CPX tests (peak VO2, r=-0.46, p<0.05; O2 pulse, r=-0.54, p<0.005) were observed in HF.

CONCLUSION
ΔT2* instead of increased M-T2* at oxygen inhalation is greater in HF patients, demonstrating reduced oxygen consumption. ΔT2* is a candidate for cardiac functional reserve in refractory HF.

CLINICAL RELEVANCE/APPLICATION
Our method allows assessing non-invasively myocardial oxygen metabolism in vivo. ΔT2* could predict the prognosis of refractory HF, and could be used as an indicator for heart transplant.
A total of 130 patients consecutively received CTA and coronary angiography (CAG). For 379 main coronary arteries in the epicardium, the average transluminal Hounsfield units (HU) of the regions of interest were consecutively measured at an interval of 5 mm from the ostium to the distal level where the vessel cross-sectional area fell below 2.0mm², followed by the calculation of TAG. The effects of different plaque components on TAG were analyzed. The diagnostic performance of CTA, TAG and CCTA+TAG for the stenosis degree of coronary calcified lesions and their reclassification for stenosis degree were analyzed, especially for calcified lesions.

RESULTS

Compared with CAG, the TAG in CCTA was consistent with the largest stenosis degree of each blood vessel: 0%-49% stenosis showed a TAG of 3.49±43.23HU/10mm and 100% stenosis showed a TAG of -24.67±18.41HU/10mm. TAG improved the accuracy of CCTA in the diagnosis of calcified lesions (c-statistic=0.958 vs.0.866, p<0.0001). When threshold was ≤6.9HU/10mm, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of CCTA+TAG in the diagnosis of coronary calcified lesions were 90.26%, 95.45%, 98.58% and 73.66%. In addition, TAG can help to improve the reclassification of CCTA for coronary stenosis degree, especially for calcified lesions (NRI=0.127, P=0.045).

CONCLUSION

TAG can help to improve the diagnostic performance of CCTA for the stenosis degree of coronary calcified lesions, and it may also help to improve the reclassification of the stenosis degree of calcified lesions.

CLINICAL RELEVANCE/APPLICATION

(dealing with CT angiography) To evaluate the accuracy of transluminal attenuation gradient (TAG) in diagnosing the stenosis degree of coronary calcified lesions using coronary computed tomography angiography (CCTA).

CA203-SD-SUA4 Compressed Sensing Real-time Cine Imaging for Assessment of Ventricular Function, Volumes and Mass in Clinical Practice

Station #4

Participants
Benjamin Longere, MD, Lille, France (Presenter) Nothing to Disclose
Matthide Vermersch, Lille, France (Abstract Co-Author) Nothing to Disclose
Julien Pagniez, MD, Lille, France (Abstract Co-Author) Nothing to Disclose
Hedi Farah, Lille, France (Abstract Co-Author) Nothing to Disclose
Michaela Schmidt, Erlangen, Germany (Abstract Co-Author) Employee, Siemens AG
Christoph Forman, Erlangen, Germany (Abstract Co-Author) Employee, Siemens AG
Aurélien Monnet, Lille, France (Abstract Co-Author) Employee, Siemens AG
François Pontana, MD, PhD, Lille, France (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the accuracy of a compressed sensing (CS) real-time prototype cine sequence (Sparse 2D cine, Siemens Healthcare) for quantification of left ventricular (LV) function, volumes and mass and right ventricular (RV) function and volumes in clinical practice.

METHODOLOGY AND MATERIALS

50 consecutive adult patients (30 males, 20 females; mean age= 53 ± 18.3 years) referred for cardiac magnetic resonance (CMR) examination were prospectively enrolled. CMR were performed for ischemic heart disease (n = 11), dilated cardiomyopathy (n = 8), valvular disease (n = 8), heart rhythm disorder (n = 7), infiltrative cardiomyopathy (n = 6), hypertrophic cardiomyopathy (n = 5), myocarditis (n = 2) or others (n = 3). Grown-up congenital heart disease patients were excluded. The CMR protocol included short-axis stack, one four-chamber slice and one long-axis slice using (a) a conventional segmented multi-breath-hold steady-state free precession acquisition (bSSFP) as a reference (Group 1) and (b) a CS real-time single-breath-hold sequence (Group 2) providing the same slice number, position and thickness. Two radiologists independently assessed the ejection fraction (LVEF & RVEF), end-diastolic (LVEDV & RVEDV) and end-systolic (LVESV & RVESV) volumes and LV mass (LVM) in both Groups.

RESULTS

The CS sequence mean scan time was 22.2 ± 5.6 seconds and for the multi-breath-hold bSSFP sequence it was 503.7 ± 94.3 seconds (p<0.001). There was a high correlation between Group 1 and Group 2 regarding mean LVEF (48.8 ± 15.2 % vs 48.9 ± 15.3 %; r=0.98), mean LVEDV (93.8 ± 33.8 ml/m² vs 98.2 ± 34.2 ml/m²; r=0.98), mean LVESV (52.5 ± 32.0 ml/m² vs 53.2 ± 33.3 ml/m²; r=0.98) and mean LVM (75.5 ± 21.3 g/m² vs 73.3 ± 19.6 g/m²; r=0.92). There was also strong correlation between Group 1 and Group 2 for RV assessment: mean RVEF = 54.5 ± 10.8 % vs 54.7 ± 11.1 % (r=0.93), mean RVEDV = 79.2 ± 20.5 ml/m² vs 80.6 ± 23.1 ml/m² (r=0.90) and mean RVESV = 37.4 ± 15.6 ml/m² vs 36.8 ± 18.3 ml/m² (r=0.87).

CONCLUSION

Compressed sensing single-breath-hold cine imaging provides LV function, volumes and mass as well as RV function and volumes, which are comparable to the conventional SSFP multi-breath-hold imaging.

CLINICAL RELEVANCE/APPLICATION

CS real-time cine imaging reduces CMR scan time while providing comparable measurements in patients with cardiac condition that may prevent from iterative breath-holds.

CA204-SD-SUA5 Dynamic CT Myocardial Perfusion Imaging Combined with On-site CT Derived FFR for Detection of Functional Coronary Artery Disease

Station #5

Participants
Adriaan Coenen, MD, Rotterdam, Netherlands (Presenter) Nothing to Disclose
Purpose

In the presence of atheroclesrosis CTA tends to overestimate, especially when validated against the current functional standard fractional flow reserve (FFR). Two CT applications to improve specificity are CT myocardial perfusion imaging (CT-MPI) and CTA derived FFR (CTA-FFR). CT-MPI images the distribution of a first pass contrast agent over the left ventricle wall. CTA-FFR applies computational fluid dynamics onto CTA data to simulated the coronary blood flow. In this study both techniques are validated against invasive FFR measurements.

Method and Materials

Patients with suspect or known CAD, underwent a CTA and dynamic CT-MPI examination ≤ 14 days before invasive angiography. An invasive FFR was performed in vessels with a stenosis grade between 30-90%. The dynamic CT-MPI acquisition uses an alternating cranial caudal table position. The myocardial blood flow was computed as index MBF normalizing the ROI suspected perfusion defect for the 75 percentile of the left ventricle myocardial perfusion. CTA-FFR was computed on-site using a hybrid model. (cFFR version 1.4, Siemens Healthcare, Forchheim, Germany; not commercially available).

Results

In 74 patients, an invasive FFR was measured in 142 vessels. 67 out of 142 vessels were considered functionally obstructed with an invasive FFR≤0.80. 49 vessels/territories were classified as positive for ischemia with both CTA-FFR and CT-MPI, and 33 vessels as negative with both CTA-FFR and CT-MPI. The sensitivity and specificity for the 82 vessels/territories with concordance between both modalities was 90% (81-99%) and 77% (61-89%) (Figure 1). Overall sensitivity and specificity were 82% (71-90%) and 60% (48-71%) for CTA-FFR and 73% (61-83%) and 68% (56-78%) for CT-MPI. The area under the curve was identical for both CTA-FFR and CT-MPI (0.78).

Conclusion

Dynamic CT-MPI and CT derived FFR are different pathways towards improving the diagnostic accuracy of CT in the detection of functional coronary artery stenosis. In this study shows both dynamic CT-MPI and CT derived FFR perform well in the detection of functional coronary artery stenosis. In the subset of vessels/territories with concordance between CT-MPI and CTA-FFR diagnostic accuracy is increased.

Clinical Relevance/Application

CT derived FFR and dynamic CT myocardial perfusion imaging are different methods for detection of functional coronary artery disease, combination of both modalities could improve diagnostic performance.

Cardiac Lymphomas: Spectrum of Cardiovascular Magnetic Resonance Features with Histological Correlation

Purpose

The purpose of this exhibit is: 1. To review the pathophysiology of cardiac lymphomas 2. To explain the utility of CMR and suggest an protocol for imaging 3. To review the CMR appearances of cardiac lymphomas by correlating the cases with the histopathologic features

Table of Contents/Outline

Cardiac lymphomas are rare tumours that may occur as a primary or secondary malignancy and infiltrate the heart in an ill-defined, diffuse manner. The clinical presentation is non-specific and depends on the site and the size of the tumour, therefore the diagnosis is often late. This and the status of patient’s immunocompetence lead to poor prognosis in most cases. On histology, both Hodgkin and non-Hodgkin lymphomas affect the heart. Cardiovascular magnetic resonance imaging is an advanced technique which may show features highly suggestive of cardiac lymphoma and aid to diagnose the disease earlier. This exhibit will provide a case-based review of the spectrum of cardiac lymphoma appearances by correlating CMR imaging appearance with histopathologic findings. 1. Pathophysiology of cardiac lymphomas 2. Imaging cardiac lymphomas by CMR 3. Case-based review of imaging findings 4. Differential diagnosis

Role of Cardiac CT in the Work Up Prior to Percutaneous Pulmonary Valve Implantation

Purpose

The purpose of this exhibit is: 1. To review the pathophysiology of cardiac lymphomas 2. To explain the utility of CMR and suggest an protocol for imaging 3. To review the CMR appearances of cardiac lymphomas by correlating the cases with the histopathologic features

Table of Contents/Outline

Cardiac lymphomas are rare tumours that may occur as a primary or secondary malignancy and infiltrate the heart in an ill-defined, diffuse manner. The clinical presentation is non-specific and depends on the site and the size of the tumour, therefore the diagnosis is often late. This and the status of patient’s immunocompetence lead to poor prognosis in most cases. On histology, both Hodgkin and non-Hodgkin lymphomas affect the heart. Cardiovascular magnetic resonance imaging is an advanced technique which may show features highly suggestive of cardiac lymphoma and aid to diagnose the disease earlier. This exhibit will provide a case-based review of the spectrum of cardiac lymphoma appearances by correlating CMR imaging appearance with histopathologic findings. 1. Pathophysiology of cardiac lymphomas 2. Imaging cardiac lymphomas by CMR 3. Case-based review of imaging findings 4. Differential diagnosis
TEACHING POINTS

Percutaneous pulmonary valve implantation (PPVI) is used to treat pulmonary valve insufficiency or stenosis which often occurs in patients with corrected congenital heart disease. CT has an important role in the work-up prior to PPVI to select suitable patients by evaluating size and shape of the pulmonary trunk (PT) and its relationship to the coronary arteries to assess the risk of coronary compression (CC).

TABLE OF CONTENTS/OUTLINE

Background of the PPVI procedure and commonly implanted valve types How to perform CT analysis: measurements of pulmonary conduit/right ventricle outflow tract (RVOT) performed with double oblique reconstructed images; measurements of the relationship between coronary arteries and PT and changes after PPVI. Difference in CA-PT relationship between diastole and systole. How to assess CC-risk in candidate patients for PPVI; imaging features that indicate high risk of CC. Case presentations including CT pre and post PPVI and per procedural angiography illustrating different aspects mentioned above.
Prevalence of Coronary Artery Disease in Adults Under 30 Presenting with Acute Chest Pain - A Retrospective Study

Purpose
To evaluate the prevalence of coronary artery disease in the young adult population (age 18-30) presenting to the emergency department for evaluation of acute chest pain as determined by coronary computed tomography angiography (CCTA).

Method and Materials
This retrospective study was granted a waiver of the informed consent as required by HIPAA. A Montage search was performed for CCTAs performed on young adults age 18-30 from January 1, 2013 to October 1, 2015, yielding 914 studies. 30 patients were excluded on the basis of preexisting congenital heart disease, previous cardiac surgery or study performed for reason other than chest pain (e.g. mass), the final study population consisted of 884 patients (age range 18-30, average age 26). Each study was reviewed by 1 of 5 fellowship trained cardiac radiologists. The study was deemed abnormal if any atherosclerotic plaque, coronary artery stenosis or coronary artery anomaly was identified.

Results
Of the 884 patients, 28 (3.2%) had abnormal coronary findings. 9 (1.0%) had stenosis caused by myocardial bridging, 9 (1.0%) had coronary artery anomalies, and 11 (1.2%) had stenosis caused by atherosclerotic disease. 1 patient (0.1%) had stenosis caused by both atherosclerosis and myocardial bridging. Of the 9 patients with myocardial bridging, 2 (0.2%) had moderate to severe stenosis. Of the 9 patients with coronary artery anomalies, 3 (0.3%) were malignant and 6 (0.7%) were benign. Of the 11 patients with atherosclerotic disease, 1 (0.1%) had moderate to severe stenosis.

Conclusion
This single institution retrospective study provides evidence for low prevalence of coronary artery disease in the young adult population (age 18-30). Only 6 (0.7%) patients were identified as having moderate to severe stenosis caused by atherosclerosis, myocardial bridge or a malignant coronary artery anomaly.

Clinical Relevance/Application
This study provides evidence for more restricted use of CCTAs in young adults age 18-30 presenting with acute chest pain. The cost versus benefit of CCTA in this young population requires further research.
In previous reports the coronary artery calcium score were lower on image reconstructed with iterative reconstruction (IR) than filtered back projection (FBP) images. An iterative reconstruction (adaptive statistical iterative reconstruction V: ASiR-V) includes object, noise and X-ray physics models and reduces both noise and low signal induced artifacts. The purpose of our study was to assess the possibility of reducing the radiation dose for coronary artery calcium (CAC) scoring by using ASiR-V on a 256-detector CT scanner.

METHOD AND MATERIALS

We scanned a cardiac CT calibration phantom (QRM, Germany) that featured different calcium hydroxyapatite concentrations on a 256-detector CT scanner (Revolution CT, GE) with prospective ECG-triggering. We scanned the phantom 5 times. We reduced dose applied ten IR strength levels (0-100%, 10% step) The tube current was 198-,177-,157-,139-,122-,105-,91-,77-,65-,54-,49 mA. Calcification scoring was compared after calculating the Agatston, volume and mass scores.

RESULTS

The average Agatston score with ASiR-V (0-100%, step10%) were 639, 644, 641, 639, 636, 641, 645, 636, 639, 627 and 629, respectively. The average volume score with ASiR-V (0-100%, step10%) were 546-, 545-, 546-, 543-, 543-, 539-, 542-, 530- and 531 mm3(true value: 358.2 mm3), respectively. The average mass score with ASiR-V (0-100%, 10% step) were 181-, 180-, 180-, 180-, 180-, 180-, 178-, 174- and 174 mgHA(true value: 167.1 mgHA), respectively. There was no significant difference in the Agatston, volume and mass scores among images with various degrees of ASiR-V. Regarding the mean Agatston, volume and mass scores, the difference values obtained at 198- and 49 mA with ASiR-V 100% were very small. The use of ASiR-V made it possible to reduce the radiation dose. The use of ASiR-V (10-100%, 10% step) could reduce the radiation dose was 11, 21, 30, 38, 47, 54, 61, 67, 73 and 75%.

CONCLUSION

The use of ASiR-V made it possible to reduce the radiation dose by 75% for CAC scoring without impairing quantification of coronary calcification.

CLINICAL RELEVANCE/APPLICATION

The use of ASiR-V can reduced radiation dose in CAC scoring at CT.
A Winding Road: The Spectrum of Coronary Artery Anomalies

Station #6

Awards
Certificate of Merit

Participants
Lea Azour, MD, New York, NY (Presenter) Nothing to Disclose
Adam Jacoby, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Javier Sanz, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Gina Larocco, New York, NY (Abstract Co-Author) Nothing to Disclose
Rebecca Chang, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Matthew D. Cham, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
- To understand normal coronary arterial anatomy and vascular territory.
- To identify congenital and acquired coronary artery anomalies.
- To distinguish between benign anomalies and those requiring intervention.

TABLE OF CONTENTS/OVERSEVIEW
1. Overview of the incidence of coronary artery anomalies.
2. Typical coronary arterial anatomy:
   a. Right dominant system;
   b. Left dominant system;
   c. Co-dominant system.
3. Congenital coronary artery anomalies (Cine Images will be included):
   a. Absence of a coronary artery
      i. Absent left main trunk
      ii. Absent RCA
      iii. Anomalous Origin
      iv. Anomalous left coronary artery from the pulmonary artery (ALCAPA)
      v. Anomalous right coronary artery from the pulmonary artery (ARCAPA)
      vi. Anomalous coronary artery from opposite sinus (ACAOS)
   b. Anomalous course
      1. Pre-pulmonary
      2. Retro-aortic
      3. Myocardial bridging
      4. Intramuscular septal course
      5. Intra-atrial
      1. Inter-arterial
      2. Inter-atrial
   c. Acquired coronary artery anomalies:
      a. Fistula
      b. Aneurysm

CT Imaging after the Bentall Procedure: An Updated and Comprehensive Guide

Station #7

Awards
Certificate of Merit

Participants
Sara Boccolini, MD, Genova, Italy (Presenter) Nothing to Disclose
Laurens E. Swart, MD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Jos A. Bekkers, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Koen Nieman, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Gabriel P. Krestin, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Research Grant, General Electric Company; Research Grant, Siemens AG; Consultant, Bracco Group; Scientific Advisor, Zebra Medical Vision Ltd; Advisory Board, Quantib BV
Ad J. Bogers, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Ricardo P. Budde, MD, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
To review the indications and surgical technique of the Bentall and associated procedures.
To illustrate normal postoperative changes and complications and their respective CT appearance.
To highlight differences between normal postoperative features and complications and raise awareness of the gray zones.
To present a series of challenging and previously undetectable complications.

TABLE OF CONTENTS/OVERSEVIEW
Clinical indications for the Bentall procedure in emergency and elective settings.
The Bentall procedure.
The classic Bentall and its modifications.
Surgical and/or interventional associated or subsequent procedures (including the Ross procedure, aortic debranching, elephant trunk, TEVAR).
CT imaging after the procedure.
CT exam technical considerations.
The normal postoperative anatomy and its uncomplicated variations.
The CT appearance of surgical material (including aortic valves, aortic prosthesis, suture lines, Amplatzer devices).
The appearance of complications.
Classical findings.
Findings of previously undetectable complications that are now assessable due to the recent improvements in CT scanners technology.
How to distinguish complications from normal postoperative changes: the known and the unknown.
Challenging cases.
Imaging of Atherosclerosis

Sunday, Nov. 27 2:00PM - 3:30PM Room: E352

Participants
John J. Carr, MD, MS, Nashville, TN (Moderator) Nothing to Disclose

Sub-Events

RC103A The Biology of Atherosclerosis

Participants
Pamela K. Woodard, MD, Saint Louis, MO, (woodardp@mir.wustl.edu) (Presenter) Research Grant, Astellas Group; Research Grant, Bayer AG; Research agreement, Siemens AG; ; ; ;

LEARNING OBJECTIVES

1) Discuss the initiation of the atherosclerotic disease process, including chemical, mechanical and immunological factors. 2) Discuss the molecular biology of atherosclerosis and cellular mechanisms involved in plaque remodeling, progression, instability and repair. 3) Discuss potential molecular targets in atherosclerosis imaging.

ABSTRACT

Atherosclerosis is a chronic progressive disease, affecting the medium and large arteries, in which lipid-triggered inflammation plays a pivotal role. The major clinical manifestations of atherosclerosis are coronary artery disease (CAD), leading to acute myocardial infarction (MI) and sudden cardiac death; cerebrovascular disease, leading to stroke; and peripheral arterial disease, leading to ischemic limbs and viscera. These complications of atherosclerosis are leading causes of death worldwide. Despite progress in medical and revascularization therapies for atherothrombotic disease, the incidence of MI and stroke remain high under the current standard of care, and the past decade has generated few new medical therapies to prevent atherosclerosis-induced events. Similarly, current diagnostic approaches to atherosclerosis do not accurately identify those individuals who will suffer an ischemic complication. The field of atherosclerosis is therefore ripe for reengineering in both the therapeutic and diagnostic arenas. Research into the process of atheroma lesion development and maturation has implicated many immune cells including lymphocytes, dendritic cells, and neutrophils. The most numerous cells in atherosclerotic plaque are macrophages, which are leukocytes that are central to the innate immunity. Because they play a major role in instigating plaque development and complication—both of which are inflammation-related disease processes—leukocytes are promising targets for more effective atherosclerosis treatments. However, the complexity of the immune system and its role as a defensive force against infection require novel tools to very precisely identify and treat the inflammatory cells that promote atherosclerosis. Biomedical engineering offers unique possibilities for diagnosing and treating atherosclerotic plaque inflammation. Thus, interfacing engineering with immunology will be essential to meaningful advances in disease management. This talk will discuss how recent discoveries in atherosclerosis immunology can provide opportunities for diagnostic imaging of atherosclerotic plaques and cardiovascular complications of atherosclerosis, including transplantable molecular imaging techniques. Integrated diagnostic modalities have uncovered new pathways that can serve as potential diagnostic and therapeutic targets, and show that these pathways can be specifically modulated by nanomedicine based interventions.

RC103B Molecular Imaging of Atherosclerosis

Participants
Zahi A. Fayad, PhD, New York, NY, (zahi.fayad@mssm.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Define Nanomedicine and its opportunity in cardiovascular disease detection and treatment. 2) Demonstrate the methods of plaque molecular imaging with MR Imaging, PET, CT. 3) Discuss the advantages and limitations of plaque molecular imaging using MR Imaging, PET, CT. 4) Discuss the preclinical and clinical relevance of plaque molecular imaging by MR Imaging, PET, CT. 5) Discuss novel methods for atherosclerotic plaque treatment using nanomedicine.

ABSTRACT

Atherosclerosis is a chronic progressive disease, affecting the medium and large arteries, in which lipid-triggered inflammation plays a pivotal role. The major clinical manifestations of atherosclerosis are coronary artery disease (CAD), leading to acute myocardial infarction (MI) and sudden cardiac death; cerebrovascular disease, leading to stroke; and peripheral arterial disease, leading to ischemic limbs and viscera. These complications of atherosclerosis are leading causes of death worldwide. Despite progress in medical and revascularization therapies for atherothrombotic disease, the incidence of MI and stroke remain high under the current standard of care, and the past decade has generated few new medical therapies to prevent atherosclerosis-induced events. Similarly, current diagnostic approaches to atherosclerosis do not accurately identify those individuals who will suffer an ischemic complication. The field of atherosclerosis is therefore ripe for reengineering in both the therapeutic and diagnostic arenas. Research into the process of atheroma lesion development and maturation has implicated many immune cells including lymphocytes, dendritic cells, and neutrophils. The most numerous cells in atherosclerotic plaque are macrophages, which are leukocytes that are central to the innate immunity. Because they play a major role in instigating plaque development and complication—both of which are inflammation-related disease processes—leukocytes are promising targets for more effective atherosclerosis treatments. However, the complexity of the immune system and its role as a defensive force against infection require novel tools to very precisely identify and treat the inflammatory cells that promote atherosclerosis. Biomedical engineering offers unique possibilities for diagnosing and treating atherosclerotic plaque inflammation. Thus, interfacing engineering with immunology will be essential to meaningful advances in disease management. This talk will discuss how recent discoveries in atherosclerosis immunology can provide opportunities for diagnostic imaging of atherosclerotic plaques and cardiovascular complications of atherosclerosis, including transplantable molecular imaging techniques. Integrated diagnostic modalities have uncovered new pathways that can serve as potential diagnostic and therapeutic targets, and show that these pathways can be specifically modulated by nanomedicine based interventions.

RC103C MR Imaging of Atherosclerosis

Participants
Chun Yuan, PhD, Seattle, WA (Presenter) Research Grant, Koninklijke Philips NV; ;

LEARNING OBJECTIVES

1) Identify the clinical goals of MRI of atherosclerosis, describe the critical information needed for different vascular beds. 2) Explain the technical need and challenges in imaging atherosclerosis. 3) Assess current approaches and applications and future directions.

ABSTRACT
Participants
Pal Maurovich-Horvat, MD, PhD, Pecs, Hungary (Presenter) Nothing to Disclose
Transcatheter Aortic Valve Replacement (TAVR)

Sunday, Nov. 27 2:00PM - 3:30PM Room: S404AB

LEARNING OBJECTIVES
1) Understand the epidemiology, surgical and novel transcatheter treatment options for aortic stenosis. 2) Be able to analyze current evidence for the effectiveness of TAVR in different risk groups. 3) Comprehend the elements of a successful TAVR program implementation.

LEARNING OBJECTIVES
1) Review the recent advancements in the field of TAVR. 2) Review the published literature defining the role of MDCT for device selection and annular sizing. 3) Discuss the other ancillary roles of MDCT in TAVR planning.

LEARNING OBJECTIVES
1) Define elements of an effective TAVR image analysis workflow. 2) Discuss the variety and applicability of measurement/imaging tools. 3) Develop training plans to improve inter observer agreement. 4) Improve efficiency and reliability through quality assurance.
**Cardiac Monday Case of the Day**

**Monday, Nov. 28 7:00AM - 11:59PM Room: Case of Day, Learning Center**

**AMA PRA Category 1 Credit ™: .50**

**Participants**
- Kaushik S. Shahir, MD, Milwaukee, WI (Presenter) Nothing to Disclose
- Dhiraj Baruah, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
- Rahul D. Renapurkar, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
- Sushil Kumar K. Sonavane, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
- Sachin S. Saboo, MD, FRCR, Dallas, TX (Abstract Co-Author) Nothing to Disclose
- Suhny Abbara, MD, Dallas, TX (Abstract Co-Author) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
- Nicholas Clayton, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
- Jubal R. Watts Jr, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
- Satinder P. Singh, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
- Subha Ghosh, MBBS, MD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
- Michael A. Bolen, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
- Christopher Maroules, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
- Tyler M. Flessner, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
- Nagina Malguria, MBBS, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
- Melissa M. Wein, MD, Shorewood, WI (Abstract Co-Author) Nothing to Disclose
- Zachary R. Laste, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
- Prabhakar Rajjah, MD, FRCR, Dallas, TX (Abstract Co-Author) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

**TEACHING POINTS**

1) Identify pertinent findings and generate differential diagnosis for cardiac imaging studies. 2) Develop differential diagnoses based on the clinical information and imaging findings. 3) Recommend appropriate management for patients based on imaging findings.

**Honored Educators**

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

Rahul D. Renapurkar, MD - 2016 Honored Educator
Suhny Abbara, MD - 2014 Honored Educator
Prabhakar Rajjah, MD, FRCR - 2014 Honored Educator
RSNA Diagnosis Live™: Winter is Coming

Monday, Nov. 28 7:15AM - 8:15AM Room: E451B

Participants
Adam E. Flanders, MD, Narberth, PA, (adam.flanders@jefferson.edu) (Presenter) Nothing to Disclose
Sandeep P. Deshmukh, MD, Philadelphia, PA, (sandeep.deshmukh@jefferson.edu) (Presenter) Nothing to Disclose
Christopher G. Roth, MD, Philadelphia, PA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage “active” consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

ABSTRACT

URL
Participants
Jill E. Jacobs, MD, New York, NY (Director) Nothing to Disclose
Pamela K. Woodard, MD, Saint Louis, MO, (woodardp@wustl.edu) (Moderator) Research Grant, Astellas Group; Research Grant, Bayer AG; Research agreement, Siemens AG; ; ; ;
Jill E. Jacobs, MD, New York, NY (Moderator) Nothing to Disclose

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

Sub-Events
MSMC21A  Normal Coronary Anatomy

Participants
Prachi P. Agarwal, MD, Ann Arbor, MI, (prachia@med.umich.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Recognize normal anatomy and common variants of the coronary arteries. 2) Review normal cardiac anatomy. 3) Describe the mimics and pitfalls in cardiac imaging that can simulate pathology.

ABSTRACT
Active Handout: Prachi P. Agarwal

MSMC21B  Anomalous Coronary Arteries

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

LEARNING OBJECTIVES
1) Using Coronary Artery CT cases to review anomalous origins of the coronary arteries
Participants
Albert De Roos, MD, Leiden, Netherlands (Moderator) Nothing to Disclose

LEARNING OBJECTIVES

ABSTRACT

Sub-Events
RC203A  **CT Imaging of Native Valves**

Participants
Fabian Plank, Innsbruck, Austria (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Review the full spectrum of CT imaging findings in native valvular disease (from stenosis, regurgitation to infective endocarditis).
2) Understand technical basics and state-of-the-art imaging of heart valves by cardiac CT. 3) Discuss when and why use cardiac CT for diagnosis of valvular disease and patient management.

ABSTRACT

While echocardiography is the primary screening modality for valvular disease, it has some inherent limitations. Cardiac CT provides incremental value in the assessment of native valvular disease and allows for 3D- and 4D-imaging of valvular function. The specific settings in clinical practice ("when-and-why") using cardiac CT, patient management and multimodality imaging (including PET/CT) will be discussed. Topics of this course are: 1) the assessment of native valvular disease (stenosis, regurgitation and prolapse) and congenital abnormalities by cardiac CT 2) cardiac CT in infective endocarditis 3) CT for differential diagnosis/characterization of valvular masses.

RC203B  **MRI of Native Valves**

Participants
Gautham P. Reddy, MD, Seattle, WA (Presenter) Nothing to Disclose

Honored Educators

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Gautham P. Reddy, MD - 2014 Honored Educator

RC203C  **The Role of Imaging Prior to TAVR**

Participants
Jonathon A. Leipsic, MD, Vancouver, BC, (jleipsic@providencehealth.bc.ca) (Presenter) Speakers Bureau, General Electric Company; Speakers Bureau, Edwards Lifesciences Corporation; Consultant, Heartflow, Inc; Consultant, Circle Cardiovascular Imaging Inc; Consultant, Edwards Lifesciences Corporation; Consultant, Neovasc Inc; Consultant, Samsung Electronics Co, Ltd; Consultant, Koninklijke Philips NV; Consultant, Arineta Ltd; Consultant, Pi-Cardia Ltd;

LEARNING OBJECTIVES

1) Understand the role of pre-procedural imaging and in particular MDCT in TAVR planning. 2) Discuss new data highlighting novel imaging parameters that help improve clinical outcomes. 3) Discuss the role of MDCT sizing for next generation TAVR devices.

ABSTRACT

NA

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Jonathon A. Leipsic, MD - 2015 Honored Educator

RC203D  **Mitral Valve Interventions**
Participants
Philipp Blanke, MD, Freiburg, Germany, (phil.blanke@gmail.com) (Presenter) Consultant, Edwards Lifesciences Corporation; Consultant, Neovasc Inc; Consultant, Tendyne Holdings, Inc; Consultant, Circle Cardiovascular Imaging Inc
**Precision Medicine through Image Phenotyping**

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

- **CA**
- **CH**
- **VA**
- **BQ**
- **IN**

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

**Participants**

Ella A. Kazerooni, MD, Ann Arbor, MI, (ellakaz@umich.edu) *(Moderator)* Nothing to Disclose

Ella A. Kazerooni, MD, Ann Arbor, MI, (ellakaz@umich.edu) *(Presenter)* Nothing to Disclose

Eliot L. Siegel, MD, Baltimore, MD, (esiegel@umaryland.edu) *(Presenter)* Board of Directors, Brightfield Technologies; Board of Directors, McCoy; Board of Directors, Carestream Health, Inc; Founder, MedPerception, LLC; Founder, Topoderm; Founder, YYESIT, LLC; Medical Advisory Board, Bayer AG; Medical Advisory Board, Bracco Group; Medical Advisory Board, Carestream Health, Inc; Medical Advisory Board, Fovia, Inc; Medical Advisory Board, McKesson Corporation; Medical Advisory Board, Merge Healthcare Incorporated; Medical Advisory Board, Microsoft Corporation; Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, Toshiba Corporation; Research Grant, Anatomical Travelogue, Inc; Research Grant, Anthro Corp; Research Grant, Barco nv; Research Grant, Deli Inc; Research Grant, Evolved Technologies Corporation; Research Grant, General Electric Company; Research Grant, Herman Miller, Inc; Research Grant, Intel Corporation; Research Grant, MModal IP LLC; Research Grant, McKesson Corporation; Research Grant, RedRick Technologies Inc; Research Grant, Steelcase, Inc; Research Grant, Virtual Radiology; Research Grant, XYBIX Systems, Inc; Research, TeraRecon, Inc; Researcher, Bracco Group; Researcher, Microsoft Corporation; Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG;

John J. Carr, MD, MS, Nashville, TN *(Presenter)* Nothing to Disclose

**LEARNING OBJECTIVES**

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

**ABSTRACT**

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

**Honored Educators**

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Ella A. Kazerooni, MD - 2014 Honored Educator
**Participants**

Jill E. Jacobs, MD, New York, NY (Director) Nothing to Disclose
Geoffrey D. Rubin, MD, Durham, NC (Moderator) Consultant, Fovia, Inc; Consultant, Informatics in Context, Inc; Research Consultant, General Electric Company;
Arthur E. Stillman, MD, PhD, Atlanta, GA (Moderator) Nothing to Disclose

**LEARNING OBJECTIVES**

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

**ABSTRACT**

CT Coronary Angiography is a robust tool for evaluation of coronary artery pathology and CT findings correlate well with invasive coronary angiography. CT findings have prognostic implications, particularly in the characterization of non-calcified plaque, where certain features correlate with increasing downstream acute ischemic events.

**Active Handout:** Andrew John Bierhals

**SSC01**

**Cardiac (Non-Ischemic Cardiomyopathy)**

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

**CA** **BQ** **MR**

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

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

**Participants**

Konstantin Nikolaou, MD, Tuebingen, Germany (*Moderator*) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG

Balazs Ruzsics, MD, PhD, Charleston, SC (*Moderator*) Nothing to Disclose

Friedrich D. Knollmann, MD, PhD, El Dorado Hls, CA (*Moderator*) Nothing to Disclose

Karin E. Dill, MD, Evanston, IL (*Moderator*) Nothing to Disclose

**Sub-Events**

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

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

**Awards**

**Student Travel Stipend Award**

**Participants**

Maxim Avanesov, MD, Hamburg, Germany (*Presenter*) Nothing to Disclose

Julia Munch, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

Lennart Well, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

Ully Saring, Wedel, Germany (*Abstract Co-Author*) Nothing to Disclose

Christian Stehning, Hamburg, Germany (*Abstract Co-Author*) Employee, Koninklijke Philips NV

Enver G. Tahir, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

Monica Patten, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

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

**METHOD AND MATERIALS**

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

**RESULTS**

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

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

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

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

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

**Awards**

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

**METHOD AND MATERIALS**

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

**RESULTS**

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

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

CMR should be performed early to reliably detect inflammatory myocardial alterations. Repetitive CMR can monitor disease activity and may help to identify patients with persistent myocarditis.
0.790). Inter- and intra-observer agreement of native T1 value, post T1 value was improved and excellent high (Inter-observer: ICC=0.997, 0.999 and 0.994, respectively; Intra-observer: ICC=0.996, 0.998 and 0.995).

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

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

SCSC01-04 Characterization of Left Ventricular Remodeling in Professional Soccer Players: Can we Prevent Sudden Cardiac Death Using CMR?

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

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

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

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

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

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

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

Participants
Mariangela Cava, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Diego Palumbo, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Esposito, MD, Milan, Italy (Presenter) Nothing to Disclose
Giovanni La Canna, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Del Mascio, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (Abstract Co-Author) Nothing to Disclose

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

**METHOD AND MATERIALS**

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

**RESULTS**

All patients showed systolic mitral valve leaflets excursion towards left atrium > or equal 2 mm, with mean MVPE of 8.2±5 mm. Mean mitral indexed annular diameter (MADI) was 23.3±5.12 mm; MADI and MVPE were directly related (p=0.028). During systole, a bulging of LV inferior wall near mitral annulus in 18 cases was recorded. Patients with bulging had greater MVPE (10.7±4.8 vs 4.2±2 mm p=0.001) and MADI (25.3±4.4 vs 19.6±4.4 mm p=0.004). 17 patients showed LGE, in 4 cases involving the posterior papillary muscle (PP), in 7 cases the infero-lateral LV wall (IBW), in 6 cases both. Patients showing LGE in PP frequently had systolic bulging (90% of cases, p=0.044) and showed greater MVPE (12.9±4.7 vs 5.8±3.4 p<0.001). In 17 cases patients suffered from arrhythmic events (2 VF, 9 NSVT, 5 LBBB, 1 AV-block); these events were significantly related with presence of ventricular LGE (p=0.006).

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

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

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

**METHOD AND MATERIALS**

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

**RESULTS**

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

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

Recent studies have correlated T1 Mapping and extracellular volume assessment by MR with diffuse fibrosis in some cardiomyopathies, with prognostic relevance, but not still in LVNC.
The purpose of this study was to assess the utility of T1 mapping and extracellular volume for detecting the myocardial fibrosis in subclinical cardiomyopathy in patients with SLE.

**METHOD AND MATERIALS**

We included patients with idiopathic and familial DCM, that underwent a comprehensive CMR with a 3-T scanner (Siemens, Erlangen, Germany), as part of their diagnostic work-up. Left ventricular (LV) volumes, ejection fraction (LVEF) and mass were measured using dedicated software (ARGUS Software™, Siemens Healthcare Global). LV late gadolinium enhancement (LGE) presence, pattern and location were assessed; extensive fibrosis was defined as LGE presence in >2 LV segments. Molecular analysis included LMINA/C, MYH7, MYBCP3, TNNT2, ACTC1, TPR3, TCAP, SGCD, PLN, MYL2, MYL3, TNNI3, TAZ and LBD3 genes.

**RESULTS**

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

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

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

**CLINICAL RELEVANCE/APPLICATION**

Native T1 mapping and ECV may offer as a novel biomarker to prevent the progress of cardiomyopathy and receiving treatment early in SLE patients.
SSC02
Cardiac (PET/CT/MRI/SPECT I)
Monday, Nov. 28 10:30AM - 12:00PM Room: S504AB

CA CT MR NM
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
FDA

Discussions may include off-label uses.

Participants
Hildo J. Lamb, MD, PhD, Leiden, Netherlands (Moderator) Nothing to Disclose
Jacobo Kirsch, MD, Weston, FL (Moderator) Nothing to Disclose

Sub-Events
SSC02-01 Wideband Cardiovascular MRI for Imaging Patients with Intracardiac Device Implantation
Monday, Nov. 28 10:30AM - 10:40AM Room: S504AB

Participants
Daniel Kim, PhD, Chicago, IL (Presenter) Nothing to Disclose
Daniel Lee, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Jane Wilcox, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Rod Passman, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Kyung-Pyo Hong, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Duc Thinh Pham, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Bradley Knight, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (Abstract Co-Author) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;
Jeremy D. Collins, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
James C. Carr, MD, Chicago, IL (Abstract Co-Author) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

PURPOSE
Implantable Cardiac Defibrillator (ICD) therapy is indicated for primary prevention of sudden cardiac death in patients with persistent systolic heart failure (LVEF ≤ 35%) despite optimal medical therapy. Some of these patients with conduction delays are also candidates for implantation of an ICD that provides Cardiac Resynchronization Therapy (CRT-D). It is increasingly recognized that cardiac MRI (CMR) is useful in guiding treatment strategies in heart failure. Despite the increasing awareness that CMR can be performed safely in patients with ICDs, the devices may cause significant artifacts limiting diagnostic utility. We have developed and implemented wideband MRI methods for perfusion T1 mapping, and late gadolinium enhancement (LGE) that suppress image artifacts and produce diagnostically acceptable images. This study demonstrates initial results using this wideband CMR protocol (Fig. 1A) in patients with ICDs referred for myocardial scar assessment.

METHOD AND MATERIALS
We have developed wideband (RF pulse bandwidth > 4kHz) MRI methods, including perfusion, LGE, and T1 mapping, on a 1.5T scanner (Avanto, Siemens) with specific absorption rate less than the safe limit of 2.0 W/kg. Wideband and standard MRI methods with typical imaging parameters (spatial resolution, temporal resolution, flip angle, etc.) were tested in 10 patients (age = 58 ± 19 years, 7 males) with an ICD who were scheduled to undergo clinical cardiovascular MRI. Three expert readers, blinded to each other, patient identity, and pulse sequence, independently graded the image quality on a scale of 1-5 (worst-best).

RESULTS
All study subjects completed the imaging protocol. Figure 1B shows representative perfusion, LGE, and T1 maps of patients with an ICD. Compared with standard MRI methods, wideband counterparts produced significantly (p < 0.01) higher image quality (perfusion: 3.4 ± 1.0 vs. 4.5 ± 0.6; LGE: 2.7 ± 1.1 vs. 3.8 ± 1.2; T1: 2.8 ± 1.1 vs. 4.1 ± 1.0) in all 10 patients.

CONCLUSION
This study demonstrates feasibility of a new wideband cardiovascular MRI protocol for comprehensive assessment of cardiac function, perfusion, and viability in patients with an ICD.

CLINICAL RELEVANCE/APPLICATION
This new protocol is a major step forward in MRI technology and may be used to advance existing or facilitate new therapies for patients with an ICD or CRT-D and to help with clinical decisions regarding: (i) VT therapies (ii) advanced therapeutics for myocardial recovery.

SSC02-02 Diffuse Fibrosis in Negative Late Gadolinium Enhancement Patients with Systemic Lupus Erythematosus-A Clinical Study using Native Myocardial T1 Mapping and Extracellular Volume Quantification
Monday, Nov. 28 10:40AM - 10:50AM Room: S504AB

Participants
Rui Wu, PhD, Shanghai, China (Presenter) Nothing to Disclose
Lian-Ming Wu, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Rong-Zhen Ou Yang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Dongaoei An, Shanghai, China (Abstract Co-Author) Nothing to Disclose
To detect myocardial fibrosis in negative late gadolinium enhancement patients with SLE, using native myocardial T1 mapping and ECV quantification.

METHOD AND MATERIALS

ECV quantification in SLE patients was higher than control subjects and associated reduction in peak systolic circumferential strain. For diffuse fibrosis in negative LGE SLE patients, ECV may provide better value than native T1 values, and as a novel biomarker, helps patients receive early treatment.

CONCLUSION

Though the effects of coronary artery stenosis on downstream flow reserve are known, technical limitations to measure flow velocity on the distal vessels by MRI exist. We have developed a method to measure coronary flow velocity reserve (CFVR) on the left main trunk (LM) during stress and at rest non-invasively. The purpose here was to validate CFVR-LM on MRI by comparing with the analogous measure on O-15-labeled water PET (CFR_PET) and to evaluate its diagnostic value in detecting significant coronary artery disease (CAD).

RESULTS

CFVR could be assessed in all volunteers, but not in 4 CAD patients due to overtime scan during stress (n=1) or poor image quality (n=3). Among patients evaluated (n=13), 8 had 1-vessel disease (left anterior descending artery [n=5], left circumflex artery [n=3]) and 5 patients had 2-vessel disease. None had LM lesions. CFVR was well correlated with CFR_PET (r=0.61, P=0.0003) (Fig. b). A Bland-Altman plot between CFVR and CFR_PET showed agreement within 1.96 SD with bias (mean=0.83), suggesting that CFVR trended lower than CFR_PET (Fig. c). Inter-observer consistency showed good correlation (r=0.85, P<0.0001). CFVR in CAD patients was significantly lower than that in healthy volunteers (Fig. d), which was concordant with results of CFR_PET (Fig. e). In receiver operating characteristic (ROC) analysis of CFVR for the detection of CAD, the area under the ROC curve was 0.76 (P=0.0078). The Sensitivity was 76.9% and the Specificity was 65.7% using a cutoff of 2.15.

CONCLUSION

CFVR with 3.0-T MRI validated with PET could accurately detect CAD. This method enables us to evaluate coronary circulatory function without radiation or contrast material.

CLINICAL RELEVANCE/APPLICATION

Coronary flow velocity reserve measured using 3.0-T MRI is clinically feasible for the detection of coronary artery disease with good sensitivity and specificity.
METHODS AND MATERIALS

A total of 8 CS patients were retrospectively reviewed. They fulfilled the clinical diagnosis criteria of the CS and underwent 3T-MRI segmented strain analysis based on MR tagging imaging, and compared with LGE in MR, and cardiac accumulation in FDG-PET.

PURPOSE

The prognostic stratification of patients with ST-segment elevation myocardial infarction (STEMI) and treated by primary percutaneous coronary intervention (PCI) is crucial in the management of this population. The aim of this study is to evaluate the additional value of a multi-parametric cardiac magnetic resonance (CMR) score in comparison with traditional TIMI (Thrombolysis in Myocardial Infarction) score and transthoracic echocardiography (TTE) score in prognostic stratification of STEMI patients.

RESULTS

The mean follow-up was 931±495 days. Patients experiencing MACE showed higher TIMI score (p<0.05), LVEF (p<0.01), LVEF-CMR (p<0.01), WMI (p<0.01), prevalence of MVO (p<0.01), and lower EFTTE (p<0.01), EFCMR (p<0.01), and MSI (p<0.01). Two different models based on a binary score were created: a) Model 1 based on clinical parameters and TTE: TIMI <3 = 0 or ≥3 = 1; LVEF < 55% = 0 or > 55% = 1; EFTTE < 50% = 0 or > 50% = 1; WMI < 7 = 0 or > 7 = 1; b) Model 2 based on CMR: LVEF-CMR < 55% = 0 or > 55% = 1; EFCMR > 50% = 0 or < 50% = 1; WMI < 7 = 0 or > 7 = 1; MSI > 0.47 = 0 or < 0.47 = 1; MVO: absence = 0 or presence = 1. Clustering the study population for both models with a score threshold > 2, model 2 provide a better prognostic stratification with a significant incremental prognostic value on the top of traditional outcome model (p=0.0001).

CONCLUSION

A multiparametric approach with CMR including markers of myocardial damage provide incremental prognostic information in addition to traditional risk scores.

CLINICAL RELEVANCE/APPLICATION

A multiparametric approach with CMR provide incremental prognostic information in addition to traditional risk scores.

SSC02-05 Strain Analysis of Cardiac Sarcoidosis Based on Tagging Imaging Can Predict Focal Late Gadolinium Enhancement in MRI and FDG Accumulation in PET

PURPOSE

Focal cardiomyopathy is one of features of cardiac sarcoidosis (CS). FDG-PET and late gadolinium enhancement (LGE) in cardiac MR play an important role in evaluating this focal cardiomyopathy. In this study, we characterized focal cardiomyopathy in CS with segmented strain analysis based on MR tagging imaging, and compared with LGE in MR, and cardiac accumulation in FDG-PET.

METHOD AND MATERIALS

A total of 8 CS patients were retrospectively reviewed. They fulfilled the clinical diagnosis criteria of the CS and underwent 3T-MRI and FDG-PET within 2 months. We demarcated their hearts according to the 16-segment model by American Heart Association and evaluated their focal peak values of circumferential strain (Ecc) in systolic phase as the index of cardiac contractility, max value of Ecc rate as the index of diastolic function. Max Ecc rate was defined as the maximum gradient of a tangent to the Ecc curve in the diastolic phase. We also evaluated LGE, and FDG accumulation. LGE was defined as hyperenhanced lesions when signal intensity (SI) ≥ mean SI + 5 SD of normal myocardium. FDG accumulation was defined as lesions determined by two cardiovascular radiologists’ consensus reading. Subsequently, we evaluated the mean value of peak Ecc and max Ecc rate among FDG (+)
segments and FDG (−) segments, LGE (+) and LGE (−) segments by Welch’s t test.

RESULTS

In the 128 segments evaluated, peak Ecc and max Ecc rate in LGE (−) segments was better than in LGE (+) segments (−12.9% vs. −8.9%, p<0.01, 42.0%/sec vs. 31.6%/sec, p<0.01). The max Ecc rate in FDG (−) segments was also higher than in FDG (+) segments (40.2%/sec vs. 31.2%/sec, p<0.01), while no significant difference was revealed in the peak Ecc between FDG (+) and FDG (−) segments (−11.7% vs. −10.3%, p=18).

CONCLUSION

As an index of diastolic function, max Ecc rate calculated from strain analysis can predict focal FDG accumulation and LGE of CS. Further, a relationship of peak Ecc with LGE was identified, and attributed to systolic dysfunction.

CLINICAL RELEVANCE/APPLICATION

Focal cardiomyopathy due to cardiac sarcoidosis was effectively detected using strain analysis based on MR tagging imaging. This technique does not require any contrast agent or radiation exposure.

SSC02-06 Cardiac Remodeling and Changes in Blood Pressure Following Renal Denervation in Patients with Treatment-Resistant Hypertension

Monday, Nov. 28 11:20AM - 11:30AM Room: S504AB

Participants

Enver G. Tahir, MD, Hamburg, Germany (Presenter) Nothing to Disclose
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Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Koops, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

In recent years, catheter-based renal denervation (RDN) has been investigated as a promising strategy in the treatment of resistant hypertension. The purpose of this study was to investigate the effect of RDN on blood pressure (BP) as well as cardiac mass and function via cardiac magnetic resonance imaging (CMR).

METHOD AND MATERIALS

RDN was performed on 15 patients with a history of resistant hypertension (Table 1). Office and ambulatory long term blood pressures were measured before and 12 months after RDN. For quantitative CMRI, an electrocardiographically triggered steady-state free precession (SSFP) cine sequence (TR/TE, 3.2/1.6ms; pixel-size, 1.7mm×1.7mm) was performed in short- and long-axis views previous to and 12 months after RDN (Fig. 1). Quantitative analysis included end-diastolic (EDV) and end-systolic volumes (ESV), stroke volume (SV), left ventricular ejection-fraction (EF) as well as left ventricular myocardial mass (LVMM). CMR data were analyzed by two independent observers using an in-house developed software (Heart Analysis Tool (HeAT)) (Fig. 2). Data are given as the mean of both observers. Statistical analysis was performed using GraphPad Prism 5 and Excel, Microsoft.

RESULTS

In patients with resistant hypertension, RDN let to a significant decrease of LVMM (165 ± 52 g vs 154 ± 51 g; p< 0.01) and LVMM indexed to body surface area (BSA) (80 ± 22 g/m² vs 73 ± 21 g/m²; p< 0.01) within 12 months post-intervention (Fig. 3 and 5). EDV (161 ± 37 ml vs 166 ± 50 ml), EDV indexed to BSA (78 ± 15 ml/m² vs 82 ± 21 ml/m²), ESV (69 ± 32 ml vs 70 ± 40 ml), ESV indexed to BSA (45 ± 8 ml/m² vs 46 ± 13 ml/m²), SV (92 ± 20 ml vs 96 ± 30 ml) and EF (59 ± 11 % vs 60 ± 13 %) did not change on a significant level (Fig. 3). BP measurements revealed a significant decrease of the minimal diastolic BP in ambulatory long term measurements (53 ± 9 mmHg vs 49 ± 13 mmHg; p<0.05). No additional significant changes of average, systolic or diastolic, office or ambulatory, diurnal or nocturnal BP measurements were detected (Fig. 4).

CONCLUSION

Despite a rather small effect on blood pressure, RDN lead to a decrease of left ventricular mass within 12 months after intervention.

CLINICAL RELEVANCE/APPLICATION

Our study indicates, that patients may benefit from RDN beyond reduction of the blood pressure.

SSC02-07 Diagnostic Accuracy of Coronary CT Angiography using Low Tube Voltage, Low Tube Current, Prospective ECG Triggering and Knowledge-based Model Reconstruction: Comparison with Invasive Coronary Angiography

Monday, Nov. 28 11:30AM - 11:40AM Room: S504AB

Participants

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Chul Hwan Park, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Tae Hoon Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

The aim of this study was to evaluate the diagnostic accuracy of coronary CT angiography (CCTA) using a low tube voltage, low
tubecurrent,prospectivenelectrocardiogram(ECG)triggeringanditerativemodelreconstruction(IMR).Diagnosticaccuracywaseven Evaluatingusinginvasivecoronaryangiography(ICA)asareferencestandard.

**METHOD AND MATERIALS**

FromJanuary2014toFebruary2016,atotaleducf63patients(Male:Female=46:17,meanage=61.8±9.0years,BodyMassIndex (BMI)=24.5±2.6kg/m2)withsuspectedcoronaryarterydisase,whounderwentCCTAandICA,wereretrospectivelyenrolled. CCTAwasperformedatalowtubevoltage(80kVpor100kVp),lowtubecurrent(100-200mAs),andwithprospectivE CGtriggering,followedbyimagerecostructionusingIMR.Coronaryarterydisease(CAD)wasdefinedas>50%luminalnarrowing andassessedusingCCTAandICAdataselectivitypositivepredictivevalue(PPV),negativepredictivevalue(NPV)and diagnosticaccuracyofCCTAwerenevaluatedusingICAastherereference.

**RESULTS**

The mean radiation dose of CCTA was 1.07±0.35 mSv. A total of 793 segments were enrolled. The mean attenuation and image noise of CCTA images were 468.1±67.3 HU and 31.9±8.6. There were no nondiagnostic segments. The per segment sensitivity, specificity, PPV, NPV and accuracy of CCTA were 85.9%, 96.1%, 80.0%, 97.4% and 94.5% respectively. The corresponding per vessel values were 93.3%, 94.3%, 87.5%, 97.1% and 94.0% respectively, and the per patient values were 100%, 83.3%, 93.8%, 100% and 95.2% respectively.

**CONCLUSION**

A low radiation dose CCTA protocol using a low tube voltage, low tube current, prospective ECG-triggering and IMR could be a useful strategy for diagnosing CAD as it reduces the radiation dose, while maintaining diagnostic accuracy.

**CLINICAL RELEVANCE/APPLICATION**

CCTA, using an effective radiation dose of 1 mSv and IMR reconstruction, is an accurate, non-invasive, diagnostic method for CAD, and it might be applicable for CAD screening.

**SSC02-09 Heart Rate Dependency in Cardiac T1 Mapping: An Analysis of the Modified Look-Locker Inversion Recovery (MOLLI) in a Phantom Model at Different Heart Rates**

**METHOD AND MATERIALS**

The phantom studies were carried out at a 3.0 Tesla MRI system with multitransmission technology. Phantoms with different dilutions of gadopentetate dimeglumine were examined at different simulated heart rates (60, 70, 80, 90, 100 and 110 bpm) with a MOLLI sequence with a 5s-(3s)-3s read-out pattern in comparison to a 5b-(3b)-3b pattern. The dilutions resulted in samples with 220, 390, 550, 750, 890, 1100 and 1500 ms of T1 relaxation times. T1 relaxation times were measured three times for each sample.

**RESULTS**

All scans with the MOLLI 5b-(3b)-3b-sequence showed a significant inverse correlation of the measured relaxation time and the heart frequency for T1 phantoms with T1 relaxation times of 550 ms to 1500 ms (p < 0.05; mean slope: -4.1ms/beat per minute). For samples with a relaxation times of ≤ 390 ms the determined T1 time was independent of the heart rate (p > 0.05, mean difference: -0.01 ms) for the MOLLI 5b-(3b)-3b-sequence. However, no significant correlation of the measured T1 values and the heart rate was observed for the MOLLI 5s-(3s)-3s-sequence (p > 0.15; mean slope: 0.04 ms/beat per minute).

**CONCLUSION**

The already shortened MOLLI 5b-(3b)-3b showed a significant heart rate dependency while the MOLLI 5s-(3s)-3s-sequence did not.

**CLINICAL RELEVANCE/APPLICATION**

Therefore, MOLLI seems theoretically to be eligible for comparisons of values at different heart rates e.g. under stress medication or exercise.
Cardiac Monday Poster Discussions

Monday, Nov. 28 12:15PM - 12:45PM Room: CA Community, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

Participants
Ethan J. Halpern, MD, Philadelphia, PA (Moderator) Nothing to Disclose

Sub-Events

CA210-SD-MOA1 Distensibility Characteristics of Ascending Aorta, Descending Aorta and Pulmonary Artery without Coronary Artery Disease

Station #1

Participants
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Shujun Cui, Zhangjiakou, China (Abstract Co-Author) Nothing to Disclose
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Jing Wen, Shenyang, China (Abstract Co-Author) Nothing to Disclose
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Xiaohong Yang, Zhangjiakou, China (Abstract Co-Author) Nothing to Disclose

PURPOSE

As the prevalence of coronary computed tomographic angiography (CCTA), it is meaningful that CCTA can provide not only the structural details of aorta and pulmonary artery, but also functional information of vessel elasticity. Our aim was to study the distensibility characteristics of ascending aorta (AA), descending aorta (DA), main pulmonary artery (MPA), left pulmonary artery (LPA) and right pulmonary artery (RPA), their relationship between each other, and relations with age using 640 slice-volume CT.

METHOD AND MATERIALS

42 subjects who underwent CCTA on 640 slice-volume CT without cardiovascular disease, high blood pressure, diabetes and hyperlipidemia were enrolled in this study. CT data were reconstructed in 10% step throughout the RR interval. The maximal, minimal area and changes in area of AA, DA, MPA, LPA and RPA were measured, and the aortic distensibility (AD) was calculated.

Then the subjects divided into 2 groups, Group 1 age<46, Group 2 age≥46. The AD of AA, DA, MPA of each group was calculated and compared.

RESULTS

The AD of AA, DA, MPA, LPA and RPA was (4.02±2.16), (3.16±1.49), (7.94±3.04), (5.89±3.61) and (7.37±2.77). The correlation coefficient of AA and DA, r=0.661, p=0.000. The correlation coefficient of AA and MPA, r=0.520, p=0.000. The correlation coefficient of DA and MPA, r=0.303, p=0.051. Group 1 the mean AD of AA was 5.21±2.32, Group 2 the mean AD of AA was 2.71±0.85, there was statistically significant difference (t=4.546, p=0.000). Group 1 the mean AD of DA was 3.75±1.70, Group 2 the mean AD of DA was 2.50±0.85, there was statistically significant difference (t=3.055, p=0.005). Group 1 the mean AD of MPA was 8.98±3.02, Group 2 the mean AD of MPA was 6.80±2.69, there was statistically significant difference (t=2.454, p=0.019).

CONCLUSION

The distensibility of AA, DA, MPA, LPA and RPA could be well shown by ECG-gated 640 slice-volume CT. The distensibility relativity was observed between AA and DA, AA and MPA. A obvious age-related decrease in vascular distensibility was found in AA, DA and MPA, which should be taken into account in clinical trials and treatments for the distensibility related cardiovascular diseases.

CLINICAL RELEVANCE/APPLICATION

The correlation relationship of distensibility between AA and DA, AA and MPA was positive correlation. The distensibility of AA, DA and MPA was age-related decreased.

CA211-SD-MOA2 Multi-parametric Approach to Myocarditis at 3-Tesla Including T1 Relaxation Times, T2 Imaging, and Myocardial Strain Analysis Assessed by Cardiac Magnetic Resonance Feature Tracking

Station #2

Participants
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Claas P. Naehle, MD, Bonn, Germany (Abstract Co-Author) Consultant, Medtronic, Inc

PURPOSE

In a clinical setting, acute myocarditis is frequently observed and is associated with a high morbidity and mortality in its acute phase and the long-term. We aimed to evaluate cardiac magnetic resonance feature tracking analysis as a post-processing tool for detection of strain alterations as an ad on tool in a multi-parametric protocol for the diagnosis of myocarditis.
METHOD AND MATERIALS

Cardiac magnetic resonance (CMR) was performed on a 3-Tesla whole body scanner (Ingenia, Philips Healthcare). A multi-parametric protocol was applied which comprised balanced-SSFP cine imaging in common orientations (SAX, HLA, VLA, LVOT), T1-mapping, T2 imaging. A total of 17 patients who were admitted with acute myocarditis were included in this study and 10 patients who were examined for other indications served as healthy controls. In addition to T1 relaxation times and T2 ratio, circumferential and longitudinal strain as well as global radial displacement was assessed using the feature tracking technique.

RESULTS

No between group differences were observed for baseline characteristics. Global native T1 relaxation times were significantly prolonged in patients with myocarditis (1181±43ms vs. 1098±40ms, P<0.0001). T2 imaging revealed an increased T2 ratio in patients with myocarditis (1.8±0.35I vs. 1.5±0.35I, p=0.01). Furthermore, ejection fraction (EF) (57±49% vs. 65±6%, p<0.05), global longitudinal strain (17.2±2.7% vs. 19.9±2.6%, p<0.05) and global circumferential strain (-22.7±4.2% vs. -26.2±4.1%, p<0.05) as well as global radial displacement (4.9±0.7mm vs. 5.9±0.8mm, p<0.01) were significantly reduced in such patients.

CONCLUSION

Patients with acute myocarditis show signs of myocardial dysfunction which can be detected and quantitatively assessed using feature tracking analysis. This approach gives further insights in regional myocardial function without the need of additional dedicated tagging sequences and should therefore considered as an ad on tool in the wide variety of CMR features for the diagnosis of acute myocarditis. Nevertheless, further studies need to evaluate the clinical value of segmental analysis especially in patients with myocarditis and preserved EF.

CLINICAL RELEVANCE/APPLICATION

Feature tracking derived strain analysis may be a useful ad on tool for the diagnosis of myocarditis in a multi-parametric protocol, without the need of additional tagging sequences.

CA212-SD-MOA3 Cardiovascular Risk Stratification in Diabetic Patients with Maturity Onset Diabetes of the Young (MODY) Using Coronary Artery Calcium Score

Station #3

Participants
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Carlos G. Verrastro, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Alfredo A. Rodrigues, MD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose
Andre F. Reis, MD,PhD, Sao Paulo, Brazil (Abstract Co-Author) Nothing to Disclose

PURPOSE

Monogenic diabetes due to glucokinase mutations (GCK-Maturity Onset Diabetes of the Young - MODY) is characterized by mild nonprogressive hyperglycemia. This condition can be potentially associated with lower cardiovascular (CV) risk compared to Type 2 diabetes, but solid data are lacking in literature. It was shown that coronary artery calcium (CAC) score provides incremental predictive value over the Framingham risk score when used in asymptomatic patients. It also outperformed other cardiovascular risk stratification tools, as C-reactive protein and carotid intima media thickness. The aim of this study is to compare the CAC score between type 2 diabetes patients, individuals with GCK-MODY diabetes and controls.

METHOD AND MATERIALS

Forty individuals without CAD have been assessed for coronary artery calcium score using non-contrast multi-slice computed tomography of the heart (Agatston score). Twenty of those were type 2 diabetes patients, 12 were individuals with GCK-MODY from 7 families (diagnosed by Sanger sequencing), and 8 were controls (age- and BMI-matched spouses or non-affected relatives of MODY patients).

RESULTS

Seventy percent of the type 2 diabetes patients were female compared to 12.5% in the control group and 91.7% among the GCK-MODY individuals. Mean age was 54.7±6.7, 44.9±5.5 and 37.8±10.8 years for the type 2 diabetes patients, the control group and the GCK-MODY patients respectively. Body mass index was different (statistically significant) between type 2 diabetes (30.5±5.4 kg/m2) versus GCK-MODY patients (23.9±2.0 kg/m2). 84.2% of patients with type 2 diabetes had low Framingham risk score and 15.9% were in the intermediate risk group. All GCK-MODY individuals and controls had low risk. Glycated hemoglobin was significantly higher in type 2 diabetes patients compared to GCK-MODY and control groups. Coronary calcium score was significantly lower in GCK-MODY individuals 0 [0-0] and in the control group 0 [0- 4.41] compared to Type 2 diabetes patients 6.2 [0- 161.4] (median[interquartile range]).

CONCLUSION

Our data suggest that GCK-MODY patients to bear a low long term risk for CAD, despite having lifelong hyperglycemia.

CLINICAL RELEVANCE/APPLICATION

These data could have potential implications in the clinical management of GCK-MODY diabetes patients as they probably have a lower cardiovascular risk compared to Type 2 diabetes patients. Prospective large studies are necessary to further clarify this point.

CA220-SD-MOA4 Diagnostic Additive Value of MDCT-scan in Case of Suspected Left-sided Prosthetic Heart Valve Dysfunction

Station #4

Participants
Giacomo Agliata, MD, Saint-Denis, France (Presenter) Nothing to Disclose
To define diagnostic performances and contribution of MDCT in the follow-up of left-sided prosthetic heart valve (PHV)

METHOD AND MATERIALS

We retrospectively enrolled 64 patients (33 patients referred for PHV dysfunction and 31 with left-sided PHV as the control group, 44 mechanical and 20 bioprosthesis) who underwent an ECG-gated 256-MDCT scan. The acquisition (axial, one beat scanning, 280 msec/rot, multi-phase, 120 kV, 600 mA, 3.9 mSv of mean radiation dose) was performed after IV administration of iodinated contrast media (75 ml; three-phase injection). MDCT findings were blindly reviewed and compared to echocardiographic data, surgical reports (n=11, surgical group) and follow-up.

RESULTS

Sensitivity and specificity of MDCT for the diagnosis of PHV dysfunction were 96.9% (32/33) and 100% (31/31) respectively, resulting in a diagnostic accuracy of 98.2%. Only one small paravalvular leakage on a mechanical aortic prosthesis was not visualised by MDCT. Among the 33 patients with PHV dysfunction (20 cases of obstructive pathology, 12 regurgitations and 1 endocarditis), MDCT demonstrated a 100% concordance with echocardiographic diagnosis in assessing the kind of dysfunction. More importantly, MDCT identified among the patients with obstructive pathology 9 valve degenerations, 4 pannus, 3 thrombosis and 2 cases of mixed pannus+thrombus, with confirmation by surgical findings (n=9) and follow-up data in 100% of the cases. Also of note, MDCT findings were confirmed in all patients among the surgical group.

CONCLUSION

256 MDCT-scan enables with high accuracy the discrimination between normal and pathological PHV and the characterization of PHV dysfunction. In obstructive PHV, MDCT is also able to correctly establish etiology, suggesting potential therapeutic impact.

CLINICAL RELEVANCE/APPLICATION

MDCT-scan assesses Prosthetic Heart Valve conditions as well as the gold standard echocardiography, adding the possibility to evaluate also etiology in obstructive dysfunctions, suggesting therapy.

Characterization of Left Ventricular Remodeling in Professional Soccer Players: Can We Prevent Sudden Cardiac Death Using CMR?

PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

CMR imaging enables studies to the mechanisms of LV adaptation in professional soccer players and may help to differentiate physiological changes to high-level exercise from inherited cardiomyopathy.
CA215-SD-MOA6 The Effect of New Generation Motion Correction Algorithms on Diagnostic Image Quality and Reproducibility in Aortic Annular Computed Tomography Evaluation Pre Transcatheter Aortic Valve Replacement (TAVR)

Station #6

Awards
Student Travel Stipend Award

Participants
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PURPOSE
Vendor specific motion correction algorithms (SnapShot Freeze, GE Health care, Milwaukee, WI) have shown to improve image quality, interpretability and diagnostic accuracy with regard to coronary assessment in CCTA. We aim to determine if a new generation motion correction algorithm, extended to the whole heart, demonstrates similar improved image quality and reproducibility of annular measurements in pre TAVR CT.

METHOD AND MATERIALS
Thirty consecutive prospective, ECG triggered pre TAVR CT’s without rate control were retrospectively identified. Standard (STD) 35% and 75% R-R interval phases were constructed, from which new motion corrected (MC) data sets were generated offline. Four data sets sets (2 MC, 2 STD) per patient were analyzed by 2 independent, blinded readers for aortic annular size, short and long axis, perimeter and average diameter. Image quality was graded using a 5 point Likert score (1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent). Statistical analysis was performed using paired Student t tests and Bland Altman plots.

RESULTS
120 data sets were analysed (60 STD, 60 MC). 8 data sets (3,5) were excluded due to post TAVR status abnormal valve morphology. At 35%, a significant improvement in Likert score image quality was present after motion correction was applied (mean±STDEV 3.318±0.883 vs. 3.931±0.661, p < 0.001). Bland Altman plots also demonstrated a narrower agreement interval with regard to short and long axis, average diameter, aortic annular area (bias 0.033mm², 95% limits of agreement -0.323 to 0.388mm² vs -0.504 to 0.545mm²), and perimeter (bias 0.292 mm, 95% limits of agreement -3.171 to 3.755mm vs -4.845 to 5.237mm). At 75%, there was a trend toward improved image quality (3.318±0.883 vs. 3.477±0.762 (p =0.302)), and narrower limits of agreement for annular measurement, however, this did not reach statistical significance.

CONCLUSION
Application of a vendor specific motion correction algorithm yields improvement in image quality, as well as higher interobserver reproducibility of aortic annular measurements at 35% of the R-R cycle. While no difference was observed at 75%, this may reflect improved baseline image quality with little margin for incremental gain.

CLINICAL RELEVANCE/APPLICATION
Accurate CT measurement of the aortic annulus and evaluation of morphology is integral to device and size selection, and is recommended pre transcatheter aortic valve replacement.

CA216-SD-MOA7 Monochromatic Evaluation versus Iodine Maps for Myocardial Perfusion Assessment Using Dual Energy CT

Station #7

Participants
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Alejandro Deviggiango, MD, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
Macarena De Zan, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
Gaston Rodriguez Granillo, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose
Roxana Campisi, Vicente Lopez, Argentina (Abstract Co-Author) Nothing to Disclose

PURPOSE
Dual energy CT has the potential to evaluate myocardial perfusion (CTP) using different approaches such as virtual monochromatic evaluation or material decomposition using "iodine maps". We sought to explore the diagnostic performance of monochromatic
evaluations versus iodine maps for the identification of perfusion defects in stress-rest CTP.

**METHOD AND MATERIALS**

We prospectively included patients with suspected CAD who had a clinical indication of a stress-rest SPECT. In all patients, a stress-rest CTP was performed. The same pharmacological agent was used in both studies (dipyridamole). Single-source dual energy CTP was performed, allowing the generation of monochromatic image reconstructions with 10 keV increments from 40 to 140 keV. Stress-CTP was first using prospective scan at 60% phase with 150 - 200 msec of padding was employed so as to cover from 40 to 80% of the R-R interval. A second prospective scan at 75% of the R-R interval with 100 milisecond of padding was complemented 30 minutes later after the administration of aminophylline to revert the effect of the dipyridamole. For monochromatic evaluation, a perfusion defect was defined if present at 40, 60 and 80 keV; whereas if the defect was only present at 40 keV, reduced at 60 keV, and faded away at 80 keV it was considered a BHA. For both iodine maps and monochromatic evaluation, perfusion defects were initially identified in a qualitative manner, and subsequently complemented with a semiquantitative analysis that defined defects as myocardium having a signal density/amount of iodine two standard deviations below the mean myocardium.

**RESULTS**

A total of 28 patients were included. The mean effective radiation dose associated to stress-rest CTP was 8.1±2.0mSv. Both at stress and rest, the diagnostic performance of the monochromatic evaluation was significant higher than the iodine map evaluation (p<0.0001) and the combination of both for myocardial perfusion evaluation (p<0.0001).

**CONCLUSION**

In the present study, CTP analysis using virtual monochromatic analysis derived from dual energy CT showed an improved diagnostic performance compared to iodine maps for the detection of perfusion defects. Furthermore, the addition of iodine maps to the monochromatic assessments failed to provide any incremental diagnostic value in this subset of patients.

**CLINICAL RELEVANCE/APPLICATION**

Dual energy CT has the potential to evaluate myocardial perfusion using different approaches.

CA131-ED-MO8  **How to Take Full Advantage of Dual Source CT for Daily Clinical Cardiovascular Imaging**

Station #8

Participants
Tatsuya Nishi, MD, PhD, Kobe, Japan (Presenter) Nothing to Disclose
Shinsuke Shimoyama, MD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Erina Suehiro, RT, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Wakiko Tani, RT, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Toshinori Sekitani, MS, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Yoshiaki Watanabe, MD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Atsushi K. Kono, MD, PhD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Shumpei Mori, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Satoru Takahashi, MD, Suita, Japan (Abstract Co-Author) Nothing to Disclose
Kazuro Sugimura, MD, PhD, Kobe, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Elsai Co, Ltd Research Grant, DAIICHI SANKYO Group

**TEACHING POINTS**

In dual source CT (DSCT), two x-ray source/detector simultaneously rotate acquiring the image data. Two systems are oriented with 90 degree offset in the gantry contributing unique advantages. The advantage of DSCT has been well investigated for the coronary examination; however, the applicability of DSCT is not sufficiently utilized in daily clinical routine examination. This exhibit shows both basic and detailed tips for using DSCT in daily clinical cardiovascular examination. The aims of this exhibit are: (1) To review each scanning mode that can use only in dual source system, and (2) To share the clinical impacts of each scanning mode with representative cases.

**TABLE OF CONTENTS/OUTLINE**

1. Brief review of what is DSCT
2. The concepts and advantages of scanning modes with dual source system
   2-1. Cardiac scanning
   2-2. High-pitch dual-spiral scanning
   2-3. Dual energy scanning
   2-3. Dual power scanning
   3. Sharing the clinical impacts of DSCT
   3-1. High temporal resolution
   3-2. Fast and wide volume coverage
   3-3. Sedation free and breath-hold free
   3-4. Radiation dose reduction
   3-5. Contrast material amount reduction
   3-6. Iodine uptake analysis with material decomposition method
   3-7. Maximization of iodine enhancement

CA138-ED-MO9  **MSCT Imaging of Various Shunts and Grafts in Post Operative Cases of Congenital Heart Diseases**

Station #9

Participants
Yashpal Rana, MD, MBBS, Ahmedabad, India (Abstract Co-Author) Nothing to Disclose
Megha Sheth, Ahmedabad, India (Abstract Co-Author) Nothing to Disclose
Dinesh Patel, MD, DMRE, Ahmedabad, India (Abstract Co-Author) Nothing to Disclose
Zalak Patel, MD, Ahmedabad, India (Presenter) Nothing to Disclose
S. Patel, Ahmedabad, India (Abstract Co-Author) Nothing to Disclose
Milin Garach, Ahmedabad, India (Abstract Co-Author) Nothing to Disclose
**TEACHING POINTS**

Understanding various shunts and grafts in congenital heart diseases Normal & abnormal post-operative findings on MSCT

**TABLE OF CONTENTS/OUTLINE**

Details of various shunts and grafts used in congenital heart diseases correction MSCT technique and imaging appearances MSCT imaging appearances of abnormal post-operative findings Summary

**CA008-EB-MOA**  
Non-congenital Ventricular Septal Defects: A Pictorial Review

Hardcopy Backboard

Participants
Christopher M. DeClue, MD, Tampa, FL (Presenter) Nothing to Disclose
Jonathan M. Ford, PhD, Tampa, FL (Abstract Co-Author) Nothing to Disclose
John Donatelli, MD, Tampa, FL (Abstract Co-Author) Nothing to Disclose
Summer J. Decker, PhD, Tampa, FL (Abstract Co-Author) Nothing to Disclose
Carlos Andres Rojas, MD, Tampa, FL (Abstract Co-Author) Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is to: I. Examine the etiology and pathophysiology of non-congenital ventricular septal defects (VSDs) II. Describe the imaging features of traumatic and ischemic VSDs on echocardiography, CT, and MRI III. Review imaging pitfalls and differential considerations IV. Discuss the role of surgical and endovascular repair

**TABLE OF CONTENTS/OUTLINE**

Lunch & Learn: Transitioning to DR, Clinical and Financial Benefits Beyond Preventing Reimbursement Penalties: Supported by Fujifilm (invite-only)

Monday, Nov. 28 12:30PM - 1:30PM Room: S403B

Participants

PARTICIPANTS

Jerry Thomas, MS, FAAPM, DABR, CHP, DABSNM Wichita, KS
William Tobin BS, Tyler, TX

PROGRAM INFORMATION

This course does not offer CME credit.
3D Printing: Clinical Applications I

Monday, Nov. 28 12:30PM - 2:00PM Room: S501ABC

RCC23A Introduction to 3D Printing

Participants
Shi-Joon Yoo, MD, Toronto, ON (Moderator) Owner, 3D HOPE Medical; CEO, IMIB-CHD; John P. Lichtenberger III, MD, Bethesda, MD (Moderator) Author, Reed Elsevier

LEARNING OBJECTIVES

Define 3D Printing and understand the basic terminology
Understand the steps to 3D printing
Understand the software that can be used to prepare a 3D print

ABSTRACT

Active Handout: J. Elliott Brown


RCC23B Role of 3D Printing in Congenital Heart Disease

Participants
Shi-Joon Yoo, MD, Toronto, ON (Presenter) Owner, 3D HOPE Medical; CEO, IMIB-CHD;

LEARNING OBJECTIVES

1) Understand 3D printing process for heart models. 2) Know how 3D printing helps pediatric cardiac surgery, with case examples. 3) Know the future directions of 3D printing for cardiac surgery.

ABSTRACT

Using rapid prototyping or 3D printing, physical replicas of the hearts can be provided to surgeons before their surgical decision and procedure. The replicas fill the gap between the imagination from the medical images and the reality. By having the replicas in hands, the surgeons can make optimum surgical decision and simulate the intended procedures on the replica prior to the procedure. This allows precise surgical procedures with reduced procedure and anesthesia time. In cases in the grey zone for biventrical versus univentricular repair, the replicas are tremendously helpful in a binary decision. The presentation will include a few clinical cases where 3D printing played a crucial role in surgical decision making.

RCC23C 3D Printing in Maxillofacial/ Orthopedic Surgery

Participants
Edward J. Caterson, MD, PhD, Boston, MA (Presenter) Nothing to Disclose

RCC23D Creating a 3D Printing Lab in Radiology

Participants
Kent R. Thielen, MD, Rochester, MN (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Gain basic understanding of the resources and infrastructure utilized in creating a collaborative 3D Printing Lab in Radiology. 2) Understand potential patient and organizational benefits of a centralized 3D Printing Lab. 3) Recognize potential limitations / barriers to creating a centralized 3D Printing Lab.

ABSTRACT
CA217-SD-MOB1 Utility of Late Iodine Enhancement Computed Tomography with Image Subtraction Technique of Left Ventricular Cavity

Station #1

Participants
Takanori Kouchi, Toon, Japan (Presenter) Nothing to Disclose
Yuki Tanabe, Toon, Japan (Abstract Co-Author) Nothing to Disclose
Tomohisa Okada, Toon, Japan (Abstract Co-Author) Nothing to Disclose
Takahiro Yokoi, Toon, Japan (Abstract Co-Author) Nothing to Disclose
Naoki Fukuyama, Toon, Japan (Abstract Co-Author) Nothing to Disclose
Akira Kurata, PhD, Toon, Japan (Abstract Co-Author) Nothing to Disclose
Tomoyuki Kido, Toon, Japan (Abstract Co-Author) Nothing to Disclose
Masao Miyagawa, MD, PhD, Toon, Japan (Abstract Co-Author) Nothing to Disclose
Teruhito Mochizuki, MD, Toon, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
The purpose of this study was to evaluate utility of late iodine enhancement computed tomography (LIE-CT) with image subtraction of left ventricular (LV) cavity for assessment of myocardial infarction (MI) extent.

METHOD AND MATERIALS
The study group consisted of 21 patients (mean age: 69.0 years) who underwent comprehensive cardiac CT protocol and late gadolinium enhancement magnetic resonance imaging (LGE-MRI) for assessment of coronary artery disease (CAD). Comprehensive cardiac CT scan protocol consisted of stress CT perfusion (CTP), coronary CT angiography (CTA) and LIE-CT using 256-slice CT (Philips Healthcare, Cleveland, OH). LIE-CT data was acquired 10 minutes after CTP and CTA (mean contrast medium (CM) volume: 92 mL, 370 mg iodine/mL) using low tube voltage of 80 kV (mean radiation dose: 0.41 mSv) without additional CM. LIE-CT images were reconstructed with iterative model reconstruction (IMR). Subtracted LIE-CT images were also created by deducting image signal of LV cavity from original images using a dedicated workstation (Ziostation2, Ziosoft Inc., Tokyo, Japan). For global assessment of MI extent, %MI volume in LIE-CT with/without image subtraction was analyzed, and compared with LGE-MRI. For regional assessment of MI extent, transmural extent of LV wall thickness (TME; 0%, 1-24%, 25-49%, 50-74%, and 75-100%) was visually assessed in LIE-CT with/without image subtraction according to the 16-segment model, and the concordance ratio was evaluated between LGE-MRI and LIE-CT with/without image subtraction.

RESULTS
Of 21 patients, 103 of 336 segments showed MI in LGE-MRI. For global assessment, close correlations for %MI volume were observed between LGE-MRI and LIE-CT with/without image subtraction (r= 0.90 / 0.85, p <0.05 in each). For regional assessment, concordance ratios of TME were 80% / 75% between LGE-MRI and LIE-CT with/without image subtraction. In the assessment of TME ≥50% or not, concordance ratios were 91% / 86% between LGE-MRI and LIE-CT with/without image subtraction. Concordance ratios of TME assessed by LGE-MRI was significantly higher in LIE-CT with image subtraction than in original LIE-CT images (p <0.05).

CONCLUSION
LIE-CT with image subtraction of LV cavity allowed for accurate assessment of MI extent assessed by LGE-MRI.

CLINICAL RELEVANCE/APPLICATION
LIE-CT with image subtraction of LV cavity has a potential for accurate assessment of myocardial viability in patients with CAD.

CA219-SD-MOB3 Image Quality of a Novel Motion Correction Algorithm in Coronary CT Angiography for Patients with Atrial Fibrillation

Station #3

Participants
Hideyuki Sato, Edogawa-ku, Japan (Presenter) Nothing to Disclose
Maiko Miyamoto, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Aki Iwasa, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Masahiro Uematsu, RT, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
Patients with atrial fibrillation cannot undergo conventional motion artifact reduction application in coronary CT angiography (CCTA), since high heart rates lead to motion artifacts. However, a motion-correction algorithm (MCA) can reduce these artifacts.
The aim of this study is to evaluate the effect of a novel MCA on the diagnostic image quality of CCTA for patients with atrial fibrillation.

**METHOD AND MATERIALS**

A total of 40 patients with atrial fibrillation (age, 73.0±11.6 years; heart rate, 69.4±12.6 bpm; range, 36–96 bpm) underwent CCTA with a 64-multidetector-row CT. The diagnostic image quality of their results was then evaluated for images with or without MCA application using a four-step linear measure method (4, excellent; 1, very poor).

**RESULTS**

Diagnostic image quality scores obtained with MCA were higher than those obtained without MCA at the average heart rate (3.9±0.4 vs. 3.7±0.6, P < 0.01), >70 bpm (3.7±0.5 vs. 3.4±0.7, P < 0.01), >80 bpm (3.5±0.6 vs. 3.1±0.8, P < 0.01), and >90 bpm (3.3±0.7 vs. 2.8±0.7, P < 0.01).

**CONCLUSION**

Application of this novel MCA improves diagnostic image quality in patients with high heart rates attributable to atrial fibrillation.

**CLINICAL RELEVANCE/APPLICATION**

In patients with atrial fibrillation, a clear image of CCTA can be obtained even if the patient has a high heart rate.

**PURPOSE**

The purpose of this study was to analyze the reproducibility of native and contrast-enhanced CMR techniques to measure lesion size after acute myocardial infarction (AMI) using native T1/T2 mapping, T2-weighted (T2w) imaging, late gadolinium enhancement (LGE), post-contrast T1 mapping and extracellular volume (ECV) quantification.

**METHOD AND MATERIALS**

Lesion size was independently quantified by 2 experienced observers in total of 176 consecutive CMRs obtained in 44 patients within the first 6 months after AMI using native and contrast-enhanced sequences. Lesion sizes were quantified using a threshold method (cutoff >2SD of remote myocardium) on short-axis left ventricular slices. Lesion size is given as the mean of both observers. Non-parametric Levene’s test was used to compare the variances of the relative differences. Statistical analysis was performed using GraphPad Prism 6.

**RESULTS**

The relative median difference of the native CMR techniques were -1.95% (-12.7% and 9.8%) for T2w, -5.3% (-19.6% and 14.8%) for native T1 and -4.0% (-23.9% and 9.9%) for native T2. Results for contrast-enhanced CMR imaging were: 2.9% (-4.5% and 10.5%) for LGE, 7.5% (-2.4% and 21.5%) for post-contrast T1 and -2.9% (-11.4% and 9%) for ECV measurement. Bland-Altman analysis revealed a better agreement for all post-contrast sequences indicated by lower limits of agreement compared to native sequences. The increased variability of native imaging was caused by higher interobserver differences in small lesions with sizes between 0-15 %LV compared to lager lesions >15 %LV. This bias was not observed for post-contrast imaging.

**CONCLUSION**

In general, there was a good agreement between the two observers to measure lesion size after AMI, but all post-contrast sequences had a better agreement compared to the native sequences. The low agreement of native imaging was mainly caused by higher interobserver differences in small lesions with lesion sizes between 0-15 %LV compared to lager lesions >15 %LV.

**CLINICAL RELEVANCE/APPLICATION**

Accurate ischemic lesion size measurement with non-invasive techniques can help to explore different aspects of the ischemic cardiomyopathy and lead to a better clinical patient management. It has also the potential to improve our understanding of ischaemic cardiomyopathy for research purposes.
**PURPOSE**

Myocardial computed tomography perfusion (CTP) has gained relevance during the past years. Since the pharmacological agents used for stress-CTP tend to increase the heart rate, both systolic and diastolic acquisition are frequently performed in order attain motion-free images. This can be achieved using either a retrospective scan, or a prospective scan with wide padding. Both strategies demand a higher radiation dose in order to cover systolic and diastolic phases. Accordingly, we sought to explore the diagnostic performance of using a systolic, a diastolic, or a combination of both for the assessment of CTP.

**METHOD AND MATERIALS**

We prospectively included patients with suspected CAD who had a clinical indication of a stress-rest SPECT. In all patients, a stress-rest CTP was performed. Dipyridamole was used in both studies. Single-source dual energy CTP was performed, allowing the generation of monochromatic image reconstructions with 10 keV increments from 40 to 140 keV. The stress scan was performed using a prospective mode with a wide padding ranging from 40 to 75% of the R-R interval. Images were reconstructed independently in systolic and diastolic phases. Patients were categorized in tertiles according to the heart rate in order to determine the best phase to analyze myocardial perfusion in relation to heart rate.

**RESULTS**

A total of 48 patients were included. The mean age was 67.9±5.1 years, and 39 (81%) were male. The mean heart rate during stress was 67.9±5.1 bpm. The mean effective radiation dose associated to stress DE-CTP was 5.1±1.7 mSv. Compared to the diastolic and sisto-diastolic evaluation, the diagnostic performance was lowest at the systolic evaluation independently of the heart rate, but particularly at low heart rates (Table). The best results for CTP evaluation were obtained by the combination of systole an diastole and diastole alone, with no significant differences between them among patients with low (tertile 1) and average (tertile 2) heart rates. In patients with heart rate above 75 bpm, the combined evaluation was the best approach.

**CONCLUSION**

In the present study, we found that the scanning technique of stress-CTP can be adapted according to the patient’s heart rate, requiring both systolic and diastolic phases only among patients with heart rate above 75 bpm.

**CLINICAL RELEVANCE/APPLICATION**

Myocardial computed tomography perfusion scans can be adapted according to each patient.

**CA222-SD-MO86**

Cardiac Magnetic Resonance Imaging for Detection of Subclinical Chemotherapy-Induced Cardiac Injury: Feasibility and Initial Findings

**PURPOSE**

Cancer mortality in the Western world is slowly decreasing but many patients now suffer from long-term side-effects. One of the most significant long-term complications of chemotherapy (CTx) is cardiotoxicity. The purpose of this work was to investigate to ability of cardiac magnetic resonance (CMR) to detect and quantify CTx-induced cardiac damage.

**METHOD AND MATERIALS**

In this retrospective study all patients with a documented history of CTx >1 year ago who underwent CMR over a 21-month period were identified. All patients underwent a comprehensive CMR protocol including cine steady state free precession imaging for determination of functional parameters and wall-motion abnormalities, delayed gadolinium-enhancement imaging for detection of focal myocardial scarring and T1-mapping for detection of non-focal myocardial abnormalities. Wall-motion abnormalities were assessed with global longitudinal left ventricular strain (LV-GLS) using commercially available software (Q-mass V7, Medis, The Netherlands). Due to the retrospective nature of the study, the IRB waived the need for informed consent.

**RESULTS**

A total of 19 patients were identified. The median indexed left ventricular end-diastolic volume (LV-EDV) was 100 (82-140 m³/m²). Median left ventricular ejection (LV-EF; %) was 39 (28-54) and 13 (68,4%) patients had an ejection fraction of less than 50%. Median T1 values without contrast were 1088 (1045-1132) and 1630 (1526-1673) for the myocardium and bloodpool, respectively. The median calculated extracellular volume (ECV) was 0.27 (0.25-0.36). The median LV-GLS value was -12.25 (range: -21.33 - -7.82). 13 (68%) patients had a values under -10, which is considered abnormal. Six patients had ECV and LV-GLS abnormalities in the absence of decreased LV-EF.

**CONCLUSION**

Cardiac magnetic resonance imaging can unmask myocardial abnormalities in patients who received cardiotoxic chemotherapy, even in the presence of normal left ventricular ejection fraction.

**CLINICAL RELEVANCE/APPLICATION**

Chemotherapy can induce myocardial damage that can be detected with CMR prior to a decline in left ventricular function. This may offer opportunities to institute preventive measures to avoid CTx-induced heart failure.
**Flow Patterns and Peak Velocity in Dilated Ascending Aorta With and Without Aortic Valve Stenosis and Regurgitation**

Station #7

**Student Travel Stipend Award**

Participants

Kenichiro Suwa, MD, Chicago, IL (*Presenter*) Nothing to Disclose

Ozair A. Rahman, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Emilie Boilache, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Michael Rose, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Amr Ali Rahsepar, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

James C. Carr, MD, Chicago, IL (*Abstract Co-Author*) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

Jeremy D. Collins, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Alex Barker, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

Michael Markl, PhD, Chicago, IL (*Abstract Co-Author*) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;

**PURPOSE**

To characterize differences in aortic blood flow patterns and velocity between patients with AAo dilatation and either Aortic valve stenosis (AS), regurgitation (AR), and neither AS nor AR (no AS/AR), and healthy controls using 4D flow MRI.

**METHOD AND MATERIALS**

Five patients with moderate to severe ASR (56±18 years, 4 men, mid ascending aorta diameter [MAAd]: 40.3±3.2mm), 7 patients with moderate to severe AS (72±10 years, 6 men, MAA diameter: 40.5±2.9mm), 7 patients with moderate to severe AR (63±14 years, 16 men, MAAd: 44.9±4.2 mm), 18 patients with no AS/AR (64±10 years, 13 men, MAAd: 41.6±4.6 mm) all with dilated AAo were selected from the existing database. All subjects underwent in-vivo 4D flow MRI for the measurement of 3D blood flow velocities. AAo flow patterns were visualized using time resolved pathlines and were semi-quantitatively graded for the presence of vortex and helix flow using a 3-point scale (1, no vortex/mild helix [flow rotation: less than 180°]; 2, 1-2 large vortex/moderate supra-physiologic helix [flow rotation: 180° to 360°]; 3, more than 2 large vortex/prominent supra-physiologic helix [flow rotation: more than 360°]). Further quantification included systolic peak velocities in analysis planes at the aortic root, proximal-, mid- and distal-AAo, proximal- and distal-arch, as well as proximal-, mid- and distal-descending aorta.

**RESULTS**

Patients with AR showed significantly elevated vortex flow compared to control subjects (2.00±0.46 vs. 1.45±0.52, p<0.05). Helix flow was significantly elevated for the patients with ASR, AS, AR, and without AS/AR compared to control subjects (3.00±0.00, 2.71±0.49, 2.40±0.82, and 2.50±0.86, respectively, vs. 1.45±0.52, p<0.05). Peak velocities were significantly greater in the patients with ASR from root to distal arch and AS from root to proximal arch compared to those with AR and without AS/AR, as well as controls.

**CONCLUSION**

Patients with ASR and AS demonstrated elevated peak velocity from the root to proximal arch compared to those with AR and without AS/AR. Interestingly blood flow patterns were similar between groups.

**CLINICAL RELEVANCE/APPLICATION**

The elevated peak flow observed in the dilated AAo in patients with ASR and those with AS may lead to accelerated aneurysm progression; further outcomes studies are warranted.

**CA115-ED-MOB8**  Advanced MR and CT Imaging Techniques in the Diagnosis of Cardiac Thrombus

Station #8

**Participants**

Ana Alvarez Vazquez, Madrid, Spain (*Presenter*) Nothing to Disclose

Vicente Martinez, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

Manuel Recio Rodriguez, Pozuelo de Alarcon, Spain (*Abstract Co-Author*) Nothing to Disclose

Gonzalo Pizarro, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

Chawar Hayoun, Pozuelo De Alarcon, Spain (*Abstract Co-Author*) Nothing to Disclose

Julio Fernandez Mata, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**

- To know the clinical situations where the presence of cardiac thrombi must be suspected.
- To outline an appropriate MR imaging protocol to assess cardiac thrombus for each clinical context.
- To use perfusion imaging and delayed-enhancement imaging to check the presence of thrombi.
- To learn new CT scanning equipments enable detect trombus in the left atrial appendage.
- To list the most common congenital abnormalities that simulate a trombus.

**TABLE OF CONTENTS/OUTLINE**

A. Anatomical variants
   B. The most common causes of cardiac thrombus
   C. Diagnostic Imaging: value of CT angiography
   D. Diagnostic Imaging: perfusion and delayed-enhancement MRI
   E. Diagnostic Imaging: MR imaging oriented parallely to the longitudinal catheter axis.
Awards
Cum Laude

Participants
Dmitry Levin, Seattle, WA (Presenter) Nothing to Disclose
Mario M. Ramos, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Elizabeth Perpetua, PhD,RN, Seattle, WA (Abstract Co-Author) Nothing to Disclose
G. B. Mackensen, MD,PhD, SEATTLE, WA (Abstract Co-Author) Nothing to Disclose
Mark Reisman, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Beth A. Ripley, MD, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

There is an unmet need for catheter-based therapies to treat mitral valvular disease, with 9% of the population over age 75 suffering from mitral valvular disease. The growing number of percutaneous mitral valve replacement and intervention devices requires a detailed understanding of 3-dimensional mitral anatomy. Understanding mitral valve anatomy will allow radiologists to report essential information regarding the safety and feasibility of both surgical and catheter-based approaches to repair. The choice of access site and approach for mitral valve intervention is informed by patient-specific anatomy assessed during preprocedural imaging.

TABLE OF CONTENTS/OUTLINE

Exposure to essential mitral valve anatomical structures including commissures, leaflets, annulus, papillary muscles and chords with radiology-pathology correlation. Imaging approach to mitral valve anatomy, including optimal imaging planes for viewing different components and optimization of imaging parameters. Measurement and documentation of valve shape, annulus size, LV size and annular calcification in anticipation of catheter-based repair. Anatomical considerations relating to catheter approach for mitral repair- including trans-septal versus retrograde approach through the aorta and left ventricular outflow tract. Anomalous mitral apparatus anatomy and imaging pitfalls.
LEARNING OBJECTIVES

1) Identify cardiac and coronary artery anatomy. 2) Recognize cardiac disease processes, including coronary atherosclerosis, as diagnosed on CT. 3) Understand methods of cardiac CT and coronary CT angiography post-processing. 4) Understand the role of coronary artery calcium scoring.

ABSTRACT

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

Honored Educators

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

Elliot K. Fishman, MD - 2012 Honored Educator
Elliot K. Fishman, MD - 2014 Honored Educator
Elliot K. Fishman, MD - 2016 Honored Educator
**Bienvenida/Welcome**

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

**LEARNING OBJECTIVES**

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

**ABSTRACT**

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

**URL**

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

**LEARNING OBJECTIVES**

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

**ABSTRACT**

Multiple sclerosis (MS) is a chronic demyelinating and neurodegenerative disease that affects the central nervous system (CNS). Brain and spine MRI are most important paraclinical tool for the diagnosis of MS as conventional MRI techniques, such as T2/FLAIR weighted and gadolinium-enhanced T1-weighted sequences are highly sensitive for detecting focal active white matter lesions. However, these techniques are not specific enough to detect diffuse injuries in both grey and white matter. Pathological and imaging data indicated that lesion pattern and timely detection of tissue damage could help identify patients with an increased risk...
of developing severe disability and cognitive impairment. In this context, advanced quantitative MR tools have been used to access brain and spinal cord lesions in MS. Proton magnetic resonance spectroscopy (MRS) has been used in patients with CIS to identify tissue damage apart from the visible T2 lesions. Diffusion tensor imaging and magnetization transfer imaging have also revealed differences in normal-appearing brain tissue between patients with CIS and controls. Additionally, double inversion recovery (DIR) sequence, quantitative susceptibility mapping and phase sensitive inversion recovery (PSIR) are promising technique to monitor cortical damage and disease progression in patients with MS. The purpose of this lecture are (1) to describe basic background regarding quantitative MRI techniques applied to multiple sclerosis and (2) to discuss how quantitative MRI techniques contribute to monitoring of MS progression.

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

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

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

ABSTRACT

Dynamic contrast-enhanced (DCE) Breast MRI is the standard imaging modality in the response evaluation to neoadjuvant chemotherapy (NAC). Diagnostic accuracy of DCE-MRI in response evaluation to NAC is limited to around 70% in published meta-analysis with very few studies dealing with early response evaluation and DCE-MRI. Diffusion MRI has been show to be a solid imaging biomarker in the evaluation of response to neoadjuvant chemotherapy (NAC) and a recent meta-analysis (Wu, Breast Cancer Res Treat, 2012) showed that it adds sensitivity to the high specificity provided by DCE-MRI. Pickles et al showed in 2006 that diffusion changes precede size reduction in neoadjuvant treatment of breast cancer (Magnetic Resonance Imaging, 2006). Diffusion Tensor imaging (DTI) is a three-dimensional technique, one must apply diffusion gradients along at least 6 non-co-linear, non coplanar directions in order to provide enough information. The mammary ducts are anisotropic structures which need non-scalar or multiple ADC measurements in order to characterize the orientation-dependent water mobility in this tissues. These multiple ADC measurements are provided by DTI. We show our preliminary results in more than 30 patients treated with NAC in which we performed an early evaluation after the first two cycles of treatment with DTI, proving that the prediction of response to NAC is earlier and more accurate than the response evaluation with DCE-MRI.
Teaching Congenital Heart Disease with 3D Printed Models (Hands-on) I: Double Outlet Right Ventricle

Monday, Nov. 28 2:30PM - 4:00PM Room: S401CD

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

LEARNING OBJECTIVES

1) Understand the terms used in describing the pathology of double outlet right ventricle.
2) Understand the pathologic and surgical anatomy of various forms of double outlet right ventricle.
3) Develop ideas how to image the patients with double outlet right ventricle for surgical management.

ABSTRACT

Congenital heart diseases are the most common significant birth defects requiring surgical treatment in the majority of cases. Understanding of pathologic anatomy is crucial in surgical decision and performing optimal surgical procedures. Learning cardiac morphology has relied on the pathologic specimens removed from dead patients or at the time of transplantation. However, the pathologic specimens are rare and hardly represent the whole spectrum of diseases. 3D print models from the CT and MR angiograms of the patients with congenital heart disease are great resources for teaching and can revolutionize education. In this hands-on session, 3D print models of hearts will be used for comprehensive understanding of various morphologic spectrum of double outlet right ventricle. The session will consist of 15-minute introductory lecture, 60-minute hands-on observation and 15-minute discussion and evaluation. Experts on congenital heart disease pathology will be available for guidance and answering questions throughout the session.

Honored Educators

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

Frank J. Rybicki III, MD, PhD - 2016 Honored Educator
SSE03

Cardiac (Dual-Energy CT Imaging)

Monday, Nov. 28 3:00PM - 4:00PM Room: S502AB

CA CT

AMA PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00
FDA Discussions may include off-label uses.

Participants

Jadranka Stojanovska, MD, MS, Northville, MI (Moderator) Nothing to Disclose
Robert M. Steiner, MD, Philadelphia, PA (Moderator) Consultant, Educational Symposia; Consultant, Johnson & Johnson

Sub-Events

SSE03-01 Uric Acid Crystals in Coronary Plaque by 128-slice Dual Energy Computed Tomography (DECT)?: Ex-vivo and In-vivo Case Controlled Study

Monday, Nov. 28 3:00PM - 3:10PM Room: S502AB

Participants

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Philipp Burghard, Innsbruck, Austria (Abstract Co-Author) Nothing to Disclose
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PURPOSE

Whether hyperuricemia is a dependent or independent cardiac risk factor, is controversely debated. Pathomechanisms are complex and fairly understood, and systemic inflammation may play a role. There is anecdotal histological evidence of urate in vessels walls. Our objective was to assess whether dual energy computed tomography (DECT) detects uric acid precipitation in coronary artery plaque in-vivo and ex-vivo.

METHOD AND MATERIALS

We performed an IRB approved ex-vivo phantom and an in-vivo matched case-controlled study: 1) In – vivo: 53 patients underwent 128-slice dual energy computed tomography (DECT) (Definition Flash; Siemens) with both a cardiac (prospective ECG-gated; 100 kV/140 kV) and peripheral extremity protocol of one anatomic region (either knee, hand or foot). Gout positives (G+) were defined as presenting with gout tophi>1cm in peripheral extremities. Post-processing was performed with "gout" DE subtraction curves. 2) Ex-vivo: Urate crystals in different NaCl solutions (5%, 10%, 15%, 20%, 25%) were placed in tubes and scanned by DECT. Coronary plaque models simulating urate plaque, calcifying plaque and normal coronary arteries, were scanned with the same standardized CT protocols.

RESULTS

53 patients (20 G+ and 33 G-) were included. Prevalence of urate precipitations in coronary artery plaque in the G+ group was higher with 13/20 vs 4/33 (65% vs 1.2%); (p<0.001). When matching 20 G+ with 20 controls without hyperuricemia for age and gender, more urate positive coronary plaque were found in G+ (OR 9.8; 95% CI 2.2- 54.9) (p=0.003). The number of urate+ coronary plaques by DECT was higher (32 vs 4; p<0.0001) in G+ than in controls. In urate plaque, 6 lesions were only non-calcifying and 26 mixed calcified, mean density was 232.3 HU (range, 213- 264). Calcium Score was higher in G+ (578 vs 120.6 Agatston Units, p=0.007). Ex-vivo: Urate crystals were detected by DECT in 15% solutions upwards. The urate coronary plaque modell (green) was clearly distinguished from calcifying (blue).

CONCLUSION

Uric acid crystal detection in coronary artery plaque seems feasible by cardiac DECT. Patients with clinical prooven gout precipitated more urate in coronary plaque, which may stimulate intraplaque inflammation.

CLINICAL RELEVANCE/APPLICATION

Hyperuricemia is a rather independent cardiac risk factor. Patients with urate crystal positive coronary plaque might benefit from drugs targeting systemic crystal resolution.

SSE03-02 Dual-Energy CT for Detection of Acute Myocardial Infarction: Is Delayed Acquisition Better than First-Pass Acquisition? Comparison with PET

Monday, Nov. 28 3:10PM - 3:20PM Room: S502AB
Purpose
To compare the diagnostic performance of first-pass and delayed dual-energy CT (DECT) for the detection of acute myocardial infarction (AMI).

Method and Materials
This study was approved by the local ethics committee, and written informed consent was obtained from each patient. Consecutive AMI patients were prospectively recruited in this study. First-pass and delayed DECT were underwent before 13N-ammonia PET. All examinations were performed under rest. The DECT iodine distribution maps of first-pass and delayed acquisition were visually assessed. Diagnostic performances of first-pass and delayed DECT were compared on a per-segment basis with 13N-ammonia PET as the reference standard.

Results
CT and PET examinations were successfully performed in 27 patients. A total of 459 segments were analyzed. The diagnostic accuracy of first-pass and delayed DECT was high on a per-segment basis (89.8% and 91.5%). The area under the receiver operating characteristic curve of delayed DECT (0.915) was larger than first-pass (0.897) on a per-segment basis but the difference between them has no statistical significance (P < 0.05) using the method of DeLong et al.

Conclusion
First-pass DECT shows high diagnostic accuracy for detection of acute myocardial infarction with no inferior to delayed DECT.
the specificity of lesion characterization, thus avoiding unnecessary catheterization.

**SSE03-04 Volume-Based Quantification Using Dual-Energy Computed Tomography in Patients with Cardiac Tumors: Comparison with Late Gadolinium Enhancement Cardiac Magnetic Resonance Imaging**

**Monday, Nov. 28 3:30PM - 3:40PM Room: S502AB**

**Participants**
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**PURPOSE**
The purpose of this study was to assess the diagnostic value of a volume based quantification using dual-energy cardiac computed tomography (CCT) for differentiating between cardiac tumors and thrombi and to compare quantitative CCT values with late gadolinium enhancement cardiac magnetic resonance (LGE-CMR) parameters.

**METHOD AND MATERIALS**
Our institutional review board approved this study, and patients provided informed consent. We prospectively enrolled 31 patients who had a cardiac mass on echocardiography or computed tomography (CT). All patients underwent dual-energy CCT (GE HD750, electrocardiography-gated) and 20 patients underwent LGE-CMR imaging. For quantitative analysis, the following parameters of the cardiac masses were measured: CT attenuation values in Hounsfield units (HU), iodine concentration (IC, mg/ml), and signal intensity (SI) ratio. A mixed effects model was used to evaluate the significance of differences in mean CT attenuation values, mean iodine concentration, and SI ratios between the cardiac tumor and thrombus groups. Diagnostic performance of each parameter was evaluated by constructing a receiver operating characteristics (ROC) curve.

**RESULTS**
There were a total of 17 cardiac tumors and 15 cardiac thrombi. The mean iodine concentration (mg/ml) was significantly higher in cardiac tumors than cardiac thrombi (3.405 ± 2.624 for cardiac tumors; 2.056 ± 2.793 for cardiac thrombi, p=0.001). The diagnostic performance of the IC and SI ratio for differentiating cardiac tumors from thrombi was not significantly different (AUC; 0.822 vs. 0.945, p=0.084).

**CONCLUSION**
Dual-energy CCT using volume-based iodine measurements can be used to differentiate between cardiac tumors and thrombi.

**CLINICAL RELEVANCE/APPLICATION**
Given the superiority of iodine-based measurements using dual-energy CCT in differentiating cardiac tumors from thrombi compared with conventional contrast CT, CCT parameters can be incorporated into the decision process of selecting candidates for surgery. Dual-energy CCT is a helpful complementary tool to differentiate a tumor from a thrombus in cases in which echocardiography or conventional contrast CT is inconclusive.

**SSE03-05 Diagnostic Accuracy of Monoenergetic Reconstruction and Nonlinear Blending on Myocardial Infarction Using Dual-Energy CT: Comparison with 3 T Cardiac MR**

**Monday, Nov. 28 3:40PM - 3:50PM Room: S502AB**

**Participants**
Rui Wang, Beijing, China (Abstract Co-Author) Nothing to Disclose
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Zhanming Fan, Beijing, China (Abstract Co-Author) Nothing to Disclose
Bo Wen, MD, PhD, Beijing, China (Presenter) Nothing to Disclose

**PURPOSE**
To evaluate the image quality and diagnostic accuracy of both monoenergetic reconstruction and nonlinear blending LE-DECT in detecting myocardial infarction, as 3T cardiac MR a reference.

**METHOD AND MATERIALS**
Twenty patients with coronary artery disease were prospectively enrolled and underwent LE-DECT and late gadolinium enhancement CMR (LGE-CMR). LE-DECT images were reconstructed as monoenergetic spectral images 40-190 Kev with 10 Kev interval and non-linear blending setting. Images were assessed for image quality, LE extent (percentile % of whole ventricle segments).

**RESULTS**
Fifty-two myocardial segments (15%) showed LGE on CMR. LE-DECT detected 70 myocardial segments. The signal-noise ratio, contrast-to-noise ratio of images at 70Kev was better than that of other series. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 70 Kev in detecting myocardial infarction in per-segment level was 58%,92%,78%,90%,88%, respectively. However, LE extent detected at 70 Kev was overestimated 12% in comparison with CMR in per-segment level.
CONCLUSION

LE-DECT using monoenergetic reconstruction at 70Kev significantly improves image quality and diagnostic accuracy. However, LE extent of myocardial infarction detected with LE-DECT is overestimated compared with CMR.

CLINICAL RELEVANCE/APPLICATION

LE-DECT with monoenergetic reconstruction at 70 keV significantly improves image quality for detection of myocardial infarction.

SSE03-06 Value of a Noise-optimized Virtual Monoenergetic Reconstruction Technique in Dual-Energy CT for Planning of Transcatheter Aortic Valve Replacement

Monday, Nov. 28 3:50PM - 4:00PM Room: S502AB

Participants
Simon S. Martin, MD, Frankfurt, Germany (Presenter) Nothing to Disclose
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Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Julian L. Wichmann, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate objective and subjective image quality of a noise-optimized virtual monoenergetic imaging (VMI+) reconstruction technique in dual-energy computed tomography (DECT) angiography prior to transcatheter aortic valve replacement (TAVR).

METHOD AND MATERIALS

Datasets of 47 patients (35 men; 64.1±10.9 years) who underwent DECT angiography of heart and vascular access prior to TAVR were reconstructed with standard linear blending (F_0.5), VMI+ and traditional monoenergetic (VMI) algorithms in 10-keV intervals from 40-100 keV. Vascular enhancement and image noise of 10 arterial segments were measured in each patient; signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) of multiple arterial segments were calculated. Three radiologists with different levels of experience in cardiac CT imaging subjectively assessed image quality, iodine enhancement and image noise to compare the different post-processed datasets.

RESULTS

Overall, 470 arterial segments were evaluated. Mean SNR and CNR were highest in 40 keV VMI+ series (SNR, 27.8±13.0; CNR, 26.3±12.7), significantly (all p<0.001) superior to all VMI series which showed highest values at 70 keV (SNR, 18.5±7.6; CNR, 16.0±7.4), as well as linearly-blended F_0.5 series (SNR, 16.8±7.3; CNR, 13.6±6.9). Highest subjective image quality scores were observed for 40, 50, and 60 keV VMI+ reconstructions (all p>0.05), significantly superior to all VMI and standard linearly-blended images (all p<0.01).

CONCLUSION

Low-keV VMI+ reconstructions significantly increase CNR and SNR compared to VMI and standard linear-blending image reconstruction and improve subjective image quality in preprocedural DECT angiography in the context of TAVR planning.

CLINICAL RELEVANCE/APPLICATION

Noise-optimized virtual monoenergetic DECT imaging improves image quality for TAVR planning.
Impact of Institutional Volume on Transcatheter Aortic Valve Replacement Sizing: A Multicenter Retrospective Study

PURPOSE
Computed tomography (CT) is the standard imaging modality for aortic annular sizing in transcatheter aortic valve replacement (TAVR). We sought to assess the relationship between TAVR procedural volume and CT measurement accuracy.

METHOD AND MATERIALS
Within a large health system, TAVR is performed at low (<40/year), intermediate (40-75/year), and high volume sites (>75/year). 181 patients underwent TAVR with Sapien XT from 1/14-6/15: 21 low volume site, 62 intermediate volume site, and 98 high volume site. All patients had a pre-procedural CT interpreted by the site radiologist. Heart teams independently decided TAVR prosthesis sizing. Patient data was obtained from the medical record. Two blinded readers remeasured the annulus minor axis, major axis, mean diameter, area-derived diameter, and perimeter. Data was analyzed using Pearson coefficient, chi-squared test, student's t-test, or Mann-Whitney test, and adjusted for multiple comparisons using Hommel procedure.

RESULTS
Baseline patient characteristics were similar across sites. Aortic annular measurements were incompletely reported at 45% of low volume sites, 80% intermediate sites, and 10% high volume sites (p<0.01). Reported mean annular size differed significantly across sites (p<0.01), whereas independent reviewers found no significant differences (p=0.25). There was a poor correlation between reported CT measurements and independent reviewers at low (r=0.31) and intermediate volume sites (r=0.34), and a strong correlation at the high volume site (r=0.96), p<0.01. Significant mismatch between predicted valve size based on CT reports and implanted valve size occurred at all sites (p<0.01), less often at high volume (18%) compared to intermediate (80%) and low volume sites (29%), p<0.01. Undersizing the TAVR prosthesis relative to predicted size on CT was associated with increased risk of paravalvular leak at the high volume site (OR 2.9, p<0.01) and with independent reviewers measurements (OR 3.1, p<0.01). Size mismatch was not associated with 30-day mortality or major cardiovascular events.

CONCLUSION
CT reported annular measurements vary based on TAVR procedural volume, and are associated with mismatch between site predicted valve size and implanted valve size. Valve undersizing was associated with paravalvular leak.

CLINICAL RELEVANCE/APPLICATION
Adopting measurement strategies from high volume TAVR sites may help reduce variability in CT measurements of the aortic annulus.

Quantification of Mitral and Tricuspid Regurgitation with Cardiac 4D Flow MRI

PURPOSE
Adopting measurement strategies from high volume TAVR sites may help reduce variability in CT measurements of the aortic annulus.

METHOD AND MATERIALS
Within a large health system, TAVR is performed at low (<40/year), intermediate (40-75/year), and high volume sites (>75/year). 181 patients underwent TAVR with Sapien XT from 1/14-6/15: 21 low volume site, 62 intermediate volume site, and 98 high volume site. All patients had a pre-procedural CT interpreted by the site radiologist. Heart teams independently decided TAVR prosthesis sizing. Patient data was obtained from the medical record. Two blinded readers remeasured the annulus minor axis, major axis, mean diameter, area-derived diameter, and perimeter. Data was analyzed using Pearson coefficient, chi-squared test, student's t-test, or Mann-Whitney test, and adjusted for multiple comparisons using Hommel procedure.

RESULTS
Baseline patient characteristics were similar across sites. Aortic annular measurements were incompletely reported at 45% of low volume sites, 80% intermediate sites, and 10% high volume sites (p<0.01). Reported mean annular size differed significantly across sites (p<0.01), whereas independent reviewers found no significant differences (p=0.25). There was a poor correlation between reported CT measurements and independent reviewers at low (r=0.31) and intermediate volume sites (r=0.34), and a strong correlation at the high volume site (r=0.96), p<0.01. Significant mismatch between predicted valve size based on CT reports and implanted valve size occurred at all sites (p<0.01), less often at high volume (18%) compared to intermediate (80%) and low volume sites (29%), p<0.01. Undersizing the TAVR prosthesis relative to predicted size on CT was associated with increased risk of paravalvular leak at the high volume site (OR 2.9, p<0.01) and with independent reviewers measurements (OR 3.1, p<0.01). Size mismatch was not associated with 30-day mortality or major cardiovascular events.

CONCLUSION
CT reported annular measurements vary based on TAVR procedural volume, and are associated with mismatch between site predicted valve size and implanted valve size. Valve undersizing was associated with paravalvular leak.

CLINICAL RELEVANCE/APPLICATION
Adopting measurement strategies from high volume TAVR sites may help reduce variability in CT measurements of the aortic annulus.
Purpose

Quantification of the severity of mitral and tricuspid regurgitation is essential for determining the need for valve repair. Transthoracic echocardiography (TTE) has been shown to have poor interobserver reliability, and technical constraints limit availability of conventional MRI. This study seeks to assess the reliability of 4D Flow MRI for quantifying mitral and tricuspid regurgitation, in comparison to conventional phase-contrast (2D-PC) MRI.

Method and Materials

With IRB approval and HIPAA compliance, we retrospectively identified all patients who underwent cardiac MRI with 4D Flow for further quantification of inlet valvular regurgitation between April 2015 and February 2016. Thirteen adult patients (10 male, 3 female) with mitral and/or tricuspid regurgitation were identified. Regurgitant volumes (RVol) and fractions (RF) were calculated with (a) direct quantification of the regurgitant jets and (b) indirect quantification based on the difference between ventricular stroke volume and outlet valve flow for both 4D Flow and 2D-PC. Measurements were compared with Bland-Altman and Pearson correlation analysis.

Results

4D Flow image data was successfully acquired in all thirteen patients referred for MRI quantification. RVol ranged from 0.5 – 14.5 L/min and RF ranged from 10-76%. 2D-PC was also obtained in eleven patients. Direct measurement of regurgitant volume had high concordance between both techniques (p=0.93), as did indirect measurements (p=0.96-0.99). Direct and indirect measurements within 4D Flow also demonstrated high concordance (p=0.92-0.99), whereas direct 4D Flow measurements were slightly less well correlated with indirect 2D-PC measurements (p = 0.88).

Conclusion

Cardiac 4D Flow MRI can be used to accurately quantify mitral and tricuspid regurgitant flow, relative to conventional 2D-PC. Because it is simpler to prescribe, 4D Flow MRI may be a more efficient method for assessing valvular disease in routine clinical practice.

Clinical Relevance/Application

Cardiac 4D Flow MRI is a promising technique for direct quantification of mitral and tricuspid regurgitation and may improve availability of cardiac MRI to guide management of these patients.
Participants
Gudrun Feuchter, MD, Innsbruck, Austria (Abstract Co-Author) Nothing to Disclose
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PURPOSE
Imaging of prosthetic valve dysfunction (PVD) is a challenge by echocardiography. Delayed or misdiagnosis may have fatal consequences with a high mortality risk. Therefore the purpose of our multicenter study was to evaluate the accuracy of cardiac computed tomography angiography (CTA) for diagnosis of PVD in comparison with surgery and transesophageal echocardiography (TEE).

METHOD AND MATERIALS
84 patients (age, 66.6y, 30.9% females) with n=90 prosthetic devices (38 mechanical, 45 bioprostheses, 7 mitral annuloplasty-rings) were examined with retrospective-ECG-gated Cardiac CT-Angiography (CTA) between 2006 and 2015 were included into our multicenter registry consisting of 4 cardiac imaging reference centers (US/Canada/Europe). CTA was compared with intraoperative findings and transesophageal echocardiography (TEE). Receiver operating curve (ROC)-analysis was performed to detect differences in the diagnostic performance of CTA and TEE vs surgery, respectively. Device infection rate was 15 (29.4%). Time from CTA to surgery was mean 7.7y±5.2

RESULTS
The sensitivity and specificity of CTA for diagnosis of PVD as compared to surgery (in 51 patients) were 94.0% and 98.5% per-lesion; agreement was k=0.93. CTA detected 12/13 (92.3%) paravalvular leaks and 10 abscesses (4 false positives). For pseudoaneurysm (n=10), accuracy of CTA was c=1.0 (95%CI:0.93-1) and for TEE vs surgery c=0.80 (95%CI:0.66-0.90; p=0.014).
22/25 (88%) masses (13 thrombi/pannus;8 vegetations;1 other) were correctly identified by CTA while for TEE vs surgery accuracy was lower (c=0.935; 95%CI:0.81-0.98 vs c=0.761; 95%CI: 0.6-0.88; p=0.001). 6/17 (94.1%) structural bioprosthetic degenerations were identified by CTA. 12 (100%) dehiscences (c=1.0; 95%CI:0.91-1) were diagnosed by CTA while the accuracy of TEE vs surgery was lower with c=0.66 (95%CI:0.5-0.8; p=0.002). For CTA vs TEE (per-lesion), sensitivity was 95.6%, specificity 96.3% and PPV 85.7%, resp. (k=0.88; 95%CI:0.79-0.97).

CONCLUSION
Cardiac CTA is an accurate imaging modality for PVD detection, in particular for paravalvular pathologies and thrombus/pannus, and outperforms TEE for paravalvular involvement such as dehiscence and pseudoaneurysm.

CLINICAL RELEVANCE/APPLICATION
Cardiac CTA should be systematically integrated in the diagnostic work-up algorithm of patients with prosthetic valve dysfunction.

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

Jonathon A. Leipsic, MD - 2015 Honored Educator

SSE04-05 CT Myocardial Extracellular Volume Fraction (ECV) Quantification in Patients Undergoing Evaluation for Transcatheter Aortic Valve Replacement

Monday, Nov. 28 3:40PM - 3:50PM Room: S504AB

Participants
Stefan L. Zimmerman, MD, Baltimore, MD (Presenter) Nothing to Disclose
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Jill E. Jacobs, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Jon Resar, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Elliott K. Fishman, MD, Baltimore, MD (Abstract Co-Author) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company;
David A. Bluemke, MD, PhD, Bethesda, MD (Abstract Co-Author) Research support, Siemens AG

PURPOSE
In patients with aortic stenosis (AS), chronically elevated left ventricular (LV) wall stress leads to myocyte damage and interstitial fibrosis. Greater extent of myocardial fibrosis from biopsy specimens in AS has been associated with reduced LV ejection fraction (EF) and worse long-term survival after valve replacement. Extracellular volume fraction (ECV) quantification with cardiac CT is an
emerging method for non-invasive measurement of myocardial fibrosis. Our purpose was to measure cardiac CT ECV in patients with severe AS undergoing evaluation for transcatheter aortic valve replacement (TAVR) and to correlate with severity of aortic stenosis and LV function by echocardiography.

**METHOD AND MATERIALS**

After informed consent, 37 consecutive patients with severe AS undergoing pre-TAVR CT were enrolled. Standard TAVR imaging as well as pre- and 10 minute post-contrast cardiac CT acquisitions were obtained on a dual source scanner in dual energy mode (90/150 kV, Siemens, Erlangen, Germany). Patients received 150 mL iodinated contrast for glomerular filtration rate (GFR) >60 mL/min/1.73m² (n=20) and 100-120 mL for GFR<60 (n=17). To calculate ECV, 1 cm² regions of interest (ROI) were placed in the mid ventricular septum and blood pool in matching locations on pre- and delayed post-contrast images. Focal myocardial scar was excluded from ROIs. ECV was calculated with the formula: ECV CT = (1−Hematocrit) × (ΔHUseptum/ΔHUblood) where HU is the mean Hounsfield unit measurement for each ROI.

**RESULTS**

Mean age of cohort was 83±5.9 years with median LV EF of 55% [interquartile range (IQR), 47-63] and aortic valve area of 0.68 cm² (IQR, 0.39-0.97). Median myocardial ECV was 0.29 (IQR, 0.22-0.36). Myocardial ECV showed a significant negative correlation with echocardiographic LV EF (Spearman’s rho = -0.36, p=0.03), but was not correlated with either peak aortic valve velocity, aortic valve area, or peak aortic valve gradient. Mean contrast dose was 1.8±0.5 mL/kg and was not significantly associated with ECV.

**CONCLUSION**

Increased myocardial ECV by cardiac CT is associated with reduced LV function in patients with aortic stenosis, suggesting more extensive diffuse (interstitial) fibrosis in these patients.

**CLINICAL RELEVANCE/APPLICATION**

Non-invasive measurements of ECV with cardiac CT may be able to identify aortic stenosis patients with a greater fibrosis burden, which could be useful for pre-operative risk stratification and prognosis.

**Honored Educators**

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Stefan L. Zimmerman, MD - 2012 Honored Educator
Stefan L. Zimmerman, MD - 2015 Honored Educator
Elliot K. Fishman, MD - 2012 Honored Educator
Elliot K. Fishman, MD - 2014 Honored Educator
Elliot K. Fishman, MD - 2016 Honored Educator

**SSE04-06 Cardiac CT to Evaluate Risk of Coronary Compression in Candidate Patients for Percutaneous Pulmonary Valve Implantation**

**PURPOSE**

To evaluate the relationship between the coronary arteries and pulmonary trunk/conduit assessing the risk of coronary compression in candidate patients for percutaneous pulmonary valve implantation (PPVI) with cardiac CT.

**METHOD AND MATERIALS**

A retrospective evaluation of candidate patients for PPVI who underwent CT prior to the procedure in our hospital was performed. Patient data were retrieved from electronic patient files and the reasons why PPVI was not performed were re-assessed with an experienced congenital cardiologist. The analysis of coronary arteries included the distance of the coronary artery to the intended site of the future valve implantation in the pulmonary trunk as well as the length of the coronary segment involved.

**RESULTS**

CT analysis was performed for 52 patients. Thirty patients underwent PPVI after CT and 22 didn't. In 6 out of 22 patients the reason not to perform PPVI was high risk of CC when the distance between the coronary artery and the pulmonary trunk at CT was less than 2 mm, in particular it was 1 mm for RCA (1 patient), 1.8±0.47 mm for the LAD (4 patients) and 0 mm for the LCX (1 patient). In the other 16 patients not undergoing PPVI the main reason was a non suitable RVOT size (10/16 cases). The relationship between CA and PT for every coronary of the patients who safely underwent the procedure was compared with the group who didn't undergo PPVI because of a high CC risk. The distance between the RCA, LM, LAD and LCX and the site of future valve's implantation was 13.4±8.4 mm, 14.8±9.9 mm, 13.8±8.8 mm and 21.9±11.4 mm respectively for the patients who received PPVI. None of the patients that received PPVI experienced CC.

**CONCLUSION**

CT allows detection of coronary arteries at high risk of compression during PPVI. Therefore CT can be useful in pre-procedural
selection and planning by identifying which patients can be excluded from the procedure because they are unlikely to undergo a successful intervention.

CLINICAL RELEVANCE/APPLICATION

Cardiac CT could be helpful in planning for PPVI identifying which patients are at high CC-risk and which patients have a sufficient distance between the coronary arteries and pulmonary trunk.
PURPOSE
We hypothesized that a 72-hour high-fat, high protein and very low-carbohydrate (HFHPVLC) diet preparation can suppress physiological myocardial uptake of FDG, which is the limiting factor in using FDG-PET/CT for cardiac sarcoidosis (CS).

METHOD AND MATERIALS
This retrospective study included 215 FDG-PET/CT tests from 207 patients with biopsy proven sarcoidosis and clinical suspicion for CS between July 2014 and December 2015. These patients were classified into 2 groups. Group 1 includes 12 FDG PET/CT scans from 12 patients who had 24-hour or less pretest HFHPVLC diet preparation. Group 2 includes 203 FDG PET/CT scans with 72-hour HFHPVLC diet before FDG-PET/CT. All patients were given detailed instructions about diet preparation. Diet adherence were verified by imaging physician during test. Nonadherent patients and patients with coexisting cancer were excluded. Patterns of cardiac FDG uptake were classified into: “none” and “ring like diffuse at base” (negative for CS); “focal” (positive for CS); and “diffuse” (indeterminate for CS). Quantitative cardiac FDG uptake was measured. Final diagnoses were made with consensus among physicians in view of all available comprehensive clinical information, other imaging and diagnostic test results, with reference to modified Japanese Ministry of Health and Welfare criteria.

RESULTS
In group 1, there were 1(1/12, 8.3%) positive, 5 (5/12, 41.7%) indeterminate, and 6 (6/12, 50.0%) negative for CS. In group 2, 10 patients were excluded (6 due to noncompliance diet, 2 with concurrent diagnosis of cancers, 2 due to insulin and steroid use within 4hr before PET/CT); the remaining 185 patients had 193 FDG PET/CT tests (8 repeats), of which there were 19 (19/193, 9.8%) positive, 5 indeterminate (5/193, 2.6%), and 169 (169/193, 87.6%) negative for CS. The SUVmax of PET positive CS lesions range from 3.4 to 12.5, while mediastinal blood pool SUVmean range from 1.1 to 3.6. The indeterminate rate is significantly lower in group 2 compared with group 1 (p < 0.001). The NPV and PPV in group 2 are 100% and 94.7% respectively.

CONCLUSION
The 72-hr HFHPVLC diet preparation protocol successfully suppresses physiological myocardial FDG uptake with minimal nondiagnostic rate. This patient preparation protocol may permit a more sensitive and accurate method of diagnosing active CS.
a low-carbohydrate diet (LCD) and that with an additional unfractionated heparin (UFH) injection.

**METHOD AND MATERIALS**

Thirty healthy, non-diabetic volunteers (16 males, age: 56±5.5 y.o.) were participated in this randomized-control study. They were divided into 2 groups: 15 subjects with more than 18-h fast with LCD (less than 4 g) preparation (group A) and the other 15 subjects with an additional injection of UFH (50 IU/kg) 15 min prior to FDG injection (group B). At the 4 time points of 3-h before, just before, 15 min after, and 1-h after UFH injection, blood samples were obtained to measure free fatty acid (FFA), immunoreactive insulin (IRI), and plasma glucose (FPG) level. Cardiac spot and whole body PET/CT imaging started 60 min after FDG injection. Imaging data were analyzed visually and quantitatively using a standard uptake value (SUV), and compared with pooled data of biopsy-proven CS (n=37) and non-CS (n=18) pts.

**RESULTS**

All subjects were well tolerated the protocol. Fasting durations of group A and B were 1160±48 and 1160±66 min, respectively. There were also no significant difference in serum levels of FPG and IRI. Although the FFA levels of 15 min after UFH injection significantly increased in group B as compared to group A (1.55 ± 0.49 vs. 1.97 ± 0.58 mEq/L, P=0.039), there was no difference in left ventricular (LV) SUVmax (1.57±0.27 vs. 1.59±0.26, P=0.84). There was no FDG uptake visually in the LV of all subjects. In addition, each LV SUVmax was lower than that of the liver (1.58±0.26 vs. 1.91±0.33, P<0.0001). Finally, it is obviously higher in CS pts than those in the other 3 groups (p<0.0001, Figure).

**CONCLUSION**

The complete suppression of physiological FDG uptake in the LV myocardium is visually and quantitatively achieved by means of more than 18-h LF with LCD preparation protocol. Under these circumstances, the use of UFH brings no added value to the suppression.

**CLINICAL RELEVANCE/APPLICATION**

The low-carbohydrate diet of the day before FDG PET together with a fasting more than 18-h completely suppresses physiological FDG uptake in the heart.

**SSE16-03 Recent Nationwide Trends in Utilization of Standard and PET Myocardial Perfusion Imaging: Is There Growth or Contraction?**

**PURPOSE**

The development of PET myocardial perfusion imaging (PET MPI) has been somewhat controversial. It has certain technical advantages over the standard SPECT techniques (STD MPI) but is much more expensive. Our purposes were to see how rapidly PET MPI is growing relative to STD MPI and to study utilization trends among radiologists and cardiologists.

**METHOD AND MATERIALS**

Nationwide Medicare Part B fee-for-service databases from 2002 through 2014 were used. They provide volume data for all CPT codes. The codes for primary STD MPI and PET MPI were selected. No add-on codes were included. Medicare specialty codes were used to identify radiologists, cardiologists, and all other physicians as a group. Medicare place-of-service codes were used to identify exams done in hospital inpatients, hospital outpatient departments (HOPDs), private offices, and emergency departments (EDs).

**RESULTS**

Medicare STD MPI volume increased from 2,456,043 in 2002 to 3,136,573 in 2006 (+28%). Thereafter it declined every year, reaching 2,092,102 in 2014 (-33% vs peak). That year, cardiologists did 77% of the studies, radiologists 18%, others 5%. Medicare PET MPI volume was 9,563 in 2005 (the first year a CPT code was available), increasing almost every year thereafter, and reaching 100,619 in 2014 (+952%). That year, cardiologists did 86% of PET MPIs, radiologists 8%, others 6%. In 2014, PET MPI constituted 4.6% of all MPI exams. In 2014, there were 1,029,699 STD MPIs done in private offices; 792,332 in HOPDs; 244,836 in hospital inpatients; 23,356 in EDs; and 1,879 elsewhere. Also in 2014, there were 74,038 PET MPIs done in private offices; 20,343 in HOPDs; 4,570 in hospital inpatients; 281 in EDs; and 1,387 elsewhere.

**CONCLUSION**

The use of STD MPI has contracted substantially in recent years. This is likely due to large reductions in reimbursement, leading to closure of many cardiology private offices. At the same time, PET MPI has grown substantially, although by 2014 it still constituted less than 5% of all MPI exams. The rapid growth of PET MPI should continue to be monitored, as it is an expensive exam and is done mostly by cardiologists who could be in a position to self-refer.

**CLINICAL RELEVANCE/APPLICATION**

n/a
PURPOSE

F-18 fluorodeoxyglucose (FDG) PET has been proposed to play a role in the diagnosis of sarcoidosis including cardiac involvement. However, its specificity is relatively low. 3’-deoxy-3’-F-18 fluorothymidine (FLT) has been investigated as a promising PET tracer for evaluating tumor proliferative activity. The purpose of this study was to investigate the usefulness of FLT PET/CT for the detection of active cardiac sarcoidosis, compared with FDG PET/CT.

METHOD AND MATERIALS

The study evaluated 25 patients who were suspected of having cardiac sarcoidosis. The patients fasted for at least 18 hrs before FDG PET studies, although no special dietary instructions were given to them before FLT PET studies. PET emission scanning of the cardiac region with a 10-min acquisition was performed 60 min after each radiotracer injection. For visual analysis, FLT PET images were classified into 2 patterns: no and focal uptake. FDG PET images were classified into 4 patterns: no, diffuse, focal, and focal on diffuse uptake. A focal FLT uptake and focal or focal on diffuse FDG uptake were defined as an active pattern. For semiquantitative analysis, the myocardium-to-blood cavity ratio (MBR) was calculated by dividing the maximal standardized uptake value (SUV) in myocardium by the mean SUV in blood cavity.

RESULTS

Twelve patients were found to have active sarcoidosis (group A); 8, non-active sarcoidosis (group B); and 5, heart failure without sarcoidosis (group C). In group A, all 12 showed an active pattern on both PET studies. In group B, 3 of 8 showed diffuse uptake on FDG PET but all 8 showed no uptake on FLT PET. In group C, 3 showed diffuse uptake and 2 showed focal uptake on FDG PET but all 5 showed no uptake on FLT PET. A significant correlation was observed between FDG MBR and FLT MBR. The mean FLT MBR in group A was significantly higher than that in groups B and C. The area under the receiver operating curve value of FLT MBR was significantly higher than that of FDG MBR for detection of active cardiac sarcoidosis.

CONCLUSION

These preliminary results suggest that FLT PET/CT is a potentially useful tracer for detecting active cardiac sarcoidosis, being especially more specific than FDG PET/CT.

CLINICAL RELEVANCE/APPLICATION

FLT PET/CT is a potentially useful tracer for detecting active cardiac sarcoidosis, being especially more specific than FDG PET/CT.

SSE16-05 Myocardial Ischemia Detected by Myocardial Perfusion Single-photon Emission Computed Tomography (SPECT) in Obese Patients: Prevalence and Clinical Correlates

Monday, Nov. 28 3:40PM - 3:50PM Room: S505AB

Participants
Andrea R. Lorenzo, Rio de Janeiro, Brazil (Presenter) Nothing to Disclose
Ronaldo Lima, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the prevalence and clinical correlates of myocardial ischemia detected by myocardial perfusion single-photon emission computed tomography (SPECT) in obese patients.

METHOD AND MATERIALS

5563 patients (26.6% obese) were evaluated. A 1-day, rest/stress protocol was used, with injection of 222-370 MBq of Tc-99m sestamibi at rest and 666-1110 MBq at stress. SPECT was performed either with a dual-head Ventri camera (GE Healthcare) or a CZT-SPECT system (Discovery 530, GE Healthcare). Images were reconstructed on a dedicated Xeleris workstation (GE Healthcare). Semiquantitative 17-segment visual interpretation of the gated myocardial perfusion images was performed using a standard 5-point scoring system. Summed stress and rest scores (SSS and SRS) were calculated and their difference was recorded as summed difference score (SDS). Patients with a SDS>1 were considered to have ischemic MPS. Categorical variables were expressed as number and percentage and compared by chi-square or Fisher’s exact test. A p-value <0.05 was considered statistically significant.

RESULTS

The prevalence of ischemia was not significantly different between obese or nonobese patients with ≤1 cardiovascular risk factor (10.9% vs 9.1%, p=0.3), but was higher for those with body mass index (BMI) ≥40 kg/m2 (21.9% vs 9.9% in the nonobese, p=0.02). Patients with hypertension, diabetes or dyslipidemia also had higher rates of myocardial ischemia (16% for the obese and 10.3% for the nonobese, p<0.05). Image quality was good/excellent in 94.5% of the obese patients.

CONCLUSION

Myocardial ischemia was more frequent in patients with hypertension, diabetes or dyslipidemia, or in patients with BMI ≥40 kg/m2 even without other risk factors.

CLINICAL RELEVANCE/APPLICATION

Obesity is a limitation for several imaging methods, but myocardial perfusion SPECT has been increasingly feasible in these patients due to new gamma-camera systems, offering high-quality images with relevant clinical information.

SSE16-06 Prognostic Value of a New Ultrafast, Low-radiation Myocardial Perfusion SPECT Protocol in a CZT Camera

Monday, Nov. 28 3:50PM - 4:00PM Room: S505AB

Participants
PURPOSE

Myocardial perfusion SPECT (MPS) is one of the most used imaging methods for the evaluation of patients for coronary artery disease (CAD) due to its diagnostic and prognostic value. Two of its main limitations are radiation use and scan duration. However, new CZT cameras (CZT-C) have allowed tracer dose and scan timereductions. However, the prognostic value of these new protocols is not known. Objective: To determine the prognostic value of a new, ultrafast, low dose protocol in a CZT-C.

METHOD AND MATERIALS

Patients with suspect CAD undergoing MPS from 11/2011 to 6/2012 were studied. They had a 1-day 99m-Tc-MIBI protocol starting with rest study (5 mCi dose) followed by stress (15 mCi). Acquisition times were 6 and 3 minutes respectively. MPS studied were classified as normal or abnormal and perfusion scores (SSS, SRS and SDS) were calculated. Patients were accompanied by 6-month phone calls. Events were defined as death, nonfatal myocardial infarction and late revascularization (>60 days after MPS) and analyzed with the Cox method.

RESULTS

2936 patients were followed for 922 ± 226 days. Age was 64.7 ± 12.1 years, 53.5% were male and BMI was 27.1 ± 5.1. Hypertension was the most frequent risk factor (61.6%), followed by hypercholesterolemia (52.1%) and diabetes (22.7%). Exercise was used in 1705 patients (58.1%). 2274 (77.4%) MPS studies were normal. Mean dosimetry was 5.5 mSv and mean scan time, 48 ± 13 minutes. During FU, there were 62 deaths, 28 nonfatal infarctions, 147 angioplasties and 22 coronary artery bypass surgeries. Annual hard event rate was higher in patients with abnormal MPS (3.64% vs. 0.72% P <.001), as well as the frequency of patients undergoing late revascularization (16.8% vs 2.5%, P <.001). SSS and SDS were higher in patients with hard events compared to those without events (5.0 ± 6.3 vs 2.6 ± 5.0, p<0.001; 1.7 ±3.4 vs 0.7 ±1.9, P <.001) and among revascularized patients compared to non-revascularized (SSS: 6.05±6.83 vs 2.45±4.74 , p<0.001/ SDS: 2.57±3.75 vs 0.57±1.71, p<0.001). Hard events and revascularization occurred 2 and 5.5 times more in patients with extensive ischemia.

CONCLUSION

A new MPS protocol in a CZT-C allowed faster, lower radiation studies without compromising the prognostic ability of this imaging method.

CLINICAL RELEVANCE/APPLICATION

This new protocol for Cardiac SPECT in new CZT cameras demonstrated an excellent prognostic value using half of the radiation dose and ultrafast acquisition lasting < 1 hour.
LEARNING OBJECTIVES

1) To understand the clinical indications for retrospective ECG gated cardiac CT.
2) To illustrate methods to assess myocardial function from cine cardiac CT images.
3) To illustrate methods to assess normal and abnormal valvular function from cine cardiac CT images.

ABSTRACT

The mentored case review provides the opportunity for the attendees to learn the image acquisition, post-processing, and diagnosis for a wide variety of cardiac diseases commonly encountered in CT.

MSMC24A  Coronary Artery Disease and Incidental Noncardiac Findings

Participants
Karin E. Dill, MD, Evanston, IL, (karin.dill@umassmemorial.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

ABSTRACT

CT Angiography (CTA) is a guideline endorsed strategy to assess symptomatic patients with low to intermediate risk of coronary artery disease in both the non-emergent and emergent settings. Coronary CTA uses ECG gating to freeze cardiac motion and enables assessment of the lumen for stenosis. Coronary CTA has a high negative predictive value, but suffers when a lesion is detected with a moderate stenosis. Emerging CT methods are also exploring the role of CT to assess individual lesions, including ones that have been problematic, for hemodynamic significance. The clinical relevance relates to the fact that only lesions that are hemodynamically significant should undergo intervention, for example with balloon angioplasty and stenting. In addition, each coronary CTA should include images reconstructed "skin to skin" over the entire craniocaudal field of view that encompasses the heart. Thus, incidental lesions can and should be reported for all coronary CTA studies.

MSMC24B  Congenital Heart Disease

Participants
Dianna M. Bardo, MD, Phoenix, AZ, (dbardo@phoenixchildrens.com ) (Presenter) Speaker, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Author, Thieme Medical Publishers, Inc

LEARNING OBJECTIVES

1) Recognize the most common congenital heart disease (CHD) findings found in adults with unsuspected CHD.
2) Recognize and understand findings of CHD in patients with known CHD and the findings which may trigger surgical intervention.
3) Recognize the CT findings of commonly performed surgical procedures for palliation of CHD.
4) Develop an organized pattern for search and reporting of CHD findings.
5) Understand why CT is chosen as the advanced imaging modality over MR.

ABSTRACT

Adults with congenital heart disease (CHD) now outnumber children with CHD two to one. This phenomenon is due to the success of surgical palliation and medical management of patients with even the most severe forms of CHD. Surgical intervention is often performed at the time of diagnosis and in patients with residual hemodynamic lesions is often required throughout life. Though echocardiography is typically the initial imaging modality of choice, diagnosis and imaging surveillance of complex hemodynamic and anatomic CHD lesions is now most often accomplished with CT and MR. CT and CTA imaging techniques may be used to show detailed anatomic and functional images of the heart, postoperative changes and long term consequences of CHD. An organized, reproducible approach to identify cardiac anatomy of CHD lesions and surgical palliation should be adopted in order to accurately and thoroughly describe findings.

Active Handout:Dianna M. Ehrhart Bardo

MSMC24C  Coronary Atherosclerosis and Bypass Grafts

Participants
Gautham P. Reddy, MD, Seattle, WA (Presenter) Nothing to Disclose
LEARNING OBJECTIVES

1) Identify focal areas of stenosis in the coronary arteries on CT. 2) Describe the appearance of bypass graft stenosis on coronary CT. 3) Review the diagnosis of aneurysms in the native coronary arteries and in bypass grafts.

ABSTRACT

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Gautham P. Reddy, MD - 2014 Honored Educator
Cardiac Tuesday Case of the Day

Tuesday, Nov. 29 7:00AM - 11:59PM  Room: Case of Day, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

Participants
Kaushik S. Shahir, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Dhiraj Baruah, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Rahul D. Renapurkar, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Sushikumar K. Sonavane, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Sachin S. Saboo, MD, FCR, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Suhny Abbara, MD, Dallas, TX (Abstract Co-Author) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
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Zachary R. Laste, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Prabhakar Rajah, MD, FCR, Dallas, TX (Abstract Co-Author) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

TEACHING POINTS
1) Identify pertinent findings and generate differential diagnosis for cardiac imaging studies. 2) Develop differential diagnoses based on the clinical information and imaging findings. 3) Recommend appropriate management for patients based on imaging findings.

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Rahul D. Renapurkar, MD - 2016 Honored Educator
Suhny Abbara, MD - 2014 Honored Educator
Prabhakar Rajah, MD, FCR - 2014 Honored Educator
LEARNING OBJECTIVES

1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage "active" consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.
LEARNING OBJECTIVES

1) Describe principles of multi-spectral CT for evaluation of the coronary arteries and myocardium. 2) Describe technical principles of various approaches to multi-spectral CT and their differences. 3) Describe applications of multi-spectral CT for optimization of cardiovascular CT.

ABSTRACT

Multi-spectral (multi-energy) CT is increasingly available for cardiovascular applications. Different approaches to multi-spectral CT are implemented on different CT instruments. Current implementations include rapid KV switching, dual scan, split beam, dual-layer detectors, dual source x-ray. While there are strengths and weaknesses of each approach, all share the common goal of providing improved discrimination of abnormal myocardium or arterial wall from normal areas. Multi-spectral CT scanners can generate synthetic monoenergy or combination energy images which in turn can be used to increase conspicuity of atherosclerotic plaque and visualization of calcifications. Multi-spectral CT holds the potential for improved plaque characterization, better detection of myocardial fibrosis and perfusion abnormalities.

URL

LEARNING OBJECTIVES

View learning objectives under the main course title.

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Suhny Abbara, MD - 2014 Honored Educator
Multicenter Study of Utility of Left and Right Ventricular Strain Analysis for Diagnosis of Arrhythmogenic Right Ventricular Dysplasia (ARVD/C)

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

Awards
Student Travel Stipend Award

Participants
Muhammad Akbar, MD, Baltimore, MD (Presenter) Nothing to Disclose
Amelie S. tie Rele, MD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Manijeh Manjapeema, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Cynthia James, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Crystal Thrift, MSc, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Brittney Murray, MS, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Bhavik Ambale Venkatah, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Editha Chamara, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Jose A. Lima, MD, Baltimore, MD (Abstract Co-Author) Research Grant, Toshiba Corporation
Beatrice K. Velthuis, MD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
David A. Buerki, MD, PhD, Bethesda, MD (Abstract Co-Author) Research Support, Siemens AG
Hannah C. Tabo, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Hugh Collins, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Abel B. Card, MD, PhD, Baltimore, MD (Abstract Co-Author) Research Grant, Siemens AG
Stefan L. Zimmerman, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

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

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

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

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

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

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Stefan L. Zimmerman, MD - 2012 Honored Educator
Ihab R. Kamel, MD, PhD - 2015 Honored Educator

Institute/research agreement, Siemens AG
Research support, Siemens AG

Spectral energy CT images can be acquired via several routes, including dual scan, rapid kV switching, Dual source, split beam, and dual layer, as well as photon counting. This presentation will review the general characteristics of dual and single energy approaches resulting in spectral CT images. 2) Describe the potential applications of dual layer spectral detector cardiovascular CT.

METHOD AND MATERIALS
Forty consecutive patients (HR<65BPM) with acute chest pain were randomly assigned into two groups to undergo triple-rule-out CTA on a Discovery CT750HD scanner. 20 patients in the study group (group A) were examined using prospective ECG-triggering dual-energy Spectral CT mode with a triphasic contrast injection of 1 mL/s. 20 patients in the control group (group B) of 20 patients underwent a conventional 120kVp retrospective ECG-gated spiral CT with automatic mA and contrast concentration of 350mgI/ml. 120 kVp images were reconstructed with 40% ASiR. Region-of-interest placed on coronary artery, pulmonary artery, thoracic aorta and muscle to measure CT number and standard deviation, and to calculate the contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR) for arteries. Two experienced radiologists also evaluated image quality using dual-blindly a 4-point scoring system on MIP and VR images. Kappa test was used to test the interobserver consistency. The effective dose was obtained. Measurements between the two groups were statistically compared.

RESULTS
The CT number, SNR, CNR, subjective score of the two groups were statistically the same (p>0.05), and the agreement between the two observers were excellent (k=0.80). There was a significant difference in CTI values between the two groups. The effective dose was significantly less in the dual-energy group.

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

CLINICAL RELEVANCE/APPLICATION
Prospective ECG-triggering Spectral CT may be used in triple-rule-out CT angiography.
**RC303-04**  
Non-binary Myocardial Infarct Quantification Technique Accounting for Partial Volume Averaging Predicts Segmental Left Venricular Myocardial Contraction

**METHOD AND MATERIALS**

Twenty patients (57±11 years, 16 males) with prior MI underwent 1.5T MRI (Avantos, Siemens). Short-axis balanced steady-state free-precession (bSSFP) cine imaging, post-contrast (0.1mm/kg gadobenate dimeglumine) T1-mapping (modified Look-Locker inversion recovery (IR), scheme 4(1)3(1)2), and late gadolinium enhancement (LGE) imaging (bSSFP with IR pulse) were performed. Myocardial contraction was quantified as radial wall thickening (RWT) using the centrlme method according to the 17-segment model. Segmental MI content was calculated based on both T1 and LGE images applying the previously described infarct quantification algorithm (PIM1 and PIMLGE, respectively) using an in-house developed application. MI was also quantified based on LGE images using a binary approach (full-width at half-maximum, PIMH). Relationship between MI percentage (PIMA) and RWT was tested using a linear regression.

**RESULTS**

Sixteen segments were excluded due to image artifacts. MI was observed in 69 of the remaining 324 segments. The PIMM method measured significantly higher global MI% compared to PIMT1 and PIMLGE (13.3±3.3%, 8.3±2.9%, and 8.7±3.5%, respectively, P<0.0024), as well as higher segmental MI% (66.1±26.1%, 47.4±18.0%, and 44.9±15.7%, respectively, P<0.0009). Average RWT in the normal and MI segments was 49.6±4.7% and 43.1±4.6%, respectively (P<0.0001). Strong correlation between MI% and RWT was observed using PIMA (r=0.605, P=0.0012) and PIMLGE (r=0.757, P<0.0001) methods, while the conclusion was weaker using the binary PIMH threshold (r=0.399, P=0.0319).

**CONCLUSION**

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

**CLINICAL RELEVANCE/APPLICATION**

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

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

**METHOD AND MATERIALS**

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

**RESULTS**

No significant difference was found in the TOP for most complex procedure performed with both endo-epicardial approach (p=0.04). No significant differences were observed in term of procedural complication and success rate between standard and CT-3D model guided ablation.

**CONCLUSION**

CT-guided therapy may be an effective tool for reduction of TOP and real-time guidance of VT ablation.

**CLINICAL RELEVANCE/APPLICATION**

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

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

RESULTS

This retrospective study cohort included 29 patients (78±7 years, 64% males). Watchman™ and ACP™ devices were deployed in 17 and 12 patients, respectively. Two procedures were aborted (Watchman™) all through the procedure itself. There was post agreement between the 3D models and the inserted device for Watchman™ devices; Un’s concordance correlation coefficient 0.9 (95% CI 0.8, 0.96) as compared with a very good correlation between the 3D models and the inserted device for ACP™ devices; Un’s concordance correlation coefficient 0.9 (95% CI 0.9, 0.93) and of 0.85 (95% CI 0.59, 0.91) respectively.

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

METHOD AND MATERIALS

Sixty-seven patients with first reperfused AMI were enrolled. T2w, T2, T1 mapping and late gadolinium enhancement (LGE) CMR were obtained at 2 time points after AMI at 8 ±5 days after infarction (baseline) and 6 ±1.4 months. CMR acquisitions were performed on end-diastolic LV short-axes. Myocardial relaxation times were measured using a free-breathing navigator-gated multiecho sequence. Myocardial T1 and T2 relaxation times were measured using the modified Look-Locker inversion recovery sequence before and after administration of 0.7 mmol/kg gadobenate dimeglumine. T2, T1, and ECV maps were generated using a plug-in for OsiriX software (Pieleo, Bernex, Switzerland). Two experienced observers independently placed regions of interest in the infarcted areas using LGE as a reference standard. A T2w-ratio was generated using the formula: T2w-ratio = Mean SI LGE / Mean SI control.

RESULTS

Native T1 had an almost perfect discriminative performance to differentiate between acute (baseline CMR) and the chronic stage (6-months follow-up) with an AUC of 0.994. The AUC of native T1 was significantly superior to the T2w-ratio with an AUC of 0.966 (P<0.05) and to T2 with an AUC of 0.909 (P<0.05). ECV of infarcted myocardium had a poor discriminative performance with an AUC of 0.655, which was significantly inferior compared to native T1, T2w-ratio and T2, respectively (P<0.001). The optimal cutoffs of 3138 ms for native T1 provided a sensitivity and specificity of 96% and 100%, respectively. The optimal cutoffs for the other CMR parameters were: ≥3.3 for T2w-ratio, ≥69ms for T2 and ≥39% for ECV.

CONCLUSION

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

RC303-09 Multiparametric Myocardial MR Mapping (T1, T2 and T2*) Tuesday, Nov. 29 10:30AM - 10:55AM Room: S504AB

METHOD AND MATERIALS

A custom build cartodigraph was used to derive DUS signals. In order to reduce common-mode currents effects, six cable traps tuned to 297 MHz were placed within the transmission line. A sufficient MR compatibility was evaluated using field probes and by flip angle maps. Cardiac MRI was performed at a 7T (Magnetom 7T, Siemens Healthcare GmbH, Germany) in healthy subjects. The ultrasound transducer was placed in an apical location under the RF coil. The E-wave in early diastole was selected as a trigger time point. For validation of the trigger signal, ECG, pulse, and DUS signals were recorded simultaneously. The validation of the DUS trigger signal resulted in a high correlation to the ECG signal of r = 0.99. The DUS signal showed a mean time delay compared to the R-wave of 516±20 ms and a similar variation compatibility was evaluated using field probes and by flip angle maps. Cardiac MRI was performed at a 7T (Magnetom 7T, Siemens Healthcare GmbH, Germany) in healthy subjects. The ultrasound transducer was placed in an apical location under the RF coil. The E-wave in early diastole was selected as a trigger time point. For validation of the trigger signal, ECG, pulse, and DUS signals were recorded simultaneously.

PURPOSE

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

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

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

METHOD AND MATERIALS

A custom build cartodigraph was used to derive DUS signals. In order to reduce common-mode currents effects, six cable traps tuned to 297 MHz were placed within the transmission line. A sufficient MR compatibility was evaluated using field probes and by flip angle maps. Cardiac MRI was performed at a 7T (Magnetom 7T, Siemens Healthcare GmbH, Germany) in healthy subjects. The ultrasound transducer was placed in an apical location under the RF coil. The E-wave in early diastole was selected as a trigger time point. For validation of the trigger signal, ECG, pulse, and DUS signals were recorded simultaneously.

RESULTS

The maximal measured change in the E and H-field distribution with and without transducer was 5 %. As a consequence, no interferences were observed between DUS and MRI in the E1 maps and during CMR imaging. The validation of the DUS trigger signal resulted in a high correlation to the ECG signal of r = 0.99. The DUS signal showed a mean time delay compared to the R-wave of 3138 ms and a similar variation of 51 ms. Analysis of myocardial thinning between ventricular blood and myocardium resulted in 3.4±0.9 pixel.

CONCLUSION

Doppler ultrasound was applied as a new trigger method in cardiac MRI at 7T. The DUS transmission line and transducer were approved for RF safety and successfully tested for CMR image synchronization at 7T.

In future, this method needs to be evaluated in more detail in a larger patient population.

CLINICAL RELEVANCE/APPLICATION

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

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

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

METHOD AND MATERIALS

A custom build cartodigraph was used to derive DUS signals. In order to reduce common-mode currents effects, six cable traps tuned to 297 MHz were placed within the transmission line. A sufficient MR compatibility was evaluated using field probes and by flip angle maps. Cardiac MRI was performed at a 7T (Magnetom 7T, Siemens Healthcare GmbH, Germany) in healthy subjects. The ultrasound transducer was placed in an apical location under the RF coil. The E-wave in early diastole was selected as a trigger time point. For validation of the trigger signal, ECG, pulse, and DUS signals were recorded simultaneously.

RESULTS

The maximal measured change in the E and H-field distribution with and without transducer was 5 %. As a consequence, no interferences were observed between DUS and MRI in the E1 maps and during CMR imaging. The validation of the DUS trigger signal resulted in a high correlation to the ECG signal of r = 0.99. The DUS signal showed a mean time delay compared to the R-wave of 3138 ms and a similar variation of 51 ms. Analysis of myocardial thinning between ventricular blood and myocardium resulted in 3.4±0.9 pixel.

CONCLUSION

Doppler ultrasound was applied as a new trigger method in cardiac MRI at 7T. The DUS transmission line and transducer were approved for RF safety and successfully tested for CMR image synchronization at 7T.

In future, this method needs to be evaluated in more detail in a larger patient population.
Valvular Flow Quantification with Phase Contrast Imaging (2D, 4D)

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

Participants
Christopher J. Francois, MD, Madison, WI (Presentor) Nothing to Disclose
Anji Tang, Boston, MA (Abstract Co-Author) Nothing to Disclose
Andrea L. Vavere, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

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

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

RESULTS
Two patients were excluded from analysis due to motion artifact. FFR was measured on average 36.5 days after CTA. 25 lesions (41%) had FFR<0.8. AUC to detect FFR<0.8 was significantly higher using the contrast gradient (AUC=0.95), than using the Huo-Kassab (AUC=0.80, p=0.033) or Murray law models (AUC=0.87, p=0.041). Figure]. Correlation coefficients were highest for the gradients (Spearmann p=0.81), followed by the Huo-Kassab (p=0.57) and Murray law models (p=0.50). Bland-Altman limits of agreement were narrowest for the gradients (-0.181 to 0.150), followed by the Huo-Kassab (-0.240 to 0.152) and Murray law models (-0.286 to 0.260).

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

CLINICAL RELEVANCE/APPLICATION
Cardiovascular imagers can perform CT-FFR using a simple four-step approach with or without a proprietary basis to accurately detect a significant FFR<0.8.

Anemia is a very common clinical condition in patients with heart failure. It is clinically important to evaluate the stability of ECV in anemic patients. Contrast enhanced T1 mapping MRI is simple, non-invasive, and successful modeling of anemia. All CMR, including cine, pre T1, and post T1 mapping, were performed using a 9.4T MR scanner (Bruker Biospin Co., Billerica, MA). Pre- and post-T1 values were measured from 6 segments of the mid-LV and the LV cavity. The partition coefficient and ECV were calculated. After post-model MR scanning, all rats were sacrificed and histology was performed on their hearts.

RESULTS
After anemia modeling, the Hct level was 46.4% ± 4.0% (range: 39–64%), which was significantly lower than pre-modeling levels (59.0% ± 3.3%; range: 56–65%; p < 0.001). The mean Hct drop was 22%. The LV EF of the pre-modeling group was significantly different from the post-modeling group (72.3% ± 2.6% vs. 72.7% ± 4.5%, respectively; p = 0.83). Post-contrast T1 values in the LV cavity in the anemia group were significantly lower than the pre-model group (629.6 ± 175.3 vs. 722.7 ± 104.1, respectively; p = 0.02). The partition coefficient of the anemia group was significantly lower than the pre-model group (30.2 ± 3.5 vs. 37.4 ± 5.4, respectively; p < 0.001). The ECV of the anemia group was not significantly different from the pre-model group (15.9 ± 2 vs. 15.6 ± 2, respectively; p = 0.70).

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

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

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

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

Awards
Student Travel Stipend Award

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

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

METHOD AND MATERIALS
Sixteen adult male Sprague-Dawley rats (weight, 300–500 g) underwent pre-model CMR without intervention. Six days after the MR scan, anemia was modeled and post-model CMR scanning was performed. For modeling anemia, an experienced veterinarian withdrew 31% of the total circulating blood by volume from the tail vein and replaced it by Hartmann’s solution. A Hct drop of more than 15% was regarded as successful modeling of anemia. All CMR, including cine, pre T1, and post T1 mapping, were performed using a 9.4T MR scanner (Bruker Biospin Co., Billerica, MA). Pre- and post-T1 values were measured from 6 segments of the mid-LV and the LV cavity. The partition coefficient and ECV were calculated. After post-model MR scanning, all rats were sacrificed and histology was performed on their hearts.

RESULTS
After anemia modeling, the Hct level was 46.4% ± 4.0% (range: 39–64%), which was significantly lower than pre-modeling levels (59.0% ± 3.3%; range: 56–65%; p < 0.001). The mean Hct drop was 22%. The LV EF of the pre-modeling group was significantly different from the post-modeling group (72.3% ± 2.6% vs. 72.7% ± 4.5%, respectively; p = 0.83). Post-contrast T1 values in the LV cavity in the anemia group were significantly lower than the pre-model group (629.6 ± 175.3 vs. 722.7 ± 104.1, respectively; p = 0.02). The partition coefficient of the anemia group was significantly lower than the pre-model group (30.2 ± 3.5 vs. 37.4 ± 5.4, respectively; p < 0.001). The ECV of the anemia group was not significantly different from the pre-model group (15.9 ± 2 vs. 15.6 ± 2, respectively; p = 0.70).

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

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

MRI flow imaging is based on flow-sensitive, phase contrast sequences. This presentation will introduce the basic MRI physics responsible for imaging flow, extending 1-directional flow imaging to 3-directional flow imaging used in 4D flow MRI. Normal cardiac valve anatomy and function will be reviewed and serve as a basis to classify valvular heart disease — including congenital abnormalities, valvular stenosis and valvular regurgitation. The presentation will initially focus on the use of standard 2D phase contrast MRI for quantifying the severity of disease. The future potential for 4D phase contrast MRI to be used to quantify velocities and flow in patients with valvular disease will be described. In addition, more advanced hemodynamic parameters that can be quantified with 4D phase contrast MRI will be identified.
**Imaging of Childhood Interstitial Lung Disease**

**Participants**
R. Paul Guillerman, MD, Houston, TX (Moderator) Nothing to Disclose
Elizabeth F. Sheybani, MD, Saint Louis, MO (Moderator) Nothing to Disclose

**LEARNING OBJECTIVES**
1) To understand and define the Childhood Interstitial Lung disease ChILD classification. 2) To illustrate examples within this classification. 3) To update on more recent additions with clinicopathological examples.

**ABSTRACT**

**Radiologic Evaluation of Drug-Induced Pneumonitis following Carmustine (BCNU)-Based Preparative Regimens in Children**

**Participants**
Yu Jin Kim, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Woo Sun Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young Hun Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jung-Eun Cheon, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
In-One Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young Jin Ryu, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To describe radiologic findings of drug-induced pneumonitis following carmustine (BCNU)-based preparative regimens for autologous peripheral blood stem cell transplantation (aPBSCT) in children.

**METHOD AND MATERIALS**
From 2010 through 2014 in our institution, among 35 patients who received carmustine-based preparative regimens for aPBSCT, 9 patients (6 boys and 3 girls; 3-17 years, mean 10 years; 7 lymphoma and 2 leukemia patients) presented respiratory symptoms and radiologic abnormalities. They had no evidence of infection, cardiogenic edema, and other explainable causes. The chief complaints were fever (n=8, 89%), dyspnea (n=4, 44%), and cough (n=2, 22%). The symptoms developed at 40th day on average (range 34-51 days) after receiving carmustine-based preparative regimens. Chest radiographs and CT scans performed under the impression of infection at the first of respiratory symptoms were reviewed by 2 pediatric radiologists who reached consensus in analyzing the presence and distribution of ground-glass opacity (GGO), consolidation, septal thickening and other various patterns of interstitial pneumonitis, and pleural effusion.

**RESULTS**
Radiographic findings were bilateral patchy GGO (n=9, 100%) combined with consolidation (n=3, 33%) and septal thickening (n=6, 67%). Pleural effusion were noted in 5 patients (56%). CT findings were patchy GGO (n=9, 100%), localized consolidations (n=4, 44%) and septal thickening (n=7, 78%). The distribution of lesions were bilateral (n=9, 100%) and lower lobar predominant (n=6, 67%). There was no central/peripheral, or anterior/posterior predilection. Pleural effusion was seen in 6 patients (67%) at CT scans and was bilateral in all.

**CONCLUSION**
Bilateral patchy GGO combined with or without consolidation, septal thickening and bilateral pleural effusion were common radiologic findings in drug-induced pneumonitis following carmustine-based preparative regimens. It should be differentiated from pulmonary infection which is critical and frequently encountered in oncologic patients.

**CLINICAL RELEVANCE/APPLICATION**
Carmustine can cause pneumonitis. Common radiologic findings of this pneumonitis were bilateral patchy GGO combined with or without consolidation, septal thickening and bilateral pleural effusion.

**High-temporal Resolution Chest CT Examinations in Infants and Young Children without Sedation or General Anesthesia: Frequency and Severity of Motion Artifacts**

**Participants**
Catherine M. Owens, MD, London, United Kingdom (Presenter) Nothing to Disclose
Participants
Suonita Khung, MD, Lille, France (Abstract Co-Author) Nothing to Disclose
Nicolas Lasalle, Lille, France (Abstract Co-Author) Nothing to Disclose
Younes Arous, MD, Lille, France (Abstract Co-Author) Nothing to Disclose
Antoine Deschildre, Lille, France (Abstract Co-Author) Nothing to Disclose
Jacques Remy, MD, Mouvaux, France (Abstract Co-Author) Research Consultant, Siemens AG
Martine J. Remy-Jardin, MD, PhD, Lille, France (Abstract Co-Author) Research Grant, Siemens AG
Antoine Hutt, MD, Lille, France (Presenter) Nothing to Disclose

PURPOSE
To evaluate the frequency and severity of motion artifacts on chest CT examinations acquired without sedation nor general anesthesia in infants and children younger than 5 years.

METHOD AND MATERIALS
The study population included all consecutively registered infants and young children (age <5 years) who had been referred for a standard chest CT examination on a third-generation, dual-source CT system. The examinations were obtained with a high-pitch and high-temporal resolution protocol (pitch: 3.0; rotation time: 250 ms). Children were scanned while freely breathing, without sedation or general anesthesia. In order to scan quiet children, each examination was supervised by a paediatric nurse practitioner. For each examination, we recorded (a) the number of acquisitions necessary to reach a diagnostic image quality, (b) the frequency and severity of motion artifacts in the upper, mid and lower lung zones using a 4-point scale (0 : no artifact ; 1 : mild; 2 : moderate ; 3 : severe) and (c) the diagnostic value of each acquisition.

RESULTS
The study population comprised 343 patients (mean age: 14.92 months) who underwent a contrast (n=240) or noncontrast (n=103) chest CT examinations; the mean duration of data acquisition was 0.23 ± 0.05 s (range: 0.11 – 0.52). For 330 patients (96.2%), the investigation comprised a single acquisition which was rated as follows: (a) no motion artifact over the entire thorax (n=193); (b) presence of motion artifacts that did not affect the overall diagnostic value of the examination (n=137) with a mean score of artifact of 0.72 (median: 0.67; range: 0.33 – 2.33). In 13 patients (3.8%): (a) the acquisition was rated as nondiagnostic due to the presence of severe artifacts (mean score: 1.62; range: : 1.67-2.67); (b) a second acquisition was then performed, rated as diagnostic in 13 cases (mean score of artifact: 0.47; median: 0.17; range: 0-2) and nondiagnostic in 1 patient.

CONCLUSION
Diagnostic image quality is obtained with a single examination in 96.2% of children scanned while freely breathing.

CLINICAL RELEVANCE/APPLICATION
High-quality chest CTA can be routinely obtained in freely-breathing infants and young children when evaluated with high-temporal resolution, making sedation and anesthesia unnecessary.

PURPOSE
To analyze high resolution computed tomography (HRCT) findings in neonate with bronchopulmonary dysplasia (BPD). To evaluate correlation between HRCT findings and clinical severity.

METHOD AND MATERIALS
From 2008 to 2015, fifty very low birth weight infants with BPD underwent HRCT exams at the mean postmenstrual age of 38.7 weeks. HRCT findings were classified as two categories and 7 findings: 1) hyperaeration; area of decreased lung attenuation, mosaic attenuation, bulla/bleb and 2) parenchymal lesions; linear lesions, consolidation, bronchial wall thickening, bronchiectasis. These HRCT findings were recorded in each lobe of lungs. Clinical severity was graded as mild, moderate and severe. Each HRCT finding, sum of hyperaeration scores, sum of parenchymal lesion scores and total scores of HRCT findings were analyzed for correlation with clinical severity of BPD.

RESULTS
The total scores of HRCT findings were significantly correlated with clinical severity of BPD (r>0.6, p=0.03). Parenchymal lesion scores were well correlated with clinical severity of BPD while hyperaeration scores were not significantly correlated with clinical severity of BPD. The best correlated HRCT finding is consolidation (p=0.006). Area of decreased lung attenuation was frequent findings regardless of clinical severity of BPD.

CONCLUSION
Total scores of HRCT findings are correlated with clinical severity of BPD and parenchymal lesion scores have a key part, especially consolidation. Unlike previous reports about HRCT of BPD, hyperaeration scores are not correlated with clinical severity of BPD.

CLINICAL RELEVANCE/APPLICATION
On HRCT of infants with BPD, hyperaeration is not specific for clinical severity of BPD but consolidation is predictive findings of that of BPD.

Participants
Min Yeong Kim, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

PURPOSE
To analyze high resolution computed tomography (HRCT) findings in neonate with bronchopulmonary dysplasia (BPD). To evaluate correlation between HRCT findings and clinical severity.

METHOD AND MATERIALS
From 2008 to 2015, fifty very low birth weight infants with BPD underwent HRCT exams at the mean postmenstrual age of 38.7 weeks. HRCT findings were classified as two categories and 7 findings: 1) hyperaeration; area of decreased lung attenuation, mosaic attenuation, bulla/bleb and 2) parenchymal lesions; linear lesions, consolidation, bronchial wall thickening, bronchiectasis. These HRCT findings were recorded in each lobe of lungs. Clinical severity was graded as mild, moderate and severe. Each HRCT finding, sum of hyperaeration scores, sum of parenchymal lesion scores and total scores of HRCT findings were analyzed for correlation with clinical severity of BPD.

RESULTS
The total scores of HRCT findings were significantly correlated with clinical severity of BPD (r>0.6, p=0.03). Parenchymal lesion scores were well correlated with clinical severity of BPD while hyperaeration scores were not significantly correlated with clinical severity of BPD. The best correlated HRCT finding is consolidation (p=0.006). Area of decreased lung attenuation was frequent findings regardless of clinical severity of BPD.

CONCLUSION
Total scores of HRCT findings are correlated with clinical severity of BPD and parenchymal lesion scores have a key part, especially consolidation. Unlike previous reports about HRCT of BPD, hyperaeration scores are not correlated with clinical severity of BPD.

CLINICAL RELEVANCE/APPLICATION
On HRCT of infants with BPD, hyperaeration is not specific for clinical severity of BPD but consolidation is predictive findings of that of BPD.
Tuesday, Nov. 29 9:20AM - 9:30AM Room: N228

Participants
Sabrina Fleischer, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Ilias Tsilifakis, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Verena Langlois, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Matthias Teufel, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Ute Graepel-Mainka, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Joachim Riethmüller, MD, Tubingen, Germany (Abstract Co-Author) Nothing to Disclose
Andreas Hector, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolau, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Speakers Bureau, Bayer AG
Juergen F. Schaefer, MD, Tuebingen, Germany (Presenter) Nothing to Disclose

PURPOSE
Morphological assessment of lung damage is already part of diagnostic work-up in cystic fibrosis (CF). Imaging biomarkers as lung volume (Vol) or signal intensity (SI) can be calculated at baseline and in follow-up. Aim of this study was to correlate MR values of regional pulmonary function with lung clearance index (LCI) and forced expiratory volume in 1 second (FEV1) as the most important parameter for the monitoring the disease.

METHOD AND MATERIALS
IRB waived informed consent and approved this retrospective, HIPAAA-compliant study. 49 consecutive CF-patients (23 f, 26 m) mean age 17 +/- 7 y (7-40y) received MRI at 1.5 T of the lung as standard of care in our institution. In this protocol, a 2D GRE sequence with very-short echo time was applied in submaximal inspiration as well as expiration. Semiautomatic segmentation of ventilated areas was performed. Absolute Vol and SI values at in- and expiration, relative differences (Vol_Delta and SI_Delta) and cumulative histograms for relative SI values across entire lung volume were computed.

RESULTS
Strong correlation between Vol_Delta and SI_Delta was found (R=0.86; P<0.0001). Individual Vol-SI-curves created by cumulative histograms allowed visually the differentiation between clinically minimal and strongly affected patients (LCI > 10). The expiratory volume at a relative SI of 100% correlated significantly with LCI and FEV1 (R=0.63 and R=0.81; P<0.0001).

CONCLUSION
A close relation of pulmonary volume and SI during respiration was observed. Individual Vol-SI-curves were suitable to estimate the severity of disease clinically assessed by LCI. The cross correlation with LCI and FEV1 might be promising for the quantification of areas with low SI values due to air trapping.

CLINICAL RELEVANCE/APPLICATION
Cumulative histograms for relative SI values across lung volume by unenhanced MRI offer information of regional ventilation and can estimate the severity of disease in CF.

RC313-06 Characterization of All-Terrain Vehicle-Related Chest Injury Patterns in Children

Tuesday, Nov. 29 9:30AM - 9:40AM Room: N228

Participants
Kelly N. Hagedorn, MD, Houston, TX (Presenter) Nothing to Disclose
Jennifer H. Johnston, MD, Cerritos, CA (Abstract Co-Author) Nothing to Disclose
Sean K. Johnston, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Nagaremesh Chinapuvvula, MBBS, Houston, TX (Abstract Co-Author) Nothing to Disclose
Chunyai Cai, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate chest injury patterns in pediatric patients involved in all-terrain vehicle (ATV) accidents.

METHOD AND MATERIALS
A retrospective review of the trauma registry at a level I trauma institution from 1992-2013 was performed for patients between 0-18 years admitted after ATV-related incidents. Only patients with chest imaging were included. Type of chest injuries, mechanism of injury, driver/passenger status and demographic data were recorded. Clinical data such as length of hospital stay and intensive care unit (ICU) admission were documented. Comparison of demographic data and clinical data between patients with and without chest injury was conducted using the Chi-square test for categorical variables and two-sample t test for continuous variables.

RESULTS
A total of 455 pediatric patients were admitted after an ATV injury during the study period. Of these, 102 patients (22%) had a chest injury. Most injuries occurred due to a rollover (44/102, 43%), collision with landscape (20/102, 20%) or falls (16/102, 16%). The patient was the driver in 41 (40%) and passenger in 33 (32%) cases (others unknown). Patients with chest injuries were older (13 vs 11 years, P = 0.0027), taller (157 cm vs 148 cm, P = 0.0012), and heavier (57 kg vs 48 kg, P = 0.0006) than those without chest injury. The most common injury was pulmonary contusion (62/102, 61%), followed by pneumothorax (46/102, 45%) and non-flail rib fracture(s) (35/102, 34%). There were no cardiac, esophageal, or airway injuries, and no vascular injury other than a case of subclavian artery transection. Patients with chest injury more often required ICU care (41/102, 40%, compared to 77/353, 22%, P = 0.0002) and had longer median hospital stay (3 days vs 2 days, P = 0.0054) compared to patients without chest injury. Eight patients with chest injury died (8%).

CONCLUSION
Chest injuries are a relatively common occurrence in children following ATV accidents, which remain a significant public health issue in terms of morbidity and mortality. Patients with chest injuries were more likely to require ICU care and to have a longer hospital
CLINICAL RELEVANCE/APPLICATION

Chest injuries following ATV accidents in the pediatric population are common and increased public awareness of these potentially devastating injuries is needed.

RC313-07  Does a Normal Chest X-ray Obviate the Need for Thoracic CT Scanning in Pediatric Trauma?

Tuesday, Nov. 29 9:40AM - 9:50AM Room: N228

Participants
Mohammed F. Mohammed, MBBS, Vancouver, BC (Presenter) Nothing to Disclose
Reem S. Zakzouk, MD, Riyadh, Saudi Arabia (Abstract Co-Author) Nothing to Disclose
Nizar Bhulani, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Savvas Nicolaou, MD, Vancouver, BC (Abstract Co-Author) Institutional research agreement, Siemens AG
Hesham M. Alshaalan, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Anna M. Kashgari, MD, Halifax, NS (Abstract Co-Author) Nothing to Disclose

PURPOSE

Motor vehicle collisions and road traffic related injuries constitute one of the leading causes of premature death worldwide. In children with multiple injuries, the presence of chest trauma increases the mortality rate by 20 times. Whole-body CT has become the mainstay in assessment of patients involved in traumas of various causes. The drawback has been an increase in exposure to medical imaging. Pediatric patients are more sensitive to the negative effects of ionizing radiation, and minimizing exposure is a priority. We assess the role of a negative chest x-ray in obviating the need for further chest CT in stable pediatric patients that have sustained trauma in an attempt to reduce unnecessary imaging.

METHOD AND MATERIALS

A retrospective study was carried out on all patients under 14 years of age that presented to our institution, a level 1 trauma center, from 2010 to 2013. A total of 304 patients received whole-body trauma CT and had received chest x-rays within 30 minutes of the CT. The chest x-rays and thoracic CT scans were independently reviewed by two radiologists who were blinded to the clinical outcome. The presence of pulmonary contusions/consolidations, pneumothorax, pneumomediastinum, subcutaneous emphysema, pleural effusion and fractures was recorded.

RESULTS

165 (54.3%) of the chest x-rays were normal. Of these, 41 (24.8%) demonstrated minimal airspace opacity on CT. These were confined to one lobe and were small. They did not warrant further management in all 41 patients. 2 out of the 41 patients had tiny pneumothoraces on CT which did not require further follow up or intervention. The remaining 139 chest x-rays had at least 1 positive finding and demonstrated good correlation to significant CT findings that required further intervention and management (p <0.01). The likelihood of significant CT findings was greater when pleural effusion was present on the x-ray or when 2 or more findings were positive on the chest x-ray.

CONCLUSION

A normal chest x-ray virtually excludes the presence of significant findings on the thoracic CT scan; however, if the chest x-ray demonstrates any pathology, particularly pleural effusion, a chest CT is required to exclude significant findings which may require immediate intervention.

CLINICAL RELEVANCE/APPLICATION

In a stable, assessable pediatric patient with a low suspicion mechanism of injury, a normal chest x-ray likely obviates the need for further assessment or intervention.

RC313-08  Imaging of Vascular Rings

Tuesday, Nov. 29 9:50AM - 10:10AM Room: N228

Participants
Elizabeth F. Sheybani, MD, Saint Louis, MO, (elizabeth.sheybani@wustl.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the presentation and clinical significance and developmental anatomy of vascular rings. 2) Identify major findings indicative of vascular rings on multiple modalities including radiography, fluoroscopy, CT and MRI. 3) Classify vascular rings and identify key features on cross-sectional imaging for surgical planning. 4) Compare available modalities and optimize evaluation of vascular rings.

ABSTRACT

RC313-09  Imaging of Tetralogy of Fallot

Tuesday, Nov. 29 10:30AM - 10:50AM Room: N228

Participants
Taylor Chung, MD, Oakland, CA, (tchung@mail.cho.org) (Presenter) Travel support, Koninklijke Philips NV;

Active Handout: Taylor Chung

LEARNING OBJECTIVES

1) Understand the clinical indications therefore imaging goals for post-operative imaging of patients with tetralogy of Fallot. 2) Review practical clinical MR protocol for post-operative imaging of patients with tetralogy of Fallot.
Assessment of the Reliability of Ventricular Function and Flow Evaluation for Repaired Tetralogy of Fallot with 4D Flow MRI

**Participants**
Qiong Yao, MD, Shanghai, China (Presenter) Nothing to Disclose
Michael A. Kadoch, MD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Floris-Jan S. Ridderbos, BSC, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Shreyas S. Vasenawala, MD, Stanford, CA (Abstract Co-Author) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;
Francis P. Chan, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Patients with repaired tetralogy of Fallot (rTOF) require regular monitoring by MRI to assess for right ventricular enlargement and pulmonary regurgitation. 4D flow, a time-resolved, volumetric, accelerated phase contrast technique, may efficiently acquire this information in 10 minutes. We evaluate (1) the consistency between ventricular volumes and flows within 4D flow data and (2) the agreement of these parameters with conventional 2D SSFP-cine and 2D phase contrast acquisitions in patients with rTOF.

**METHOD AND MATERIALS**
Following IRB approval, patients diagnosed with uncomplicated rTOF who underwent combined 2D and 4D flow MRI studies were identified. Patients with residual shunts, pulmonary conduits, pulmonary stenosis, and/or significant non-pulmonary valvular regurgitation were excluded. Using post-processing software (Arterys for 4D data, Medis for 2D data), pulmonary and systemic flows (Qp, Qs), pulmonary regurgitant volume (PRV), and left/right diastolic/systolic ventricular volumes (LVEDV, RVEDV, LVESV and RVESV) were quantified. From these measurements, stroke volumes (LVSV, RVSV), ejection fractions (LVEF, RVEF), pulmonary regurgitant fraction (PRF), and left/right ventricular outputs (LVO, RVO) were calculated. Internal consistency between Qp and Qs as well as between PRV and RVO-LVO difference was measured using intra-class correlation (ICC). Agreement with 2D data was measured using Pearson correlation and Bland–Altman plot.

**RESULTS**
24 patients (10 males, 6.4 ± 4.8 years) were identified. For 4D MRI, Qp and Qs had good agreement (ICC 0.446-0.866) as did PRV with RVO-LVO difference (ICC 0.315-0.820). 4D and 2D results were well correlated (r =0.885 for LVEDV, 0.974 for RVEDV, 0.898 for LVESV and 0.980 for RVESV, 0.863 for EF1, 0.925 for EFR, 0.447 for Qp/Qs and 0.764 for PRF). Bland–Altman analysis showed wider limits of agreement for flow relative to ventricular function.

**CONCLUSION**
Ventricular function and flow measurements can be accomplished with 4D flow MRI and are consistent with 2D results.

**CLINICAL RELEVANCE/APPLICATION**
Monitoring of patients with uncomplicated rTOF can be achieved in under 10 minutes with an MRI protocol consisting of a single 4D flow sequence, improving patient experience and reducing costs.

A Prospective Evaluation of Contrast and Radiation Dose and Image Quality in Cardiac CT in Children with Complex Congenital Heart Disease using Low-Concentration Iodinated Contrast Agent and Low Tube Voltage and Current

**Participants**
Qiaoru Hou, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Li Wei Hu, DIPLENG, MENG, Pudong, China (Abstract Co-Author) Nothing to Disclose
Haisheng Qiu, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Yumin Zhong, MD, Shanghai, China (Presenter) Nothing to Disclose

**PURPOSE**
To assess image quality and contrast and radiation dose in cardiac CT in children with congenital heart disease using low-concentration iodinated contrast agent and low tube voltage and tube current.

**METHOD AND MATERIALS**
110 consecutive patients (54 male, 56 female, 5kg

**RESULTS**
There was no difference in age, weight between the two groups (all p>0.05). The iodine load in Group A was 30% lower than in Group B (3.98±0.75gI vs. 5.76±1.02gI, p <0.001). And CTDIvol, DLP and ED in Group A (1.35mGy, 15.29±1.91mGy/cm and 0.60±0.07mSv) were lower than in Group B(1.81 mGy, 20.11±2.12mGy/cm and 0.77±0.10 mSv) (all p<0.001). However, the mean CT value, noise, CNR and SNR for Group A and Group B were similar (all p>0.05), and the mean image quality score for Group A and Group B was also similar with good agreement between the two observers. Comparing to the surgery results (n=26 in Group A and n=38 in Group B), Group A was 96% accurate in the diagnosis for extracardiac defects and 92% accurate for intracardiac defects, while Group B was 95% accurate in the diagnosis for extracardiac defects and 93% accurate for intracardiac defects.

**CONCLUSION**
The scanning protocol using low tube voltage (80kVp), low tube current (120mA) and low-concentration iodinated contrast agent (270mgI/mL) enables reduction in iodine load and radiation dose while maintaining compatible image quality.

**CLINICAL RELEVANCE/APPLICATION**
Low tube voltage (80kVp), low tube current (120mA) and low-concentration iodinated contrast agent (270mgI/mL) may be used
**RC313-12**  

**Tuesday, Nov. 29 11:10AM - 11:20AM Room: N228**

**Participants**
Ramy El Jalbout, MD, Montreal, QC (Presenter) Nothing to Disclose  
Guy Cloutier, PhD, Montreal, QC (Abstract Co-Author) Nothing to Disclose  
Melanie Henderson, Montreal, QC (Abstract Co-Author) Nothing to Disclose  
Chantale Lapiere, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose  
Gilles P. Soulez, MD, Montreal, QC (Abstract Co-Author) Speaker, Bracco Group Speaker, Siemens AG Research Grant, Siemens AG Research Grant, Bracco Group Research Grant, Cook Group Incorporated Research Grant, Object Research Systems Inc  
Josee Dubois, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To compare IMT measurements in children according to three different techniques: Math’s system software, radiofrequency generated ultrasound sequences and NIVE software. To compare IMT measurements between two groups of normal and overweight/obese children using 3 different techniques.

**METHOD AND MATERIALS**
Children aged between 8 and 10 years (n=120) were randomly chosen such that 60 children were of normal weight (group A) and 60 children were overweight (group B). We compared 3 methods of IMT measurement of the far away common carotid artery wall relative to the transcutaneously placed linear ultrasound probe. The first used a dedicated software Math’s system allowing an automated measurement of IMT on B-mode ultrasound images. The second measured IMT automatically using an echotracking system based on the amplitude of radiofrequency (RF) signal. The third used a semi automated segmentation analysis generated by the NIVE platform of video sequences obtained with radiofrequency ultrasound.

**RESULTS**
There is no significant correlation between any of the three different techniques neither in group A nor in group B. In group A, the interclass correlation coefficients were as follows: IMT B-mode-IMT RF ICC=0.010 (p=0.28), IMT B-mode-IMT NIVE ICC=0.003 (p=0.45), IMT RF-IMT NIVE ICC=0.006 (p=0.52). In group B, IMT B-mode-IMT RF ICC=0.003 (p=0.42), IMT B-mode-IMT NIVE ICC=0.005 (p=0.43) and IMT RF-IMT NIVE ICC=0.002 (p=0.42). Each technique has its limitations in the pediatric population. However, when comparing IMT values across weight, IMT was significantly lower for normal weight youth using all 3 techniques: using B-mode (0.553 mm versus 0.573 mm for groups A and B respectively; p=0.026); using RF (0.457 mm for group A vs 0.489 mm for group B; p=0.031 and using NIVE algorithm (0.325 mm vs 0.355 mm for groups A and B; p=0.010).

**CONCLUSION**
Significant IMT measurement variation was observed between the different techniques. However, overweight children tend to have higher IMT values regardless of the method used. There is no gold standard technique and future studies are needed to validate our results.

**CLINICAL RELEVANCE/APPLICATION**
Risk factors for atherosclerosis begin in chidhood. IMT using the same technique can be used to target children at risk and follow them in time until one technique proves to be the gold standard.

**RC313-13**  
**Utility of 1.5-T Three-dimensional Steady-State Free Precession Whole-heart MRI in the Assessment of Coronary Artery Anatomy with and without Contrast Enhancement in Children**

**Tuesday, Nov. 29 11:20AM - 11:30AM Room: N228**

**Participants**
Quanli Shen, Shanghai, China (Presenter) Nothing to Disclose  
Xihong Hu, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose  
Qiong Yao, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To compare the performance of a contrast-enhanced with a noncontrast 1.5-T three-dimensional (3D) steady-state free precession (SSFP) sequence for magnetic resonance coronary angiography (MRCA) in children.

**METHOD AND MATERIALS**
The study was approved by the institutional review board. Seventy-nine children in the age range of 1 month to 18 years were enrolled in this study. They were classified into three groups according to the age: group 1 = patients 2 years or younger (n = 19), group 2 = patients older than 2 years to 5 years (n = 17), group 3 = patients older than 5 years (n = 43). A free-breathing, navigator-gated, 3D SSFP whole-heart protocol at 1.5-T was used before and after injection of Gadolinium-DTPA. The image quality, vessel length, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) of the left main trunk (LMT), left anterior descending coronary artery (LAD), left circumflex coronary artery (LCX), and right coronary artery (RCA) were assessed by using Wilcoxon signed-rank test.

**RESULTS**
The application of Gadolinium-DTPA improved the image quality of all the coronary arteries in group 1 (P 0.05). Contrast-enhanced 3D SSFP sequence revealed longer length for LAD and LCX in group 1, and LCX in group 2 (P 0.05). SNR and CNR of all the coronary arteries in group 1 and 2, and the LCX and RCA in group 3 increased after application of Gadolinium-DTPA (P 0.05).

**CONCLUSION**
Contrast-enhanced 3D SSFP whole-heart MRCA at 1.5-T significantly improves the image performance in young children. but the
Feasibility of Low Iodine Containing Iodixanol 270 Contrast Media for Cardiac Computed Tomography Angiography Using a Peak Tube Voltage of 80kV in Neonates and Infants

Tuesday, Nov. 29 11:30AM - 11:40AM Room: N228

Participants
Ki Seok Choo, MD, Yangsan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jae-Yeon Hwang, MD, Yangsan-si, Korea, Republic Of (Abstract Co-Author) Research Grant, Bayer AG; Research Grant, Guerbet SA
Jin Hyeok Kim, MD, Yangsan-si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yoon Young Choi, MD, Yangsan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hwaseong Ryu, Yangsan-si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jun Woo Lee, MD, Pusan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jeongmin Lee, MD, Yangsancity, Korea, Republic Of (Presenter) Nothing to Disclose

PURPOSE
Contrast media (CM) of different concentrations are widely used for pediatric cardiac computed tomography angiography (CCTA). However, lower concentration < 300 mgI/ml CM is not routinely used in CTA due to concerns of suboptimal enhancement of cardiac structures and smaller vessels. The aim of the present study was to evaluate the feasibility of using iso-osmolar CM containing a low iodine dose for CCTA in neonates and infants.

METHOD AND MATERIALS
The iodixanol 270 group consisted of 79 CT scans and the iopromide 370 group of 62 CT scans in patients less than one old year. Radiation dose, volume of contrast media, and total iodine dose were retrospectively reviewed. Regarding objective measurements, enhancement and image noise of the ascending aorta (AA), main pulmonary artery (MPA), descending aorta (DA), and left ventricle (LV) were analyzed and contrast-to-noise ratios (CNRs) of the AA and LV were calculated. Regarding subjective measurement, a visual analytic scoring system was devised to evaluate degrees of contrast enhancement, image noise, motion artifact, and overall image quality of each image set. Reader performance for correctly differentiating iodixanol 270 and iopromide 370 by visual assessment was evaluated.

RESULTS
No significant intergroup differences were found between radiation doses or volumes of contrast media. However, iodine doses differed in the two groups (2.1 ± 0.94 g in the iodixanol 270 group and 2.94 ± 1.3 g in iopromide 370 group, P< .001). Group objective and subjective measurements were non-significantly different. Overall sensitivity, specificity, positive predictive value, and negative predictive value for correctly differentiating iodixanol 270 and iopromide 370 by visual assessment were 44.3 %, 57.3 %, 57.8 %, and 43.8 %. Overall area under the curve was 0.51.

CONCLUSION
In conclusion, the application of iodixanol 270 was found to be feasible for performing pediatric CCTA at 80 kVp in neonates and infants. Objective measurements of contrast enhancement and subjective image quality assessments were not statistically different in the iodixanol 270 and iopromide 370 groups.

CLINICAL RELEVANCE/APPLICATION
Low-iodine containing contrast media was not inferior to the high-iodine containing contrast media for cardiac CT angiography using 80 kVp in neonates and infants.

Coronary Artery Imaging in Children

Tuesday, Nov. 29 11:40AM - 12:00PM Room: N228

Participants
Lorna Browne, MD, FRCR, Aurora, CO (Presenter) Nothing to Disclose
CTA from Head to Toe

Tuesday, Nov. 29  8:30AM - 10:00AM  Room: E353B

**Participants**

Christopher Lee, MD, Los Angeles, CA, (christopher.lee.1@med.usc.edu)  (Moderator) Nothing to Disclose

**ABSTRACT**

CT angiography (CTA) is essential for diagnosis and evaluation of arterial vascular pathology of the head and neck. Protocol adjustments for optimal imaging will be discussed. Advanced data post-processing including multiplanar reformations, maximum intensity projection (MIP) reconstructions, and volume rendering will also be discussed. By the end of the presentation, participants should be able to set up CTA protocols for the head and neck and understand how advanced imaging post-processing techniques can be used in everyday practice.

Acute aortic syndrome (AAS) represents the triad of aortic dissection, intramural hematoma, and penetrating atherosclerotic ulcer. Imaging with CTA is essential for the accurate diagnosis of AAS. CTA protocols should optimally image the aorta while minimizing radiation exposure and intravenous contrast administration. Newer CT technology can reduce radiation dose and contrast delivery while preserving image quality. Minimally invasive treatment of acute aortic syndrome with thoracic endovascular aortic repair (TEVAR) has become increasingly popular. The radiologist should be aware of TEVAR’s potential complications and their imaging appearances.

Cardiac CTA involves slightly more preparation than standard CTA acquisition. Heart rate control is one of the most important factors that needs to be addressed prior to performing cardiac CTA. Periprocedural issues mostly involve 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. This presentation will discuss these aspects and include treatment options as well as their alternatives.

**LEARNING OBJECTIVES**

1) Describe techniques for CTA of the neck, upper and lower extremities.
2) Distinguish common artifacts on CTA of these anatomic regions.
3) Evaluate protocol/scanner modifications for optimal CTA imaging.

**Active Handout:**


**Participants**

Cameron Hassani, MD, Los Angeles, CA  (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe pre-procedural patient preparation including appropriate patient selection, contraindications, and beta-blockade.
2) Evaluate peri-procedural issues including vasodilation, continued heart rate control, and breathholding.
3) Evaluate Image acquisition including radiation dose reduction techniques and technique choice.
4) Describe postprocedural complications including contrast reactions and their management.
SSG02
Science Session with Keynote: Cardiac (Coronary Artery Disease)
Tuesday, Nov. 29 10:30AM - 12:00PM Room: S502AB

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

Participants
Sanjeev Bhalla, MD, Saint Louis, MO (Moderator) Nothing to Disclose
Albert De Roos, MD, Leiden, Netherlands (Moderator) Nothing to Disclose
Hajime Sakuma, MD, Tsu, Japan (Moderator) Departmental Research Grant, Siemens AG; Departmental Research Grant, Bayer AG; Departmental Research Grant, Guerbet SA; Departmental Research Grant, DAIICHI SANKYO Group; Departmental Research Grant, FUJIFILM Holdings Corporation; Departmental Research Grant, Nihon Medi-Physics Co, Ltd

Sub-Events
SSG02-01 Cardiac Keynote Speaker: Correlation of Coronary Anatomy and Pathology with Functional Evaluation on CT Angiography
Tuesday, Nov. 29 10:30AM - 10:50AM Room: S502AB

Participants
Ethan J. Halpern, MD, Philadelphia, PA (Presenter) Nothing to Disclose

PURPOSE
Evaluations of cardiac chamber size and geometry, cardiac structural anatomy, as well as ventricular function are essential components of a cardiac evaluation. A major criticism of cardiac CT is that it evaluates coronary anatomy, but does not provide functional information. Echocardiography and cardiac MRI are often preferred for evaluation of cardiac morphology and function, though CTA clearly excels in evaluation of coronary anatomy. Many investigators have used newer techniques to expand the domain of coronary CTA for evaluation of perfusion. However, precise anatomic evaluation of cardiac chamber morphology and function are available as part of the basic gated cardiac CTA. This information should be combined with a detailed assessment of coronary anatomy and valves in order to derive the most benefit from the cardiac CT evaluation. This presentation will highlight the application of cardiac CTA for evaluation of cardiac function, intracardiac shunts, obstructive physiology, and valvular pathology, in order to demonstrate the complementary information that may be combined along with visualization of coronary anatomy, to provide a more complete understanding of cardiac pathology.

SSG02-03 Clinically Equivalent Coronary Artery Calcification Scoring at 75% Lower Dose Radiation with Forward Projected Model Based Iterative Reconstruction
Tuesday, Nov. 29 10:50AM - 11:00AM Room: S502AB

Participants
Andrew Choi, MD, Washington, DC (Presenter) Nothing to Disclose
Sujata Shanbhag, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Jeannie Yu, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Shirley Rollison, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
John Schuwer, Vernon Hills, IL (Abstract Co-Author) Employee, Toshiba Corporation
Chloe Steveson, MS, Otawara, Japan (Abstract Co-Author) Employee, Toshiba Corporation
Marcus Y. Chen, MD, Bethesda, MD (Abstract Co-Author) Institutional research agreement, Toshiba Corporation

PURPOSE
Coronary artery calcification (CAC) quantification is important for cardiovascular risk assessment, but exposes patients to radiation. Forward projected model based iterative reconstruction (FIRST) reduces image noise and enables lower radiation; however, it has not been prospectively validated against conventional filtered back projection (FBP). The purpose of this study was to test whether FIRST with 75% radiation dose reduction results in similar Agatston coronary calcium as standard radiation dose FBP.

METHOD AND MATERIALS
Under Institutional Review Board approved protocol, 100 consecutive patients (61% male, 58.8±8.5 yrs, 27.7±5.8 BMI) prospectively underwent both a low radiation dose coronary calcium score using FIRST and a standard dose coronary calcium score using conventional FBP on a 320 detector row scanner (Aquilion ONE VISION, Toshiba Medical Systems, Otawara, Japan). CAC was quantified using the Agatston method and compared using linear regression, Bland-Altman and weighted kappa for standard clinical Agatston risk groups (0, 1-10, 11-100, 101-400, >400).

RESULTS
Radiation exposure was 75% lower for low vs. standard dose scans (30.5 mGy.cm [IQR 16.2-35.5] vs 98 mGy.cm [IQR 64.3-140.5], p<0.0001). Low FIRST compared to standard FBP showed no significant difference in Agatston score [mean 156.6 vs 147.3 (range 0-1590), mean difference 9.4 ± 28.4, p=NS] and near perfect correlation (R=0.99). Clinical equivalence of low FIRST vs standard FBP was similar to 2 standard FBP scans with 81% (81/100) subjects classified in the same Agatston group and a 0.884 weighted K (95% CI 0.834 – 0.933).

CONCLUSION
Low dose FIRST, when compared to standard FBP, achieves 75% radiation dose reduction with similar image quality and near-clinically equivalent CAC scoring.
**Coronary Artery Calcium Scoring at the Radiation Dose of a Chest X-ray: The Impact of 3rd Generation Dual-Source CT with Tin Filtration**

**Tuesday, Nov. 29 11:00AM - 11:10AM Room: S502AB**

**Participants**
Christian Tesche, MD, Charleston, SC (Presenter) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Moritz H. Albrecht, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (Abstract Co-Author) Consultant, Guerbet SA
Ulrich Ebersberger, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (Abstract Co-Author) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; ;

**Purpose**
To prospectively investigate the diagnostic performance and potential radiation dose reduction of 3rd generation dual-source CT (DSCT) with tin filtration for coronary artery calcium scoring (CACS) compared to the standard acquisition protocol.

**Method and Materials**
We prospectively enrolled 50 subjects (61% male, 62.1±10.8 years) who underwent a clinically indicated coronary artery calcium scoring study using the 120kV convention for image acquisition. These participants were investigated with a second 100kV coronary artery calcium scan as the research test using a tin filter comprised within the DSCT X-ray tube. Tin filtration reduces the portion of weaker photons that would unnecessarily contribute to effective radiation exposure without generating a signal. Agatston scores and MESA percentiles were derived from 120kV and 100kV studies and their correlation determined. Radiation dose estimates were compared between the low-dose acquisition protocol and the established standard acquisition protocol as the reference standard.

**Results**
The low- vs. standard-dose mAs was 402.2±119.5mAs vs. 110.1±51.2mAs (p=0.34), computed tomography dose index volume (CTDVol) was 1.2±1.4mGy for low-dose and 4.2±1.9mGy for standard dose (p=0.08). The effective radiation dose resulted in 0.20±0.05mSv for low-dose scans and 0.20±0.05mSv for standard acquisition (p<0.0001). Mean image noise was 26.5±5.9 for low-dose scans and 17.5±4.0 for standard dose (p=0.019). Mean Agatston scores were 239.3±439.4 with low-dose and 263.4±467.9 in standard dose acquisitions with a range of scores from 0 to 2263. A good correlation of Agatston scores between low-dose and standard dose was shown (r=0.994, p<0.0001). Comparison of Agatston score categories and percentile-based risk categories showed excellent agreement for standard acquisition and low-dose scans (κ=0.923 and κ=0.972)

**Conclusion**
Coronary artery calcium scoring using CT tin-filtration showed excellent correlation and agreement for cardiac risk categories with the standard acquisition protocol based on the Agatston method, while reducing radiation dose to the levels of a chest X-ray. Such radiation dose reductions appear desirable for a screening test to be used in a priori healthy subjects.

**Clinical Relevance/Application**
3rd Generation Dual-Source CT with Tin Filtration significantly decreases radiation dose while maintaining excellent accuracy for coronary calcium detection and quantification.

**Gender and CT Coronary Artery Calcium Score Differences in Patients Offered No-Cost PCP Referred Screening vs Standard Clinical Referrals**

**Tuesday, Nov. 29 11:10AM - 11:20AM Room: S502AB**

**Participants**
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**Purpose**
Clinical evidence indicates that females underestimate the prevalence of CV disease and their individual-specific CV risk. The purpose of this study was to determine if a greater proportion of females participated in a PCP referred no-cost CAC screening program and had higher mean CAC scores than female patients traditionally referred for CAC scoring ($99 out-of-pocket cost) based on medical evaluation.

**Method and Materials**
We compared the gender participation and CAC score data between 3 groups. Group 1 received mailed invitations for a no-cost PCP referred CAC screening during 06/2015, (N= 876, M=436, F=440). Groups 2 and 3 (self-pay 99 $) were referred for CAC...
evaluation in 06/2014, (N=94, M=60, F=34) and 11/2014-05/2015, (N= 911, M=508, F=403), respectively. The difference in mean CAC scores between groups was evaluated using ANOVA. Group differences were evaluated by the χ2 test and the Marascuilo procedure. P values < 0.05 were considered to be significant.

RESULTS

Female subjects had significantly higher CAC scores in Group 1 (124.6±353.5) when compared to Group 3 (74.1±202.3), p = 0.028. Significantly more females were screened in Group 1 (50.2%) compared to females in Groups 2 (42.6%) and 3 (44.2%) and fewer males were in Group 1 than Groups 2 and 3 (χ2=10.79, p=0.005). The number of females in Groups 2 and 3 were not significantly different (p=0.30). Finally, Group 1 had a significantly larger proportion of females with CAC scores ≥400 (9.6%) when compared to both Groups 2 (8%) and 3 (4.7%), (p=0.008). Males in Group 1 also had a significantly higher proportion of CAC scores ≥400 when compared to Group 3 (p=0.013)

CONCLUSION

Offering CAC as a no cost screening exam increased our one month volume six fold during the screening period with an increase of 32% in overall average volumes following the no cost pilot.No-cost PCP referred CAC screening identified a significantly larger proportion of females with CAC scores in the critical range of ≥ 400 and larger average CAC scores when compared to the other groups. Males had significantly overall higher CAC scores than females but also had more individuals with CAC scores ≥ 400 in Group 1.

CLINICAL RELEVANCE/APPLICATION

These results suggest that males and particularly females, may benefit from no-cost CAC screening to identify those at high risk for future CV disease.

SSG02-06  Association between Alcohol Consumption and Presence of Coronary Artery Disease

Tuesday, Nov. 29 11:20AM - 11:30AM Room: S502AB

Awards

Trainee Research Prize - Fellow

Participants

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PURPOSE

It has been suggested that light alcohol consumption is associated with reduced risk for coronary artery disease (CAD). However, data regarding regular alcohol consumption and its association with the presence of CAD still remain controversial. The aim of this study was to assess the association between alcohol consumption and the presence of CAD as detected by coronary CT angiography (CTA).

METHOD AND MATERIALS

Consecutive patients referred for coronary CTA were enrolled in our study. We excluded patients with history of stroke, acute myocardial infarction or coronary revascularization. The weekly alcohol consumption was registered using a questionnaire. Alcohol units were calculated as follows: 1 unit equals 2 dl beer or 1 dl wine or 4 cl spirit. Based on the presence of any plaque on coronary CTA we classified the patients into CAD and no CAD groups.

RESULTS

In total, 1925 patients were enrolled (mean age 57.3±16.1 years, females 43.1%). Atherosclerotic plaque was present in at least one coronary segment in 74.3% of the patients. Alcohol consumption was reported by 37.3% of the patients with a median of 6.7 (IQR:3.3;10.8, range:0.2-66.7) units weekly. Using univariate analysis to compare CAD and no CAD patients we found significant difference regarding cardiovascular risk factors (p<0.001) but no difference in alcohol consumption (p=0.35). After adjusting for cardiovascular risk factors with logistic regression we found no association between alcohol intake and the presence of CAD (OR:1.00;CI:0.98-1.02;p=0.76). We performed a secondary analysis to assess the relationship between alcohol consumption and CAD among no drinkers and light drinkers (maximum 14 units per week; 82.7% of alcohol drinkers) and found no association (OR:1.02;CI:0.98-1.06;p=0.33). Furthermore, we analyzed the effect of different alcohol types (wine, beer, spirit) on the presence of CAD, but no relationship was found.

CONCLUSION

Our study suggests that the amount of weekly alcohol consumption does not show association with the presence of CAD. We did not detect any association between alcohol intake and CAD among light drinkers either. In addition, we did not find any association between the different alcohol types and the presence of coronary atherosclerosis.

CLINICAL RELEVANCE/APPLICATION

It seems that there is no association between light to moderate alcohol consumption and coronary artery disease.
Photon-counting CT for Coronary Artery Calcium Scoring: Potential for Dose Reduction in a Human Population

Tuesday, Nov. 29 11:30AM - 11:40AM Room: S502AB

Participants
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Mark A. Ahiman, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
David A. Bluemke, MD, PhD, Bethesda, MD (Presenter) Research support, Siemens AG

PURPOSE
The Agatston coronary calcium score (CAC) is one of the best known quantitative radiologic measurements. Photon counting CT detectors (PCD) have the potential to reduce noise at very low doses and therefore may enable ultra-low dose calcium scoring. The purpose of this study was to compare CAC scoring with PCD versus energy-integrating detector (EID).

METHOD AND MATERIALS
We used a hybrid (dual-source) whole-body prototype CT system (Siemens Healthcare, Germany), which consists of an energy integrating detector and a photon-counting detector. We compared 40 datasets from 10 subjects. Subjects were scanned with radiation dose-matched conventional EID and PCD at 120 kVp using two preset quality reference standards (standard dose: 80 mAs, low dose: 20 mAs), 3 mm slice thickness and kernel B35f. Calcium scoring was performed using Vitrea (Vital Images). Multiple areas were measured (LM/LAD, LCX, RCA, ascending aorta, descending aorta, total). Agreement of measurements was assessed using intra-class correlation (ICC) and Bland-Altman analysis. Noise was measured in the blood pool. An analysis of number of pixels >130 HU was performed, which relates to the practicality of calcium scoring.

RESULTS
Average dose-length-product (DLP) was 78.2 ± 22.5 mGy cm for standard dose and 21.4 ± 4.9 mGy cm for low dose CAC, resulting in effective radiation doses of 1.1 ± 0.3 mSv and 0.3 ± 0.1 mSv, respectively. Agreement between EID and PCD in standard dose calcium scores was excellent (ICC=0.98). Using the standard dose EID scan as a reference, the agreement of the low dose PCD CAC was superior to the low dose EID CAC (ICC 0.93 vs 0.98, respectively (figure 1A). Using standard dose calcium CAC as reference, PCD low dose showed less bias for CAC scores compared with EID low dose (-10.8 vs -24.8, respectively) (figure 1B) with smaller limits of agreement ([-52, 30.4] vs [-85.6, 36], respectively). Noise levels were similar between EID and PCD, but the fraction of voxels >130 in the blood pool (which may complicate semiautomatic calcium scoring) was higher for low dose EID (p=0.047).

CONCLUSION
The findings suggest that photon counting technology has the potential to reduce radiation dose further in low dose calcium scoring.

Darkfield Imaging in Coronary Atherosclerosis

Tuesday, Nov. 29 11:40AM - 11:50AM Room: S502AB

Participants
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Fabian Bamberg, MD, MPH, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Bayer AG; Speakers Bureau, Siemens AG; Research Grant, Bayer AG; Research Grant, Siemens AG;
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Tobias Saam, MD, Munich, Germany (Abstract Co-Author) Research Grant, Diamed Medizintechnik GmbH Research Grant, Pfizer Inc

PURPOSE
Microlcalcifications have been recognized as an important marker for atherosclerotic plaque instability. Darkfield imaging based on small angle X-ray scattering has been shown to be highly sensitive for calcifications, e.g. in breast tissue. We hypothesized that high signal areas in darkfield imaging of atherosclerotic plaque are associated with microlcalcifications and that darkfield imaging is more sensitive for microlcalcifications than absorption-X-ray techniques.

METHOD AND MATERIALS
Fifteen coronary artery specimens were examined at an experimental set-up consisting of X-ray tube, grating-interferometer and detector. Tomographic darkfield-, absorption- and phase-contrast data were simultaneously acquired. Ten cross-sections with high darkfield signal and no signs of calcification in absorption- and phase-contrast were identified. Ten positive and ten negative controls were selected. Histopathology served as standard of reference. A simulation of darkfield and absorption signal for a detector. Tomographic darkfield-, absorption- and phase-contrast data were simultaneously acquired. Ten cross-sections with high darkfield signal and without high signal areas in all three modalities (10 cross-sections showed microlcalcifications and 9/10 (90%) additional microlcalcifications. In negative controls without high

RESULTS
According to histopathology microlcalcifications were present in 10/10 (100%) cross-sections with high darkfield signal and without evidence of calcifications in absorption- or phase contrast. In positive controls with high signal areas in all three modalities (10/10 (100%) cross-sections showed microlcalcifications and 9/10 (90%) additional microlcalcifications. In negative controls without high
signal areas, no micro- or macrocalcifications were detected in histopathology (0/10). In simulations for bigger pixel sizes the darkfield signal is highly sensitive especially for small particle sizes, while showing similar behaviour with the increasing amount of calcifications like the absorption signal.

CONCLUSION
Darkfield imaging can detect microcalcifications with a higher sensitivity than other x-ray contrast imaging techniques and might provide complementary information in the assessment of plaque instability.

CLINICAL RELEVANCE/APPLICATION
Currently darkfield imaging might serve as a non-destructive method for accurate ex-vivo assessment of microcalcifications in cardiovascular research.

SSG02-09 Effect of a Cardiac Motion Correction Algorithm on Coronary CT Angiography Image Quality of Patients with Heart Rates over 70bpm

Tuesday, Nov. 29 11:50AM - 12:00PM Room: S502AB

Participants
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PURPOSE
To explore the value of a cardiac motion correction algorithm (snapshot freeze (SSF)) to improve the image quality of coronary computed tomography angiography (CCTA) for patients with high heart rates.

METHOD AND MATERIALS
65 patients with heart rates (HR) over 70 beats per minute (71-93bpm) who underwent retrospective ECG-gated CCTA were included in the study. Cardiac images were reconstructed with both SSF and the standard (STD) methods. Image quality was evaluated. Two independent readers assessed the overall image quality of the two reconstruction methods using a five-point scale (0-4), and the results were statistically analyzed.

RESULTS
Image quality was higher by using SSF than STD reconstruction on a per-patient level (3.34±0.76 vs. 2.28±0.96), with statistical significance (Z=-9.21, P<0.05). 96.9% of the patients could be diagnosed confidently by the SSF reconstruction while only 80% by the STD reconstruction. The difference in the interpretability on a per-patient level was statistically significant between the two groups (χ²=9.12, P<0.05).

CONCLUSION
The motion correction algorithm (SSF) can effectively decrease artifacts caused by the cardiac motion to significantly improve image quality and interpretability in cardiac patients with high heart rates undergoing CCTA.

CLINICAL RELEVANCE/APPLICATION
The motion correction algorithm (SSF) can effectively decrease artifacts caused by the cardiac motion to significantly improve image quality and interpretability in cardiac patients with high heart rates undergoing CCTA.
CA224-SD-TUA1
Radiation Dose Reduction for Coronary Artery Calcium Scoring at 320-detector CT with Full Iterative Reconstruction: Study using a Cardiac CT Calibration Phantom

Station #1

Participants
Jay S. Leb, MD, Baltimore, MD (Moderator) Nothing to Disclose

Sub-Events

PURPOSE
The coronary artery calcium (CAC) score measured on computed tomography (CT) scanners is an unequivocal marker of coronary atherosclerosis. It has been reported that the use of hybrid IR (AIDR 3D) made it possible to reduce the radiation dose for CAC measurements without impairing the quantification of coronary calcification. However, on low-dose CT studies, blooming artifacts are not reduced by AIDR 3D and the CAC score may be overestimated. The forward-projected model-based iterative reconstruction solution (FIRST) is a new reconstruction algorithm that repeats both back and forward projections in the image-reconstruction process. The advantages of FIRST include higher spatial resolution, lower image noise, and the reduction of artifacts. We assessed the possibility of reducing the radiation dose for CAC scoring by using the FIRST- rather than the AIDR 3D algorithm or FBP.

METHOD AND MATERIALS
We quantitatively evaluated the CAC score using the QRM-Cardio-Phantom and a 320-detector row CT scanner. The tube current was set at 150-, 100-, 70-, 50-, 40-, and 20 mA; the standard deviation (SD) of the CT values on images reconstructed with FBP corresponds to 20-, 25-, 30-, 35-, 40-, and 50 HU. Reconstruction was performed using FBP, AIDR 3D (strength level: standard), and FIRST. CAC scoring was compared after calculating the Agatston-, volume- and mass scores.

RESULTS
The Agatston scores for the FBP, AIDR 3D, and FIRST at 150 mA were 771, 756, and 717, respectively; at 20 mA, they were 948, 808, and 714, respectively. The volume scores for FBP, AIDR 3D, and FIRST at 150 mA were 627, 621, and 589, respectively; at 20 mA, they were 742, 661, and 597, respectively (true value of 361 mm³). The mass scores for the FBP, AIDR 3D, and FIRST at 150 mA were 172, 170, and 174, respectively and at 20 mA, they were 191, 167, and 166, respectively (true value of 168 mg). The Agatston-, volume- and mass scores obtained at 150 mA and reconstructed with FIRST were comparable to those at 20 mA.

CONCLUSION
The use of FIRST made it possible to reduce the radiation dose by 87% for CAC measurements without impairing the quantification of coronary calcification.

CLINICAL RELEVANCE/APPLICATION
FIRST can reduce the radiation exposure of patients undergoing CAC scoring by 87% compared with the dose currently applied with FBP.

CA232-SD-TUA2
Diagnostic Performance of Peak Enhancement Ratio of Myocardium to Aorta for Detecting Myocardial Ischemia in Dynamic MyocardialComputed Tomography Perfusion Imaging

Station #2

Participants
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PURPOSE
Myocardial CT perfusion (CTP) imaging with pharmacological stress has emerged as a useful method for the assessment of hemodynamic significance of coronary artery disease. The purpose was to evaluate the diagnostic performance of peak enhancement ratio of myocardium to aorta (PER) for detecting myocardial ischemia.

METHOD AND MATERIALS
The study population consisted of 39 patients (mean age 68.6±10.3 years), who underwent pharmacological stress dynamic myocardial CTP, and magnetic resonance myocardial perfusion imaging (MR-MPI) for assessment of coronary artery disease. Stress dynamic CTP (whole-heart datasets over 30 time points at every cardiac cycle, tube voltage of 100 kV, tube current of 80mAs) was acquired with prospective ECG gating (mean radiation dose: 10.6 mSv). Per segment-based analysis using the 16-segment model, peak enhancement (PE) [Hounsfield units (HU)] of the ascending aorta and myocardium was measured by analyzing the time attenuation curves. PE of myocardium was divided by that of the aorta to obtain PER. All myocardial segments were classified as normal and ischemic segments assessed by MR-MPI. The relations for PE values between the aorta and myocardium were assessed by Spearman test. Diagnostic performance of PER and PE for detecting myocardial ischemia were evaluated by the receiver operating characteristics curve analysis, and compared.

RESULTS
Of 39 patients, a total of 242/624 (39%) segments were diagnosed as ischemic segments. The close correlation for PE was observed between the aorta and myocardium (r= 0.79 for normal segments and r= 0.53 for ischemic segments, p <0.05, in each). PE and PER in the ischemic segments were significantly lower than those of normal segments (p <0.05, in each). Sensitivity and specificity for detecting ischemic segments were 64% (95%CI: 58-70) and 81% (95%CI: 77-85) for PE, and 74% (95%CI: 68-79) and 85% (95%CI: 81-88) for PER, respectively. The area under the curve of PER was significantly higher than that of PE [0.86 (0.82-0.89) vs. 0.77 (0.73-0.81), p<0.05].

CONCLUSION
For the assessment of myocardial perfusion, PER is a feasible quantitative method for detecting myocardial ischemia with high diagnostic performance.

CLINICAL RELEVANCE/APPLICATION
PER is a simple quantitative method for the assessment of myocardial perfusion, and it has a potential for establishing a standardized cut-off independently of substantial individual variations in myocardial perfusion.

CA226-SD-TUA3 Assessment of Contrast Enhanced MRA Volumetry to Detect Growth of the Ascending Aorta in Patients with Bicuspid Aortic Valves

Awards
Student Travel Stipend Award

Participants
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Jeremy D. Collins, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
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PURPOSE
Patients with BAV have an increased risk for developing thoracic aortic aneurysms (TAA) and require serial imaging to monitor aortic growth. Aortic diameter measurements, the clinical standard, may be insensitive to focal aneurysmal changes. This study assesses the reliability of CEMRA volumetry compared to two-dimensional diameter measurements to identify TAA growth in BAV patients with significant power.

METHOD AND MATERIALS
A retrospective, IRB approved and HIPAA compliant study was conducted on 20 BAV patients (45±8.9 years old, 80% males) who underwent serial CEMRA with a minimum imaging follow-up of 11 months. MRI was performed at 1.5 T with ECG-gated time-resolved CEMRA. Two independent analysts (MB, BT) measured diameters at the sinuses of valsalva (SOV) and mid-ascending aorta (MAA). Two other independent analysts (IA, OR) measured volume between the aortic annulus and innominate branch using Mimics. Growth rates were calculated via baseline and follow-up exam and differences assessed by two-sided, paired Student’s t-test; p<0.05 considered statistically significant. Intra/inter-observer error was computed. Intraclass correlation coefficient (ICC) was calculated for reliability. The power to detect growth for diameter and volume was computed.

RESULTS
The mean time of follow-up was 2.6±0.82 years. Average aortic measurements at baseline (follow-up) were 4.2±0.3 cm (4.2±0.3 cm, p=0.074) at SOV, 4.6±0.4 cm (4.7±0.4 cm, p=0.05) at MAA, and 130±23 mL (144±24 mL, p<0.05) with volumetry. Average growth was 0.07±0.06 cm/y (2%±1%) at MAA and 6±5 mL/y (4%±2%) with volumetry. Inter-observer mean error was 0.2±0.1 cm (3%±3%) at SOV, 0.2±0.1 cm (4%±3%) at MAA, and 6±5 mL (5%±4%) with volume measurements. ICC was 0.89 for diameter and 0.95 for volume. Based on aortic growth rate reported in the literature, the power for detecting a significant change was 10.0% for MAA and 99.5% for volume.

CONCLUSION
3D CEMRA volumetric analysis exhibited a larger percentage growth, better ICC, and higher power to detect size changes. Thus,
CARDIA-SD-TU44  Change in Coronary Artery Calcium Scores over 10 years: Results from the CARDIA Study

Participants
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Cora E. Lewis, MD, Birmingham, AL (Abstract Co-Author) Institutional Research Grant, Novo Nordisk AS
John J. Carr, MD, MS, Nashville, TN (Abstract Co-Author) Nothing to Disclose

METHOD AND MATERIALS
Participants (n=2,158) included those with CAC scores at the exam in 2000-01 (ages 33-45 years) and at follow-up 10 years later, in 2010-11. CAC was measured blinded to clinical information and reported as Agatston scores (AU) with paired CT scans in 2000-2001 and single scan at follow-up. Blinded adjudications were performed within and across the CT exams and technical errors, coronary stents, and coronary grafts identified and resolved.

RESULTS
CAC prevalence in 2000-01 was 9.9% (213/2,158) and 29.1% (627/2,158) had measurable CAC 10 years later. CAC was not detected in 70.9% (1,351/2,158) at both exams. Focusing on those with non-zero CAC in 2000-1, 13 of 2,158 (0.6%) had a decreased score at follow-up. Their median score in 2000-01 was 1.6 AU (range 0.5-12) with a median change of -2.9 AU noted at follow-up (interquartile range -4.5 to -2.0). Using the criterion of any, 1 or 5 AU/year change in score to categorize results as stable, increased or decreased, the percentage of people with any CAC in 2000-01 that decreased at follow-up was 6.1%, 0.5%, and 0%, respectively (Table).

CONCLUSION
CAC was observed to increase almost exclusively over 10 years in adults initially ages 33-45 years. 10-year decreases in score were small in magnitude and indistinguishable from the expected magnitude of measurement error in this highly quality-controlled longitudinal study. Findings do not support measurable regression of calcified plaque. Criteria of 1 AU/year or 5 AU/year are reasonable for categorizing change in CAC when there is careful reading to avoid false positives and negatives.

CLINICAL RELEVANCE/APPLICATION
We evaluated 10-year change in coronary artery calcium (CAC) by cardiac CT in 2,158 participants to determine how many increased, decreased or were stable to help inform clinical decision-making.

CA228-SD-TUAS  Cardiac-Gated-CT Angiography for Evaluation of The Proximity of Left Atrial Appendage and Pulmonary Artery in Patients with Atrial Fibrillation

Station #5

Participants
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Galit Aviram, MD, Tel-Aviv, Israel (Abstract Co-Author) Institutional Research Grant, Koninklijke Philips NV

METHOD AND MATERIALS
The study includes 100 consecutive patients diagnosed with paroxysmal atrial fibrillation who underwent CCTA. Mean age was 59.7±10.0, 66% were male. This cohort was used as our model for patients who are candidates for treatment of atrial fibrillation;
However, they eventually underwent treatment by pulmonary vein isolation. Using 2D and 3D reconstructions of the CTA data along the central line created within the LAA, the various R-LAA-PA variants were analyzed and classified into 3 types, based on the location, length, and width of the LAA-PA segment of contact. Type I: proximal LAA-PA contact, defined as a contact within first 15mm of the LAA ostium into the LAA and the PA; Type II: distal LAA-PA contact, defined as contact within the distal end of the LAA (> 15mm of the ostium) and the PA; and Type III: no LAA-PA contact.

RESULTS

Types I, II, and III anatomic subsets were present in 25 (25%), 68 (68%), and 7 (7%) patients, respectively. Among Type I patients, mean contact width was 0.6 mm±0.3 and mean contact length was 18.1mm±10.6.

CONCLUSION

In this series, the proximal LAA, serving as the landing zone for most commercially available LAAC devices, came in direct contact with the PA in one quarter of cases.

CLINICAL RELEVANCE/APPLICATION

The LAA-PA anatomical relationship described by CTA may contribute to patients’ safety during LAA closure.

CA229-SD-TUA6 Non-binary Myocardial Infarct Quantification Technique Accounting for Partial Volume Averaging Predicts Segmental Left Ventricular Myocardial Contraction

Station #6

Participants

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PURPOSE

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

METHOD AND MATERIALS

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

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

CA230-SD-TUA7 Contrast-enhanced T1 Mapping-based Extracellular Volume Fraction Independently Predicts Clinical Outcome in Patients with Non-Ischemic Dilated Cardiomyopathy

Station #7

Participants

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Byoung Wook Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hye-Jeong Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
PURPOSE

We aimed to evaluate the prognostic role of contrast-enhanced T1 mapping-based extracellular volume fraction (ECV) in patients with non-ischemic dilated cardiomyopathy (NIDCM) and compare this parameter with conventional late gadolinium enhancement (LGE) parameters.

METHOD AND MATERIALS

We examined 117 NIDCM patients (71 men; age, 51.9±16.7 years) who underwent cardiac magnetic resonance imaging, including pre- and post-contrast T1 mapping, and cine and late gadolinium enhancement (LGE) imaging with a clinical 3T magnetic resonance scanner. Myocardial ECV was calculated from the pre- and post-contrast T1 values of the myocardium (16 segments) and hematocrit value. LGE was quantified using the 5-SD threshold method, and the presence of midwall LGE was also detected. Nineteen healthy volunteers served as controls. Patients were followed for a median duration of 11.2 months (25–75 percentile, 7.8–21.9 months), and survival analyses were performed. The primary end-points were cardiovascular death, re-hospitalization due to heart failure, and heart transplantation.

RESULTS

The mean ECV and native T1 values were higher in NIDCM patients (32.0±5.7% and 1326.3±91.1 ms) than in controls (25.8±2.2% and 1213.9±37.4 ms; p<0.001). During the follow-up period, a certain outcome was noted in 19 patients (16.2%). A 3% increase and 1% increase in ECV was associated with a hazard ratio (HR) of 1.80 and 1.22 (95% confidence interval (CI): 1.48–2.20, 1.14–1.30; p<0.001) for the clinical outcome. Native T1, LGE quantification values, and midwall LGE could predict the clinical outcome with an HR of 1.01 (95% CI: 1–1.01; p=0.03), 1.04 (95% CI: 1.01–1.08; p=0.01), and 4.89 (95% CI: 1.43–16.80; p=0.01), respectively. Multivariate analysis also indicated that ECV was still an independent prognostic factor (3% increase: HR=1.97, 95% CI=1.53–2.52, p<0.001; 1% increase: HR=1.25, 95% CI=1.15–1.36, p<0.001), and had a higher prognostic value (Harrell’s c statistic, 0.89) than LGE quantification values (0.76) or midwall LGE (0.80).

CONCLUSION

Contrast-enhanced T1 mapping based-myocardial ECV independently predicts the clinical outcome in patients with NIDCM. We determined a noninvasive measure of risk stratification among these patients.

TEACHING POINTS

1. To learn the basic principles of myocardial late iodine enhancement (LIE) using dual-energy CT. 2. To learn how to acquire good LIE images for interpretation of various ischemic and non-ischemic cardiomyopathies. 3. To review the image features of LIE in various ischemic and non-ischemic cardiomyopathies by comparison with gadolinium delayed enhancement MRI.
Cardiac Tuesday Poster Discussions
Tuesday, Nov. 29 12:45PM - 1:15PM Room: CA Community, Learning Center

**CA**
AMA PRA Category 1 Credit ™: .50

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

**Participants**
Jay S. Leb, MD, Baltimore, MD (*Moderator*) Nothing to Disclose

**Sub-Events**

**CA231-SD-TUB1** Pulmonary Venous Drainage: Anatomical Comparative Study through MDCT between Patients with Atrial Arrhythmias and Subjects with Sinus Rhythm

**Station #1**

**Participants**
Alfonso Martin Diaz, BMedSc, San Sebastian De Los Reyes, Spain (*Presenter*) Nothing to Disclose
Emilio Cuesta-Lopez, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Carmelo Palacios Miras, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Montserrat Bret, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Inmaculada Pinilla Fernandez, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Maria Fernandez Veilla, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Maribel Torres Sanchez, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Jose Antonio Blazquez, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**
To determine possible differences in diameter and anatomy of the pulmonary vein (VP) ostium between patients with susceptible radiofrequency ablation for atrial arrhythmias, compared to controls.

**METHOD AND MATERIALS**
73 patients: 49% (36) with paroxysmal atrial fibrillation (PAF), 32% (23) with atypical atrial flutter (AAF) and 19% (14) controls. Angio-MDCT study (64 detectors) was performed without cardiac synchronization.

**RESULTS**
Craniocaudal (cc) and anteroposterior (ap) diameter (mm) of the pulmonary veins ostium in patients with arrhythmias and controls, respectively:
- **RSPVcc:** 17 and 14.8; Signif. 0.02
- **RSPVap:** 15.7 and 12.8; Signif. 0.008
- **RIPVcc:** 15.4 and 13.2; Signif. 0.04
- **RIPVap:** 14.7 and 12.3; Signif. 0.04
- **LSPVcc:** 17 and 15.8; Signif. 0.34
- **LSPVap:** 15.2 and 12.8; Signif. 0.01
- **LIPVcc:** 15.9 and 13.3; Signif. 0.05
- **LIPVap:** 13.7 and 12.3; Signif. 0.28

PV anatomical variability of both right (r) and left (l) in patients with PAF, AAF, controls and total values, respectively. p=NS
- **2r+2l:** 69%(25); 56%(13); 72%(10); 66%(48)
- **2r+1l:** 8%(3); 35%(8); 7%(1); 16%(12)
- **3r+2l:** 17%(6); 0%; 14%(2); 11%(8)

Others: 3%(1); 0%(0); 0%(0); 1%(1)
Total: 100%(36); 100%(23); 100%(14); 100%(73)

**CONCLUSION**
A larger diameter (both craniocaudal and anteroposterior) of the ostium of the right pulmonary veins (both upper and lower) was observed in patients with atrial arrhythmias (FAP and FTA) susceptible of ablation, compared to controls. A trend to drainage of right PV in middle lobe was observed in patients with FTA.

**CLINICAL RELEVANCE/APPLICATION**
Our data seem to indicate that patients with AAT and PAF have a higher variability in the anatomy of the pulmonary veins. Future studies should be necessary to analyze whether the same degree of variability in subjects with no history of atrial arrhythmia.

**CA225-SD-TUB2** Influence of Heart Rate on Coronary CT Angiography Image Quality Using a Third-generation Dual Source Scanner: Defining an Optimal Heart-rate Target for Beta-blocker Administration

**Station #2**

**Participants**
Brian Trinh, Chicago, IL (*Presenter*) Nothing to Disclose
Lee Goodwin, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Vahid Yaghmai, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
James C. Carr, MD, Chicago, IL (*Abstract Co-Author*) Research Grant, Astellas Group Research support, Siemens AG Speaker,
PURPOSE

To evaluate the influence of heart rate (HR) on image quality at coronary CT angiography (CCTA) using a third-generation dual source (3GDS) CT system, before and after the institution of a beta-blocker protocol with a HR threshold of 75 beats per minute (bpm) for prospectively ECG-triggered scans.

METHOD AND MATERIALS

A single-center, retrospective, IRB approved, HIPAA compliant study of 140 consecutive patients with low to intermediate risk for coronary artery disease who underwent CCTA on a 3GDS CT system between 2/1/2015 and 8/31/2015. The first 80 of the 140 consecutive patients comprised the derivation cohort and were scanned by ECG-gated prospective triggering or retrospective gating depending on the patients' baseline rhythm without routine administration of beta-blockers. An optimal threshold for beta-blockade was defined using the derivation cohort and applied to the validation cohort. The remaining 60 patients comprised the validation cohort and were scanned with prospective ECG-triggering (pulsing 65-75% R-R) if HR ≤75 bpm, or with retrospective gating (pulsing 35-70% R-R) if HR >75 bpm following beta-blocker administration (Table 1). 0.4mg sublingual nitroglycerin was administered to all patients unless contraindicated. Image quality (IQ) was assessed by a single observer and rated on a four-point scale. The body mass index (BMI), HR, and dose length product (DLP) were recorded. Differences between numerical data were assessed using the student’s t-test and differences in proportions were assessed with the Chi-squared test.

RESULTS

In the derivation cohort, patients with HR >75 bpm had significantly lower IQ than those with HR ≤75 bpm (p<0.05). The derivation cohort had 6 non-diagnostic studies (7.5%), all of which were from patients with HR >75 bpm while the validation cohort had 1 non-diagnostic study (1.7%, p=0.12) from a patient with HR of 283 bpm. Overall IQ was similar between derivation and validation cohorts (p>0.05). The derivation cohort recorded higher DLP than the validation cohort (p<0.05) (Table 2).

CONCLUSION

Chronotropic protocols on 3GDS CT systems should endeavor to achieve a target resting HR of ≤75 bpm for prospective ECG-gating, reserving retrospective ECG-gating for patients with HR >75 bpm.

CLINICAL RELEVANCE/APPLICATION

A defined target HR for ECG-gated prospectively triggered CCTA on a 3GDS CT system reduced the rate of non-diagnostic scans while simultaneously reducing the radiation dose.

Honored Educators

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

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

CA247-SD-TUB3 Role of Magnetic Resonance in the Prediction of Development of Adverse Outcome and Atrial Fibrillation in Hypertrophic Cardiomyopathy

Station #3

Participants
Ana Belen Alcalado Jaramillo, MD, PhD, MAJADAHONDA, Spain (Presenter) Nothing to Disclose
Isabel Zegri, MAJADAHONDA, Spain (Abstract Co-Author) Nothing to Disclose
Miguel Pastrana, MD, Majadahonda, Spain (Abstract Co-Author) Nothing to Disclose
Pablo Garcia Pavia, MAJADAHONDA, Spain (Abstract Co-Author) Nothing to Disclose

PURPOSE

The presentation and clinical course of the Hypertrophic cardiomyopathy (HCM) are extremely variable. The identification of patients at risk of unfavorable out-come is one of the most important issues of the disease. We have analyzed the factors that are associated with adverse events and to the development of atrial fibrillation (AF) in magnetic resonance imaging (MRI).

METHOD AND MATERIALS

352 HCM patients in sinus rhythm who underwent CMR in 5 centers during the period for 2006-2012 were retrospectively evaluated. Left atrial (LA) volume, indexed LA volume, Left Ventricular (LV) function, myocardial thickness, presence and the extent of late gadolinium-enhancement (LGE) were assessed using CMR. We analyzed the MRI findings in relation to cardiovascular events (heart failure requiring hospitalization, appropriate discharge of Implantable Cardioverter-desfibrillator (ICD) / aborted sudden death (SD), cardiovascular death) and relating to the development of AF

RESULTS

During a follow-up time of 42±24 months, 40 patients developed AF and 30 patients presented adverse events (4 cardiovascular death, 3 aborted sudden deaths, 22 heart failure requiring hospitalization, 5 appropriate discharge of ICD). LA volume and indexed LA volume are predictors of adverse events (LAV 150,5±53,1ml vs 126.9±51,8ml, p<0,001 and LAV ind 80,5±30,1ml/mm2 vs 66,5±26,6ml/m2, p<0,001). LA volume and Indexed LA volume were significantly higher in HCM patients with AF than in HCM patients without AF (LAV 152,4±74,9 vs 126,1±48,3ml, p<0,05 and LAV ind 81,4±27,3 vs 66,1±25,0ml/m2, p<0,05). However, we have not found a statistically significant relation between fibrosis and development of adverse events or atrial fibrillation.

CONCLUSION

To evaluate the influence of heart rate (HR) on image quality at coronary CT angiography (CCTA) using a third-generation dual source (3GDS) CT system, before and after the institution of a beta-blocker protocol with a HR threshold of 75 beats per minute (bpm) for prospectively ECG-triggered scans.

METHOD AND MATERIALS

A single-center, retrospective, IRB approved, HIPAA compliant study of 140 consecutive patients with low to intermediate risk for coronary artery disease who underwent CCTA on a 3GDS CT system between 2/1/2015 and 8/31/2015. The first 80 of the 140 consecutive patients comprised the derivation cohort and were scanned by ECG-gated prospective triggering or retrospective gating depending on the patients' baseline rhythm without routine administration of beta-blockers. An optimal threshold for beta-blockade was defined using the derivation cohort and applied to the validation cohort. The remaining 60 patients comprised the validation cohort and were scanned with prospective ECG-triggering (pulsing 65-75% R-R) if HR ≤75 bpm, or with retrospective gating (pulsing 35-70% R-R) if HR >75 bpm following beta-blocker administration (Table 1). 0.4mg sublingual nitroglycerin was administered to all patients unless contraindicated. Image quality (IQ) was assessed by a single observer and rated on a four-point scale. The body mass index (BMI), HR, and dose length product (DLP) were recorded. Differences between numerical data were assessed using the student’s t-test and differences in proportions were assessed with the Chi-squared test.

RESULTS

In the derivation cohort, patients with HR >75 bpm had significantly lower IQ than those with HR ≤75 bpm (p<0.05). The derivation cohort had 6 non-diagnostic studies (7.5%), all of which were from patients with HR >75 bpm while the validation cohort had 1 non-diagnostic study (1.7%, p=0.12) from a patient with HR of 283 bpm. Overall IQ was similar between derivation and validation cohorts (p>0.05). The derivation cohort recorded higher DLP than the validation cohort (p<0.05) (Table 2).

CONCLUSION

Chronotropic protocols on 3GDS CT systems should endeavor to achieve a target resting HR of ≤75 bpm for prospective ECG-gating, reserving retrospective ECG-gating for patients with HR >75 bpm.

CLINICAL RELEVANCE/APPLICATION

A defined target HR for ECG-gated prospectively triggered CCTA on a 3GDS CT system reduced the rate of non-diagnostic scans while simultaneously reducing the radiation dose.

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

CA247-SD-TUB3 Role of Magnetic Resonance in the Prediction of Development of Adverse Outcome and Atrial Fibrillation in Hypertrophic Cardiomyopathy

Station #3

Participants
Ana Belen Alcalado Jaramillo, MD, PhD, MAJADAHONDA, Spain (Presenter) Nothing to Disclose
Isabel Zegri, MAJADAHONDA, Spain (Abstract Co-Author) Nothing to Disclose
Miguel Pastrana, MD, Majadahonda, Spain (Abstract Co-Author) Nothing to Disclose
Pablo Garcia Pavia, MAJADAHONDA, Spain (Abstract Co-Author) Nothing to Disclose

PURPOSE

The presentation and clinical course of the Hypertrophic cardiomyopathy (HCM) are extremely variable. The identification of patients at risk of unfavorable out-come is one of the most important issues of the disease. We have analyzed the factors that are associated with adverse events and to the development of atrial fibrillation (AF) in magnetic resonance imaging (MRI).

METHOD AND MATERIALS

352 HCM patients in sinus rhythm who underwent CMR in 5 centers during the period for 2006-2012 were retrospectively evaluated. Left atrial (LA) volume, indexed LA volume, Left Ventricular (LV) function, myocardial thickness, presence and the extent of late gadolinium-enhancement (LGE) were assessed using CMR. We analyzed the MRI findings in relation to cardiovascular events (heart failure requiring hospitalization, appropriate discharge of Implantable Cardioverter-desfibrillator (ICD) / aborted sudden death (SD), cardiovascular death) and relating to the development of AF

RESULTS

During a follow-up time of 42±24 months, 40 patients developed AF and 30 patients presented adverse events (4 cardiovascular death, 3 aborted sudden deaths, 22 heart failure requiring hospitalization, 5 appropriate discharge of ICD). LA volume and indexed LA volume are predictors of adverse events (LAV 150,5±53,1ml vs 126.9±51,8ml, p<0,001 and LAV ind 80,5±30,1ml/mm2 vs 66,5±26,6ml/m2, p<0,001). LA volume and Indexed LA volume were significantly higher in HCM patients with AF than in HCM patients without AF (LAV 152,4±74,9 vs 126,1±48,3ml, p<0,05 and LAV ind 81,4±27,3 vs 66,1±25,0ml/m2, p<0,05). However, we have not found a statistically significant relation between fibrosis and development of adverse events or atrial fibrillation.

CONCLUSION
The LA volume and indexed LA volume are markers of adverse events, regardless of the presence of atrial fibrillation and the presence of fibrosis. LA volume and indexed LA volume have prognostic value more sensitive than fibrosis in predicting adverse cardiovascular events among HCM patients. The LA volume and indexed LA volume are predictors of atrial fibrillation more sensitive than the presence of fibrosis.

**CLINICAL RELEVANCE/APPLICATION**

Our findings could have important implications for the management of these patients. Patients with increased LA volume would benefit from a comprehensive monitoring and more aggressive therapies for diastolic dysfunction even anticoagulation.

**CA234-SD-TUB4**

**Predictive Value of Aortic Valve Calcification and Cerebral White Matter Lesion Load on Peri-procedural Acute Cerebrovascular Events in Patients Undergoing Transcatheter Aortic Valve Implantation (TAVI)**

*Station #4*

**Awards**

**Student Travel Stipend Award**

**Participants**

Jonas Doerner, MD, Cologne, Germany (*Presenter*) Nothing to Disclose

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Klaus Storm, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

Tilman Hickethier, MD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose

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Hans H. Schild, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

Alexander Gharem, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Cerebral magnetic resonance imaging (MRI) is able to detect and quantify morphological signs of hypo perfusion and vascular embolism. This is of particular interest in patients with symptomatic aortic stenosis, since the evolving valve dysfunction impairs brain perfusion. In addition, subjects who undergo transcatheter aortic valve implantation (TAVI) are prone to suffer clinically silent peri-procedural cerebrovascular events (CVEs). We aimed to investigate the influence of aortic valve calcification on acute peri-procedural CVEs and to characterize brain phenotypes by MRI in order to find risk factors associated with acute peri-procedural CVEs.

**METHOD AND MATERIALS**

A total of 119 patients who were referred to TAVI were investigated for aortic valve calcification using transesophageal echocardiography. Furthermore, subjects were consecutively investigated using MRI with a dedicated scan protocol including: T2-, FLAIR-, and Diffusion-Weighted Imaging (DWI). Prior to TAVI brains were characterized for total brain volume (TBV), white matter lesion load (WML) and lacunar infarction. Post TAVI, brains were investigated for the onset of acute peri-procedural CVEs using DWI.

**RESULTS**

Seventy-eight patients (65.5%) revealed acute peri-procedural CVEs on MRI after TAVI procedure with a favor for the left hemisphere (57.5%). The severity of valve degeneration was associated with peri-procedural CVE burden. Further, patients with acute peri-procedural CVEs demonstrated a baseline WML burden twice as high as patients without (OR 2.36 (95% CI: 1.09 – 5.15; p=0.037)). In particular, a peri-ventricular WML distribution pattern was associated with procedural events (OR: 3.27; 95% CI: 1.47 – 7.26; p=0.0038)). In contrast, lacunar infarctions prior TAVI were not related to acute peri-procedural CVEs. In total, three clinically relevant strokes were observed.

**CONCLUSION**

Patients undergoing TAVI demonstrated a wide variety of baseline WML burden, as well as different degrees of aortic valve calcification. Since, the degree of aortic calcification and peri-ventricular WML burden was correlated with acute peri-procedural CVEs, future studies are needed to evaluate the value of such parameters for the prediction of clinical outcome.

**CLINICAL RELEVANCE/APPLICATION**

Echocardiography and cerebral MRI prior to TAVI can help to identify and allocate patients with high procedural risk.

**CA235-SD-TUB5**

**Coronary Calcium Detectability and Score across Three Generations of Dual-source CT: A Comparative Phantom Study**

*Station #5*

**Participants**

Marleen Vonder, MSc, Groningen, Netherlands (*Presenter*) Nothing to Disclose

Gert Jan Pelgrim, MD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Marcel Greuter, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Thomas Henzler, MD, Mannheim, Germany (*Abstract Co-Author*) Research support, Siemens AG; Speaker, Siemens AG

Rozemarijn Vliegenthart, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Matthijs Oudkerk, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Jan Willem C. Gratama, MD, Apeldoorn, Netherlands (*Abstract Co-Author*) Nothing to Disclose

Sevin Ezrah Murray Huijsse, MSc, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Until now, it remains unclear whether follow-up for coronary calcium score should only be performed on equal generations of dual-source CT (DSCT), or whether different generations of DSCT lead to comparable results. The purpose of this study was to compare coronary calcium detection and quantification of three generations of DSCT systems.
METHOD AND MATERIALS

Three successive generations of DSCT systems (SOMATOM Definition, Definition Flash, Force, Siemens, Forchheim, Germany) were used to scan a non-moving anthropomorphic thorax phantom in which two calcium inserts were placed consecutively (QRM, Möhrendorf, Germany). The first insert, containing 100 small calcifications, was used to determine the detectability. The second insert, containing nine larger calcifications, was used to determine the Agatston calcium score. Scan data acquisition was performed at 120 kVp and 90 reference mAs and reconstructed with generation-specific vendor-recommended settings. Measures were determined automatically using a Matlab script. Kruskal-Wallis test and Mann-Whitney U test were used to analyze differences in detectability and Agatston score.

RESULTS

The median number and range of detected calcifications were 11(8), 11(4) and 12 (2) for first, second and third generation DSCT respectively (p>0.143 for all comparisons). The respective median Agatston score and range were 599 (549-695), 635 (616-685) and 638 (607-680) for the insert with large calcifications. Significant differences in distribution of the Agatston score were found between the first and second (p=0.019), as well as the first and third generation DSCT systems (p=0.026).

CONCLUSION

This comparative phantom study showed a significant difference in distribution of the Agatston score of first generation compared to second and third generation DSCT. Therefore, one should be cautious when comparing a calcium score or risk stratification based on first generation DSCT with a calcium score based on second or third generation DSCT.

CLINICAL RELEVANCE/APPLICATION

Due to lower variability in calcium scores for second and third generation DSCT, the percentage of misclassification of a patient into one of the CVD risk categories is probably lower compared to stratification based on first generation DSCT calcium score.

CA236-SD-TUB6  Dynamic CT Perfusion Study on the Optimal Timing of Single-shot Iodine Distribution Scans

METHOD AND MATERIALS

Dynamic stress CT MPI (Definition Flash, Siemens, Germany) at 100 kV and 300 mAs and adenosine perfusion MRI (Magnetom Avanto 1.5T, Siemens, Germany) were used to analyse twenty-five symptomatic patients (59 ± 8.4 years, 14 male). MRI analysis was only used to determine whether segments were ischemic or non-ischemic. For CT, the Hounsfield units (HU) were monitored during the dynamic CT scan for all myocardial segments along with regions of interest (ROIs) in the ascending (AA) and descending aorta (DA). The time difference between peak enhancement in the myocardium and peak AA and peak DA was calculated. In patients with myocardial ischemia, we calculated the time delay to observe a minimal difference of 15 Hounsfield Unit between normal and ischemic segments after a pre-defined baseline enhancement of 150 or 250 HU in the AA or DA.

RESULTS

Ischemia on MRI was observed in 10 patients (56 ± 9 years; 8 male). Time delay between maximal HU in the non-ischemic segments and maximum HU in the DA and AA and was 0.0 s [0.0-2.8] and 2.8 s [2.2-4.3], respectively. Differentiation between ischemic and non-ischemic myocardial segments in CT was best during a time window of 8.6 ± 3.8 s, with a mean maximal HU difference of 28.0 ± 14.5 HU. For the AA, time delays were 4.5 s [2.2-5.6] and 2.2 s [0-2.8] for the 150 HU and 250 HU thresholds, respectively. With the DA, time delays were 2.4 s [0.0-4.8] and 0.0 s [-2.2-2.6] for the 150 HU and 250 HU thresholds, respectively.

CONCLUSION

Differentiation between normal and ischemic myocardium is best accomplished during a time interval of 8.6 ± 3.8 s. In order to scan during this time window, test bolus or bolus tracking in the AA or DA can be used with the time delays identified here.

CLINICAL RELEVANCE/APPLICATION

The time delays provided in this study can be used to acquire single shot CT MPI. Imaging at the right moment will secure optimal differentiation between ischemic and non-ischemic segments.

CA237-SD-TUB7  Volume-Outcome Relationships for Transcatheter Aortic Valve Replacement - Risk-Adjusted and Volume Stratified Analysis of Outcomes

METHOD AND MATERIALS

Three successive generations of DSCT systems (SOMATOM Definition, Definition Flash, Force, Siemens, Forchheim, Germany) were used to scan a non-moving anthropomorphic thorax phantom in which two calcium inserts were placed consecutively (QRM, Möhrendorf, Germany). The first insert, containing 100 small calcifications, was used to determine the detectability. The second insert, containing nine larger calcifications, was used to determine the Agatston calcium score. Scan data acquisition was performed at 120 kVp and 90 reference mAs and reconstructed with generation-specific vendor-recommended settings. Measures were determined automatically using a Matlab script. Kruskal-Wallis test and Mann-Whitney U test were used to analyze differences in detectability and Agatston score.

RESULTS

The median number and range of detected calcifications were 11(8), 11(4) and 12 (2) for first, second and third generation DSCT respectively (p>0.143 for all comparisons). The respective median Agatston score and range were 599 (549-695), 635 (616-685) and 638 (607-680) for the insert with large calcifications. Significant differences in distribution of the Agatston score were found between the first and second (p=0.019), as well as the first and third generation DSCT systems (p=0.026).

CONCLUSION

This comparative phantom study showed a significant difference in distribution of the Agatston score of first generation compared to second and third generation DSCT. Therefore, one should be cautious when comparing a calcium score or risk stratification based on first generation DSCT with a calcium score based on second or third generation DSCT.

CLINICAL RELEVANCE/APPLICATION

Due to lower variability in calcium scores for second and third generation DSCT, the percentage of misclassification of a patient into one of the CVD risk categories is probably lower compared to stratification based on first generation DSCT calcium score.

CA236-SD-TUB6  Dynamic CT Perfusion Study on the Optimal Timing of Single-shot Iodine Distribution Scans

METHOD AND MATERIALS

Dynamic stress CT MPI (Definition Flash, Siemens, Germany) at 100 kV and 300 mAs and adenosine perfusion MRI (Magnetom Avanto 1.5T, Siemens, Germany) were used to analyse twenty-five symptomatic patients (59 ± 8.4 years, 14 male). MRI analysis was only used to determine whether segments were ischemic or non-ischemic. For CT, the Hounsfield units (HU) were monitored during the dynamic CT scan for all myocardial segments along with regions of interest (ROIs) in the ascending (AA) and descending aorta (DA). The time difference between peak enhancement in the myocardium and peak AA and peak DA was calculated. In patients with myocardial ischemia, we calculated the time delay to observe a minimal difference of 15 Hounsfield Unit between normal and ischemic segments after a pre-defined baseline enhancement of 150 or 250 HU in the AA or DA.

RESULTS

Ischemia on MRI was observed in 10 patients (56 ± 9 years; 8 male). Time delay between maximal HU in the non-ischemic segments and maximum HU in the DA and AA and was 0.0 s [0.0-2.8] and 2.8 s [2.2-4.3], respectively. Differentiation between ischemic and non-ischemic myocardial segments in CT was best during a time window of 8.6 ± 3.8 s, with a mean maximal HU difference of 28.0 ± 14.5 HU. For the AA, time delays were 4.5 s [2.2-5.6] and 2.2 s [0-2.8] for the 150 HU and 250 HU thresholds, respectively. With the DA, time delays were 2.4 s [0.0-4.8] and 0.0 s [-2.2-2.6] for the 150 HU and 250 HU thresholds, respectively.

CONCLUSION

Differentiation between normal and ischemic myocardium is best accomplished during a time interval of 8.6 ± 3.8 s. In order to scan during this time window, test bolus or bolus tracking in the AA or DA can be used with the time delays identified here.

CLINICAL RELEVANCE/APPLICATION

The time delays provided in this study can be used to acquire single shot CT MPI. Imaging at the right moment will secure optimal differentiation between ischemic and non-ischemic segments.
PURPOSE

The relationship between procedural volume and patient outcome has not been extensively studied in patients undergoing transcatheter aortic valve replacement (TAVR). This study sought to evaluate patient outcomes at low, intermediate, and high volume TAVR sites.

METHOD AND MATERIALS

Within a large health system, TAVR is performed at low volume (<40 cases/year), intermediate volume (40-75 cases/year), and high volume sites (>75 cases/year). 181 consecutive patients undergoing TAVR from 1/2014-6/2015 were studied: 21 from a low volume site, 62 from an intermediate volume site, and 98 from a high volume site. All patients had a pre-procedural CT interpreted by the site radiologist. Heart teams independently decided TAVR prosthesis sizing. Patient data was abstracted from the medical record. The primary endpoint was defined as a 30-day composite of all-cause mortality, in-hospital major adverse cardiovascular events, new post-TAVR hemodialysis, post-procedural cerebrovascular accident, new permanent pacemaker implantation, and hospital readmission. Data were analyzed using risk-adjusted multivariate logistic regression and propensity score analysis.

RESULTS

The primary endpoint was reached in 38.8% of patients at the high volume site, 50% at the intermediate volume site, and 76.2% at the low volume site (p<0.01). A significant difference in 30-day readmission rate was primarily responsible for differences in the primary endpoint (47.6%, 32.3% and 9.2% respectively; p<0.01). Propensity score and multivariate regression models identified the following independent predictors of the 30-day composite endpoint: larger hospital volume (OR 0.33, p<0.01), Society of Thoracic Surgeons Predicted Risk of Mortality Score ≥12 (OR 5.72, p<0.01), and female gender (OR 1.99, p=0.04). Bivariate regression analysis identified additional patient characteristics associated with better post-TAVR outcomes at the high volume site compared to intermediate or low volume sites: age≥80 yrs, BMI>30, diabetes, hypertension, prior coronary artery disease (CAD), chronic kidney disease (CKD), and NYHA class III/IV heart failure.

CONCLUSION

Higher risk patients undergoing TAVR have a better 30-day outcome at a high volume site compared to intermediate and low volume sites.

CLINICAL RELEVANCE/APPLICATION

Among patients undergoing TAVR, those with greater clinical complexity may have better outcomes by undergoing their procedure at a high volume TAVR site.

Beyond the Heart: Expanding Applications of 4D-Flow from Head to Toe

Awards

Identified for RadioGraphics

Participants

Horacio Murillo, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose
John Axerio-Cilies, PhD, San Francisco, CA (Abstract Co-Author) Founder, Arterys Inc; Officer, Arterys Inc

TEACHING POINTS

To learn the basics of 4D flow MRI acquisition and developing applications; The quantitative and qualitative advantages of 4D flow MRI wherever hemodynamic measurements are needed for shunts, regurgitation, and flow patterns/stress; To learn about the added value to patient care that radiologists can provide with 4D flow MRI speed and convenience.

TABLE OF CONTENTS/OUTLINE

PURPOSE
Review the fundamentals of 4D Flow MRI and its developing and expanding applications. Describe 4D Flow MRI applications with illustrative examples from head to toe. Discuss the advantages of 4D Flow MRI over 2D Flow MRI beyond pretty pictures.

CONTENT
Fundamentals of 4D Flow MRI. Data postprocessing and storage. Developing and expanding applications illustrative examples:- Comprehensive congenital heart MRI in minutes- Neurovascular imaging-Gastrointestinal arterial and venous imaging- Advantages and challenges of 4D flow MRI- Quantitative hemodynamics- Qualitative flow patterns

SUMMARY

The major learning points of this exhibit are (i) to learn the basics of 4D flow MRI acquisition and developing applications; (ii) the quantitative and qualitative advantages of 4D flow MRI for hemodynamic measurements and flow patterns/stress; and, (iii) the added value to patient care that radiologists can provide with 4D flow MRI speed and convenience.
TEACHING POINTS

The purpose of the educational exhibit is to:
- define the diagnostic criteria of left ventricular hypertrophy
- identify the features and classification of the phenotypes of hypertrophic cardiomyopathy (HCM) via MRI and precise the key sequences needed in the MR exploration of HCM
- explore the different etiologies of HCM and their MR features
- emphasize the prognostic value of MRI in in the clinical outcome of patients suffering from HCM.

TABLE OF CONTENTS/OUTLINE

Classification of cardiomyopathies
Diagnosis of left ventricular hypertrophy
Hypertrophic Cardiomyopathy: definition, semiology, forms and prognostic value sought in MRI
Other etiologies of myocardial hypertrophy:
  - Athlete's heart
  - Fabry's disease
  - Hemochromatosis
  - Glycogen Storage Disease type III
  - Sarcoidosis
  - Left ventricular non-compaction

Conclusion
**Cardiac (Cardiovascular Angiography/Intervention)**

**Tuesday, Nov. 29 3:00PM - 4:00PM Room: SS02AB**

**CA VA CT IR**

**AMA PRA Category 1 Credit ™: 1.00**

**ARRT Category A+ Credit: 1.00**

**Participants**
Antoinette S. Gomes, MD, Culver City, CA (Moderator) Nothing to Disclose
Gregory W. Gladish, MD, Houston, TX (Moderator) Nothing to Disclose

**Sub-Events**

**SSJ03-01 Influence of Contrast Material Density and kV Setting on Detectability of Calcified Plaques on Coronary CT Angiography in Patients with Suspected Coronary Artery Disease**

**Tuesday, Nov. 29 3:00PM - 3:10PM Room: SS02AB**

**Participants**
Patricia Dewes, MD, Frankfurt, Germany (Presenter) Nothing to Disclose
Christophe Arendt, MD, Frankfurt am Main, Germany (Abstract Co-Author) Nothing to Disclose
Claudia Freiliesen, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Ralf W. Bauer, MD, Frankfurt, Germany (Abstract Co-Author) Speakers Bureau, Siemens Healthcare GmbH; Speakers Bureau, Bayer Healthcare; Speakers Bureau, GE Healthcare

**PURPOSE**
Calcified plaque may be missed on coronary CT angiography (cCTA) with highly concentrated iodinated contrast material (CM) at low kV settings. We analyzed the impact of different iodine density CM at varying tube potential for the assessment of calcified plaques on cCTA images.

**METHOD AND MATERIALS**
164 consecutive patients with suspected coronary artery disease underwent non-enhanced calcium scoring (CaSc) at 120 kV followed by cCTA with topogram-based automated kV selection on third- or second-generation dual-source CT. Based on prior observations 37 patients were injected diluted CM with a resulting iodine concentration of 280 mg/ml (group1) between September 2015 and March 2016 whereas 127 patients were injected undiluted CM with an concentration of 400 mgI/ml (group2). Amount (50 ml) and flow rate (5 ml/s) were kept constant. The sensitivity of cCTA for detecting calcified plaques was evaluated with CaSc at 120 kV serving as the reference.

**RESULTS**
97 patients (59%) had calcified plaques on CaSc, 78 patients of group 2 and 19 patients of group 1. The overall sensitivity of cCTA for detection of calcified plaques was 79% in group 1 and 73% in group 2. Sensitivity for patients examined at 70 kV was significantly higher with diluted CM (76% vs. 57%). There was no significant difference in sensitivity at 100 and 120 kV in both groups (100% and 82% in group 1 and 2, respectively). The overall median luminal contrast density was 389 HU with diluted CM and 503 HU with undiluted CM. At 70 kV, values were at 463 HU and 655 HU, at 100 kV they were at 197 HU and 365 HU with diluted vs. undiluted CM.

**CONCLUSION**
The combination of highly concentrated CM and 70 kV tube potential reduces the detectability of calcified plaques. In order to preserve reliable information on relevant calcifications, cCTA at 70 kV should be performed with CM with lower iodine concentration. If undiluted CM is used, 100 kV tube potential should preferably be chosen.

**CLINICAL RELEVANCE/APPLICATION**
Patients may benefit from both low radiation and contrast exposure when examined at 70 kV cCTA. However, 100 kV protocols yield higher sensitivity or reliable calcified plaque visualization.

**SSJ03-02 Comparison of Transcatheter Coronary Artery Fistula Closure Versus Surgery Closure**

**Tuesday, Nov. 29 3:10PM - 3:20PM Room: SS02AB**

**Participants**
Junzhou Pu, Beijing, China (Presenter) Nothing to Disclose
Lianjun Huang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Wenhui Wu, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The aim of this study was to compare transcatheter coronary artery fistula (CAF) closure (TC) with surgery closure (SC).

**METHOD AND MATERIALS**
From 2011 to 2015, 21 patients (age range from 18 to 76 years, 11 males) were diagnosed CAF in our center. Twelve of them were underwent transcatheter closure, 9 patients were attempted to closure in surgery. Hemodynamic evaluation and coronary artery angiography had been carried out before procedures.

**RESULTS**
Nine procedures in TC group were successful, 3 failures due to inabilities to cannulate the distal of lesion. There was no death in TC group. One patient in SC group had procedure related death. Procedure room time (103 ± 89 min vs. 305 ± 118 min, p < 0.001), intensive care unit time (0 hour vs. 24 hours, p < 0.001), length of stay (5 days ± 15 days, p < 0.001) were significantly less in TC group. Two cases of residual shunts were detected in immediate angiography of TC group. One of them turned to a significant recanalization, and a second intervention was performed. No recanalization was found in SC during follow-ups. Follow-up was obtained in all the patients. At a median time of 17.5 months, there was no significant difference in survival (TC, 100% vs. SC, 94.4%, p = 0.471).

CONCLUSION
Both transcatheter and surgery closure can achieve satisfactory results of CAF. However, the procedure time, length of stay and resource use was significant lower in TC group.

CLINICAL RELEVANCE/APPLICATION
Coronary artery fistula intervention is a safe and feasible method, and should be considered firstly if the anatomic condition was appropriate.

SS303-03 Improving Patient to Patient CT Value Uniformity in Coronary CT Angiography with an Individualized Contrast Injection Protocol Tailored to Fat Free Mass and kVp

Tuesday, Nov. 29 3:20PM - 3:30PM Room: SS02AB

Participants
Laurence Delombaerde, MSC, Heverlee, Belgium (Presenter) Nothing to Disclose
Federica Zanca, PhD, Leuven, Belgium (Abstract Co-Author) Employee, General Electric Company
Gert Van Gompel, PhD, Brussel, Belgium (Abstract Co-Author) Nothing to Disclose
Kaoru Tanaka, MD, PhD, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose
Nicolas Buis, DSC, PhD, Jette, Belgium (Abstract Co-Author) Nothing to Disclose
Johan De Mey, Jette, Belgium (Abstract Co-Author) Nothing to Disclose
Kristof De Smet, MD, MSc, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose

PURPOSE
To achieve a consistent enhancement in coronary CT angiography (CCTA) by implementing a contrast injection protocol with adjusted iodine concentration based on patient habitus and kVp.

METHOD AND MATERIALS
Retrospective data from 80 consecutive patients (group 1) scanned on a Revolution CT (GE Healthcare) with one-heartbeat automated triggering, 100 kVp (N=74) or 120 kVp (N = 6), noise index = 25 and standard iodine dose (70 ml of 370 mg I/ml, 350 mg I/ml or 320 mg I/ml) was collected, using DoseWatch (GE Healthcare). The optimal correlation between arterial enhancement (HU) and body habitus normalized to total iodine dose (TID) was determined by considering following parameters: weight, Body Mass Index (BMI), Body Surface Area (BSA), Lean Body Mass (LBM) and Fat Free Mass (FFM). From the parameter giving the best correlation, a model for optimal contrast concentration to achieve a target enhancement value of 550 HU at target was determined and prospectively applied to 62 patients (N=1 at 80 kVp, N=55 at 100 kVp and N=6 at 120 kVp) undergoing a CCTA exam (group 2). Personalized iodine concentration was administered by parallel mixing of iodine with saline on a dual-head power injector (Nemoto-Kyorindo, Japan). Enhancement was compared between group 1 and 2 (Mann-Whitney U-test) and homogeneity of variances was tested (Levene's test).

RESULTS
Compared to other body habitus parameters (R² range 0.1 – 0.5), Free Mass (FFM) showed the strongest correlation (R² = 0.5) with enhancement. Following contrast injection model was established for 100 kVp: TID = (HU_target - 237)*FFM/946; for 120 and 80 kVp TID should be scaled by 1.22 and 0.77 respectively. With the modified protocol, variance (standard deviation) reduced from 102 HU to 67 HU (p < 0.01). The mean enhancement 506 HU was lower than the target 550 HU (p <0.01).

CONCLUSION
An injection protocol with contrast concentration adapted to body habitus, iodine concentration and kVp improves patient-to-patient CT value uniformity.

CLINICAL RELEVANCE/APPLICATION
Personalizing the iodine injection protocol for CCTA homogenizes image quality in terms of contrast enhancement for an easier interpretation and correlation of images.

SS303-04 The Effect of Full Iterative Reconstruction on The Image Quality of Coronary Artery Stent at 320 Detector–Row CT Scanner

Tuesday, Nov. 29 3:30PM - 3:40PM Room: SS02AB

Participants
Fuminari Tatsugami, Hiroshima, Japan (Presenter) Nothing to Disclose
Toru Higaki, PhD, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
Chikako Fujioka, RT, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
Watari Fukumoto, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
Yoko Kaichi, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
Kazuo Awai, MD, Hiroshima, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd; Research Grant, Bayer AG; Research Grant, Eisai Co, Ltd; Medical Advisor, General Electric Company; ; ; ;
Makoto Iida, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose
Hiroyuki Sakane, MD, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
Cardiac CT is an important and indispensable method for the assessment of coronary artery stent patency. However, when the CT
images are reconstructed with filtered back projection (FBP) or hybrid iterative reconstruction (IR) the diagnosis of in-stent restenosis is occasionally difficult due to blooming- and streak artifact. A new type of full IR algorithm (forward projected model-based iterative reconstruction solution; FIRST, Toshiba Medical Systems) improves the spatial resolution and decreases the artifacts. We compared the image quality of coronary artery stent between the CT images reconstructed with FIRST and with hybrid IR (AIDR 3D, Toshiba).

**METHOD AND MATERIALS**

We prospectively enrolled thirty patients (11 women, mean age 71.4 ± 8.6 years) who had 34 coronary stents. They underwent coronary CT angiography (CTA) using a 320-slice CT scanner. Images were reconstructed with AIDR 3D (standard setting) using a medium soft-tissue convolution kernel and with FIRST (cardiac setting). For each of the two reconstruction methods we generated attenuation profiles and measured the width of the 10-90% edge rise distance (ERD) at the boundary and determined a slope of linear function as follow: Slope = (CT90% - CT10%) / ERD. Two radiologists visually evaluated the image quality based on the blooming artifacts from the stent using a 4-point scale ranging from 1 = impaired diagnostic information to 4 = minimal or absent. The ERD and slope between the two reconstruction methods were compared using the paired t-test, image quality scores with the Wilcoxon signed-rank test.

**RESULTS**

There was no significant difference in the mean ERD between the two reconstruction methods (0.7 ± 0.2 mm vs.0.6 ± 0.2 mm; p = 0.14). The mean slope for FIRST images was higher than AIDR 3D (378.7 ± 149.5 vs.195.2 ± 136.6; p < 0.001). The mean image quality score for AIDR 3D and FIRST images were 2.7 and 3.6, respectively; the difference was also significant (p < 0.05).

**CONCLUSION**

As the use of the FIRST improved image quality of the coronary artery stent on coronary CTA, it may improve the detection of in-stent restenosis compared to the conventional method.

**CLINICAL RELEVANCE/APPLICATION**

The diagnostic performance could be improved when FIRST is used for the detection of in-stent restenosis compared to the conventional method.

**SSJ03-05 How To Make Use of Coronary CT Angiography to Decrease Patient Dose in the Catheterization Laboratory**

**Tuesday, Nov. 29 3:40PM - 3:50PM Room: SS02AB**

**Participants**

Christophe Arendt, MD, Frankfurt am Main, Germany (Presenter) Nothing to Disclose
Patricia Dewes, MD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Julian W. Wichmann, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Josef Matthias Kerl, MD, Frankfurt, Germany (Abstract Co-Author) Research Consultant, Siemens AG Speakers Bureau, Siemens AG AG Thomas J. Vogl, MD, PhD, Frankfurt, Germany (Abstract Co-Author) Nothing to Disclose
Ralf W. Bauer, MD, Frankfurt, Germany (Abstract Co-Author) Speakers Bureau, Siemens Healthcare GmbH; Speakers Bureau, Bayer Healthcare; Speakers Bureau, GE Healthcare

**PURPOSE**

Cardiologists currently catheterize all three major coronary arteries as standard of care in patients with coronary artery disease (CAD), even though previously performed coronary CT angiography (cCTA) showed only one- or two-vessel disease with no or non-relevant atherosclerosis in the other vessels. We investigated the potential reduction of patient exposure during invasive coronary catheterization (ICA) if the procedure had only been directed to the vessel of interest by utilizing information of the CT report.

**METHOD AND MATERIALS**

Dose reports of 52 patients who were referred to ICA because of at least one moderate or severe stenosis on cCTA were retrospectively included. There was no selection of patients based on CT image quality. The dose-area product (DAP) was documented separately for the left (LAD, CX) and the right coronary artery (RCA) by summing up the single DAPs for each projection. The study population was further subdivided according to the procedure performed: coronary angioplasty/stent insertion of LCA (group 1) or RCA (group 2) only, or of both vessels (group 3), or no intervention (group 4). Furthermore, patients with no intervention but subsequent coronary artery bypass grafting were included (group 5).

**RESULTS**

All 36 arteries (LCA or RCA) classified as non-significantly diseased on cCTA out of 104 coronary arteries (35%) were confirmed by ICA with no further intervention. Half of the study population could have benefit from reduced exposure if catheterization had been directly guided to the vessel of interest as described on cCTA. Potential mean relative DAP reduction were as follows: group 1 (n = 14) 10.5%; group 2 (n = 1) 43.4%; group 3 (n = 10) 0%; group 4 (n = 24) 25.7%; group 5 (n = 3) 0%. However, calcium blooming artifacts caused overestimation of stenosis severity in 16/104 (15%) vessels on cCTA with subsequent need for diagnostic ICA.

**CONCLUSION**

Directing ICA to the vessel of disease as described on cCTA would be safe and reduce patient exposure in the cath lab substantially, especially for patients with one-vessel disease. Calcified plaques remain a limitation on cCTA leading to unnecessary ICA referrals.

**CLINICAL RELEVANCE/APPLICATION**

cCTA can guide cardiologists directly to the vessel of interest for coronary intervention with substantial dose reduction for the invasive procedure, making coronary catheterization safer and faster for patients.
PURPOSE
To investigate the image quality (IQ) and diagnostic value of single-phase coronary artery CT angiography (CCTA) image from stress dynamic myocardial CT perfusion (CTP) scan on the third-generation dual-source CT (DSCT).

METHOD AND MATERIALS
Nineteen consecutive symptomatic patients (13men and 6women; 58.5±10.3years) who underwent CCTA and diagnosed with at least one moderate stenosis (degree≧50%) lesion of the three main coronary arteries were recruited. The patients were scanned with prospective automatic CARE-kV selection ATP-stress dynamic myocardial CTP examination (44ml contrast media&60ml saline at 5.5ml/s) on a third-generation DSCT with data acquisition window at the end systole. The single-phase CCTA image with the best enhancement of coronary arteries in the process of CTP was selected for reconstruction and measurement. The quantitative (CT value, background noise, signal-to-noise ratio [SNR] and contrast-to-noise ratio [CNR]) and qualitative (Likert four-point grading scale) IQ results as well as the diagnostic value (detection of coronary artery stenosis lesion) were compared with that of the former CCTA examination images.

RESULTS
There were no significant difference in quantitative (CT values, noise, SNR and CNR) IQ between the CTP-CCTA and former CCTA (p>0.05), except for the SNR of aorta root (14.70±2.10 and 18.67±4.85, p<0.05). No significant difference in qualitative IQ has been found between CTP-CCTAand former CTA (score: 1.38±0.60 and 1.47±0.61, p>0.05). CTP-CCTA detect stenosis in good correlation with former CCTA (97%, 99 of 102), especially for moderate-severe stenosis (100%, 53 of 53). The patients’mean heart rate (HR) during stress CTP (83.92±11.03bpm) was much higher than that of the former CCTA (68.91±12.81bpm) scan (p=0.005). The mean effective radiation dose (ED) of CTP is 4.48±1.87mSv.

CONCLUSION
The IQ and diagnostic value of single-phase CCTA image from stress dynamic myocardial CTP on the third-generation dual-source CT system was great and one myocardial CTP scan is potentially feasible to replace the CTP&CTA examination.

CLINICAL RELEVANCE/APPLICATION
The single-phase CCTA image derived from CTP at the third-generation DSCT system is able to replace the CCTA scan for symptomatic patients with suspected or known CAD, which enable the greatly reduction of ED for patients and create highest possibilities for one-stop cardiac CT examination within one myocardial CTP scan.
**SSJ04-01** **Recent Trends in Medicare Payments to Radiologists and Cardiologists: Who Has Been the Bigger Loser?**

**Tuesday, Nov. 29 3:00PM - 3:10PM Room: S504AB**

**Participants**
Karen G. Ordovas, MD, San Francisco, CA (Moderator) Nothing to Disclose
Pamela K. Woodard, MD, Saint Louis, MO (Moderator) Research Grant, Astellas Group; Research Grant, Bayer AG; Research agreement, Siemens AG; ;
Pal Maurovich-Horvat, MD, PhD, Pecs, Hungary (Moderator) Nothing to Disclose

**PURPOSE**
Radiologists and cardiologists are the 2 highest users of imaging and receive the highest aggregate imaging payments from Medicare. But large cuts have been imposed on reimbursements in recent years. Our purpose was to compare trends between 2002 and 2014 in payments to the 2 specialties to determine which initially grew faster and which dropped further after peaking.

**METHOD AND MATERIALS**
The nationwide Medicare Part B Physician/Supplier Procedure Summary Master Files for 2002 through 2014 were the data source; these files provide total allowed payments for all noninvasive diagnostic imaging CPT codes to all specialties. Medicare specialty codes were used to identify payments to radiologists and cardiologists. Invasive procedures were not included. Payment amounts for all types of imaging to each specialty were tabulated each year and trends were ascertained.

**RESULTS**
Radiologists received $3.714B for Medicare diagnostic imaging in 2002, increasing to a peak of $5.300B in 2006 (+43%). In 2007, with the onset of the Deficit Reduction Act (DRA), radiologists’ payments dropped by $735M. Payments then remained relatively stable for the next 3 years but began a decline in 2011. By 2014, their payments had dropped to $4.164B (-21% vs peak). Cardiologists received $1.756B for Medicare diagnostic imaging in 2002, increasing to a peak of $2.998B in 2006 (+71%). In 2007, with the onset of the DRA, their payments dropped by exactly $300M. They then experienced even greater reductions in 2009 and 2010 as a result of code bundling in echocardiography (2009) and myocardial perfusion imaging (2010). Further reductions occurred in subsequent years. By 2014, their payments were $1.673B (-44% vs peak).

**CONCLUSION**
Between 2002 and 2006, payments to cardiologists for noninvasive diagnostic imaging grew at a much faster rate than payments to radiologists. Both specialties were then adversely impacted by the DRA in 2007, but code bundling in echocardiography and myocardial perfusion imaging created additional losses for cardiologists. The result was that by 2014, cardiologists had proportionately lost over twice as much imaging reimbursement as radiologists.

**CLINICAL RELEVANCE/APPLICATION**
not applicable.

**SSJ04-02** **Cardiac Magnetic Resonance Imaging in Stroke Patients: A Prospective Substudy of the FIND-AF Multicenter Trial**

**Tuesday, Nov. 29 3:10PM - 3:20PM Room: S504AB**

**Participants**
David C. Levin, MD, Philadelphia, PA (Presenter) Consultant, HealthHelp, LLC; Board of Directors, Outpatient Imaging Affiliates, LLC
Laurence Parker, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Vijay M. Rao, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Atrial fibrillation (AF) is associated with an increased risk of stroke, but often remains undiagnosed in acute ischemic stroke.
**METHOD AND MATERIALS**

Thirty-one participants, with a mean age of 70.5 ± 6.2 years, were included. The study was approved by the institutional review board. The participants were diagnosed with acute ischemic stroke within the last 7 days, and their heart rates were monitored throughout the imaging procedure. The time-to-peak (TTP) for radial and longitudinal velocities were calculated.

**RESULTS**

The mean age of participants was 70.5 ± 6.2 years, and 17 were female (54.9%). The time-to-peak (TTP) for radial and longitudinal velocities were calculated. The mean peak radial velocity was 0.99 ± 0.15 cm/s at systole and -1.06 ± 0.11 cm/s at diastole. The mean peak longitudinal velocity was 0.94 ± 0.11 cm/s at systole and 0.98 ± 0.11 cm/s at diastole.

**CONCLUSION**

In patients with acute ischemic stroke, left atrial fibrosis was associated with NIH stroke scale. Left atrial fibrosis with a Utah Score ≤ 10% LA wall enhancement, demonstrating a perfect correlation with Utah 1 and no finding of AF in this study population. NIHSS was 2.84 ± 3 and positively correlated with LAF (Spearman rank correlation was 0.6, Ps <0.05).

**CLINICAL RELEVANCE/APPLICATION**

DE-CMR of the left atrium adds substantial information in patients with acute ischemic stroke.

**METHOD AND MATERIALS**

Atrial fibrillation (AF) is associated with an increased risk of stroke, but often remains undiagnosed in acute ischemic stroke patients. This prospective trial evaluates the role of delayed enhancement cardiac magnetic resonance (DE-CMR) imaging of the left atrium in acute stroke patients.

**RESULTS**

The mean age of patients was 70.5 ± 6.2 years, and 17 were female (54.9%). With enhanced rhythm electrocardiogram (ECG) monitoring, AF was not detected. Left atrial volume was 50.7 ± 12.7 ml/m2, mean LAEF was 47.9 ± 7.8% with a CHA2DS2-VASc-Score of 2.84 ± 1.6. Mean LAF was 1.9 ± 0.9% (Utah Score I group ≤ 10% LA wall enhancement), demonstrating a perfect correlation with Utah 1 and no finding of AF in this study population. NIHSS was 2.84 ± 3 and positively correlated with LAF (Spearman rank correlation was 0.6, Ps <0.05).

**CONCLUSION**

In patients with acute ischemic stroke, left atrial fibrosis was associated with NIH stroke scale. Left atrial fibrosis with a Utah Score ≤ 10% LA wall enhancement, demonstrating a perfect correlation with Utah 1 and no finding of AF in this study population. NIHSS was 2.84 ± 3 and positively correlated with LAF (Spearman rank correlation was 0.6, Ps <0.05).

**CLINICAL RELEVANCE/APPLICATION**

DE-CMR of the left atrium adds substantial information in patients with acute ischemic stroke.
CONCLUSION

Myocardial fat had a 31% reduction in hazard of death, adjusting for age, setting, heart failure and kidney disease (p=0.018). In the MI group, those with hypertension, diabetes, stroke, obesity, and dyslipidemia. In the no MI group, those with myocardial fat had a 25% reduction in hazard of death, adjusting for age, sex, setting, ordinal calcium score and heart failure (p=0.04). In the MI group, those with myocardial fat had a 31% reduction in hazard of death, adjusting for age, setting, heart failure and kidney disease (p=0.018).

METHOD AND MATERIALS

Functional imaging of the LA was performed via steady-state-free-precession (SSFP) cine sequences. GLE was visualised with 3D-fast low-angle shot (FLASH) inversion recovery sequences 15 minutes post i.v. administration of GBCA. Imaging was performed on a 3 Tesla MRI system (MAGNETOM Verio, Siemens Medical) before and after CA. For statistical analysis, pre- and post-CA functional parameters were recorded. GLE was evaluated blinded and randomized in terms of pre/post ablation in consensus by a cardiologist and a radiologist with expertise in cMRI. Patients were grouped in a) subjects with successful CA, i.e. sinus rhythm, and b) subjects without sinus rhythm at the time of follow-up-MRI. Results were evaluated with a paired t-test; a p value of .05 was set as the significance level.

RESULTS

72 patients were included in the study. Pre- and post-CA MRI was performed in 44 patients. The mean time before CA and follow-up-cMRI was 111 days (76-313). 8 patients were excluded due to poor image quality. 30 patients were allotted to group a), 6 to group b). Group a) showed a significant difference in ejection fraction (23.5±6.9% vs. 28.7±4.6%; p<.01; CI=95%), end-systolic volume (107±47m³ vs. 96±37m³; p<.01; CI=95%), stroke volume (32±13m³ vs. 38±12m³; p=.002; CI=95%) and GLE (80% vs. 10%; p<.001; CI=95%) in the follow-up cMRI. Group b) showed no significant changes in LA functional parameters and in GLE in the follow-up cMRI.

CONCLUSION

Scarring along the ablation pathways could be visualized with GLE and was significantly present only in patients with successful CA. These patients also showed a significant improvement in LA function.

CLINICAL RELEVANCE/APPLICATION

cMRI is a reliable and objective method to assess left atrial function post catheter ablation. The presence of delayed enhancement along the ablation pathways shows a correlation with short term success and could be of prognostic value.

SSJ04-05 Ventricular Myocardial Fat: An Unexpected Biomarker for Long-term Survival

Tuesday, Nov. 29 3:40PM - 3:50PM Room: S504AB

Awards

Student Travel Stipend Award

Participants

Anna S. Bader, MD, Bronx, NY (Presenter) Nothing to Disclose
Jeffrey M. Levsky, MD, PhD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Benjamin Zalta, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Anna Shmukler, MD, Brooklyn, NY (Abstract Co-Author) Nothing to Disclose
Arash Gohani, MD, Brooklyn, NY (Abstract Co-Author) Nothing to Disclose
Vineet R. Jain, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Victoria Chemyak, MD, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Eran Bellin, Bronx, NY (Abstract Co-Author) Nothing to Disclose
Linda B. Haramati, MD, MS, Bronx, NY (Abstract Co-Author) Spouse, Board Member, Bio Protect Ltd; Spouse, Board Member, OrthoSpace Ltd; Spouse, Board Member, Kryon Systems Ltd

PURPOSE

Left ventricular (LV) myocardial fat has been described on CT as a sign of chronic myocardial infarction (MI). Right ventricular (RV) fat is usually considered a sign of aging. We postulated that presence of LV fat in patients without history of MI indicates silent MI and portends higher mortality. The purpose of this study is to determine the relationship between myocardial fat and all-cause mortality.

METHOD AND MATERIALS

We identified all patients with chronic MI (≥3 years prior) and 3 age- and time-matched patients without MI who underwent non-contrast chest CT between 1/1/2005-12/31/2008. Patients with cancer were excluded. All CTs were reviewed for myocardial fat by two cardiothoracic radiologists blinded to history and outcome. LV fat, RV fat, and fat in either ventricle were each classified as dichotomous variables. Electronic health records were surveyed for variables related to mortality. Death was verified by in-hospital events and the National Death Index. Logistic regression was used to identify factors associated with myocardial fat. Kaplan-Meier and Cox proportional hazard analyses were used to determine the association between myocardial fat and all-cause mortality.

RESULTS

The study population comprised 690 patients without MI and 265 patients with prior MI, mean age 73.7±10.6 years. There were 277 and 190 deaths, respectively (median follow-up 6.8 years [IQR 2.5, 8.4]). In the no MI group, 25.7% had LV and 49.9% had RV fat. In the MI group, 32.8% had LV and 42.3% had RV fat. LV and RV fat were highly associated (OR 5.3, p<0.001). The presence of fat in either ventricle was not associated with common cardiovascular risk factors and comorbid conditions, such as age, sex, hypertension, diabetes, stroke, obesity, and dyslipidemia. In the no MI group, those with myocardial fat had a 25% reduction in hazard of death, adjusting for age, sex, setting, ordinal calcium score and heart failure (p=0.04). In the MI group, those with myocardial fat had a 31% reduction in hazard of death, adjusting for age, setting, heart failure and kidney disease (p=0.018).

CONCLUSION

An improvement in left atrial (LA) functional parameters post catheter ablation (CA) with pulmonary vein isolation and ablation of the anterior mitral line in patients with persistent atrial fibrillation (AF) has been demonstrated through echocardiography. Successful CA should lead to scarring of the left atrium along the ablation pathways. We intended to confirm the improvement in left atrial function and to correlate it with the presence of gadolinium late enhancement (GLE) along the ablation pathways with cardiac MRI (cMRI).
Patients with myocardial fat have improved survival, suggesting that myocardial fat is either protective or is a biomarker of a beneficial physiologic process, even for patients with prior MI.

**CLINICAL RELEVANCE/APPLICATION**

Myocardial fat is a marker of enhanced survival and has the potential to improve patient risk stratification beyond traditional risk factors.

**SSJ04-06 Atorvastatin Reduces Aortic Plaque Volume in HIV: A Randomized Placebo-Controlled Trial**

Tuesday, Nov. 29 3:50PM - 4:00PM Room: S504AB

**PURPOSE**

HIV confers substantial risk of cardiovascular disease, including myocardial infarction (MI) and stroke. HIV is also associated with aortic inflammation; however whether statins reduce aortic plaque in HIV is not known.

**METHOD AND MATERIALS**

Forty persons with subclinical coronary atherosclerosis, LDL cholesterol <130 mg/dL, and treated HIV participated in a 12-month randomized, double blind trial of atorvastatin vs. placebo. Participants had ECG-gated CT angiography (CTA) of the thoracic aorta and coronary arteries at enrollment and after 12 months of treatment. The primary outcome was change in ascending aortic plaque volume, quantified by an independent reader blinded to scan order and treatment allocation. Change in plaque volume was compared between statin and placebo arms with the Wilcoxon rank sum test. Intra-reader reliability for plaque volume was assessed in 14 CTAs using intra-class correlation (ICC). We previously reported change in coronary plaque volume – correlation with aortic plaque volume was assessed with Spearman’s correlation coefficient.

**RESULTS**

Thirty-seven completed the trial (17 atorvastatin, 20 placebo). Twelve months of atorvastatin reduced aortic plaque volume relative to placebo: median change in aortic plaque volume was -107.0 mm³ [-441.0, 177.5] for atorvastatin vs. +151 mm³ [-34.3, 551.5] for placebo (p=0.015). The percent change in aortic plaque volume was -4.1% [-16.7, 7.9] for statin vs. +7.9% [-3.8, 17.6] for placebo (p=0.026). Excellent intra-reader reliability was found for aortic plaque volume (ICC: 0.90). There was not significant correlation between change in aortic and coronary plaque in individuals (rs=0.14, p=0.42).

**CONCLUSION**

In persons with HIV and subclinical atherosclerosis, 12 months of atorvastatin reduced aortic plaque. Absent correlation between changes in coronary and aortic plaque in individual subjects suggest possible distinct underlying pathophysiology.

**CLINICAL RELEVANCE/APPLICATION**

Further investigation is necessary to determine the association between changes in aortic plaque and cardiovascular events, including MI and stroke.

**Honored Educators**

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Udo Hoffmann, MD - 2015 Honored Educator
**Imaging of the Cardiac Ventricles**

**Tuesday, Nov. 29 4:30PM - 6:00PM Room: N227B**

**Participants**
Sachin S. Saboo, MD, FRCR, Dallas, TX, (sachin.saboo@utsouthwestern.edu ) *(Moderator)* Nothing to Disclose

**LEARNING OBJECTIVES**

1) Better understand cardiopulmonary physiology. 2) Identify predictors of outcome in pulmonary diseases. 3) Know arguments for choosing the most useful imaging modality in specific situations.

**ABSTRACT**

Introduction: Right ventricular (RV) disease may be clinically inapparent or moderately symptomatic. It is even possible to survive without RV such as in patients after palliative cavo-pulmonary connection also referred to as Fontan procedure. Dysfunction may result in heart failure, thrombus formation or rhythm disturbances. Imaging is directed towards identification, characterisation and monitoring of RV disease, mass and function. Methods & Results: Echocardiography remains first line modality because of it’s ease of use and broad availability. It is particularly useful for assessment of the tricuspid and pulmonary valve. It is hampered, however, by the complexity of RV anatomy and it’s location behind the sternum, paracentral and peripheral pulmonary arteries can not be explored. Moreover, relevant interstudy and interobserver variability may be problematic in longitudinal monitoring of RV diseases. Computed Tomography provides an excellent overview of anatomy of RV and surrounding structures. Moreover, it can be completed within a single breath hold. Calcifications such as in constrictive pericarditis are readily identified, but more detailed tissue characterisation as well as functional analysis are limited. Magnetic Resonance Imaging (MRI) is the goldstandard for analysis of mass and function of the RV such as in Arrhythmogenic Right Ventricular Dysplasia. Moreover it provides excellent soft tissue characterisation in infarction, fatty infiltration, tumors and cardiac involvement in systemic diseases such as systemic sclerosis by means of quantitative mapping techniques. Conclusion: Echocardiography remains first line modality for imaging the RV because of it’s availability and ease of use. Advantages of CT are short examination time, excellent overview of cardiac and extracardiac anatomy as well as high sensitivity and specificity for calcifications. MRI is the goldstandard for function and mass and thus excellent for longitudinal monitoring. Detailed tissue characterisation enables characterisation of RV diseases.

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

**LEARNING OBJECTIVES**

1) To understand how sequela of surgical correction for congenital heart disease can impair right ventricular function. 2) To identify best method for measuring severity of right ventricular dysfunction by magnetic resonance. 3) To name surgical procedures that result on a systemic right ventricle.

**ABSTRACT**

RC403A   **Acquired Disease of the Right Ventricle (Including Secondary RV Disease Due to Pulmonary Disease)**

Participants
Jens Bremerich, MD, Basel, Switzerland, (jens.bremerich@usb.ch ) *(Presenter)* Nothing to Disclose

**LEARNING OBJECTIVES**

1. Acquired Disease of the Right Ventricle (Including Secondary RV Disease Due to Pulmonary Disease)
2. Right Ventricular Failure in Congenital Heart Disease
3. Left Ventricular Cardiomyopathies
4. MRI and CT of Cardiac Masses
1) We will review MRI and CT techniques for investigation of cardiac masses. 2) The role for tissue characterization in narrowing the differential diagnosis, and using imaging to help stage lesions, plan therapy, and anticipate complications will be reviewed. 3) The presentation will largely be case based.

ABSTRACT
Cardiac Wednesday Case of the Day

Wednesday, Nov. 30 7:00AM - 11:59PM Room: Case of Day, Learning Center

Participants
Kaushik S. Shahir, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Dhiraj Baruah, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Rahul D. Renapurkar, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Sushikumar K. Sonavane, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Sachin S. Saboo, MD, FCR, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Suhny Abbara, MD, Dallas, TX (Abstract Co-Author) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Nicholas Clayton, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Jubal R. Watts Jr, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Satinder P. Singh, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Subha Ghosh, MBBS, MD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Michael A. Bolen, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Christopher Maroules, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Tyler M. Flessner, MD, Milwaukee, WI (Abstract Co-Author)
Nagina Malguria, MBBS, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Melissa M. Wein, MD, Shorewood, WI (Abstract Co-Author) Nothing to Disclose
Zachary R. Laste, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Prabhakar Rajiah, MD, FCR, Dallas, TX (Abstract Co-Author) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

TEACHING POINTS
1) Identify pertinent findings and generate differential diagnosis for cardiac imaging studies. 2) Develop differential diagnoses based on the clinical information and imaging findings. 3) Recommend appropriate management for patients based on imaging findings.

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Rahul D. Renapurkar, MD - 2016 Honored Educator
Suhny Abbara, MD - 2014 Honored Educator
Prabhakar Rajiah, MD, FCR - 2014 Honored Educator
LEARNING OBJECTIVES

1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage "active" consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

ABSTRACT

URL
Participants
Jill E. Jacobs, MD, New York, NY, (jill.jacobs@nyumc.org) (Moderator) Nothing to Disclose
Sanjeev Bhalla, MD, Saint Louis, MO, (sanjeevbhalla@wustl.edu) (Presenter) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Dallas, TX, (radprabhakar@gmail.com) (Presenter) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV
Eric E. Williamson, MD, Rochester, MN (Presenter) Research Grant, General Electric Company
Amar B. Shah, MD, Long Island City, NY, (ashah01@gmail.com) (Presenter) Future royalties, Wolters Kluwer nv

LEARNING OBJECTIVES

ABSTRACT

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Sanjeev Bhalla, MD - 2014 Honored Educator
Sanjeev Bhalla, MD - 2016 Honored Educator
Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
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 have provided the possibility of reduced-time and reduced radiopharmaceutical dose image acquisitions. Moreover, increased flexibility in imaging protocols has been realized. Future development of these methods hold promise in increasing diagnostic accuracy and expanding diagnostic applications. The addition of CT to SPECT and PET has afforded the ability to perform attenuation correction, thereby minimizing attenuation artifacts and increasing diagnostic specificity. With CT acquisitions of sufficient resolution, complementary anatomic diagnostic information is provided. In addition, more precise anatomic localization of SPECT and PET abnormalities significantly increases clinical applicability.

Sub-Events

RC511A Advances in Cardiac SPECT

Participants
E. Gordon Depuey, MD, New York, NY (Presenter) Steering Committee, Adenosine Therapeutics, LLC;

LEARNING OBJECTIVES

1) Implement protocols that facilitate patient-centered imaging and that reduce patient radiation exposure. 2) 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. 3) Understand instrumentation advances that allow new cameras to perform SPECT with markedly reduced acquisition times and/or less radiopharmaceutical activity and their clinical impact. 4.) Review myocardial perfusion SPECT scans systematically to avoid artifacts and maximize diagnostic accuracy.

ABSTRACT

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 following technical advancements described facilitate implementation of patient-centered imaging. New software methods and new innovative hardware now allow for significantly shortened SPECT acquisition times without a decrease in image quality. Advancements include iterative reconstruction, resolution recovery, and noise reduction software, and focused collimation and solid state detectors incorporated into new camera designs. Attenuation correction increases diagnostic specificity and facilitates stress-only protocols. Software advancements such as high resolution imaging, scatter correction, and respiratory gating increase diagnostic sensitivity. Even with such technical advancements, however, attention to technical detail is essential to assure optimal image quality. Camera and radiopharmaceutical quality control deserve the highest priority. A systematic review of myocardial perfusion SPECT images is essential to recognize artifacts and optimize diagnostic accuracy. Case examples will be presented to reinforce this approach.

RC511B Advances in Cardiac PET

Participants
Sharmila Dorbala, MBBS, Boston, MA (Presenter) Research Grant, Astellas Group; Stockholder, General Electric Company;

LEARNING OBJECTIVES

1) Review the advantages and disadvantages of myocardial perfusion PET compared to SPECT for evaluation of coronary artery disease. 2) Learn the added value of absolute quantitative parameters derived from PET for assessment of cardiovascular disease. 3) Update of current and future clinical applications of cardiac PET imaging in cardiovascular medicine.

ABSTRACT

Novel advances in PET detectors, radiotracer availability, clinical software, as well as hybrid PET/CT and PET/MR scanners have revolutionized the clinical and investigative applications of cardiac PET. Cardiac PET myocardial perfusion imaging, in the 1970’s, was a predominantly investigative tool, with home-grown software, available at select major academic centers with access to a cyclotron. Over the last decade, with easy access to PET scanners, and to positron emitting perfusion tracers, the use of cardiac PET has exploded — well beyond major academic centers to several hospitals and to large office-based practices. Commercially available software has made quantitative myocardial blood flow assessment, a main-stream clinical application. Hybrid PET/CT scanner applications— calcium score and CT based coronary angiography—have further advanced the applications of cardiac PET. PET/MR is an emerging technology with promising cardiovascular applications. Each of these exciting developments has transformed cardiac PET from a predominantly investigative tool of the 1970’s to the advanced clinical tool of the 2016. The primary goal of this session is to discuss the present-day clinical and emerging applications of cardiac PET/CT and PET/MR using a practical case-based approach.
**SSK03**

**Science Session with Keynote: Cardiac (Congenital Cardiovascular Disease)**

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

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

**SSK03-01 Cardiac Keynote Speaker: Imaging for Tetralogy of Fallot-Current Practice and Future Directions**

Participants  
Frandroid P. Chon, MD, PhD, San Francisco, CA (Moderator)  
Nothing to Disclose  
Jaye S. Leb, MD, Baltimore, MD (Moderator)  
Nothing to Disclose  

**PURPOSE**

Tetralogy of Fallot (TOF) is the most common cyanotic heart disease, representing 10% of all cases of congenital heart disease. Today, total surgical repair at early childhood greatly enhances survival and quality of life of these patients. In most cases of simple TOF, the imaging needs for initial diagnosis and surgical planning are met by echocardiography. More complicated cases, where there are additional intracardiac or coronary anomalies, abnormal pulmonary artery anatomy, malformation of the airways and lungs, may require catheterization, CT, or MRI to guide surgical planning. The most frequent and important clinical indication for cardiac MRI in patients with TOF is the evaluation of impending right heart failure after total surgical repair. A total repair of TOF calls for closure of the ventricular septal defect and relief of the pulmonary stenosis, usually accomplished by transannular patch augmentation. This leaves a variable degree of pulmonary regurgitation. In some patients, this chronic volume loading to the RV leads to ventricular dilation and heart failure. Cardiac MRI is the most accurate and least invasive way of detecting early evidence of heart failure, which triggers timely replacement of the pulmonary valve. Cardiac MRI and CT are powerful tools for investigating pathophysiology and for evaluating experimental treatments for TOF. Both MRI and CT provide patient-specific, detailed 3D or 4D structural information of the heart and the pulmonary vasculatures required for computational fluid dynamic (CFD) simulations. MRI enables multi-dimensional phase-contrast technique (4D-flow) that characterizes blood flow in the TOF heart. Finally, cardiac MRI has unique capabilities for myocardial tissue characterizations. These capabilities include myocardial tagging for strain mapping, T1-mapping and delay-enhancement for scar imaging, first-pass contrast enhancement for perfusion imaging, and diffusion imaging for myocardial fiber tracking.

**SSK03-03 Abdominal Blood Flow Assessment with Phase Contrast MRI in Children with Fontan Circulation**

Participants  
Pablo Caro-Dominguez, MD, Toronto, ON (Presenter)  
Nothing to Disclose  
Shi-Joon Yoo, MD, Toronto, ON (Abstract Co-Author)  
Owner, 3D HOPE Medical; CEO, IMIB-CHD;  
Govind B. Chavhan, MD, Toronto, ON (Abstract Co-Author)  
Nothing to Disclose  

**PURPOSE**

To establish normal ranges of blood flow in the major thoracic and abdominal vessels in children with fenestrated and completed Fontan and to identify flow differences in children with signs of hepatic damage or clinical evidence of protein-losing enteropathy.

**METHOD AND MATERIALS**

Cardiovascular MRI including PCMR and abdominal sequences were performed in 25 children with fenestrated Fontan circulation, 30 children with completed Fontan and compared with a control group of 19 healthy children.

**RESULTS**

Children with fenestrated Fontan have higher cardiac output, SVC flow (reflecting cerebral blood flow) and aorto-pulmonary collaterals with reduced flow to all abdominal vessels as compared to control and completed Fontans. Children with completed Fontan have lower cardiac output, flow in the SVC, descending aorta, IVC, celiac axis, splenic and renal veins as compared to controls, with no difference in superior mesenteric artery blood flow. The mesenteric venous blood flow is reduced in all Fontan patients, markedly in those with clinical criteria of protein-losing enteropathy. The portal venous flow is reduced in all Fontan children, especially in children with signs of cirrhosis.

**CONCLUSION**

This study showed abnormal blood flow patterns on PCMR that helps to understand better the physiology in children with fenestrated and completed Fontan circulation. We have established normal ranges of blood flow in the thoracic and abdominal vessels with PCMR that can be used in the daily practice. Finally, a significant difference between SMA and SMV blood flow can be used as a warning sign of developing protein-losing enteropathy.

**CLINICAL RELEVANCE/APPLICATION**

Phase contrast MRI can potentially be used to quantify protein-losing enteropathy and give valuable blood flow information in children with signs of failed Fontan circulation.

**SSK03-04 Visualization and Quantification of Shunt Fraction with 4D Flow MRI in Patients with Atrial Septal**
Defects - A Multicenter Pilot Study
Wednesday, Nov. 30 11:00AM - 11:10AM Room: S502AB

Participants
Raluca G. Chelu, MD, Rotterdam, Netherlands (Presenter) Nothing to Disclose
Shreyas S. Vasanawala, MD, PhD, Stanford, CA (Abstract Co-Author) Research collaboration, General Electric Company; Consultant, Arterys Inc; Research Grant, Bayer AG;
Adriaan Coenen, MD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Gabriel P. Krestin, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Research Grant, General Electric Company; Research Grant, Bayer AG; Research Grant, Siemens AG; Consultant, Bracco Group; Scientific Advisor, Zebra Medical Vision Ltd; Advisory Board, Quantib BV
Koen Nieman, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose
Albert Hsiao, MD, PhD, San Diego, CA (Abstract Co-Author) Founder, Arterys, Inc Consultant, Arterys, Inc Research Grant, General Electric Company

RESULTS
The other 6 cases had no clinical symptoms, did not show a high take-off of the RCA and medical management had been set.

The other 6 cases had no clinical symptoms, did not show a high take-off of the RCA and medical management had been set.

Surgical revascularization was performed with good results.

METHOD AND MATERIALS
With IRB-approval and HIPAA-compliance, we retrospectively identified patients referred for cardiac MRI including 4D flow for further evaluation of known ASD in 3 academic centers, as well as control subjects with matched body habitus and scanning parameters. Images were analyzed by a radiologist with 2 years of experience with cardiac 4D Flow. Three rendering techniques were compared, including (a) color speed overlay, (b) vector velocity overlay and (c) streamline rendering from the superior (SVC) and inferior vena cava (IVC), right (RUPV) and left upper pulmonary vein (LUPV). Streamline rendering was considered ‘positive’ when multiple streamlines were seen crossing into the contralateral ventricle during multiple diastolic phases.

RESULTS
We identified 18 patients known with ASD (4 males, mean age 45 yo) and 7 controls (6 males, mean age 34 yo) between May of 2014 and February of 2016. With color overlay, we visualized 14 of the 18 ASDs. With vector overlay, we visualized 15 of 18 ASDs, two of which showed bidirectionality. Streamline rendering was ‘positive’ from the SVC in 8 patients and all controls, from IVC in 7 patients and 4 controls, from RUPV in 9 patients and 2 controls and from LUPV in 11 patients and 1 control. Shunt fractions ranged from [1.1-2.25 mL/min] and correlated well with conventional phase-contrast MRI (r=0.9).

CONCLUSION
Multiple visualization strategies are possible with 4D Flow MRI for visualization of ASDs. Vector velocity overlay may help convey directionality that may not be readily apparent on color overlay visualization. Streamline rendering was more effective at differentiating interatrial left-to-right flow than right-to-left flow.

CLINICAL RELEVANCE/APPLICATION
Cardiac 4D Flow MRI may complement conventional cardiac MRI for visualization and quantification of interatrial flow in patients with ASD.

SSK03-05 Potential Role for FFRct in Guidance of Therapy of Malignant Right Coronary Anomalies: Proof of Concept
Wednesday, Nov. 30 11:10AM - 11:20AM Room: S502AB

Participants
Kristof De Smet, MD, MSc, Brussels, Belgium (Presenter) Nothing to Disclose
Jeroen Sonck, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose
Dries Belsack, MD, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose
Kaoru Tanaka, MD, PhD, Brussels, Belgium (Abstract Co-Author) Nothing to Disclose
Nico Buls, DSc, PhD, Jette, Belgium (Abstract Co-Author) Nothing to Disclose
Johan De Mey, Jette, Belgium (Abstract Co-Author) Nothing to Disclose

PURPOSE
Cardiac MRI is valuable for quantification of shunt fraction (Qp/Qs) in patients with atrial septal defects (ASD). However, ASD can be challenging to visualize with conventional cardiac MRI, especially when they are relatively small. We hypothesized that 4D Flow MRI may improve the visualization of small ASD, while providing comparable quantification of Qp/Qs.

METHOD AND MATERIALS
Anomalous right coronary artery arising from the left sinus of Valsalva and coursing between the aortic root and pulmonary trunk is seen in 0,2-0,5% of the population and is associated with increased risk of sudden cardiac death. The ACC/AHA 2008 guidelines for adults with congenital heart disease suggest surgical coronary revascularization for those patients with evidence of ischemia. FFRCT is a novel computational technique which shows very good correlation with FFR in the haemodynamic assessment of coronary arteries. We want to investigate the potential usefulness of FFRCT in evaluating ischemia in malignant right coronary artery anomalies.

METHOD AND MATERIALS
Retrospective, blinded FFRct analysis was carried out in 7 patients with CTA-reported malignant right coronary artery anomaly. Evaluation of the potential impact of clinical adoption of FFRct to guide surgical intervention was based on the ACC/AHA 2008 guidelines for adults with CHD.

RESULTS
FFRct analysis demonstrated ischemia in 1 of the seven cases with an FFRct-value of 0,73 in the distal RCA. This was a 45-year old female patient in excellent general condition who presented with a history of “exercise-induced chest pain”. CTA examination showed a typical high-take-off origin of the RCA from the left sinus of Valsalva. Surgical revascularization was performed with good result. The other 6 cases had no clinical symptoms, did not show a high take-off of the RCA and medical management had been set.

CONCLUSION
Shunt volumes and fractions were statistically compared between conventional phase-contrast and 4D Flow with Pearson correlation, Bland-Altman analysis and t-test.

CLINICAL RELEVANCE/APPLICATION
Cardiac 4D Flow MRI may improve the visualization of small ASD, while providing comparable quantification of Qp/Qs.
CONCLUSION
Utilization of FFRct analysis in the evaluation of patients with malignant right coronary anomalies is feasible and offers a one-stop-shop assessment of the anatomical and physiological aspects of this clinical entity. This technique could play an important role in clinical decision making and guidance of therapy (surgical revascularization or medical management) in patients with this congenital coronary anomaly.

CLINICAL RELEVANCE/APPLICATION
Utilization of FFRct analysis in the evaluation of patients with malignant right coronary anomalies is feasible and offers a one-stop-shop assessment of the anatomical and physiological aspects of this clinical entity, thereby potentially playing an important role in clinical decision making and guidance of therapy (surgical revascularization or medical management) in patients with this congenital coronary anomaly.

SSK03-06 Combined Anatomic and Functional CT Evaluation in Adult Congenital Heart Disease using High-Pitch Helical CTA/Low-Dose Function Protocol--An Approach for Dose Reduction While Maintaining Image Quality

Participants
Tust Techasith, MD, Stanford, CA (Presenter) Nothing to Disclose
Dominik Fleischmann, MD, Palo Alto, CA (Abstract Co-Author) Research support, Siemens AG;
Beverley M. Newman, MD, MBBCh, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Francis P. Chan, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Many congenital heart disease (CHD) patients have absolute contraindications to cardiac MR. Cardiac CT has good correlation with cardiac MR for ventricular function assessment and the ability to provide robust anatomic delineation of the complex CHD anatomy; however, its use has been limited by radiation dose. We evaluated a combined high-pitch helical (FLASH) CTA/low-dose function protocol for the evaluation of cardiac anatomy and function in adult CHD patients, in comparison to traditional ECG-modulated retrospective acquisition.

METHOD AND MATERIALS
A retrospective review of all adult CHD patients who underwent a CTA between May 1, 2014 and January 31, 2016 was performed, for the identification of patients who received anatomic and functional evaluation via a combined FLASH CTA/low-dose function (lowered reference mAs to 20% throughout) protocol. Demographics and technical parameters were recorded. Comparison of radiation dose and objective image quality (SNR & CNR) between the combined protocol and matched simulated controls (for traditional ECG-modulated retrospective acquisition) was performed.

RESULTS
Seventeen adult CHD patients underwent the combined FLASH CTA/low-dose function protocol. The radiation dose using the combined protocol was significantly less than the matched simulated controls for ECG-modulated retrospective acquisition, with effective dose of 4.74 vs. 6.66 mSv (p < 0.05). Image quality (SNR and CNR) of the combined protocol compared to the matched simulated controls at three locations (RV, LV, and IV septum) demonstrated no significant difference (all p-values > 0.05).

CONCLUSION
The combined FLASH CTA/low-dose function protocol is a clinically advantageous method compared to traditional ECG-modulated retrospective acquisition for the evaluation of anatomy and function in adult CHD patient who cannot undergo cardiac MR. The combined protocol is able to provide similar diagnostic image quality, while significantly reducing the effective radiation dose.

CLINICAL RELEVANCE/APPLICATION
Adult CHD is a growing patient population with a large portion of patients with implanted medical devices, making cardiac MR contraindicated. CTA is an alternative for the evaluation of cardiac anatomy and function in these patients. The combined FLASH CTA/low-dose function protocol provides diagnostic images at a reduced radiation dose compared to the traditional ECG-modulated retrospective protocol.

SSK03-07 Right Ventricle Function and Volumes Assessment in Congenital Heart Disease using CMR Compressed Sensing Real-time Cine Imaging

Participants
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PURPOSE
To evaluate the reliability of real-time cine imaging using the compressed sensing (CS) technique (Sparse 2D cine, Siemens Healthcare) for quantification of right ventricular (RV) function and volumes in congenital heart disease (CHD).

METHOD AND MATERIALS
32 consecutive patients (15 males, 17 females; mean age = 21 ± 7.5 years) were evaluated with cardiac magnetic resonance imaging.
**PURPOSE**

Cardiac Magnetic Resonance Quantification of Ventricular Volumes in Patients with Congenital Heart Disease: Three-dimensional Threshold-based Segmentation Versus Simplified Contouring

Wednesday, Nov. 30 11:40AM - 11:50AM Room: S502AB

**Participants**

Hyun Woo Goo, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose

**RESULT**

The mean acquisition time for the CS single-breath-hold sequence was 19.2 ± 3.5 seconds. The image quality of Group 2 was diagnostic in all examinations, mostly rated as good (n=25/32). There was a high correlation between Group 1 and Group 2 images regarding (a) the RVEF measured 49.6 ± 7.4% vs 47.9 ± 7.8% respectively (r=0.92); and (b) the RV end-diastolic volume indexed to body surface area measured 122.0 ± 30.9 ml/m2 vs 124.9 ± 33.6 ml/m2 respectively (r=0.97).

**CONCLUSION**

Compressed sensing real-time cine imaging enables, in one breath-hold, a reliable assessment of RV function and volumes in patients with CHD in comparison with standard SSFP cine imaging.

**CLINICAL RELEVANCE/APPLICATION**

As complex anatomy in CHD often requires extensive CMR examinations, use of CS cine can significantly reduce acquisition time without compromising RV assessment accuracy.

SSK03-08 Cardiac Magnetic Resonance Quantification of Ventricular Volumes in Patients with Congenital Heart Disease: Three-dimensional Threshold-based Segmentation Versus Simplified Contouring

Wednesday, Nov. 30 11:50AM - 12:00PM Room: S502AB

**RESULTS**

Higher correlations with flow volumes of the great arteries were observed in stroke volumes from simplified contouring than in those from 3D threshold-based segmentation for the left ventricle (LV) (r = 0.90 vs. 0.85) and the right ventricle (RV) (r = 0.90 vs. 0.77). Flow volumes of the ascending aorta showed no significant difference (mean difference = 0.02 ml, p = 0.98) with LV stroke volumes from 3D threshold-based segmentation but significant difference (mean difference = -8.7 ml, p < 0.001) with those from simplified contouring. In contrast, flow volumes of the pulmonary artery showed no significant difference (mean difference = 0.4 ml, p = 0.83) with RV stroke volumes from simplified contouring but significant difference (mean difference = 22.7 ml, p < 0.001) with those from 3D threshold-based segmentation.

**CONCLUSION**

Stroke volumes calculated from ventricular volumes were correlated with flow volumes of the great arteries.

**CLINICAL RELEVANCE/APPLICATION**

For ventricular volume quantification, 3D threshold-based segmentation using 3D whole heart MR angiography needs to be technically improved particularly in acquiring ED RV volume correctly.

SSK03-09 Left Ventricle Function Quantified with CMR 4D Flow

Wednesday, Nov. 30 11:50AM - 12:00PM Room: S502AB

**Participants**

Raluca G. Chelu, MD, Rotterdam, Netherlands (Presenter) Nothing to Disclose

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Koen Nieman, MD, PhD, Rotterdam, Netherlands (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare three-dimensional (3D) threshold-based segmentation using 3D whole heart MR angiography with simplified contouring using two-dimensional (2D) cardiac cine MRI in measuring ventricular volumes with flow volumes of the great arteries using phase contrast imaging as reference standard.

**METHOD AND MATERIALS**

In 110 patients with congenital heart disease (median age 18 years, age range 4 months–35 years; M:F=74:36), navigator-gated, contrast-enhanced, 3D whole heart MR angiography was acquired during end-systole (ES) and end-diastole (ED) as well as conventional cardiac cine imaging and phase contrast imaging of the great arteries. Cases showing mitral or tricuspid regurgitation greater than grade 1 (1 and 3D datasets, respectively) were excluded. ES and ED volumes were measured by using 3D threshold-based segmentation for 3D whole heart MR angiography and by using simplified contouring for 2D cardiac cine MRI. Stroke volumes calculated from ventricular volumes were correlated with flow volumes of the great arteries.

**RESULTS**

Stroke volumes calculated from ventricular volumes correlate well with flow volumes of the great arteries, slightly higher for 3D threshold-based segmentation. Simplified contouring may overestimate LV stroke volumes and 3D threshold-based segmentation may underestimate RV stroke volume.

**CLINICAL RELEVANCE/APPLICATION**

For ventricular volume quantification, 3D threshold-based segmentation using 3D whole heart MR angiography needs to be technically improved particularly in acquiring ED RV volume correctly.
Quantification of stroke volume is an integrative part of the work-up of patients with structural heart disease. Cardiac magnetic resonance is a robust and validated method for this quantification, but requires cooperation from the patient and special skills from the technician. The purpose of our study was to use the imaging technique “CMR 4D flow” to quantify the stroke volume of left ventricle and used the standard CMR technique as reference.

METHOD AND MATERIALS

Between 2014-2016 we have prospectively included 24 patients that had a clinical CMR and an extra 4D flow scan. The acquisition was performed using a 1.5T whole body scanner. Images for the standard CMR were reviewed by two radiologists with two and ten years of experience in CMR and the 4D flow images were reviewed by a radiologist with five years of CMR experience.

RESULTS

The mean age of the population was 31 years old and 5 were females. The mean stroke volume measured with 4D flow was 86 (+/- 14) ml/beat. The mean enddiastolic and endsystolic volumes were 161 (+/- 39) ml and 75 (+/-36) ml. When measured with standard CMR, the mean EDV was 171 (+/-40) ml, the mean ESV 79 (+/- 33) ml and the mean stroke volume 91 (+/-18) ml. The Pearson correlations were 0.93, 0.97 and 0.7 for end-diastolic, endsystolic and stroke volume respectively.

CONCLUSION

4D flow may be feasible for evaluating left ventricle function.

CLINICAL RELEVANCE/APPLICATION

CMR 4D flow may replace the standard CMR examinations in congenital patients.
**SSK04**

**Cardiac (General Topics I)**

Wednesday, Nov. 30 10:30AM - 12:00PM Room: S504AB

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

*FDA* Discussions may include off-label uses.

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**Participants**

Carole J. Dennie, MD, Ottawa, ON *(Moderator)* Nothing to Disclose  
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**Sub-Events**

**SSK04-01**  
**High Incidence of Renal Artery Stenosis in Post TAVI Acute Kidney Injury: Should Renal Artery Evaluation Become a Part of Pre TAVI Workup?**

**Participants**

Orly Goitein, MD, Ramat Gan, Israel *(Presenter)* Research Grant, Koninklijke Philips NV  
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Paul Fefer, Ramat Gan, Israel *(Abstract Co-Author)* Nothing to Disclose  
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Anat Berkovich, Ramat Gan, Israel *(Abstract Co-Author)* Nothing to Disclose  
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**PURPOSE**

Acute kidney injury (AKI) is a frequent complication after transcatheter aortic valve implantation (TAVI) affecting outcome and survival. The presence of atherosclerotic disease in the renal arteries might be related to post TAVI AKI, not previously addressed in this context. Objective: To quantify and correlate the presence and extent of RAS to post TAVI AKI.

**METHOD AND MATERIALS**

AKI was defined as Valve Academic Research Consortium -2 (VARC-2) score ≥ 1. Patients with AKI were matched to patients with baseline creatinine > 1.4 mg/dl (non AKI group). The presence and severity of RAS was measured using MDCT curved multiplanar reformats and graded as < 50% or ≥ 50% and > 75% in the renal artery ostium and proximal third (4 renal segments per patient).

**RESULTS**

AKI group (N=69; mean age 82 ± 6; 60% female, renal segments N=276). Non-AKI group (N=36; mean age 82 ± 7; 49% female, renal segments N=144). AKI group: RAS ≥ 50% and > 75% was seen in 27 and 15 segments, respectively. Non AKI group: RAS ≥ 50% and > 75% was seen in 3 and 2 segments, respectively (P=0.003, P=0.04).

**CONCLUSION**

There is a statistically significant higher rate of RAS in AKI as compared with non- AKI patients. This suggests that the presence and severity of RAS may be a risk factor for post TAVI AKI. Thus, we propose that renal artery evaluation should be an integral part in pre-TAVI workup. Further studies are needed in order to elucidate the role of RAS in AKI.

**CLINICAL RELEVANCE/APPLICATION**

Post TAVI AKI is a dreaded complication. RAS may play a role in its occurrence. Dedicated MDCT renal artery evaluation may identify patients predisposed for AKI.

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**SSK04-02**  
**CT Predictors of the Clinically Significant Moderate Coronary Stenosis**

**Participants**

Irina Timofeeva, MD,PhD, Saint-Denis, France *(Abstract Co-Author)* Nothing to Disclose  
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Philippe Guyon, MD,PhD, Saint-Denis, France *(Abstract Co-Author)* Nothing to Disclose

**PURPOSE**

To study CT predictors for the clinical significance of moderate coronary stenosis by coronary CT angiography (CCTA) in comparison with fractional flow reserve (FFR) studying by quantitative coronary angiography (QCA).

**METHOD AND MATERIALS**
A total of 87 patients underwent CCTA were retrospectively analyzed. 43 patients (61 lesions, group 1) with FFR assessment were studied by 256-MDCT one-beat axial acquisition, three-phase injection protocol by using smart shot dual injector. 44 patients (group 2) were examined by 64 MDCT only to compare dose and contrast volume changes. Moderate stenosis (50-69%) with FFR ≤0.8 were considered as clinically significant.

RESULTS

The average age was 67.9±10.1, BMI 27.3±4.4 kg/m² and 75% were males. No difference between coronary stenosis degree and length measured by CCTA and QCA (p>0.10 and p>0.94 respectively) were observed. There was a substantial significant difference demonstrated the prevalence of new acquisition mode of 256 MDCT in dose and contrast volume reduction. Thus, total exam dose reduction in 1st group was -73% (220±482 mGy-cm vs 815±493 mGy-cm, p<0.000) and the reduction of contrast volume of -38.6% ([57.5±2.3ml vs 110±40 ml, p<0.000]. 29% (18 arteries) from the 1st group have clinically significant moderate stenoses with FFR ≤0.8; 23% (n=14) have moderate but not clinically significant stenoses (FFR>0.80) and 48% (n=29) were presented by stenoses <50%. All of stenosis ≤50% were clinically insignificant with FFR>0.8 (p<0.05, 100% negative predictive value (NPV)). Moderate stenosis are more likely clinically significant with FFR≤0.8 if their length ≥16 mm (sensitivity (ss) 78%, specificity (sp) 79%, PPV 82%, NPV 73%, p=0.004); if they are presenting multiple stenosis in calcified arteries with the stenosis's length ≥16 mm (sp 86%, NPV 85%, p=0.012).

CONCLUSION

The CT predictors for clinical significance of moderate stenosis were the stenosis length more than 16 mm with multiple stenoses in calcified arteries.

CLINICAL RELEVANCE/APPLICATION

High reliability of CT predictors of clinical significance of moderate stenosis with a drastic radiation dose reduction, time and cost saving efficiency consider CTA as a new gold standard for the patient management.

SSK04-04 Associations between Renal Function, Urinary Albumin Excretion and Left Ventricular Mass and Function: A Population-based MR Imaging Study

Wednesday, Nov. 30 11:00AM - 11:10AM Room: S504AB

Awards

Trainee Research Prize - Resident

Participants
Ilona A. Dekkers, MD, MSc, Leiden, Netherlands (Presenter) Nothing to Disclose
Renée Deutsert, Leiden, Netherlands (Abstract Co-Author) Nothing to Disclose
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PURPOSE

Left ventricular (LV) hypertrophy and dysfunction is highly prevalent in advanced kidney disease and is an important predictor of cardiovascular morbidity and mortality. Our aim was to investigate associations between renal function (eGFR-EPI), urinary albumin excretion (UAEx), urinary albumin creatinine ratio (UACR), and LV mass, LV systolic and LV diastolic function in the general population.

METHOD AND MATERIALS

This study was approved by the institutional review board, and all participants gave informed consent. In this cross-sectional analysis of the Netherlands Epidemiology of Obesity Study a subset of 1,139 healthy participants (51% male, 97% Caucasians) underwent cardiac MR imaging to assess LV geometry, LV systolic and diastolic function. Linear regression analysis was performed while adjusting for age, sex, smoking, mean arterial pressure, total body fat and visceral adipose tissue.

RESULTS

Mean (SD) age was 56 (6) years, eGFR 85.9 (13) ml/min/1.73 m², median UAEx (IQR) 3.57 mg/L (1.77), median UACR (IQR) 0.42 (0.39) mg/mmol. Per SD of eGFR, LVMI increased with 0.115 g [95% ci: 0.02 to 0.21] and LVCI with 0.165 L/min/m² [0.07 to 0.26]. After adjustment for potential confounders these associations attenuated to 0.115 g [-0.00 to 0.23] for LVMI and 0.149 L/min/m² [0.00 to 0.32] for LVCI. eGFR was not associated with LVEF and E/A ratio. Per SD of log transformed UAEx, LVMI increased with 0.155 g [0.06 to 0.24] and for UACR with 0.149 L/min/m² [0.00 to 0.32]. After adjustment for potential confounders these associations attenuated to 0.149 g [95% ci: 0.02 to 0.21] and 0.139 L/min/m² [0.04 to 0.21] for LVMI and LVCI, respectively.

CONCLUSION

Even within a normal range, renal function and urinary albumin excretion are associated with LV mass and systolic function in the general population and may influence LV mass and function above and beyond known cardiovascular risk factors such as age, sex, blood pressure, smoking and BMI. These findings support the hypothesis that renal function influences cardiac remodelling in the general population.

CLINICAL RELEVANCE/APPLICATION
A Preliminary Study of Coronary CT Angiography within Single Cardiac Cycle in Patients with Atrial Fibrillation Using 256-Row Detector CT

Wednesday, Nov. 30 11:10AM - 11:20AM Room: S504AB

Participants
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Junfu Liang, Beijing, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the image quality and radiation dose of CCTA in single cardiac cycle using a 256-row detector CT in patients with atrial fibrillation (AF).

METHOD AND MATERIALS
Fifty-nine patients with persistent or paroxysmal AF during scan (33 men and 26 women; 62.2 ± 10.6 years; BMI, 25.8±3.5kg/m2) were enrolled. All the examinations were performed on a 256-row detector CT (Revolution CT, GE healthcare) in single cardiac cycle with 100 kV or 120 kV and 100-450 mA using kV Assist and Smart mA techniques. The patients were separated into group A (HR ≥75 bpm, n=31) or B (HR<75 bpm, n=28) according to the HR during acquisition and group I (≥50, n=23) or II (<50, n=36) according to HR variability. Each dataset was reconstructed at best phase. If necessary, snapshot freeze (SSF) reconstruction was used to reduce motion artifact. Two experienced radiologists, blinded to the ECG and reconstruction information, independently graded the images (1 = excellent, 2 = good, 3 = poor, 4 = insufficient). Subjective image quality scores and effective dose (ED) were calculated and compared.

RESULTS
The mean HR of 59 patients ranged between 28 and 222 bpm (86 ±26.9). On the patient-basis, the image qualities of 57 CT angiograms (96.6%) were high enough for diagnosis, 2 (3.4%) were considered nonevaluable. On the segment-basis, 748 of 761 coronary artery segments were diagnostically evaluable (98.3%). In 24 of 57 evaluable patients (42%), the SSF technique was applied and thus showed improved image quality (t=7.459, P<0.001). There was no statistical difference in image quality between group A and B (t=1.217, P>0.05), nor was there a difference with respect to the HR variability (t=0.486, P>0.05). The ED (mSv) was 3.06 ± 2.38 for general and 3.84±2.46, 2.26±2.18, 3.63±2.47, and 2.50±2.45 for group A, B, I and II, respectively. A statistically significant difference was revealed between group A and B (t=2.54,P<0.05), but there was no significant difference between group I and II (t=1.876,P>0.05).

CONCLUSION
The image quality of CCTA within single cardiac cycle at a considerably low radiation dose was satisfactory in most patients with AF.

CLINICAL RELEVANCE/APPLICATION
It has good feasibility in patients with AF for that single cardiac cycle scan and SSF technique can improve image quality and scan success rate at a considerably low radiation dose.

Magnetic Resonance Evaluation of Cardiac Thrombi and Masses by T1 and T2 Mapping

Wednesday, Nov. 30 11:20AM - 11:30AM Room: S504AB

Participants
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PURPOSE
To evaluate CMR T1 and T2 mapping sequences in patients with intracardiac thrombi and masses in order to assess T1 and T2 relaxometry usefulness and to allow better etiological diagnosis.

METHOD AND MATERIALS
This observational study of patients scheduled for routine cardiac MRI was performed from September 2014 to August 2015. All patients referred to our department for a 1.5T CMR were screened to participate. The native T1 (MOLLI) and T2 mapping images were obtained by the Siemens Tx-mapping WIP780 package before injection of Gadolinium.

RESULTS
41 patients were included, 22 presented with cardiac thrombi and 19 with cardiac masses. The native T1 of thrombi was 1037±152ms (vs 1032±39ms for myocardium, p=0.88; vs 1565±88ms for blood pool, p<0.0001). The post-gadolinium T1 relaxation time of thrombi was significantly higher than T1 of myocardium (731 ± 208 vs 339 ± 67 ms, p<0.0001) and as compared with blood pool T1 (222±52 ms, p<0.0001). Post contrast T1 decrease were respectively 29.5% (thrombus), 67.2% (myocardium) and 85.8% (blood pool). T2 were 74±13ms (vs 51±3ms for myocardium, p<0.0001 ; vs 170±32ms for blood pool, p<0.0001). Recent thrombi
had a native $T_1$ shorter than old thrombi ($911\pm 177$ vs $1169\pm 107$ ms, $p=0.01$). The types of masses were as follow: 2 myxomas, 2 papillary fibroelastomas, one hemangioma, one rhabdomyoma, 4 lipomas, 5 calcified masses, one lymphoma, and 3 metastases. The masses having a shorter $T_1$ than the myocardium were lipomas ($278\pm 429$ ms), calcifications ($621\pm 218$ ms), and melanoma ($736$ ms). These masses with a short $T_1$ could be distinguished by: (i) the post-gadolinium $T_1$, which did not decrease significantly for lipomas and calcifications (-1.5%) as compared to the melanoma (-59%) (ii) the value of $T_2$ : low for calcifications ($42\pm 7$ ms), intermediate for the melanoma ($58$ ms) and very high for lipomas ($111\pm 12$ ms). All other masses showed $T_1$ values higher than myocardial $T_1$, with $T_2$ consistently increased over $70$ ms. The high values of both $T_1$ ($1800$ ms) and $T_2$ ($180$ ms) of fibroelastomas should be emphasized.

**CONCLUSION**

$T_1$ and $T_2$ mapping CMR sequences can be useful and represent a new approach for the evaluation of cardiac thrombi and masses.

**CLINICAL RELEVANCE/APPLICATION**

To be able to quantify $T_1$ and $T_2$ values of cardiac masses seems to be very interesting in the seek for incremental discriminative diagnostic performance of CMR.

**SSK04-07 Multiyear Follow-up of Patients with Bicuspid or Tricuspid Aortic Valve, Assessing Aortic size and Hemodynamic Stress Using 4D Flow MRI**

**Wednesday, Nov. 30 11:30AM - 11:40AM Room: S504AB**

Participants

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James C. Carr, MD, Chicago, IL (Abstract Co-Author) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

**PURPOSE**

Monitoring the progression of aortopathy is crucial in patients with congenital aortic valve disease. Nonetheless, it is difficult to predict which patients may be at risk for aneurysm or dissection. Abnormal transvalvular blood flow, such as high velocity jets and eccentric hemodynamic wall shear stress (WSS) may detect those at risk of environmentally mediated aortopathy development. Accordingly, we studied the multiyear evolution of the transvalvular hemodynamics and regional aorta size in patients with either a bicuspid (BAV) or tricuspid (TAV) aortic valve using 4D flow MRI.

**METHOD AND MATERIALS**

A retrospective IRB approved and HIPAA compliant study was conducted on patients with BAV ($n=20$, age: $44\pm 12$ years) or TAV with dilation of the thoracic aorta ($n=20$, age: $69\pm 5$ years), and healthy controls ($n=5$, age: $60\pm 10$ years), who underwent two aortic 4D flow MRI exams (follow-up duration: $2.72\pm 0.63$ years for BAV; $1.65\pm 0.83$ years for TAV; $1.38\pm 0.47$ years for controls). Images were subsequently analyzed using custom software (Matlab, The Mathworks, USA), resulting in ascending aortic maximal velocity, WSS quantification and Contrast-Enhanced MRA was used to measure diameter. Furthermore, a regional WSS analysis was performed in 4 ascending aortic segments (Figure 1A). Two sided t-test was calculated for between group differences.

**RESULTS**

A significant increase in maximal velocity was found between baseline and follow-up exams in BAV patients ($P=0.012$) (Figure 1B, Figure 1C), but no significant change was observed in TAV patients ($P=0.17$) or controls ($P=0.40$). In addition, BAV patients had a significant decrease in aortic WSS at follow-up, while no change was obtained in TAV patients ($P=0.17$) or controls ($P=0.40$). Finally, the mid-ascending aorta significantly grew over time in BAV ($p<0.009$), as well as TAV patients ($p<0.02$), but remained insignificant in controls ($p<0.23$) (Figure-E).

**CONCLUSION**

We found a significant increase over time in aortic maximal velocity in both BAV and TAV patients. In addition, the aortic dilation in BAV patients was accompanied by a decrease in WSS, potentially illustrating a BAV-specific sensitivity to remodel in the presence of high velocity transvalvular jets and high WSS.

**CLINICAL RELEVANCE/APPLICATION**

The identification of factors associated with aortopathy in bicuspid aortic valve patients, including hemodynamics, is crucial to improve the ability to identify high-risk features associated with progression of aortopathy.

**SSK04-08 Apical Late Gadolinium Enhancement in Predicting Adverse Cardiac Events in Patients with Mid-Ventricular Hypertrophic Obstructive Cardiomyopathy**

**Wednesday, Nov. 30 11:40AM - 11:50AM Room: S504AB**

Participants

Lu Li, BA, Beijing, China (Presenter) Nothing to Disclose

Shihua Zhao, Beijing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Apical aneusysm has been considered a independent risk factor in hypertrophic cardiomyopathy (HCM). This subgroup also behave differently in pical late gadolinium enhancement (LGE). The purpose of our study is to investigate the role of apical LGE in predicting adverse cardiac events in Midventricular hypertrophic obstructive cardiomyopathy (MVHOCM) patients.
METHOD AND MATERIALS

A prospective study of 28 patients from Jan, 2008 to Mar, 2015 with MVHOCM who underwent MRI were followed up for 28.46±3.31 (range from 4 to 63) months, and were divided into apical LGE(+) group(14) and apical LGE(-) group(14). LGE scores were assessed according to the AHA 17-segment model, apical LGE was analyzed on the horizontal or vertical long axis of the left ventricle. There are 4 modes of adverse cardiac events (1) sudden cardiac death (SCD) (2) end-stage or burnt out HCM (meaning an ejection fraction <50% and dilated phenotype) or died due to HF; (3) stroke-related death; (4) potentially lethal arrhythmic incidents such as ventricular tachycardia or fibrillation, resuscitated cardiac arrest and appropriate implantable defibrillator (ICD) discharge.

RESULTS

The incidence of adverse cardiac events is higher in apical (+) group (57.14%[8/14]) compared with apical (-) group (7.14%[1/14], P=0.037). Significances between apical (+) and apical (-) group are found in LGE scores (11.71±1.22 vs 7.21±1.15, p=0.013), Left Ventricular End diastolic Volume Index (LVEDVI) (121.82±9.74 vs 90.60±7.50, p=0.017), Left Ventricular End systolic Volume Index (LVESVI) (52.04±6.28 vs 32.31±2.95, p=0.011). In logistic regression analysis, apical LGE is an independent determinant of adverse cardiac events (p=0.03), while LGE score is not an independent determinant (p=0.35).

CONCLUSION

Apical LGE shows unfavorable outcomes in MVHOCM patients, which is notable for attention in clinical practice.

CLINICAL RELEVANCE/APPLICATION

(Dealing with LGE) "Apical LGE can demonstrate unfavorable outcomes in MVHOCM patients thus is worthy to be considered in clinical strategy"

SSK04-09 Role of Surface Coils in the Evaluation of Myocardial Edema in Patients affected by Acute Myocardial Infarction (AMI) and Acute Myocarditis (AM)

METHOD AND MATERIALS

37 patients with diagnosis of AMI or with clinical suspicious of AM (average age 51±14.1) underwent a cardiac magnetic resonance (CMR) using a 1.5 T scanner (Magnetom Avanto; Siemens) equipped with high gradient system (32 channels body coil and surface coils). T2-STIR sequences were acquired in short axis planes using body coil and both body and surface coils. Quality and quantity analysis were done comparing T2-STIR values, CNR and SNR obtained using body coils and both body coils and surface coils. All values were compared with native T1. Statistical analysis was done using t test and p values were considered significant with p<0.005.

RESULTS

21(57%) patients with AMI (group A) and 16(43%) patients with suspicious of AM (group B) were evaluated. T2-STIR values of SI obtained using body coil and using both body and surface coils resulted in group A of 244.28±28.74 vs 191.65±17.12, in group B of 201.44±59.31 (p<0.0001). SNR and CNR were in group A of 107 vs 8.7 and 48.7 vs 3; in group B of 66.7 vs 7.8 and 26.7 vs 1.5 (p<0.0001). Native T1 mapping values measure in both groups confirmed the presence of edema (group A of 1101.38±72.14; group B of 1087.2±70.82 (p<0.0001).

CONCLUSION

Surface coils coupled with body coils enable a better detection of myocardial edema in AMI and in suspicious myocarditis.

CLINICAL RELEVANCE/APPLICATION

The use of surface coils coupled with body coils allow to obtain images with high SNR and CNR compared to images obtained using only body coil. In this way it is possible a better detection and quantification of myocardial edema in patients affected by AMI and in cases with suspicious myocarditis.
Cardiac Wednesday Poster Discussions

Wednesday, Nov. 30 12:15PM - 12:45PM Room: CA Community, Learning Center

CA AMAPRA Category 1 Credit™: .50

Participants
Scott R. Akers, MD, PhD, Philadelphia, PA (Moderator) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (Moderator) Consultant, Guerbet SA

Sub-Events

CA238-SD-WEA1 The Influence of Iterative Model Reconstruction on Coronary Artery Calcium Scoring - Phantom and Clinical Study

Station #1

Participants
Seitaro Oda, MD, Kumamoto, Japan (Presenter) Nothing to Disclose
Daisuke Utsunomiya, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Takeshi Nakaura, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Yoshinori Funahara, PhD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Hideaki Yuki, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
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Kenichiro Hirata, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Narumi Taguchi, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Hiroko Takaoka, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Shinichi Tokuyasu, RT, Minato-ku, Japan (Abstract Co-Author) Employee, Koninklijke Philips NV
Yasuyuki Yamashita, MD, Kumamoto, Japan (Abstract Co-Author) Consultant, DAIICHI SANKYO Group

PURPOSE
The purpose of this study was to investigate the influence of iterative model reconstruction (IMR) on coronary artery calcium (CAC) scoring as compared to the filtered back projection (FBP) and hybrid iterative reconstruction (HIR).

METHOD AND MATERIALS
CAC scan images of 30 consecutive patients (18 men and 12 women; age 70.1±12.2 years) were reconstructed with FBP, HIR, and IMR. Image noise were measured for all reconstructions. Two radiologists independently measured the CAC scores (Agaston score) using semi-automated software. Interobserver agreement was evaluated. Statistical analysis included the Spearman correlation coefficient and Bland-Altman analysis.

RESULTS
The mean image noise of FBP-, HIR-, and IMR images was 48.0±7.9 HU, 29.6±4.8 HU, and 9.3±1.3 HU, respectively; there was a significant difference among all comparison combinations for the three reconstructions (p<0.01). The CAC score decreased by 4.2 % in HIR and 8.9 % in IMR as compared to FBP. There was no significant difference in the mean CAC score among the three reconstructions. For all three reconstructions the interobserver correlations were excellent [r2=0.96 (FBP), 0.99 (HIR), 0.99 (IMR)]. Interobserver comparisons showed that the best Bland-Altman measure of agreement was with IMR, followed by HIR and FBP.

CONCLUSION
For the CAC scoring, IMR can reduce the image noise and blooming artifacts, consequently reduces the measured CAC score. IMR can lessen measurement variability and enable stable and reproducible measurement.

CLINICAL RELEVANCE/APPLICATION
IMR can lessen measurement variability and enable stable and reproducible measurement even in low dose setting. This may beneficial for comparison of CAC scores for follow-up observations.

CA239-SD-WEA2 Optimal Scan Timing for 320-row Coronary Computed Tomography Angiography (CCTA) Generated by the Time to Peak at the Ascending Aorta Using a Test-bolus Injection

Station #2

Participants
Takashi Shirasaka, BS, Fukuoka, Japan (Presenter) Nothing to Disclose
Michinobu Nagao, MD, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Satoshi Kawanami, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Yamato Shimomiya, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Yasuhiro Nakamura, RT, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
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Tsukasa Kojima, RT, MSc, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Yuzo Yamagishi, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose
Takeshi Kamitani, MD, Fukuoka, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
The time around the aortic peak enhancement on coronary computed tomography angiography (CCTA) can be predicted by using the test-bolus method. However, the actual scan timing at CCTA requires some adjustment from the peak time obtained by the test bolus, due to the long injection duration of the contrast medium (CM). The actual scan timing with aortic peak attenuation is
thus sometimes missed in the CM protocol according to Bae’s theory. In the present study we propose a new index using a time-density curve (TDC) of the ascending aorta (AAo) based on test-bolus data, to obtain the optimal scan timing for 320-row CCTA.

**METHOD AND MATERIALS**

Ninety-four consecutive patients with known or suspected coronary artery disease who underwent 320-row CCTA between August 2015 and March 2016 were enrolled. After a test-bolus injection of 25.9 mgI/kg/s of nonionic CM at a fixed duration of 4.0 s, the actual CCTA scan with 25.9 mgI/kg/s of nonionic CM at a fixed duration of 10.0 s followed by saline flushing was performed. For the initial 64 patients, the scan timing was determined as a 3.0 s delay at the peak time in the TDC of the AAo from the test bolus. For next 30 patients, three delay times (1.0, 3.0, and 5.0 s) were determined by the interval from the CM arrival to peak time (AP time) in the TDC of the AAo. In the actual CCTA, the attenuation for the AAo, descending aorta (DAO), left atrium (LA) and left ventricle (LV) was measured. The patients were divided into LA/LV, AAo, and DAO groups by the site at which the maximum attenuation among the three sites was observed. The AAo group was identified as optimal. The LA/LV and DAO groups were identified as suboptimal. The prevalence of optimal scans was analyzed by chi-squared test.

**RESULTS**

Among the initial 64 patients, 41 patients (64%) were classified as belonging to the AAo group. Among the next 30 patients, 27 patients (90%) were in the AAo group. The prevalence of optimal scans was significantly increased in this group of 30 patients (P=0.0068).

**CONCLUSION**

Optimal scan timing for 320-row CCTA is achieved by the corrected delay time obtained from the AP time in the time-density curve of the ascending aorta at a test bolus.

**CLINICAL RELEVANCE/APPLICATION**

The determination of the scan timing generated by the AP time is not influenced by the cardiac output of individual patients. Optimal scan timing can reduce the amount of contrast medium required.

### CA240-SD-WEA3 Evaluation of a High Contrast Injection Protocol in Combination with Low Tube Current for Dose Reduction in Coronary Computed Tomography Angiography: A Randomized, Single Centre, Prospective Study

**Station #3**

**Participants**

Yibo Sun, Shanghai, China (Presenter) Nothing to Disclose
Yangqiu Hu, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Mingpeng Wang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Dingbiao Mao, shanghai, China (Abstract Co-Author) Nothing to Disclose
Kailei Shi, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Jianhua Guo, shanghai, China (Abstract Co-Author) Nothing to Disclose
Xiu Jin, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To prospectively evaluate the radiation dose reduction potential and image quality of a high contrast injection protocol in combination with a low tube current (mAs) in coronary computed tomography angiography (CCTA).

**METHOD AND MATERIALS**

Eighty-one consecutive patients (mean age 62 years; 34 female; BMI 18-31) were included and were randomized assigned into two groups. All CT examinations were performed with the same tube voltage (100 kV), flow rate of contrast medium (CM) (5.0 mL/s) and iodine dose (22.8 g). The protocol entailed an automatic mAs and low concentration CM (300 mgI/mL) for group A (n = 41), whereas effective mAs was reduced by a factor 0.6 in group B (n = 40) which used high concentration CM (400 mgI/mL). Applied radiation dose was assessed (CTDIvol and DLP), overall and per vessel based objective image quality was measured for various regions of interest (enhancement, noise, signal-to-noise ratio [SNR] and contrast-to-noise-ratio [CNR]), and subjective image quality was evaluated with a five-point Likert scale.

**RESULTS**

The CT attenuation of coronary arteries in group B were significantly higher (ranges; 507.5-548.1 HU) than those in group A (407.5-444.5 HU), as well as overall image noise (20.0 ± 7.0 vs. 16.1 ± 5.3), respectively ("P" \(\leq 0.0166\)). The SNR, CNR and subjective image quality of coronary arteries revealed no significant differences between the two groups (29.4-31.7, 21.9-24.7, medium score 5 vs. 29.4-32.4, 24.3-26.5, medium score 5, respectively, "P" \(\geq 0.695\)). The mean CTDIvol, DLP and effective radiation dose of group B were both 58% of those of group A (13.6 ± 0.9, 187.5 ± 54.4 and 2.6 ± 0.8 vs. 23.5 ± 6.2, 324.0 ± 86.2 and 4.5 ± 1.2, respectively, "P" \(< 0.0001\)).

**CONCLUSION**

The protocol with a high concentrated CM combined with low tube current permits further dose reduction in CCTA and does not compromise image quality.

**CLINICAL RELEVANCE/APPLICATION**

The protocol with a high concentrated CM combined with low tube current permits further dose reduction in CCTA and does not compromise image quality.

### CA242-SD-WEA5 Segmental Agreement of T2 Mapping and Triple Inversion Recovery Sequences in Assessment of Myocardial Edema

**Station #5**

**Participants**
Ahmed E. Kharabish, MD, MSc, Aswan, Egypt (Presenter) Nothing to Disclose

PURPOSE
To evaluate the agreement of the T2 mapping and the triple inversion recovery sequences (TRIM) per myocardial segments in patients presenting with acute myocardial infarction.

METHOD AND MATERIALS
Twenty-eight patients presented with acute myocardial infarction underwent primary percutaneous revascularization were sent to cardiac magnetic resonance (CMR) in order to assess their myocardial salvage index (MSI). All CMR studies were scanned using the routine protocol of cine, TRIM and late gadolinium enhancement (LGE) in short axis views covering the whole left ventricle (LV). In addition, T2 mapping slices were added in short axis views. Position of the T2 mapping slices were copied from the TRIM in order to copy same orientation and thickness. The LV was divided into apical, mid and basal segments according to visualization of the papillary muscles. Edema mass was assessed separately in each segment using both the TRIM and T2 mapping. Total amount of edema from both sequences was compared as well as the agreement of the amount of edema measured per segment was tested.

RESULTS
No statistical significance was found neither in the total amount of edema nor the amount of edema measured per each segment. The non-parametric tests due to abnormal distribution of the standard deviation of both sequences, showed no statistically significant difference between the total amount of edema, basal segments’ edema, mid segments’ edema, and apical segments’ edema (0.409, 0.36, 0.106, and 0.84 respectively).

CONCLUSION
Quantitative T2 mapping reliably measures myocardial edema, and may therefore be clinically more robust in measuring the edema amount in acute myocardial conditions.

CLINICAL RELEVANCE/APPLICATION
T2 mapping overcomes the following TRIM limitations, through providing direct segmental edema assessment: Edema in culprit coronary disease is measured in comparison to the remote non affected myocardium using the TRIM sequence. Involvement of multi-vessel territory may give false results. Edema may be assessed in inflammatory conditions using TRIM as a signal ratio to skeletal muscle signals. False negative ratio may be obtained due to skeletal muscle involvement.

CA243-SD-WEA6 Reproducibility of Cardiac Cine MRI for Sequential Assessment of Right Ventricular Volumes and Ejection Fraction: Short-axis vs. Transverse Cine SSFP

Station #6

Awards
Student Travel Stipend Award

Participants
Luigia D’Errico, MD, Toronto, ON (Presenter) Nothing to Disclose
Mariana M. Lamacie, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Laura Jimenez-Juan, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Djeven P. Deva, MBBS, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Rachel Wald, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Sebastian Ley, MD, Heidelberg, Germany (Abstract Co-Author) Nothing to Disclose
Kate Hanneman, MD, FRCPC, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Dinesh Thavendiranathan, MD, Toronto, ON (Abstract Co-Author) Nothing to Disclose
Bernd J. Wintersperger, MD, Toronto, ON (Abstract Co-Author) Speakers Bureau, Siemens AG; Research support, Siemens AG

PURPOSE
Inter-study reproducibility is of utmost importance in follow-up of right ventricular (RV) volumes and function. The purpose was therefore to evaluate and compare inter-study reproducibility and intra-/inter-observer variability of right ventricular (RV) volumes and function with short-axis and transverse cardiac MRI cine SSFP.

METHOD AND MATERIALS
18 volunteers underwent cardiac MRI for RV assessment using cine SSFP (6mm/2mm, 1.4x1.4mm2) obtaining ventricular coverage in both, short-axis and transverse slice orientation. For comparison, free-breathing 2D phase contrast analysis at the main pulmonary artery (MPA) was performed (5mm, 1.6x1.6mm2). Repeat acquisitions were performed after a 5min break with complete repositioning of subjects. Data sets were contoured independently by two blinded observers. Statistical analysis included Student’s t-test, Bland-Altman plots, intra-class correlation coefficient (ICC) and 2-way ANOVA, SEM and minimal detectable difference calculations.

RESULTS
There was no significant difference in HR (65.0±7.4 vs. 67.6±9.9bpm; P=0.1) or MPA forward flow (92.2±18.9 vs. 87.2±14.9mL; P=0.1) between studies. EDV and ESV demonstrated a bias of 0.4% [-9.5%,10%] and 2.1% [-12%,16%], respectively for short-axis and a bias of 1.1% [-7.3%,9.4%] and 0.8% [-16%,18%], respectively, for transverse orientation. There was no significant interaction between imaging orientation and inter-study reproducibility (P=0.395-0.824), intra-observer variability (P=0.726-0.862) or inter-observer variability (P=0.447-0.706) by 2-way ANOVA. Inter-observer agreement by ICC was greater for short axis versus transverse orientation for all parameters with overlapping confidence intervals (0.769-0.986 vs. 0.625-0.983, respectively). Minimal detectable differences for short axis and transverse orientations were 10.1mL vs. 11.5mL for EDV, and 4.1 vs. 4.7% for EF, respectively.

CONCLUSION
Both, short-axis and transverse orientations provide reliable and reproducible measures of RV volumes and function. Therefore, transverse cine SSFP is not required for quantitative RV assessment which could improve workflow by limiting acquisition to short-axis cine SSFP for bi-ventricular analysis.
**CA244-SD-WEA7**  
**Isolated Partial Anomalous Pulmonary Venous Connection: Is it Really a ‘Tension’ Free Diagnosis? Cardiologist Needs to get Hyper**

*Station #7*

**Participants**
Madhav Hegde, MD, Bangalore, India (*Presenter*) Nothing to Disclose  
Ganesh Hegde, MBBS, DMRD, Hyderabad, India (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**
To test the hypothesis that isolated PAPVC involving vein draining single lobe of lung parenchyma is not a risk factor for development of pulmonary hypertension. To test the hypothesis that number of pulmonary lobe segments involved in anomalous drainage does not determine the age of manifestation of PAPVC.

**METHOD AND MATERIALS**
MDCT report database of a large tertiary care centre for cardiovascular diseases was analysed for consecutive cases of PAPVC. 122 cases of PAPVC were identified. However 12 of these patients were excluded from the study. Studies of 110 patients obtained over a period of 4 years were retrospectively analysed. All these patients had undergone detailed clinical evaluation, standard ECG, and a detailed two dimensional and Doppler echocardiography before the MDCT angiogram. Retrospective gating with ECG was used whenever deemed fit. Percentage analysis was performed in Microsoft Excel and chi squared test of association was performed using MedCalc software. Categorical variables were analysed using one variable - one way classification chi squared test.

**RESULTS**
Among the 110 subjects 54 (49%) had isolated PAPVC. Out of 54, 14 patients had pulmonary hypertension, dilated main pulmonary artery. Among these 14, in 4 cases only one pulmonary vein was involved, in 6 cases 2 pulmonary veins were involved. The remaining 4 cases had 3 anomalous pulmonary veins. Among the 110 patients, 70 patients (63.6%) are more than 18 years of age. There is significant association between drainage of anomalous veins to SVC and age above 18yrs (Chi squared test p value: .003). Among individuals with isolated PAPVC, in 18 anomalous drainage was to SVC. Among isolated PAPVC cases 38 were of the age more than 18 years. Two were infants. Among the 38 adults who had isolated PAPVC, 14 had pulmonary hypertension. Among all the individuals who had PAPVC, 6 subjects presented in infancy and two of these did not have any associated abnormality. Two individuals developed symptoms at the age of 17 years.

**CONCLUSION**
Isolated PAPVC (including anomaly involving single lobe) an independent risk factor for the development of pulmonary hypertension. Number of pulmonary veins involved has a moderate association with the age of manifestation.

**CLINICAL RELEVANCE/APPLICATION**
PAPVC being an independent risk factor needs to be ruled out using MDCT or MR before ASD closure is contemplated to prevent the development of pulmonary hypertension if found should be treated.

**CA135-ED-WEA8**  
**Fibrous Skeleton of the Heart: Comprehensive Anatomical Overview and Evaluation of Pathologies Using Cardiac CT and MR**

*Station #8*

**Awards**
Cum Laude  
Identified for Radiographics

**Participants**
Farhood Saremi, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose  
Cameron Hassani, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose  
Diane Spicer, Valrico, FL (*Abstract Co-Author*) Nothing to Disclose  
Shumpei Mori, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose  
Damian Sanchez-Quintana, MD, Badajoz, Spain (*Abstract Co-Author*) Nothing to Disclose  
Robert Anderson, MD, Newcastle, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**
The purpose of this exhibit is: 1. Review the relevant anatomy of the structures forming the fibrous skeleton of the heart. 2. Review characteristic imaging findings of common and uncommon diseases involving this region.

**TABLE OF CONTENTS/OUTLINE**
Normal embryology and anatomy of the fibrous skeleton of the heart  
Development  
Imaging characteristics of the septal components of the AV Junction  
Aorto-ventricular membrane concept  
Arterial valve fibrous elements and differences as shown by imaging with cadaveric correlation  
Right and left fibrous trigones  
Membranous septum  
Tendon of Todaro  
Tendon of the infundibulum? Difference in anatomic characteristics of the mitral and tricuspid annuluses  
Relationship to the major vessels and normal conduction pathways  
Abnormalities of the fibrous skeleton of the heart  
Degenerative changes  
Aging  
calcification and clinical significance  
Infection, para- and peri-valvular fistula and abscess  
Ischemia and trauma  
Masses and infiltrative processes
The Assessment of Aortic Flow Hemodynamics and Wall Shear Stress in Patients with Varying Aortic Valve Morphologies

Hardcopy Backboard

Participants
Ozair A. Rahman, MD, Chicago, IL (Presenter) Nothing to Disclose
Faysal Altahawi, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Bradley D. Allen, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Alex Barker, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (Abstract Co-Author) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;
Jeremy D. Collins, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
James C. Carr, MD, Chicago, IL (Abstract Co-Author) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
Patrick L. McCarthy, MD, Lisle, IL (Abstract Co-Author) Nothing to Disclose
Kenichiro Suwa, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is to: Review the developmental variants of the aortic valve and associated pathology. Describe the association of aortic valve variants with aortopathy. Describe a potential clinical role of 4D flow imaging as it applies to diagnostic assessment of aortic valve variants and associated disease states. Compare traditional cardiac MRI and 2D phase contrast with 4D flow quantitative and qualitative findings in aortic valve disease variants via a case based approach.

TABLE OF CONTENTS/OUTLINE
Table of Contents: Aortic valve variants and associated pathology Diagnostic assessment of the aortic valve morphology and classification schema Role of CT, echocardiography, Cardiac MRI alone, & Cardiac MRI with 4D flow MRI 4D flow MRI Different processing tools in 4D flow imaging Clinically applicable information derived from 4D flow MRI data Recent technical advances in 4D flow MRI Assessment of valvular and aortic flow patterns in patients with malformed aortic valves Qualitative and Quantitative evaluation complex flow hemodynamics Future directions Novel tools available for quantitative analysis of 4D flow MRI data. Potential utility of 4D flow MRI for risk stratifying patients with aortic valve disease

Congenital Anomalies of the Pulmonary Arteries: An Imaging Overview

Station #9

Participants
Jason B. Hobbs, MD, Aurora, CO (Presenter) Nothing to Disclose
Lorna Browne, MD, FRCR, Aurora, CO (Abstract Co-Author) Nothing to Disclose
Daniel Ocazionez, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Daniel Vargas, MD, Denver, CO (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. Review the clinical and imaging findings in patients with congenital anomalies of the pulmonary arteries. 2. Discuss the role of various imaging modalities in the evaluation of these patients. 3. Describe the imaging findings related to surgical and interventional procedures performed for managing these patients.

TABLE OF CONTENTS/OUTLINE
Proximal interrruption of the pulmonary artery Pulmonary atresia with VSD Pulmonary atresia with intact septum Absent pulmonary valve Congenital pulmonic stenosis Quadricuspid and bicuspid pulmonary valve Pulmonary sling Pulmonary branch stenosis

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

Carlos S. Restrepo, MD - 2012 Honored Educator
Carlos S. Restrepo, MD - 2014 Honored Educator
Cardiac Wednesday Poster Discussions

Wednesday, Nov. 30 12:45PM - 1:15PM Room: CA Community, Learning Center

AMAPRA Category 1 Credit ™: .50
FDA Discussions may include off-label uses.

Purposes

Identification and Assessment of Cardiac Amyloidosis by Myocardial Strain Analysis of Tagged Magnetic Resonance Imaging

Station #1

Participants
Scott R. Akers, MD, PhD, Philadelphia, PA (Moderator) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (Moderator) Consultant, Guerbet SA

Sub-Events

CA245-SDWEB1 Identification and Assessment of Cardiac Amyloidosis by Myocardial Strain Analysis of Tagged Magnetic Resonance Imaging

PURPOSE
Myocardial strain analysis by cardiac magnetic resonance (CMR) facilitate the noninvasive measurement regional myocardial function, and the early identification of contractile dysfunction. This study sought to explore the potential role of myocardial strain analysis by CMR for the identification of cardiac amyloidosis.

METHOD AND MATERIALS
Thirty five systemic amyloidosis patients (23 men and 12 women, age 56.5±16.5 years) underwent 3.0T CMR including tagged MR and late gadolinium enhancement (LGE) imaging. Their circumferential strain (CS) was measured using mid-ventricular short-axis images and compared between LGE-positive- and LGE-negative patients.

RESULTS
There were 29 LGE-positive- and 6 LGE-negative patients with systemic amyloidosis. The peak CS was significantly lower in LGE-positive amyloidosis patients compared to LGE-negative patients (-9.4±2.5 % vs. -12.7±1.5 %, p<0.01). The CS peak time was significantly prolonged in LGE-positive- than LGE-negative amyloidosis patients (422.7±121.8 ms vs. 355.6±43.1 ms, p=0.02). The Δ peak time was significantly longer in LGE-positive- than LGE-negative patients (79.2±49.2 ms vs. 17.2±26.6 ms, p<0.01).

CONCLUSION
Myocardial strain analysis by CMR helps to detect LGE-positive cardiac amyloidosis considered to have a poor prognosis without contrast material.

Clinical Relevance/Application
Myocardial strain analysis by CMR may be useful for the identification of cardiac amyloidosis and does not require gadolinium-based contrast material.

Accuracy of Iodine Density Image Using Single Source Dual-energy CT in the Assessment of Myocardial Infarction

Station #2

Participants
Shinichiro Kitao, Yonago, Japan (Presenter) Nothing to Disclose
Yasutoshi Ohta, MD, Yonago, Japan (Abstract Co-Author) Nothing to Disclose
Junichi Kishimoto, Yonago, Japan (Abstract Co-Author) Nothing to Disclose
Natsuko Mukai, MD, Yonago, Japan (Abstract Co-Author) Nothing to Disclose
Tomomi Watanabe, MD, Yonago, Japan (Abstract Co-Author) Nothing to Disclose
Kazuo Yamaamoto, Yonago, Japan (Abstract Co-Author) Nothing to Disclose
Toshihide Ogawa, MD, Yonago, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
To clarify the usefulness of iodine density image (IDI) using single source dual-energy CT (ssDECT) for qualitative and quantitative analysis in myocardial infarction.

METHOD AND MATERIALS
Both late iodine enhancement (LIE) and late gadolinium enhancement (LGE) images were obtained in 17 patients with myocardial
infarction in the study. LIE image was acquired using rapid-kV switching ssDECT. IDI and virtual monochromatic image (VMI) of 40 to 140keV were used as evaluating image sets. On LIE images, the presence of infarction was evaluated and extent of transmurality was graded using a 5-point scale by two experienced radiologists blinded to other clinical information. The LGE images were used as reference standard. Kappa coefficient for the concordance rate of transmurality was also calculated. Infarct myocardium volume and percentage of infarct myocardium for each patient were measured and compared with those of LGE image using linear regression analysis.

RESULTS
Myocardial infarction was identified in 89 of 272 segments. Any infarct was identified on 40 to 70keV VMI and IDI. No infarct was identified on 80 to 140keV VMI. The IDI demonstrated the best contrast-to-noise ratio (CNR) of 8.74±3.79 among the evaluating image sets (P < 0.001). The IDI achieved the best diagnostic performance (sensitivity 84.27%, specificity 100%, positive predictive value 100%, negative predictive value 92.89%, accuracy 94.85%, and area under the curve 0.921). Additionally, the IDI demonstrated the highest concordance rate of transmurality (κ=0.759) among the image sets. Both infarct myocardium volume and percentage of infarct myocardium on IDI showed the best correlation to LGE (r=0.865, 0.902, respectively, P < 0.001) among the image sets.

CONCLUSION
The IDI using ssDECT is best to visualize infarct myocardium and enables accurate measuring of infarct myocardium.

CLINICAL RELEVANCE/APPLICATION
IDI derived from ssDECT enables to evaluate accurately the transmurality and percentage of infarct myocardium as well as MRI.

CA233-SD- WEB3
Contrast Material Injection Protocols at Coronary CT Angiography with Short Injection Duration Can Yield Sufficient Arterial Enhancement in Wide Range of Cardiac Output Value: Computer Simulation Study

Station #3

Participants
Toru Higaki, PhD, Hiroshima, Japan (Presenter) Nothing to Disclose
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PURPOSE
Arterial peak enhancement (APE) on contrast-enhanced CT (CECT) images is thought to be higher and longer in patients with low cardiac output (CO). Under the hypothesis that the relationship between CO and APE is affected by the duration of contrast material (CM) injection we performed computer simulations to investigate the relationship between CO on APE by using protocols with different injection durations.

METHOD AND MATERIALS
We developed computer simulation software for contrast enhancement of various organs and vessels based on the Bae pharmacokinetics model [Bae et al., Radiology, 98]. We also implemented models for CM transmission within organs, for the diffusion of CM in blood plasma based on the osmotic pressure, and for the pulsatile flow. We confirmed the clinical validity of our software by comparing our computer data with data obtained in 136 patients undergoing test bolus for cardiac CT angiography. We simulated contrast enhancement of the ascending aorta at coronary CT angiography for a subject 166-cm tall and weighing 65 kg. The simulated injection protocols were: CM dose 40 ml, CM iodine concentration 350 mgI/ml, osmotic pressure 590 mOsm/kgH2O, injection duration 8-, 10-, 12-, 14-, 16-, 18-, and 20 sec. The simulated CO range was 0 to 10.0 L/min. We calculated simulated arrival time (sAT) of CM to the aortic aorta, peak enhancement time (sPT) time of the CM, Peak CT number (sPCT#) under different injection duration.

RESULTS
In validation study, difference between sST and actual mean AT, sPT and actual mean PT, sPCT# and actual mean CT# were less than standard deviation of each actual parameter. Percent errors between sST and actual mean AT, sPT and actual mean PT, sPCT# and actual mean CT# were 12%, 8.5%, and 2%, respectively. In the simulation study, when the injection duration was 8 or 10 sec, SAE was larger than 400 HU at CO ranging from 1.0 - 9.0 L/min. On the other hand, the injection duration was 18 or 20 sec, SAE was larger than 400 HU at CO ranging from 1.0 - 4.1 L/min.

CONCLUSION
Our software could accurately simulate arterial enhancement. In the simulation of arterial enhancement, shorter injection duration (8, 10 sec) could yield sufficient enhancement (400 HU) at cardiac outputs ranging from 1.0 - 9.0 L/min.

CLINICAL RELEVANCE/APPLICATION
CM injection durations of 8 or 10 sec can yield sufficient arterial peak enhancement at wide range of patient cardiac output.

CA248-SD- WEB4
Diagnostic Value of Quantitative Myocardial T1- and T2- Mapping in Patients with Biopsy Proven Sarcomiosis

Station #4

Participants
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Cardiac involvement of sarcoidosis hallmarkmed by myocardial inflammation and subsequent myocardial fibrosis is a life threatening condition that makes early diagnosis necessary. Native T1- as well as T2-mapping have been proposed as reliable methods to non-invasively assess diffuse myocardial fibrosis and edema respectively. Our aim was to investigate the value of both methods for the assessment of myocardial involvement in sarcoidosis.

**METHOD AND MATERIALS**

Patients with biopsy proven extracardiac sarcoidosis who previously underwent a CMR examination were included in this study. The CMR examination comprised a clinically routine CMR-protocol with additional T1- and T2-mapping in midventricular short axis (SA) slice. T1-mapping was performed using Modified Look-Locker Inversion Recovery Imaging (3-3-5 MOLLI). T1-relaxation times were quantified within the septal myocardium (CONSEPT-approach). For T2 mapping an optimized 6-echo gradient spin echo (GraSE) sequence was used measured T2 relaxation times within the whole SA slice. Cardiac involvement was diagnosed if at least one of the following pathologies occurred: pathological relative enhancement,LGE,myocardial edema. According to CMR results patients were divided into 4 groups: group 1: positive findings in both exams, group 2: positive findings only in the initial exam; group 3: sarcoidosis but inconspicuous initial CMR exam, group 4: control group of healthy age matched volunteers.

**RESULTS**

T1 relaxation times were significantly longer in patients with positive CMR findings in both the initial examination and the follow-up scan (group 1) in comparison to all other groups (p<0.05). However no significant difference in T1 relaxation time could be revealed in patients with history of cardiac involvement of sarcoidosis (group 2) as well as patients with sarcoidosis but no CMR findings (group 3; p>0.05). No significant difference in T2 relaxation times could be revealed between all 4 groups (p>0.05, Table1).

**CONCLUSION**

Patients with consistent cardiac involvement of sarcoidosis have significantly increased T1 relaxation times as a sign of diffuse cardiac fibrosis whereas no relation between diffuse myocardial edema and cardiac involvement of sarcoidosis could be revealed.

**CLINICAL RELEVANCE/APPLICATION**

Results indicate that T1-mapping has the potential to serve as an indicator for myocardial involvement of sarcoidosis.

**CA249-SD-005**  | **Value of Repeat Coronary CT Angiography in Patients Presenting with Acute Chest Pain**

**Station #5**

**Participants**

Jared Nesbitt, MD, Stony Brook, NY (Presenter) Nothing to Disclose
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**PURPOSE**

The purpose of this study is to evaluate if repeat coronary CT angiography (CCTA) in patients presenting with acute chest pain to the emergency department (ED) has any added value and shows any significant change from prior study and to identify factors associated with this change.

**METHOD AND MATERIALS**

We retrospectively evaluated 365 patients who presented to the ED with acute chest pain and underwent repeat CCTA. We excluded patients with obstructive disease (>50%) on initial CCTA from the study. The coronary artery disease (CAD) was graded on a 3 point system, grade 0 is normal, Grade 1 non-obstructive CAD (<50% stenosis) and grade 2 obstructive CAD (>50% stenosis). Significant change between the two studies was defined as change from grade 0 to 1 or 2 and grade 1 to 2. Chi square test was utilized to examine marginal association between known risk factors as diabetes, hypertension, smoking, hyperlipidemia, time interval between the two scans and significant change on repeat CCTA. Multivariable regression analysis was applied to identify significant independent risk factors.

**RESULTS**

A total of 47 (12%) patients had a significant interval change in their CAD on repeat CCTA. Of these, 32 (8.77%) grade 0-1, 1 (0.27%) from grade 0 to 2 and 14 (3.8%) grade 1 to 2 on repeat scan. Interval change was strongly associated with diabetes (p<0.039, OR=2.04) and time interval between scan of more than 3 years (p=0.038 and OR= 2.04). The rest of the risk factors were not significantly associated with interval change. Presence of non-obstructive disease was not significantly associated with a change on subsequent scan.

**CONCLUSION**

Significant interval change with repeat CCTA was seen in only 12% of our studies. Repeat coronary CT angiography is more likely to show significant interval change in diabetic patients and if scan duration is more than three years from initial scan.

**CLINICAL RELEVANCE/APPLICATION**

Acute chest pain accounts for approximately 6 million emergency department visits every year with acute coronary syndrome in 15-20% of these cases. CCTA has an established role in triaging these patients who present with acute chest pain with a clinical concern for acute coronary syndrome. Currently repeat coronary CTA does not figure in the appropriateness guidelines for CCTA.
Studies are needed to evaluate what the added value of repeat coronary CTA is in the emergency setting.

CA250-SD-WEB6  Assessing the Cardiovascular System with Whole-body Na18F PET/CT and Opportunities for New Quantitative Methodologies

Station #6

Awards
Student Travel Stipend Award

Participants
Carl I. Odom, MD, Columbus, OH (Presenter) Nothing to Disclose
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PURPOSE
Sodium fluoride-18 (Na18F) is a positron emitting radionuclide typically used for oncologic imaging of osteoblastic tumor burden but recent studies have demonstrated the potential for 18F as a PET biomarker of vascular microcalcifications (miCalcs) as well as vulnerable atherosclerotic plaque. Since the vast majority of Na18F PET studies are usually performed as whole-body evaluations for osteoblastic lesions, the purpose of this study is to assess the clinical feasibility of performing quantitative and quantitative imaging assessment of cardiovascular 18F activity on whole-body oncologic Na18F PET/CT imaging.

METHOD AND MATERIALS
In this retrospective study, 20 patients underwent routine Na18F PET/CT for prostate or thyroid cancer. Qualitative assessment for cardiovascular 18F-avidity was performed by a reader panel. Using threshold-based isocontouring, quantitative assessment of vascular 18F activity was performed and provided the total fluoride uptake (TFU) and fluoride volume (FV) for the cardiovascular structures as well as the highest SUVmax (hSUVmax) and average SUVmax values.

RESULTS
Although FV for the cardiovascular system varied widely between patients, the average SUVmax values remained relatively consistent. Vascular microcalcifications (miCalcs) represented less than half of whole body cardiovascular FV. In particular, miCalcs tended to be within the aorta whereas the majority of vascular 18F activity tended to be in lower extremity arteries with no associated vascular miCalcs on CT. Presumably this lower extremity activity represents early vascular miCalcs.

CONCLUSION
In general, it appears feasible that whole-body Na18F PET/CT can also be used to detect focally or systemically increased 18F uptake in the cardiovascular system. Although this uptake may reflect vulnerable plaque in the acute setting, it can also be used to assess for the presence of early vascular miCalcs. New quantitative 18F PET methodologies will likely enable nuclear medicine physicians to detect occult regions of cardiovascular disease earlier and potentially improve imaging response assessment to new and emerging cardiovascular therapeutic agents.

CLINICAL RELEVANCE/APPLICATION
Whole-body detection and quantification of vulnerable vascular plaques and miCalcs using Na18F PET will enable new methods for non-invasive monitoring of disease stabilization and treatment response.

CA251-SD-WEB7  Virtual Simulation of the Amplazar Septal Occluder for Atrial Septal Defect in CT: 3-D CT/CT Image Fusion with Different Subjects

Station #7

Participants
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PURPOSE
In patients with secundum atrial septal defects (ASD), the trans-catheter closure device (Amplazar septal occluder; ASO) is commonly used in clinical practice. The anatomical location and the size of ASD are carefully evaluated with echocardiography before and during the ASO closure therapy. Cardiac computed tomography (CT) allows for precise measurement of the defect size and the rim around ASD. We developed a simulation system using virtual CT/CT fusion image that obtained different objects. We assessed the proof-of-principle cohort study at single centre. Patients (aged ≥13 years) with secundum ASD who performed cardiac CT were non-selectively enrolled to the study. Eight different ASO device (size 10, 13, 14, 16, 20, 24, 32, and 38 mm) were independently done with static CT, and the 3-D data was obtained. Two datasets of patient’s heart and ASO device were...
three-dimensionally imposed, and clinically relevant ASO device were virtually deployed.

RESULTS
A total of 18 patients (median age 55 years, range 13-77) were assigned to the study. For the patients successfully performed with the ASO closure therapy (n=10), the CT/CT fusion image showed that the all-round rim around ASO device that physically deployed remained eligibly as well as transesophageal echocardiography. For the other patients (surgical ASD closure, n=4; wait and see, n=4), the CT/CT fusion image showed that the most clinically relevant ASO device virtually failed to be deployed to the ASD in size or location (Figure 1 shows that the maximum ASO device was undersized but protruding over the left atrial wall).

CONCLUSION
We propose the virtual simulation for the ASO using CT/CT image fusion with different subjects is technically accurate for guiding the trans-catheter ASO closure and feasible for clinical use in the management of ASD.

CLINICAL RELEVANCE/APPLICATION
Xenogeneic CT/CT image fusion with different subjects allows for precise virtual simulation of trans-catheter intervention in congenital heart disease.

TEACHING POINTS
1. Review the principles of phase-contrast (PC) MRI flow imaging, clinical indications, and measured parameters.
2. Review and illustrate the sources of common artifacts in PC MRI flow imaging.
3. Describe strategies for optimizing image quality and minimizing imaging artifacts.
4. Describe the spectrum of PC MRI applications in different cardiovascular imaging.
5. Describe recent advances, including 4D flow imaging and CSF flow quantification.

TABLE OF CONTENTS/OUTLINE
Phase-contrast (PC) MRI has been established as a valuable tool for measuring flow with high sensitivity and accuracy. Important hemodynamic parameters, e.g. peak flow/velocity, quantification of regurgitation, blood volume, flow rate, and pulse wave velocity, can be measured from the resulting magnitude and phase images. Herein, we review basics of PC flow imaging, clinical indications, and optimal imaging parameter settings in different applications. We then review cases acquired with imaging artifacts or poor image quality, and describe modifications of the imaging parameters / protocol settings to alleviate these artifacts and improve image quality for optimal measurements’ accuracy. We will also describe the clinical applications of PC MRI in cardiovascular imaging and CSF flow as well as recent advances, such as 4D flow imaging.
Learning Objectives

1) Understand the terms used in describing the pathology of criss-cross heart and related conditions. 2) Understand the pathologic and surgical anatomy of various forms of criss-cross heart and related conditions. 3) Develop ideas how to image the patients with criss-cross heart and related conditions for surgical management.

Abstract

Congenital heart diseases are the most common significant birth defects requiring surgical treatment in the majority of cases. Understanding of pathologic anatomy is crucial in surgical decision and performing optimal surgical procedures. Learning cardiac morphology has relied on the pathologic specimens removed from dead patients or at the time of transplantation. However, the pathologic specimens are rare and hardly represent the whole spectrum of diseases. 3D print models from the CT and MR angiograms of the patients with congenital heart disease are great resources for teaching and can revolutionize education. In this hands-on session, 3D print models of hearts will be used for comprehensive understanding of complex morphology of criss-cross or twisted hearts, supero-inferior ventricles and topsy-turvy hearts. The session will consist of 15-minute introductory lecture, 60-minute hands-on observation and 15-minute discussion and evaluation. Experts on congenital heart disease pathology will be available for guidance and answering questions throughout the session.

Honored Educators

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

Previous studies have demonstrated more efficient time-to-diagnosis and time-to-discharge with cardiac CT angiography (cCTA) as the initial imaging test in patients presenting with acute chest pain over traditional management protocols, along with reduced cost of the index episode of care; however some failed to identify benefits in downstream test utilization. We evaluated the comparative cost-effectiveness and efficacy of cCTA in the overall care for chest pain patients.

METHOD AND MATERIALS

We performed a retrospective single-center analysis in 2,156 patients who presented to the emergency department (ED) with acute chest pain. Patient cohorts matched by patient characteristics and pretest likelihood for coronary artery disease (CAD) had undergone cCTA as a primary imaging test (n=1,139) or a traditional standard of care protocol (n=1,017). Cost-relevant factors of ED visits, utilization of downstream tests, and total patient care cost were compared.

RESULTS

No significant differences between groups were observed for age, gender, race, BMI, or CAD risk factors (all \( P > 0.08 \)). In addition, no significant differences in the diagnosis of CAD, pulmonary embolism, or aortic dissection were observed (all \( P > 0.11 \)). Time to discharge (4.5 vs. 7 hours), hospital admission rate (12.6% vs. 54.2%), length of hospital stay (48 vs. 72 hours), and readmission rate within 30 days (3.5% vs. 14.6%) were significantly lower (all \( P < 0.001 \)) in cCTA patients. Reduced rates of additional downstream testing (e.g. nuclear stress test) and invasive coronary angiography (4.9% vs. 22.7%; \( P < 0.001 \)), and ultimately lower total cost per patient (11,783$ vs. 18,996$, \( P < 0.001 \)) were observed in the cCTA arm.

CONCLUSION

In this large single-center study the use of cCTA as the initial imaging test in patients presenting with acute chest pain was associated with shorter ED and hospital stays, lower readmission rates, and ultimately lower total patient care cost, mainly owing to reduced rates of additional downstream test utilization.

CLINICAL RELEVANCE/APPLICATION

cCTA may improve the efficacy of healthcare delivery in patients with acute chest pain compared to traditional management and ultimately reduce the associated overall cost of care.
Pulmonary Hypertension (PHTN) who are initiating vasodilator therapy.

**METHOD AND MATERIALS**

Patients with PHTN who underwent cardiac MRI between 2/16/2015 to 3/18/2016 for pre-vasodilator therapy assessment or reassessment while on vasodilators were retrospectively studied. Non-gadolinium enhanced MRIs were performed at 1.5T and included standard SSFP images and phase contrast assessment of pulmonary valve flow (PVF). Readers independently measured right ventricular (RV) volumes including RV end diastolic volume (RVEDV) and determined cardiac output (CO) using these volumes and using PVF. Reader agreement for measurement of RV volumes was assessed by interclass correlation coefficients (ICCs). MRI CO measurements were compared to right heart catheterization (RHC), results assessed by linear regression and Bland-Altman analysis.

**RESULTS**

20 patients underwent a total of 33 cardiac MRIs, 13 MRIs performed after initiation of treatment. Correlative RHC data was available for 20 MRIs. Median interval between MRI and catheterization was 5 days (range 0-101). Reader ICCs for RVEDV were high whether measured on 4-chamber (.981) or short axis (.976) views. ICCs for CO measured on 4 chamber view (.934) and short axis view (.868) were also high, as was the ICC for CO measured using or PVF (.942). Measurements of CO on 4-chamber and short axis views and CO measured using PVF all correlated with the RHC CO. The CO calculated from PVF attained the best correlation with RHC CO for both readers (r =.844, r2 =.712 and r =.771, r2 = .594). Bland Altman analysis confirmed agreement between the PVF CO and RHC CO, and demonstrated differences between these measures of CO to be 0.54 ± 1.3 L/min and 0.65± 1.5 L/min for the two readers.

**CONCLUSION**

In patients with PHTN being considered for vasodilator therapy cardiac MRI assessment of RV volumes is highly reproducible. CO measurement using PVF may manifest a small negative bias compared to RHC CO, but is highly correlated with it. Together MRI measurement of RV volumes and CO may be sufficient for following trends in vasodilator treatment response.

**CLINICAL RELEVANCE/APPLICATION**

Cardiac MRI may help guide therapy in the growing number of PHTN patients on long term vasodilator treatment.

**SSM03-03** Correlation between Systolic and Diastolic Left Ventricular Strain and Right Ventricular Function in Pulmonary Arterial Hypertension: Assessment by Cardiac Magnetic Resonance Imaging

**Wednesday, Nov. 30 3:20PM - 3:30PM Room: S502AB**

**Awards**

Trainee Research Prize - Fellow

**Participants**

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**PURPOSE**

Pulmonary Hypertension (PH) is characterized by increased pulmonary vascular resistance, which leads to right ventricular (RV) pressure overload and failure. Through ventricular interdependence, altered RV pressure and volumes influence left ventricular (LV) filling dynamics and function. We sought to investigate the relationship of systolic and diastolic LV strain measurements with global function of the RV and PH severity on cardiovascular magnetic resonance (CMR) imaging.

**METHOD AND MATERIALS**

In this retrospective, IRB approved and HIPPA compliant study 42 patients (87% female, mean age 59 ± 11 years) with suspected PH were referred to CMR and right heart catheterization (RHC). Cine SSFP CMR in short-axis, 2-chamber and 4 chamber planes were used with feature tracking strain software (MTT, Toshiba Medical Systems, Tokyo, Japan) to calculate longitudinal and circumferential systolic and diastolic strain indices. Pearson's Correlation coefficient was used to assess the relationship between LV strain measurements and global function of RV.

**RESULTS**

By RHC, 37 patients were diagnosed with PH and 5 had no PH. Mean pulmonary artery pressure (mPAP) was 35.3 ± 13.0 mmHg and mean pulmonary vascular resistance (PVR) was 6.5 ± 5.0 Woods units. LV peak longitudinal systolic strain was associated with RV function but not mPAP, with a significant negative correlation of RV ejection fraction (EF) and global peak longitudinal strain (r = -.45, p=0.003). Figure 1 shows an example of longitudinal strain results for one of the participants. Similar significant correlations were seen between systolic longitudinal strain and RV mass. Conversely, LV early diastolic longitudinal strain rate was not correlated with RVEF or RV mass. Peak systolic circumferential strain and early diastolic circumferential strain rate showed no significant correlated with either RVEF or RV mass.

**CONCLUSION**

Reduced RV function in the setting of PH is associated with concomitant reductions in LV longitudinal systolic function, whereas longitudinal diastolic function and circumferential strain are less affected.
CLINICAL RELEVANCE/APPLICATION

Negative effects of PH on cardiac function are not limited to the RV, but can also be associated with reduced LV systolic function, which could contribute to patient symptoms and may be relevant for patient management.

Honored Educators

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

Stefan L. Zimmerman, MD - 2012 Honored Educator
Stefan L. Zimmerman, MD - 2015 Honored Educator
Ihab R. Kamel, MD, PhD - 2015 Honored Educator

Abbreviated Interpretation of Coronary CTA in the Emergency Setting

Wednesday, Nov. 30 3:30PM - 3:40PM Room: S502AB

Participants

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PURPOSE

This study is designed to test the accuracy of limited axial interpretation (AI) of coronary CT angiography (CCTA) compared to the conventional full interpretation (FI), which uses advanced post-processing tools, to identify patients with no or minimal coronary artery disease (CAD) in the Emergency Department (ED).

METHOD AND MATERIALS

This is a retrospective IRB-approved study. A stratified random sample of 86 exams from 163 consecutive conventionally performed CCTA exams were selected to achieve a 1:1 ratio of patients with and without >30% stenosis in at least one coronary segment. 60 exams used dedicated CCTA and 26 used triple rule-out (TRO) protocols. Exams were randomly allocated among 5 readers who examined only the axial source images saved in PACS and recorded on a per-segment basis, whether there was no stenosis, 1-30% stenosis or >30% stenosis. The original reports were reviewed independently and segmental assessment of stenosis abstracted using the same criteria. The diagnostic accuracy of the AI was assessed by calculating the sensitivity and specificity per patient using the final dictated reports based on the CI as the reference standard.

RESULTS

Allowing for variations in coronary artery anatomy, 1,186 segments were identified by AI for interpretation. A total of 287 segments were not evaluable (163 due to motion, 85 which were too small to assess, 37 with poor contrast enhancement, and 2 for other reasons), leaving 899 segments from 84 patients available for analysis. Of these patients, 33 (39%) had >30% stenosis in at least one segment by FI. AI had an overall per-patient sensitivity of 91% (30/33, 95% confidence interval: 76-98%) and specificity of 78% (40/51, 95% confidence interval: 65-89%). The dedicated CCTA and TRO protocols had similar sensitivity (85% vs. 100%, p=0.26) and specificity (80% vs. 76%, p=0.74).

CONCLUSION

AI shows good sensitivity and specificity in identifying patients with minimal or no CAD compared to FI.

CLINICAL RELEVANCE/APPLICATION

Limited axial interpretation can identify patients with no or minimal CAD reduce costs, speed results delivery and improve access to CCTA in the ED while preserving data for post-processing if needed.


Wednesday, Nov. 30 3:40PM - 3:50PM Room: S502AB

Participants

Qi Yang, Xianyang, China (Presenter) Nothing to Disclose
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PURPOSE

To evaluate the clinical value of using monochromatic images in dual-energy spectral CT in triple-rule-out CT angiography (CTA).

METHOD AND MATERIALS

Thirty consecutive patients with acute chest pain (HR<65BPM) underwent prospective ECG-triggered triple-rule-out CTA with spectral mode on a Discovery CT750HD scanner. A biphasic contrast injection (Iohexol, 350mgI/ml) was used for enhancement: 0.8ml/kg at 4.5ml/s flow rate in 1st phase and 20ml at 3.0ml/s in 2nd phase, followed by 30ml of saline. Monochromatic images were reconstructed with 40%ASiR and analyzed using Gemstone Spectral Imaging (GSI) viewer on an AW4.6. Region-of-interest
was placed on coronary artery, pulmonary artery, thoracic aorta and muscle to measure CT number and standard deviation, and to calculate the contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR) as function of energy for arteries. The optimal energy level (in keV) for obtaining the best CNR for the arteries was obtained. CNR values at the optimal energy were compared with those at 70keV (which has the average energy of 120kVp). Two senior radiologists also evaluated the image quality at these two energies using a 5-point scoring system in consensus. The measurements between the two energies were statistically compared.

RESULTS

The optimal energies for achieving the highest CNR for coronary artery, thoracic aorta and pulmonary artery were 65.4±1.0keV, 65.2±1.4keV and 65.0±1.5keV, respectively. SNR and CNR values at the optimal energies for these 3 arteries were (22.80±4.06, 18.30±2.76), (17.96±1.93, 19.14±3.45) and (19.01±4.34, 19.65±3.60), respectively. These values were significantly higher than the corresponding values of (17.96±3.63, 14.10±3.19), (14.43±1.53, 15.21±4.47) and (15.22±3.52, 15.10±3.40) in the 70keV images (all p<0.05). Image quality scores for these 3 arteries at the optimal energies were also judged better than those at 70keV: 4.5±0.6 vs. 3.2±0.8 for coronary artery, 4.4±0.6 vs. 3.2±0.8 for aorta and 4.5±0.6 vs. 3.2±0.8 for pulmonary artery (all p<0.05).

CONCLUSION

Monochromatic images at 65keV in triple-rule-out CTA with spectral imaging yielded best CNR and highest diagnostic confidence.

CLINICAL RELEVANCE/APPLICATION

Dual-energy spectral CT with optimal energy level selection may improve image quality for imaging coronary artery, pulmonary artery and thoracic aorta in triple-rule-out CTA.

SSM03-06 Prevalence of Coronary Artery Disease (CAD) in Premenopausal Women Presenting with Acute Chest Pain Diagnosed by Coronary CT Angiography

Wednesday, Nov. 30 3:50PM - 4:00PM Room: S502AB

Awards

Student Travel Stipend Award

Participants

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Dharmesh Tank, MD, Stony Brook, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

The purpose of this study was to identify the prevalence of CAD in premenopausal women who present with acute chest pain as identified on Coronary Computed tomography angiogram (CCTA) and to identify the various risk factors that are associated with a positive study.

METHOD AND MATERIALS

We retrospectively evaluated the CCTA and the medical records in 498 premenopausal female patients who presented to our ER with acute chest pain and underwent CCTA. The various parameters evaluated were age, family history, diabetes, hypertension, obesity (BMI), hyperlipidemia and smoking (current, former or never). The CCTA results were categorized as normal, nonobstructive (<50% stenosis), borderline (around 50%) and obstructive CAD (includes moderate and severe obstruction >50%). We used Chi square test to examine marginal association and further evaluation with multivariable regression analysis.

RESULTS

In this study of the patients evaluated were in the age range is 22-55 yrs. Of these 498 patients a total of 106 (21%) had CAD; 85 (17.07 %) had non obstructive CAD, 11(2.2%) had obstructive CAD and 10 (2%) had borderline obstructive CAD. Increasing age was associated with higher incidence of CAD (p 0.0070 ) with no CAD on CCTA in females <35yrs. Patients who never smoked and who had quit smoking >1year had a similar risk of CAD (18.75 and 18.99 %) compared to current smokers who had twice the risk of CAD( 36.3%). Hypertension (p 0.004), hyperlipidemia (p 0.05), family history (p0.01), diabetes (0.0001) and obesity (p 0.0001) , were significantly associated with presence of CAD on CCTA. The significant independent risk factors for presence of CAD were age (p = 0.0043), diabetes (p=0.0236) and obesity (p=0.0014) based on multivariable regression analysis.

CONCLUSION

The prevalence of CAD in premenopausal females presenting to the ER with chest pain is 21.2 % as diagnosed by CCTA. The risk factors strongly associated with presence of CAD and a positive CCTA were increasing age, diabetes and obesity. Women under 35 years of age had no identifiable CAD on CCTA in our study.

CLINICAL RELEVANCE/APPLICATION

Coronary artery disease (CAD) is major cause of mortality with more than 250, 000 deaths annually in women in the United states. The mortality from CAD has decreased in the last decade however the mortality in younger women from CAD is raising . It is therefore important to identify the burden of CAD in younger women by non invasive testing such as CCTA.
Cardiac (PET/MRI/CT/SPECT 2)
Wednesday, Nov. 30 3:00PM - 4:00PM Room: S504AB

Participants
James C. Carr, MD, Chicago, IL (Moderator) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
Vincent B. Ho, MD, MBA, Bethesda, MD (Moderator) In-kind support, General Electric Company
Cristina Fuss, MD, Portland, OR (Moderator) Nothing to Disclose

Sub-Events

SSM04-01 Body Composition Profiling using MRI - Normative Data for Subjects with Cardiovascular Disease Extracted from the UK Biobank Imaging Cohort
Wednesday, Nov. 30 3:00PM - 3:10PM Room: S504AB

Participants
Olof Dahlqvist Leinhard, PhD, Linkoping, Sweden (Presenter) Stockholder, AMRA AB; Employee, AMRA AB
Jennifer Linge, Linkoping, Sweden (Abstract Co-Author) Employee, AMRA AB
Janne West, MSc, PhD, Linkoping, Sweden (Abstract Co-Author) Employee, AMRA AB; Stockholder, AMRA AB
Jimmy D. Bell, PhD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Magnus Borga, PhD, Linkoping, Sweden (Abstract Co-Author) Stockholder, AMRA AB

PURPOSE
To describe the distribution of MRI-derived body composition measurements in subjects with cardiovascular disease (CVD) compared to subjects without any history of CVD.

METHOD AND MATERIALS
1864 males and 2036 females with an age range from 45 to 78 years from the UK Biobank imaging study were included in the study. Visceral adipose tissue volume normalized with height^2 (VATi), total abdominal adipose tissue volume normalized with height^2 (ATATi), total lean thigh muscle volume normalized with body weight (muscle ratio) and liver proton density fat fraction (PDFF) were measured with a 2-point Dixon imaging protocol covering neck to knee and a 10-point Dixon single slice protocol positioned within the liver using a 1.5T MR-scanner (Siemens, Germany). The MR-images were analyzed using AMRA® Profiler research (AMRA, Sweden). 213 subjects with history of cardiovascular events (angina, heart attack, or stroke) (event group) were age and gender matched to subjects with high blood pressure (HBP group), and subjects without CVD (controls). Kruskal-Wallis and Mann-Whitney U tests were used to test the observed differences for each measurement and group without correction for multiple comparisons.

RESULTS
VATi in the event group was 1.73 (1.13 - 2.32) l/m2 (median, 25%-75% percentile) compared to 1.68 (1.19 - 2.23) in the HBP group, and 1.30 (0.82-1.87) in the controls. ATATi in the event group was 4.31 (2.90-5.39) l/m2 compared to 4.05 (3.07-5.12) in the HBP group, and 3.48 (2.48-4.61) in the controls. Muscle ratio in the event group was 0.13 (0.12 - 0.15) as well as in the HBP group, compared to 0.14 (0.12 - 0.15) in the controls. Liver PDFF in the event group was 2.88 (1.77 - 7.72) % compared to 3.44 (2.04-6.18) in the HBP group, and 2.50 (1.58 - 5.15) in the controls. Kruskal-Wallis test showed significant differences for all variables and group comparisons (p<0.007). The post hoc test showed significant differences comparing the controls to both the event group and the HBP group. These were more significant for VATi and ATATi (p<10^-4) than for muscle ratio and PDFF (p<0.03). No significant differences were detected between the event group and the HBP group.

CONCLUSION
Cardiovascular disease is strongly associated with high VATi, liver fat, and ATATi, and with low muscle ratio.

CLINICAL RELEVANCE/APPLICATION
The metabolic syndrome component in CVD can be effectively described using MRI-based body composition profiling.

SSM04-02 Monoenergetic Reconstructions for Imaging of Coronary Artery Stents Using A Novel Dual Layer CT: First In-vitro Experience
Wednesday, Nov. 30 3:10PM - 3:20PM Room: S504AB

Participants
Tilman Hickethier, MD, Cologne, Germany (Presenter) Nothing to Disclose
Bettina Baessler, MD, Cologne, Germany (Abstract Co-Author) Nothing to Disclose
Jochen von Spiczak, Muenster, Germany (Abstract Co-Author) Nothing to Disclose
Jan-Robert Kroeger, Muenster, Germany (Abstract Co-Author) Nothing to Disclose
Jonas Doerner, MD, Cologne, Germany (Abstract Co-Author) Nothing to Disclose
Walter Giepmans, Best, Netherlands (Abstract Co-Author) Employee, Koninklijke Philips NV
Guido Michels, Cologne, Germany (Abstract Co-Author) Nothing to Disclose
Alexander C. Bunck, Koln, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Discussions may include off-label uses.

Participants
Tilman Hickethier, MD, Cologne, Germany (Moderator) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
Vincent B. Ho, MD, MBA, Bethesda, MD (Moderator) In-kind support, General Electric Company
Cristina Fuss, MD, Portland, OR (Moderator) Nothing to Disclose

Sub-Events

SSM04-01 Body Composition Profiling using MRI - Normative Data for Subjects with Cardiovascular Disease Extracted from the UK Biobank Imaging Cohort
Wednesday, Nov. 30 3:00PM - 3:10PM Room: S504AB

Participants
Olof Dahlqvist Leinhard, PhD, Linkoping, Sweden (Presenter) Stockholder, AMRA AB; Employee, AMRA AB
Jennifer Linge, Linkoping, Sweden (Abstract Co-Author) Employee, AMRA AB
Janne West, MSc, PhD, Linkoping, Sweden (Abstract Co-Author) Employee, AMRA AB; Stockholder, AMRA AB
Jimmy D. Bell, PhD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Magnus Borga, PhD, Linkoping, Sweden (Abstract Co-Author) Stockholder, AMRA AB

PURPOSE
To describe the distribution of MRI-derived body composition measurements in subjects with cardiovascular disease (CVD) compared to subjects without any history of CVD.

METHOD AND MATERIALS
1864 males and 2036 females with an age range from 45 to 78 years from the UK Biobank imaging study were included in the study. Visceral adipose tissue volume normalized with height^2 (VATi), total abdominal adipose tissue volume normalized with height^2 (ATATi), total lean thigh muscle volume normalized with body weight (muscle ratio) and liver proton density fat fraction (PDFF) were measured with a 2-point Dixon imaging protocol covering neck to knee and a 10-point Dixon single slice protocol positioned within the liver using a 1.5T MR-scanner (Siemens, Germany). The MR-images were analyzed using AMRA® Profiler research (AMRA, Sweden). 213 subjects with history of cardiovascular events (angina, heart attack, or stroke) (event group) were age and gender matched to subjects with high blood pressure (HBP group), and subjects without CVD (controls). Kruskal-Wallis and Mann-Whitney U tests were used to test the observed differences for each measurement and group without correction for multiple comparisons.

RESULTS
VATi in the event group was 1.73 (1.13 - 2.32) l/m2 (median, 25%-75% percentile) compared to 1.68 (1.19 - 2.23) in the HBP group, and 1.30 (0.82-1.87) in the controls. ATATi in the event group was 4.31 (2.90-5.39) l/m2 compared to 4.05 (3.07-5.12) in the HBP group, and 3.48 (2.48-4.61) in the controls. Muscle ratio in the event group was 0.13 (0.12 - 0.15) as well as in the HBP group, compared to 0.14 (0.12 - 0.15) in the controls. Liver PDFF in the event group was 2.88 (1.77 - 7.72) % compared to 3.44 (2.04-6.18) in the HBP group, and 2.50 (1.58 - 5.15) in the controls. Kruskal-Wallis test showed significant differences for all variables and group comparisons (p<0.007). The post hoc test showed significant differences comparing the controls to both the event group and the HBP group. These were more significant for VATi and ATATi (p<10^-4) than for muscle ratio and PDFF (p<0.03). No significant differences were detected between the event group and the HBP group.

CONCLUSION
Cardiovascular disease is strongly associated with high VATi, liver fat, and ATATi, and with low muscle ratio.

CLINICAL RELEVANCE/APPLICATION
The metabolic syndrome component in CVD can be effectively described using MRI-based body composition profiling.
In-stent restenosis have an important impact on long-term prognosis after percutaneous coronary intervention (PCI). However, accurate assessment of coronary stents after PCI using non-invasive CT imaging remains challenging despite new stent materials and improvements in CT technology. A new dual layer detector technology now allows monoenergetic (monoE) image reconstructions, which are supposed to decrease artifacts caused by coronary stents. Therefore we systematically investigated the influence of different monoE reconstructions on the visualization of the coronary stent lumen.

**METHOD AND MATERIALS**

Ten different coronary stents (diameter 3.0 mm) embedded in plastic tubes filled with contrast agent (500 HU) were scanned with a 128-slice dual layer CT (IQuon, Philips, 120 kV, 125 mAs). Images were reconstructed (0.67mm slice thickness, 0.35mm increment) with standard filtered back projection (FBP) and 6 different monoE settings (60, 70, 80, 90, 100, 150 keV). Each stent and reconstruction was assessed using established parameters: image noise (standard deviation (SD) in a standardized ROI), in-stent attenuation difference (mean attenuation difference between stented and non-stented lumen) and visible lumen diameter (mean visible diameter of the stented tube).

**RESULTS**

The image noise was significantly lower in all monoE data compared with FBP (FBP 13.41, 60 keV 11.62, 70 keV 11.67, 80 keV 11.69, 90 keV 11.71, 100 keV 11.75, 150 keV 11.80 HU SD; p < .01). The in-stent attenuation difference was significantly smaller in monoE data with higher keV levels than in FBP (FBP 148.18, 60 keV 154.13 p=.036, 70 keV 143.43 p=.109, 80 keV 137.25 p=.052, 90 keV 133.02 p=.043, 100 keV 120.12 p=.039, 150 keV 123.99 HU p=.035). The visible lumen diameter was significantly greater in monoE data with higher keV levels than in FBP (FBP 0.65, 60 keV 0.68 p=.541, 70 keV 0.71 p=.053, 80 keV 0.74 p<.01, 90 keV 0.77 p<.01, 100 keV 0.79 p<.01, 150 keV 0.90 mm p<.01).

**CONCLUSION**

Well-established objective CT image-quality assessment parameters of coronary stents are significantly improved by utilization of monoE reconstructions with adequate keV level.

**CLINICAL RELEVANCE/APPLICATION**

Non-invasive evaluation of coronary stents is an important and challenging task. MonoE reconstructions have the potential to improve coronary stent assessment crucially.

**SSM04-03 Late Gadolinium Enhancement of Myocardial Scar by Spectral Photon-counting CT: Comparison with Magnetic Resonance Imaging**

**METHOD AND MATERIALS**

Participants
- Amir Pourmorteza, PhD, Bethesda, MD (Presenter) Researcher, Siemens AG
- Manu N. Lakshmanan, PhD, Bethesda, MD (Abstract Co-Author) Research support, Siemens AG
- Rolf Symons, MD, Washington, DC (Abstract Co-Author) Nothing to Disclose
- Chia-Ying Liu, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
- Tyler E. Cork, BS, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
- Poonam Sahbaee, Durham, NC (Abstract Co-Author) Employee, Siemens AG
- Cynthia Davies-Venn, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
- Mark A. Ahlman, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
- Veit Sandfort, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
- David A. Bluemke, MD, PhD, Bethesda, MD (Abstract Co-Author) Research support, Siemens AG

**PURPOSE**

Energy-discriminating photon-counting computed tomography (PCCT) has the potential to increase the contrast resolution of contrast agents based on their k-edge. The aim of this study was to compare the performance of late-enhancement PCCT with 3T magnetic resonance imaging (MRI) for the detection of chronic myocardial infarction in an animal model.

**METHOD AND MATERIALS**

We used a canine model of chronic myocardial infarction. Animals were euthanized 12 minutes after an intravenous injection of 20 ml gadoteric acid (Dotarem, Guerbet). PCCT images of the ex-vivo hearts were acquired at 140 kVp tube voltage, 300 mAs tube current, 1 second rotation time, and energy thresholds of 25, 50, 75 and 90 keV. Images were reconstructed with a quantitative soft tissue kernel (D30f), 1 mm slice thickness, and 1 mm increment. Linear material decomposition calibrated to test vials with known concentrations of gadolinium (Gd) and tissue equivalent material was used to calculate Gd-concentration maps in the myocardium. PCCT data were compared with 3T MRI late Gd enhancement (LGE) images (Verio, Siemens). A T1-weighted Inversion Recovery 3D gradient echo sequence (TR/TE, 20/3.2 ms; flip angle, 15°) was used. The field of view was 12x10 cm with a matrix of 256x208, resulting in a voxel size of 0.46x0.48x0.3 mm. Scar to myocardium contrast was calculated as the percent difference between the mean voxel intensity of 5 regions-of-interest (ROIs) in infarcted and remote myocardium.

**RESULTS**

PCCT infarct volume accurately reflected scar morphology of the subendocardial scar compared with MRI LGE images in two ex vivo hearts. Scar and myocardium Gd concentrations were measured in 5 regions in infarcted and remote myocardium. Mean Gd concentration in remote myocardium was 1.2 mM for both hearts compared to 5.2 and 7.7 mM in the scars of heart 1 and heart 2, respectively. PCCT Gd-mapping increased the contrast-to-noise ratio (CNR) between scar and remote myocardium from 3.7, 3.2 to 4.4, 8.8 for heart 1 and heart 2, respectively. In comparison, CNR for LGE MRI was 16.5 and 10.7.

**CONCLUSION**

The spectral information of PCCT has the potential to improve the detection of chronic myocardial infarction compared to conventional CT by providing quantitative maps of gadolinium concentration in late gadolinium enhancement images.

**CLINICAL RELEVANCE/APPLICATION**

The spectral information of PCCT may improve CT sensitivity for the detection of chronic myocardial infarction.
**SSM04-04** Long-term Prognosis of Unrecognized Myocardial Infarction Detected with Magnetic Resonance Imaging in an Elderly Population

**Wednesday, Nov. 30 3:30PM - 3:40PM Room: S504AB**

**Participants**
Charlotte Ebeling Barbier, MD, Uppsala, Sweden (Presenter) Nothing to Disclose
Raquel E. Themudo, MD, Uppsala, Sweden (Abstract Co-Author) Nothing to Disclose
Tomás Bjerner, MD, PhD, Uppsala, Sweden (Abstract Co-Author) Medical Advisory Board, Carestream Health, Inc
Lars O. Johansson, PhD, Uppsala, Sweden (Abstract Co-Author) Nothing to Disclose
Lars Lind, MD, PhD, Uppsala, Sweden (Abstract Co-Author) Nothing to Disclose
Hakan K. Ahlstrom, MD, PhD, Uppsala, Sweden (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The aim of the present study was to investigate the prognostic impact of unrecognized myocardial infarctions (UMIs) detected with magnetic resonance imaging (MRI) for major adverse cardiac events (MACE) in community living elderly individuals.

**METHOD AND MATERIALS**
Late enhancement MRI was performed in 248 randomly chosen 70-year-olds. Individuals with myocardial infarction (MI) scars, with or without a hospital diagnosis of MI were classified as recognized MI (RMI) or UMI, respectively. Medical records and death certificates were scrutinized. MACE was defined as cardiac death, non-fatal MI, a new diagnosis of angina pectoris, or symptom-driven coronary artery revascularization.

**RESULTS**
During follow-up (mean 11 years) MACE occurred in 10% (n=18/182) of the individuals without MI scars, in 20% (n=11/55) of the individuals with UMI, and in 45% (n=5/11) of the individuals with RMI, with a significant difference between the UMI group and the group without MI scars (p=0.045), and between the RMI group and the group without MI scars (p=0.0004). Hazards ratios for MACE adjusted for risk factors and sex were 2.55 (95% CI 1.20-5.42; p=0.015) for UMI and 3.28 (95% CI1.16-9.22; p=0.025) for RMI.

**CONCLUSION**
The presence of an MRI-detected UMI entailed a more than double risk for MACE in community living 70-year-old individuals.

**CLINICAL RELEVANCE/APPLICATION**
LE-MRI detects UMIs in individuals without cardiovascular risk factors or other signs of myocardial injury. These individuals have an increased risk for MACE. Thus, LE-MRI identifies individuals at risk who would remain undetected with prevailing techniques. Although likely, it remains to be evaluated whether these individuals would benefit from life style changes and cardiovascular medication. If such protective measures are needed, then these individuals will have to be identified. Thus, health care management will need to consider: i) the possibility of primary prevention as LE-MRI can be used to detect individuals at cardiovascular risk, and ii) to what extent LE-MRI could and should be used for this purpose.

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**SSM04-05** Whole-Heart Isotropic Late Gadolinium Enhanced Imaging in a Single Breath-Hold: Usefulness of the 3D-mDixon Sequence at 3T MRI

**Wednesday, Nov. 30 3:40PM - 3:50PM Room: S504AB**

**Participants**
Morikatsu Yoshida, Amakusa, Japan (Abstract Co-Author) Nothing to Disclose
Takeshi Nakaura, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Taihei Inoue, MD, Kumamoto, Japan (Presenter) Nothing to Disclose
Koichi Yokoyama, Amakusa, Japan (Abstract Co-Author) Nothing to Disclose
Seitaro Oda, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Masafumi Kido, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Daisuke Utsunomiya, MD, Kumamoto, Japan (Abstract Co-Author) Nothing to Disclose
Kazunori Harada, Amakusa, Japan (Abstract Co-Author) Nothing to Disclose
Yasuyuki Yamashita, MD, Kumamoto, Japan (Abstract Co-Author) Consultant, DAIICHI SANKYO Group

**PURPOSE**
The two-dimensional (2D) inversion recovery (IR) sequence is used as a reference standard for late gadolinium enhanced (LGE) imaging, however, its acquisition time tends to be long. We compared the clinical usefulness of the 3D multi-echo Dixon (mDixon)- and the 2D-IR technique for cardiac LGE imaging on a 3T MR system.

**METHOD AND MATERIALS**
This retrospective study received institutional review board approval; written informed consent was waived. We enrolled 31 patients with suspected ischemic heart disease who underwent cardiac MRI study. We obtained 2D-IR short-axis images (voxel size: 1.48 × 2.36 × 7 mm) and 3D-mDixon whole-heart transverse images (voxel size: 1.97 × 2.0 × 2.0 mm) in all patients and reconstructed the short-axis MPR images with the 3D-mDixon technique. We performed qualitative inferiority analysis of the overall image quality, artifacts, and LGE sharpness between the 3D-mDixon and the 2D-IR sequence was 0.18 (95% CI: -0.18 - 0.55), 0.27 (95% CI: -0.09 - 0.64), and 0.40 (95% CI: -0.03 - 0.83), respectively, demonstrating their non-inferiority. There was no significant difference in the LGE area between 3D-mDixon- (8.07 ± 4.93 cm²) and 2D-IR scans (6.87 ± 4.52 cm²) (p = 0.45), and the correlation was nearly perfect (r = 0.98, p < 0.001, bias: 1.10, 95%: CI 0.63 - 1.58).
CONCLUSION
The image quality of the single breath-hold 3D mDixon sequence is not inferior to the multi-breath-hold 2D-IR sequence for cardiac LGE imaging at 3T MRI, and it may shorten the acquisition time.

CLINICAL RELEVANCE/APPLICATION
Single breath-hold isotropic LGE imaging with the 3D-mDixon technique can markedly reduce the scan time and the image quality is not inferior to that of the 2D-IR sequence at cardiac 3T MRI.

SSM04-06  Left Bundle Branch Block: Usefulness of MRI in the Evaluation of Regional Left Ventricular Dyssynchrony and in the Detection of Previous Myocardial Infarction with Late Enhancement

CONCLUSION
Cardiac MRI is a useful diagnostic tool in the evaluation of LBBB when the assessment of ventricular dyssynchrony on echocardiography is not technically feasible and when the area of a previous myocardial infarction cannot be determined.

CLINICAL RELEVANCE/APPLICATION
MRI is a useful diagnostic tool in the evaluation of LBBB when US assessment of ventricular dyssynchrony isn't feasible and a previous possible myocardial infarction has to be determined.
Controversy Session: Emergency Imaging: Is Pain in the Chest a Pain in the Neck?

Wednesday, Nov. 30 4:30PM - 6:00PM Room: E450B

CA  CT  ER

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

Participants
Charles S. White, MD, Baltimore, MD, (cwhite@umm.edu) (Moderator) Consultant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Review the clinical challenges related to diagnosing the cause of acute chest pain in the ED. 2) Describe the role of current imaging techniques in evaluating patients who present with acute chest pain. 3) Discuss the feasibility, advantages, and challenges related to use of coronary CTA to evaluate ED chest pain. 4) Review the advantages and disadvantages of using a triple rule-out vs dedicated coronary CTA protocol to assess acute chest pain.

ABSTRACT

URL

Sub-Events

SPSC42A  Traditional Strategies Are Still Valuable for Evaluating Acute Coronary Syndromes (ACS)

Participants
Vasken Dilisizian, MD, Baltimore, MD (Presenter) Research Grant, General Electric Company; Research Grant, Siemens AG

LEARNING OBJECTIVES

View learning objectives under the main course title.

SPSC42B  Coronary CT Angiography (CCTA) Improves Over Traditional Strategies for ACS

Participants
Ricardo C. Cury, MD, Miami, FL, (rcury@baptisthealth.net) (Presenter) Research Grant, General Electric Company; Research Consultant, General Electric Company

LEARNING OBJECTIVES

1) Effectively utilize coronary computed tomography angiography (CTA) to properly diagnose, detect and evaluate emergency department patients with acute chest pain or other symptoms suggestive of coronary artery syndrome. 2) Explain the relationship between coronary CTA findings and the clinical outcome of patients with acute chest pain. 3) Utilize the appropriate noninvasive studies to assess risk of acute coronary syndrome.

ABSTRACT

Coronary computed tomography angiography (CCTA) is a rapid and accurate technique to exclude the presence of CAD. Furthermore, the immediate and future likelihood of cardiac events in patients with no or minimal CAD is extremely low for patients with acute chest pain. In light of these favorable test characteristics, several single-center and more recently, multicenter studies have demonstrated the feasibility, safety, and accuracy of CCTA in the ED to assess chest pain patients.

URL

SPSC42C  Which is Better: Triple Rule-out or Standard CCTA?

Participants
Charles S. White, MD, Baltimore, MD, (cwhite@umm.edu) (Presenter) Consultant, Koninklijke Philips NV

LEARNING OBJECTIVES

View learning objectives under the main course title.
ED002-TH

Cardiac Thursday Case of the Day

Thursday, Dec. 1 7:00AM - 11:59PM Room: Case of Day, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

Participants

Kaushik S. Shahir, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Dhiraj Baruah, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Rahul D. Renapurkar, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Sushilkumar K. Sonavane, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Sachin S. Saboo, MD, FRDR, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Suhny Abbara, MD, Dallas, TX (Abstract Co-Author) Author, Reed Elsevier; Other, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Nicholas Clayton, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Jubal R. Watts Jr, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
Satinder P. Singh, MD, Birmingham, AL (Abstract Co-Author) Nothing to Disclose
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Michael A. Bolen, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Christopher Maroules, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Tyler M. Flessner, MD, Milwaukee, WI (Abstract Co-Author)
Nagina Malguria, MBBS, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Melissa M. Wein, MD, Shorewood, WI (Abstract Co-Author) Nothing to Disclose
Zachary R. Laste, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Prabhakar Rajiah, MD, FRDR, Dallas, TX (Abstract Co-Author) Institutional Research Grant, Koninklijke Philips NV; Speaker, Koninklijke Philips NV

TEACHING POINTS

1) Identify pertinent findings and generate differential diagnosis for cardiac imaging studies. 2) Develop differential diagnoses based on the clinical information and imaging findings. 3) Recommend appropriate management for patients based on imaging findings.

Honored Educators

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

Rahul D. Renapurkar, MD - 2016 Honored Educator
Suhny Abbara, MD - 2014 Honored Educator
Prabhakar Rajiah, MD, FRDR - 2014 Honored Educator
LEARNING OBJECTIVES
1) Review the disease entities relevant in the setting of acute aortic emergencies. 2) Update on recent CT technological advancements relevant to the setting. 3) Assess the value of CT imaging in the diagnosis of acute aortic emergencies.

ABSTRACT
CT represents the major diagnostic modality in the management of patients with suspected acute aortic emergency. The lecture will review the underlying disease entities and imaging protocols taking into account recent technical developments in providing a straightforward diagnosis. Clinical examples will be discussed.

LEARNING OBJECTIVES
1) Explain why the diagnosis of pulmonary hypertension, in and of itself, is not sufficient to guide patient management. 2) Describe the principles of the current mechanistic classification of pulmonary hypertension. 3) Assess how CT and MR can provide crucial information regarding not only the diagnosis but also the underlying pathophysiologic mechanism of pulmonary hypertension. 4) Develop a strategy for rational, evidence based utilization of CT and MR in a patient with suspected pulmonary hypertension.

ABSTRACT
Merely diagnosing the presence of pulmonary hypertension is hardly helpful for referring providers. Understanding the etiology of pulmonary hypertension is paramount to determine the prognosis and develop an effective management strategy. This lecture aims to provide a concise, evidence-based, mechanistic framework for etiologic diagnosis of pulmonary hypertension, emphasizing the central role of advanced imaging modalities, such as CT and MR.

LEARNING OBJECTIVES
To understand the advantages and limitations of assessing coronary artery disease with coronary CT angiography.

ABSTRACT

LEARNING OBJECTIVES
1) Get to know the major clinical studies showing the benefits of cardiac MR and CT. 2) Learn about important details from these studies that will convince referring physicians selecting the right patients at the right point in time for cardiac MR and CT.

ABSTRACT
Major clinical studies have shown advantageous of using cardiac CT and MR in certain patient populations. This practical talk about the pivotal facts from ten large clinical studies about cardiac CT and MR will provide the information required for shared decision making with referring physicians.
Handout: Marc Dewey
**Imaging of Obstructive Coronary Artery Disease**

**Thursday, Dec. 1 8:30AM - 10:00AM Room: E351**

**CA CT MR**

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

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

**Participants**
Suhny Abbara, MD, Dallas, TX (Moderator) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

**Sub-Events**

**RC603A  Cardiac CT for Management of Coronary Artery Disease-State of the Evidence**

**Participants**
Leslee Shaw, PhD, Atlanta, GA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**
To understand the latest clinical trial supporting the use of cardiac CT in stable chest pain patients. To comprehend evidence supporting effective detection of obstructive coronary disease with cardiac CT.

**ABSTRACT**
Coronary computed tomography angiography (CCTA) is an established imaging technique for the noninvasive assessment of coronary arteries. However, CCTA remains a morphologic technique with the same limitations as invasive coronary angiography in evaluating the hemodynamic significance of coronary stenosis. Different computed tomography (CT) techniques for the functional analysis of coronary lesions have recently emerged, including static and dynamic CT myocardial perfusion imaging and CT-based fractional flow reserve and transluminal attenuation gradient methods. These techniques hold promise for achieving a comprehensive appraisal of anatomic and functional aspects of coronary heart disease with a single modality.

**RC603B  CT of Myocardial Perfusion, Scar and Viability Imaging**

**Participants**
U. Joseph Schoepf, MD, Charleston, SC, (schoepf@musc.edu) (Presenter) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, General Electric Company; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; ;

**LEARNING OBJECTIVES**
1) Discuss various approaches towards functional CT imaging of the heart. 2) Recognize manifestations of ischemic heart disease on functional CT. 3) Identify suitable future indications for CT myocardial perfusion imaging.

**ABSTRACT**
Coronary computed tomography angiography (CCTA) is an established imaging technique for the noninvasive assessment of coronary arteries. However, CCTA remains a morphologic technique with the same limitations as invasive coronary angiography in evaluating the hemodynamic significance of coronary stenosis. Different computed tomography (CT) techniques for the functional analysis of coronary lesions have recently emerged, including static and dynamic CT myocardial perfusion imaging and CT-based fractional flow reserve and transluminal attenuation gradient methods. These techniques hold promise for achieving a comprehensive appraisal of anatomic and functional aspects of coronary heart disease with a single modality.

**RC603C  MR Imaging of Coronary Ischemia (Coronary MRA, Stress Perfusion)**

**Participants**
David A. Bluemke, MD, PhD, Bethesda, MD (Presenter) Research support, Siemens AG

**LEARNING OBJECTIVES**
1) Describe techniques used for evaluation myocardial ischemia with MRI. 2) Describe the use of MRI for evaluating myocardial viability. 3) Describe the use of MRI for evaluating stress induced ischemia.

**ABSTRACT**
Cardiac MRI (CMR) is an established modality for evaluation of ischemic myocardial disease; appropriateness criteria increasingly recognize the role of CMR in this role. CMR has outstanding temporal resolution allowing for accurate representation of myocardial volumes and function. Excellent soft issue contrast for myocardial ischemia evaluation is achieved with the use of a gadolinium contrast agent. Stress perfusion CMR during adenosine infusion compares favorably to nuclear medicine methods but can additionally assess volumes and mass very accurately. Stress CMR is used in combination with late gadolinium enhancement (LGE) techniques to depict viable myocardium to improve the specificity of the method. Coronary artery imaging with CMR is best performed at 1.5 T and is useful to assess for anomalous coronary artery imaging and confirm perfusion results. This session will describe the techniques, indications, results and interpretation of CMR for evaluation of ischemic disease of the myocardium.

**RC603D  Late Gadolinium Enhancement**

**Participants**
Scott D. Flamm, MD, Cleveland, OH, (flamm@ccf.org) (Presenter) Medical Director, Precision Image Analysis, Inc; Board of Directors, Precision Image Analysis, Inc; Consultant, Bayer AG;

**LEARNING OBJECTIVES**
1) Understand the distinct advantages of LGE imaging by cardiac MRI. 2) Recognize the clinical situations appropriate for cardiac MRI LGE imaging. 3) Articulate the mechanisms responsible for the increased signal intensity in irreversibly damaged myocardium.
**PURPOSE**
Various degrees of aortic valve rotation may be seen in individuals with no history of congenital cardiovascular malformations, but its association with aortic sizes has not been studied.

**METHOD AND MATERIALS**
Gated computed tomographic (CT) angiograms in 217 patients were studied (66.7±15; 22-97 years old). Aortic diameters were determined at 5 anatomic locations. The length of the aorta from sinus to left subclavian artery was measured. The angle of valve rotation was recorded by measuring the angle between a line connecting the midpoint of the non-coronary sinus to the anterior commissure and another line along the interatrial septum. Rotation angles were correlated with aortic measurements. Patients were separated into two groups based on aortic sizes and into three groups based on age. The threshold for aortic dilatation was set at maximum ascending aorta diameter ≥40 mm (≥ 21 mm body surface area [BSA] indexed).

**RESULTS**
No significant difference in rotation angles was seen between the three age groups or between genders. Rotation angles were significantly correlated with maximal, average, and BSA adjustment of the aortic root and ascending aortic measurements. The aortic root angles were significantly different between the dilated versus nondilated aortas. There was no significant association between the rotation angles and age, length of ascending aorta, or diameters of descending aorta. Multivariate adaptive regression splines showed 25º of aortic root rotation as the diagnostic cut off for ascending aorta dilatation. Above the 25º rotation, every 10º of increasing rotation was associated with a 3.78±0.87 mm increase in aortic diameter (p<0.01) and a 1.73±0.25 times increased risk for having a dilated aorta (p<0.01).

**CONCLUSION**
Our study indicates an independent positive association between the rotation angles of the aortic valve and the diameters of aorta and shows that above 25º rotation cut off, every 10º of increasing rotation almost doubles the risk for having a dilated aorta. Patients with increased rotation angle of the aortic valve may have a higher risk for future dilatation of the ascending aorta.

**CLINICAL RELEVANCE/APPLICATION**
Patients with increased rotation angle of the aortic valve may have a higher risk for future dilatation of the ascending aorta.
To investigate whether there is an association between mitral valve and mitral annulus calcification severity measured in unenhanced ECG-gated MDCT and surgical outcome.

METHOD AND MATERIALS

We included all consecutive patients referred to Coronary CTA for surgical risk assessment prior to mitral valve surgery. All studies were performed in either a 64-d or 256-d scanner. We measured calcium mass, volume and Agatston Score in both mitral valve leaflets and mitral annulus. Demographic data, risk factors and surgical outcome was obtained from clinical records. We search for surgical time, surgical bleed, arrhythmia, hours of intubation, days in critical care, hospitalization days and complications.

RESULTS

We included 66 patients, 56% females. Mean age was 52.4±12.74. BMI was 25.5±3.54, smoke habit, systemic hypertension, diabetes and dyslipidemia were present in 10.6%, 13.6%, 12.1% and 12.3%, respectively. Mean valvular calcium volume (VCV) was 410.5±1174 mm3, valvular calcium mass (VCM) was 257.3±1111 mg, valvular calcium score (VCS) was 438±1267 AU. Mean annular calcium volume (ACV) was 21.69±85 mm3, annular calcium mass (ACM) was 15.6±93 mg and annular calcium score (ACS) 18.6±74 AU. Procedures were placement of mechanice valve in 80%, biologic valve in 17% and annular plasty in 4% patients. Mean surgical time was 282±88 minutes, surgical bleeding 754.6±693 ml, mean time to extubation was 1.21±1.18 days, in curogical care 3.86±1.9, hospitalization days 13±6.3. Arrhythmia and complications occurre d in 42.4 and 34.8% of the patients, respectively. Patients with higher surgical time (95th percentile) had higher VCV 885 vs. 260 cm3 (p=0.047) and VCM 788 vs. 89 (p=0.02), annular calcium was not significant. Patients with higher time in intubation (95th percentile) showed higher VCM 808 vs. 116 (p=0.032), annular calcium was not significant. Patients with longer times in critical care (95th percentile) had higher VCV 1583 vs. 316 (p=0.018), VCM 2202 vs. 102 (p=0.0001), ACV 90.7 vs. 16.8 (p=0.04) and ACS 79.7 vs. 14.2 (p=0.04).

CONCLUSION

Higher valvular calcification is associated with increased surgical time, time to extubation and days in critical care which might suggest complexity in surgical technique.

CLINICAL RELEVANCE/APPLICATION

The amount of calcification in the Mitral valve measured with unenhanced MDCT can potentially predict the technical complexity in Mitral valve surgery.

SAO02-03 Automated and Manual Measurement of the Aortic Annulus with ECG-Gated Cardiac Tomography Prior to Percutaneous Aortic Valve Replacement (TAVR): Comparison with Three Dimensional Echocardiography

Thursday, Dec. 1 10:50AM - 11:00AM Room: SS04AB

Awards

Student Travel Stipend Award

Participants

David Bekhor, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Gilda Boroumand, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
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PURPOSE

Accurate measurement of the aortic annulus is critical for percutaneous aortic valve replacement (TAVR). We compared annular measurements on cardiac CT angiography (cCTA) by automated software to manual planimetry, and compared annulus size derived from cCTA to that obtained with 3-dimensional transesophageal echocardiography (3D-TEE).

METHOD AND MATERIALS

A retrospective search identified 74 patients who underwent 3D-TEE and ECG-gated cCTA of the aortic annulus within 30 days for pre-operative TAVR planning. 3D-TEE measurements were obtained during mid-systole, while cCTA measurements were obtained at late-systole (40% of the R-R interval) and late-diastole (80% of the R-R interval). Annular area was measured independently by manual planimetry and with TAVI automated software (Intellispace Portal; Philips Medical Systems). Pearson correlation coefficients and paired t-tests were obtained to compare short axis and long axis diameters of the annulus, as well as annular area by echocardiography and cCTA.

RESULTS

Automated and manual cCTA annulus measurements were highly correlated in systole (r=0.94) and diastole (r=0.93), cCTA measurements in systole and diastole were highly correlated for short axis diameter (r=0.91), long axis diameter (r=0.92), and annular area (r=0.96). Good correlation was observed between 3D-TEE and cCTA for short axis diameter (r=0.84-0.90), long axis diameter (r=0.77-0.79) and annular area (r=0.89-0.90). Measurements by 3D-TEE were significantly smaller than cCTA during systole (p<0.001), but similar to cCTA during diastole: Short axis diameter – 3D-TEE: 22.1mm; cCTA systole: 22.6mm; cCTA diastole: 21.5mm Long axis diameter – 3D-TEE: 26.5mm; cCTA systole: 27.9mm; cCTA diastole: 27.2mm Annular area – 3D-TEE: 467sq mm; cCTA systole: 495sq mm; cCTA diastole: 466sq mm

CONCLUSION

Automated measurement of the aortic annulus is highly correlated with manual planimetry. Although all cCTA measurements are highly correlated with measurements by 3D-TEE, diastolic phase cCTA measurements tend to be closer to standard mid-systolic 3D-TEE measurements. This is especially true for measurement of aortic annular area which is over measured by an average of 28sq mm on systolic phase cCTA relative to 3D-TEE.
CLINICAL RELEVANCE/APPLICATION

cCTA measurements of the aortic annulus are highly correlated between systole and diastole, but diastolic phase measurements provide a better match with 3D-TEE, especially for annular area.

SSQ02-04  Coronary CTA Prior to Surgery for Infective Endocarditis: Clinical Efficacy, Safety and Cost-effectiveness. A Long-term Outcome Study

Participants

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PURPOSE

to assess coronary computed tomography angiography (CTA) in patients with infective endocarditis prior to surgery for evaluation of coronary artery disease (CAD) regarding its influence on immediate clinical management, long-term outcome and cost-effectiveness

METHOD AND MATERIALS

32 patients (age 55.7±12.6y; females 21.9%) with infective endocarditis (IE) referred to cardiac ECG-gated CTA (64- or 128-slice dual source) prior to surgery for clinical indications between 2009 and 2015 were included. Coronary arteries were evaluated for stenosis/>=50%. The immediate clinical management decision based on CTA was recorded (downstream testing by invasive coronary angiography (ICA); CABG surgery). Outcome measures were major cardiovascular events (MACE); late coronary revascularization (CABG/PTCA)(>10days-max. 5,8 years.) Cost effectiveness was calculated (absolute costs: 250€ CTA vs 2250€ ICA)

RESULTS

32 patients (22 native, 10 prosthetic IE) were analyzed (30 prior unknown CAD, 2 post-CABG). 20/30 (66,6%) patients had no CAD or 50% stenosis by CTA, 1 intermediate 50% and 9 >50% stenosis. 5 CABG were performed based on CTA (no ICA due to "high-risk"). In 2 patients with prior CABG, grafts were patent (1 new graft/CX placed). Total CABG rate was 6/32 (18.7%). Only 1/32 (3.1%) patient underwent downstream testing with ICA after CTA (LM 60%->2xCABG). Overall in 4/32, ICA was performed (n=3 prior to CTA, all were negative for CAD (ICA>-scould have been avoided). There was no MACE (0%) and no late revascularization (0%) during F/U. Total absolute costs in our study cohort were 17.000 €, while potential costs would have been even lower with estimated 10.250 € if n=3 negative ICAs would have been avoided. Total cost savings compared to ICA strategy were 63.000 € (vs. 69.730€ potential). (76% absolute and 79.8% potential reduction) as compared to ICA.

CONCLUSION

The strategy using coronary CTA prior to IIE surgery is safe and cost-effective (~76% absolute cost reduction). Downstream testing rate with ICA was low (3.1%) and CABG surgery rate 18.7%; while significant CAD (>50 % stenosis) was safely excluded in the majority (66.6%).

CLINICAL RELEVANCE/APPLICATION

Coronary CTA in patients with infective endocarditis prior to surgery is efficient for procedure planning, safe and cost-effective, and avoids invasive coronary angiography and the risk of embolization in the majority of patients.

SSQ02-05  Relative Value of Cardiac MRI and FDG-PET in the Initial Diagnosis of Cardiac Sarcoidosis

Participants

Richard A. Coulson, MD, Edmonton, AB (Presenter) Nothing to Disclose
Andrew P. Sionnec, MPhil, Toronto, ON (Abstract Co-Author) Research support, sanofi-aventis Group
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PURPOSE

Sarcoidosis is a multisystem disorder with cardiac involvement in 25%. Diagnosis of cardiac sarcoidosis is difficult, with FDG-PET and cardiac MR (CMR) proving most reliable. We compare FDG-PET and CMR with late gadolinium enhancement (LGE) in patients with suspected cardiac sarcoidosis.

METHOD AND MATERIALS

89 patients with suspected cardiac sarcoidosis were investigated with FDG-PET and CMR within 2 weeks (82 same day). Patients undergoing FDG-PET followed a 24 hour low-carbohydrate diet and overnight fast. CMR included SSFP assessment of left ventricular (LV) function and LGE. Images were reviewed by 2 readers blinded to the results of the other examination. FDG-PET was considered positive if any segment (17 segment model) had an SUVmax>3.6. CMR was considered positive if any segment showed ‘sarcoid-type’ LGE. Patients with biopsy proven sarcoid or lung CT changes consistent with sarcoind were classified according to modified Japanese Ministry of Health & Welfare guidelines as JMHW +ve or -ve (Ohira. Eur J Nucl Med Mol Imaging 2016:43:259).

RESULTS

82 patients had biopsy proven or lung CT evidence of sarcoid. Of these, 13 met JMHW criteria and all showed myocardial FDG uptake. 10 also showed LGE on CMR. In 69 JMHW -ve patients, 20 showed myocardial FDG uptake with 8 also showing LGE. 5 patients had LGE with no myocardial FDG uptake and 44 showed neither FDG uptake nor LGE. In 7 patients with unexplained arrhythmia but no pathology or lung CT changes of sarcoid, 1 showed myocardial FDG uptake with LGE and 3 showed LGE alone. 3
showed neither FDG uptake nor LGE. 19 patients had LV impairment, 8 were JMHW +ve (62%) and 8 JMHW –ve (12%). Patients with arrhythmia but without known sarcoid were also more likely to have LV impairment (33%).

CONCLUSION

FDG-PET detects cardiac sarcoid in all JMHW +ve patients with LGE in 77%. In JMHW –ve patients, both techniques can be positive, either together or independently. In those who only show LGE, there is often no extravascular FDG uptake to indicate active sarcoid elsewhere. In the heart, FDG appears to show active sarcoid whereas LGE shows more advanced disease that has gone on to scar. The presence of LGE is often associated with LV impairment.

CLINICAL RELEVANCE/APPLICATION

Current literature suggests FDG-PET and CMR are equivalent in detecting cardiac sarcoidosis. This is not our experience. FDG-PET and CMR are complimentary and should be used together whenever possible.

SSQ02-06  Correlation between Left Ventricular Insertion Points Delayed Enhancement and Right Ventricular Dilation with Cardiac Magnetic Resonance in Patients with Congenital Heart Disease

Thursday, Dec. 1 11:20AM - 11:30AM Room: S504AB

Participants
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Marco Scarabello, Milan, Italy (Abstract Co-Author) Nothing to Disclose
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Francesco Sandanelli, MD, San Donato Milanese, Italy (Abstract Co-Author) Speakers Bureau, Bracco Group Research Grant, Bracco Group Speakers Bureau, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific

PURPOSE

The purpose of our study was the quantitative evaluation of left ventricular (LV) delayed enhancement (DE) in relation to right ventricular (RV) function with cardiac magnetic resonance (CMR) in congenital heart disease.

METHOD AND MATERIALS

Fifty-one consecutive patients (age mean±standard deviation 30.6±15 years) with congenital heart disease (17 had Tetralogy of Fallot, 8 had pulmonary insufficiency and 6 had RV dilation as main diagnosis) were studied. CMR was performed on a 1.5 T scanner to evaluate ventricular function and mass. Inversion recovery gradient-echo sequences were used 10 minutes after the IV injection of gadobenate dimeglumine 0.1 mmol/kg to produce DE images. Medis Qmass software (version 7.6) was used to quantitatively assess LV DE using 2 standard deviation(sd), 6 sd and automatic scar threshold methods to obtain the percentage, volume and mass of contrast-enhanced myocardial tissue.

RESULTS

The mean RV end-diastolic volume (EDV) was 140±47 ml and the mean contrast-enhanced LV myocardial volume was 3.8±2.8 ml using 6sd method. All DE was localize on inferior and/or superior ventricular insertion points. A significant correlation between LV DE and EDV was found using 6sd method (Rho = 0.477 P<.001).

CONCLUSION

The amount of contrast-enhanced LV myocardial tissue was significantly correlated with right ventricular end-diastolic volume in patients with congenital heart disease.

CLINICAL RELEVANCE/APPLICATION

LV insertion points delayed enhancement could be a clinical indicator of right ventricular dysfunction and a prognostic tool in patients with congenital heart diseases.

SSQ02-07  Pre-TAVI Evaluation of Aortic Root: Correlation of Manual and Semi-Automated Measurements

Thursday, Dec. 1 11:30AM - 11:40AM Room: S504AB

Awards
Student Travel Stipend Award

Participants
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Marco Das, MD, Maastricht, Netherlands (Abstract Co-Author) Research Consultant, Bayer AG Research Grant, Siemens AG Speakers Bureau, Siemens AG Research Grant, Koninklijke Philips NV

PURPOSE

Precise evaluation of aortic root with use of retrospectively ECG-gated CT scanning is a necessary part of pre-procedural TAVI planning. Highly sophisticated manual measurements require experienced readers and a lot of time for performing this tedious task. Semi-automatic software can assist with partial automation of assessment of multiple parameters. The aim was to evaluate differences between manual and semi-automated approach in terms of measurements and to compare time consumption of the assessment.

METHOD AND MATERIALS

150 pre-TAVI candidates who underwent retrospectively ECG-gated CT scan (2nd & 3rd gen. Dual Source CT) were evaluated.
Fully manual and semi-automated measurements of aortic root dimensions were assessed in 20% phase of cardiac cycle. Semi-automated assessment was performed with dedicated software (Syngo.via Valve Pilot, Siemens). Timing of both techniques was tracked with a measuring tool programmed in MS Excel. Measured values were correlated with Pearson’s Correlation. Necessary reading time was compared using paired samples t-test.

RESULTS

Mean values (manual assessment; semi-automated assessment) were as follows: aortic annulus (AA) short axis (2.20 ± 0.23; 2.21 ± 0.24) AA long axis (2.764 ± 0.28; 2.784 ± 0.28), AA area (4.74 ± 0.95; 4.89 ± 0.95), AA area derived perimeter (2.44 ± 0.25; 2.49 ± 0.24), long axis at left coronary ostium (3.54 ± 0.42; 3.45 ± 0.39), long axis at right coronary ostium RCO (3.29 ± 0.43; 3.30 ± 0.40), widest portion of coronary sinus (3.64 ± 0.41; 3.52 ± 0.41), long axis at sinotubular junction (3.05 ± 0.43; 3.16 ± 0.40). Strong positive linear correlation was found within all measured parameters (range: r=0.80 - 0.92, all p<0.001). Time needed for aortic root evaluation was significantly lower (p<0.001) using semi-automated approach (2 min 34 sec ± 48 sec) compared to fully manual assessment (4 min 51 sec ± 56 sec).

CONCLUSION

Using semi-automatic software for pre-TAVI evaluation significantly lowers necessary reading time while achieving comparable results in terms of measurements.

CLINICAL RELEVANCE/APPLICATION

Pre TAVI assessment is tedious and time consuming, using dedicated software reading time can be significantly reduced.

SSQ02-08 Myocardial Iodine Concentration Measurement Using Spectral-CT for Diagnosis of Cardiac Amyloidosis: A Pilot Study

Thursday, Dec. 1 11:40AM - 11:50AM Room: S504AB

Participants
virgile chevance, Creteil, France (Presenter) Nothing to Disclose
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Philippe Richard, Velzy Cedex, France (Abstract Co-Author) Employee, General Electric Company

PURPOSE

To evaluate iodine myocardial concentration in patients with cardiac amyloidosis (CA) using spectral-CT (multi-energy CT)

METHOD AND MATERIALS

Twenty two patients with CA, 13 with non-amyloid hypertrophic cardiomyopathies (CH) and 9 control patients were explored with a multi-energy cardiac CT (HD 750; GE; USA). Images were acquired 5 minutes after contrast medium injection (Iomeprol; 1,5 mL/kg). Interventricular septum thickness and myocardial iodine concentration (mg/mL) were calculated on enhanced images on a dedicated platform (ADW 4.6).

RESULTS

Interventricular septum thickness was significantly (P<0.001) higher in CA (17 ± 4 mm) and CH (15 ± 3 mm) patients than in control patients (10 ± 1 mm). CA patients exhibited significantly (P<0.005) higher iodine concentration within myocardium (2.69 ± 0.6 mg.mL-1) than CH (1.84 ± 0.5 mg.mL-1; P<0.001) and control patients (1.93 ± 0.4 mg.mL-1; P<0.005). CH and control patients did not exhibit significant difference each other (P=0.9). The Area Under Curve of mean iodine concentration for diagnosis of CA patients as 82 % and 77 %, respectively.

CONCLUSION

Spectral-CT reveals high myocardial iodine concentration in patients with CA and could be used to separate CA and non-amyloid hypertrophic cardiomyopathies.

CLINICAL RELEVANCE/APPLICATION

Measurement of iodine concentration within myocardium using spectral-CT could be used as a new diagnostic criteria for cardiac amyloidosis, especially in patients with MR contraindications.

SSQ02-09 Relationship of Regional Myocardial Function with Myocardial Trabeculation: The Multi-Ethnic Study of Atherosclerosis

Thursday, Dec. 1 11:50AM - 12:00PM Room: S504AB

Participants
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Gregory Hundley, MD, Winston Salem, NC (Abstract Co-Author) Research Grant, Astellas Group; Speakers Bureau, Bracco Group; Stockholder, Prova Images
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James Moon, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
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Bharath Ambale Venkatesh, PhD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

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PURPOSE
To determine if regional myocardial function assessed by cardiac MR (CMR) is associated with the degree of trabeculation of the left ventricular (LV) myocardium.

METHOD AND MATERIALS
Trabeculation was measured as the ratio of noncompacted versus compacted myocardium (NC/C) and as fractal dimension (FD), a novel index to assess endocardial complexity, on steady-state free precession cine images in subjects from the Multi-Ethnic Study of Atherosclerosis. Included were subjects with a complete CMR exam and without myocardial scar. Regional myocardial function was measured as peak regional systolic circumferential shortening (Ecc) derived from CMR tagging. Demographic characteristics, traditional cardiovascular risk factors and CMR measures of LV volume and function were stratified by quartiles of NC/C and FD. The association of NC/C and FD with strain (n=745 and n=1123, respectively) was assessed by linear regression in univariate and multivariable models.

RESULTS
Mean age was 67±9 years, 53% women. 34% of subjects had a NC/C >2.3, considered the cut-off for LV noncompaction cardiomyopathy (LVNC) in CMR. 8% of participants had a FD of >1.3, considered the threshold for a LVNC. Subjects with higher NC/C had a lower systolic blood pressure (SBP), a higher LV end-diastolic volume (EDV) and a lower ejection fraction (EF) (p<0.05, all comparisons). Participants with a higher FD had a higher SBP (p<0.05) and higher Ecc (indicating worse regional function) (p<0.05) while there were no differences in LVEDV and LVEF between quartiles of FD. In univariate analysis, a higher FD was associated with higher Ecc (indicating worse regional function) (β=6.6%; p<0.0001). The association persisted after adjustment for demographic covariates (β=4.0%; p<0.0001), traditional risk factors (β=3.6%; p<0.0001) and CMR measures (β=2.8%; p=0.002). There was no association between NC/C and myocardial strain (Ecc).

CONCLUSION
Greater LV myocardial trabeculation assessed by fractal dimension was associated with worse regional myocardial function in individuals without clinically apparent cardiovascular disease. FD, a measure of endocardial complexity, appears to be more sensitive than the NC/C ratio to define areas of regional myocardial dysfunction.

CLINICAL RELEVANCE/APPLICATION
Hypertabeculation is difficult to quantify, and severe hypertabeculation is thought to be associated with LV dysfunction.
PURPOSE
LGE (late gadolinium enhancement) imaging is able to detect myocardial fibrosis associated with various cardiac diseases. However, gadolinium-based contrast agents cannot be used for patients with end-stage chronic kidney disease associated with heart failure (HF). T1 mapping is another cardiovascular magnetic resonance (CMR) technique for myocardial tissue characterization without contrast. We sought to determine native T1 value to identify myocardial fibrosis in patients with non-ischemic HF.

METHOD AND MATERIALS
CMR was performed in 45 patients with non-ischemic HF and 15 healthy controls. Native T1 mapping using modified Look-Locker inversion recovery (3-(3)-5 sequence) was performed in all subjects, and LGE imaging was performed in all of the patients. Basal and mid-ventricular short axis slices were divided into 4 segments, and T1 value was measured in each segment. Myocardial LGE was defined on both visual assessment and quantitative assessment (2SD threshold above remote myocardium). The T1 values of septal LGE were compared with those of the septal segments without LGE, the minimal T1 value of each patient, and T1 values of the normal myocardium.

RESULTS
LGE was present in 14 of the 45 patients (31.1%) and 16 basal or mid-ventricular septal segments (17.8%). T1 values were higher in septal segments with LGE than in those without (1377.78±65.91ms vs. 1305.28±70.56; p=0.01) and those of the normal myocardium (1209.07±56.40; p<0.01). When compared with the minimal T1 value + its SD, the sensitivity for the presence of LGE was 87.5%, specificity was 70.3%, positive predictive value (PPV) was 39.0%, negative predictive value (NPV) was 96.0%, and accuracy was 73.3%. When setting T1 value above 1350 ms for identifying LGE, the sensitivity was 75.0%, specificity was 74.0%, PPV was 38.5%, NPV was 93.2%, and accuracy was 84%. When combining the minimum T1 value + its SD and T1 value > 1350 ms, the sensitivity was 75.0%, specificity was 86.5%, PPV was 54.6%, NPV was 94.1%, and accuracy was 84%.

CONCLUSION
Native T1 mapping can be used for assessment of myocardial fibrosis in non-ischemic HF, especially when comparing with minimal T1 value in each patient.

CLINICAL RELEVANCE/APPLICATION
T1 mapping without contrast can be used for detection of myocardial fibrosis in patients with non-ischemic heart failure by comparing septal T1 value to minimal T1 value in each patient.

PURPOSE
We conducted this study in order to assess the difference in thoracic aortic wall calcification between two groups of young (20 to 30 years old) and older (60 to 75 years old) healthy subjects using NaF-PET/CT.
METHOD AND MATERIALS

We evaluated 20 healthy subjects in the 20-30 years old age group and 20 healthy subjects in the 60-75 years old age group. The subjects underwent 90-min NaF PET/CT under similar conditions. A whole vessel analysis was performed in axial section for each of the analyzed vascular districts including ascending aorta (AA), aortic arch (AR) and descending thoracic (DA) aorta using a standard workstation. The maximum and mean Standardized Uptake Values (SUV) of NaF within the Regions of Interest (ROI) which were drawn around the aorta by an experienced physician, were calculated to obtain SUVmax and SUVmean for each slice, respectively. The SUVmax and SUVmean were normalized to blood NaF activity obtained from Superior Vena Cava (SVC) and blood-normalized whole artery uptake known as the arterial target-to-background ratio (TBR) was calculated. The TBRmax and TBRmean were assessed using the independent sample T test between the two groups.

RESULTS

According to our results, the only significant difference was observed in the arch region between the two groups: TBRmax 1.31 in old vs. 1.16 in young subjects respectively; p value = 0.008. In other regions, TBRmax was slightly higher in the young subjects, though the difference was not statistically significant. With regard to TBRmean, the two groups of study were not significantly different except for the descending thoracic aorta that showed significant difference. TBRmean was higher in young subjects compared to old subjects (TBRMean 2.37 in young vs. 1.83 in old subjects respectively; P value = 0.04).

CONCLUSION

In this study, we observed a significantly higher NaF uptake in the arch of aorta in subjects of old age groups in comparison to young subjects. This finding may highlight the fact that active process of cholesterol plaque calcification continues in older ages, which may be related to the turbulent blood flow in the arch region as compared to other regions of the aorta.

CLINICAL RELEVANCE/APPLICATION

Ongoing process of thoracic aortic wall calcification with increasing age can be detected and monitored using the NaF-PET/CT.

CA254-SD-THA3

High-pitch, Double-spiral CTA with Low Radiation Exposure for Assessment of Early Postoperative Patency of Coronary Artery Bypass Grafts

Station #3

Participants
Shinsuke Shimoyama, MD, Kobe, Japan (Presenter) Nothing to Disclose
Tatsuya Nishii, MD, PhD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Yoshiaki Watanabe, MD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Atsushi K. Kono, MD, PhD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Noriyuki Negi, RT, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Shunpei Mori, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Satoru Takahashi, MD, Suita, Japan (Abstract Co-Author) Nothing to Disclose
Kazuo Sugimura, MD, PhD, Kobe, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group

PURPOSE

This study aimed to evaluate high-pitch, double-spiral acquisition (HPDS) using third-generation dual-source CT (3rd DSCT) compared with the conventional single-spiral (SS) mode for assessing coronary artery bypass graft (CABG) patency regarding image quality and radiation dose.

METHOD AND MATERIALS

Sixty-four consecutive patients who had undergone ECG-gated CT angiography (CTA) for assessment of graft-patency after CABG using 3rd DSCT were retrospectively reviewed. We included 39 patients (median, 75 years; 15 females; 26 with HPDS) who had CTA for checking early graft patency within 4 weeks after CABG surgery. In HPDS (pitch, 3.2; temporal resolution, 66 ms), when the heart rate was higher than 75 bpm, a scan was targeted to the systolic phase instead of diastolic phase. Heart rate and effective radiation dose were recorded. For patient-based analyses, the signal-to-noise ratio (SNR) in the ascending aorta (SNRA) was measured. For graft-based analyses, the SNR of each graft (SNRG) and subjective 5-point Likert scales (0=poor, and 4=excellent) of motion and metal artifacts of each graft were evaluated. Differences between the two modes were assessed by Welch's test and the Cochran–Armitage test.

RESULTS

The effective dose was significantly lower in HPDS compared with the conventional SS mode (24.1±8.0 vs. 1.8±0.6 mSv, P<0.01). The median heart rate in HPDS (72bpm, range 60 to 107bpm) was not significantly different from that of the SS mode. Mean SNR was also not significantly different (20.1±3.9 in HPDS vs. 20.1±3.9 in SS). For graft-based analyses, 54 GABGs (25 arterial grafts, 50 patent grafts) were analyzed. Mean SNRG (16.2±4.1 in HPDS vs. 14.2±5.7 in SS) and subjective image scores were not significantly different, with a sufficiently high score (median, 4 for each) for diagnosis in the two modes.

CONCLUSION

HPDS with 3rd DSCT significantly reduces the radiation dose compared with the conventional SS mode without obscuring image quality for assessing patency of CABG.

CLINICAL RELEVANCE/APPLICATION

Even with a high heart rate, HPDS with 3rd DSCT can be used as a routine method for assessing early postoperative CABG patency with low radiation exposure without obscuring image quality.

CA255-SD-THA4

Correlation Between Left Ventricular Insertion Points Delayed Enhancement And Right Ventricular Dilation with Cardiac Magnetic Resonance in Patients with Congenital Heart Disease

Station #4

Participants
PURPOSE

The purpose of our study was the quantitative evaluation of left ventricular (LV) delayed enhancement (DE) in relation to right ventricular (RV) function with cardiac magnetic resonance (CMR) in congenital heart disease.

METHOD AND MATERIALS

Fifty-one consecutive patients (age mean±standard deviation 30.6±15 years) with congenital heart disease (17 had Tetralogy of Fallot, 8 had pulmonary insufficiency and 6 had RV dilation as main diagnosis) were studied. CMR was performed on a 1.5 T scanner to evaluate ventricular function and mass. Inversion recovery gradient-echo sequences were used 10 minutes after the IV injection of gadobenate dimeglumine 0.1 mmol/kg to produce DE images. Medis Qmass software (version 7.6) was used to quantitatively assess LV DE using 2 standard deviation (sd), 6 sd and automatic scar threshold methods to obtain the percentage, volume and mass of contrast-enhanced myocardial tissue.

RESULTS

The mean RV end-diastolic volume (EDV) was 140±47 ml and the mean contrast-enhanced LV myocardial volume was 3.8±2.8 ml using 6sd method. All DE was localize on inferior and/or superior ventricular insertion points. A significant correlation between LV DE and EDV was found using 6sd method (Rho = 0.477 P<.001).

CONCLUSION

The amount of contrast-enhanced LV myocardial tissue was significantly correlated with right ventricular end-diastolic volume in patients with congenital heart disease.

CLINICAL RELEVANCE/APPLICATION

LV insertion points delayed enhancement could be a clinical indicator of right ventricular dysfunction and a prognostic tool in patients with congenital heart diseases.
PURPOSE
Previous studies have hypothesized that aortic valve stenosis leads to dilation of the ascending aorta secondary to a post-stenotic dilation phenomenon. The purpose of this study is to dispute this theory with a retrospective review of patients with clinically significant aortic stenosis undergoing preoperative CT angiography (CTA) for transcatheter aortic valve replacement (TAVR).

METHOD AND MATERIALS
120 patients (mean age 80.2 ± 8.4 years) undergoing preoperative CTA for TAVR between August 2014 and January 2016 were reviewed. All scans were performed on a 320-slice CT with retrospective gating. Maximum ascending aorta diameter and area were measured using centerline technique on a 3-D workstation. Spearman correlations were used to test relationships between ascending aorta size and preoperative echocardiographic measurements of aortic valve area, peak velocity, and peak gradient.

RESULTS
Maximum ascending aorta median diameter was 3.5 cm (interquartile range [IQR] 3.3 – 3.8 cm) and median area was 900 mm² (IQR 803 – 1120 mm²). 19 of 120 (15.8%) patients had an ascending aorta diameter over 4 cm and 3 of 120 (2.5%) had a diameter over 4.5 cm. On echocardiography, median aortic valve area was 0.7 cm², median aortic valve peak velocity was 3.9 m/s, and median aortic valve peak gradient was 61.3 mmHg. There were no significant correlations between maximum ascending aorta diameter and echocardiographic measurements of aortic valve area (R=0.16, p=0.08), peak velocity (R=-0.04, p=0.69), and peak pressure gradient (R=0.06, p=0.49). There were also no significant correlations between maximum ascending aorta area and the same echocardiographic measurements.

CONCLUSION
The ascending aorta was normal in size in the vast majority of patients undergoing evaluation for TAVR despite clinically significant aortic stenosis. There was no significant correlation between ascending aorta size and echocardiographic markers of aortic stenosis.

CLINICAL RELEVANCE/APPLICATION
Contrary to previous theories, aortic valve stenosis does not result in post-stenotic dilation of the ascending aorta.
PURPOSE
Magnetic susceptibility is a physical tissue property that varies in healthy tissue and may also change with pathologic conditions. We evaluated whether quantification of myocardial susceptibility by cardiac magnetic resonance (CMR) is useful for detection of cardiac involvement in amyloidosis.

METHOD AND MATERIALS
Sixteen cardiac amyloidosis patients underwent 3.0T CMR including magnetic phase imaging with multi-echo spoiled gradient echo sequence. Their myocardial susceptibility was quantified by magnetic phase analysis; measurement of phase values for each echo time, then the phase shift slope was obtained by the method of least squares. Those were compared with 15 healthy volunteers. The diagnostic performance of myocardial susceptibility imaging was also assessed using receiver operating characteristic curve (ROC) analysis.

RESULTS
There was significant difference in the myocardial susceptibility (magnetic phase shift in myocardium) between cardiac amyloidosis patients and healthy volunteers. The ROC analysis demonstrated that the area under curve of 0.858 for the slope of the myocardial phase shift, and 0.908 when using a logistic regression model.

CONCLUSION
The quantification of myocardial susceptibility by CMR is capable of identifying cardiac involvement in amyloidosis.

CLINICAL RELEVANCE/APPLICATION
The quantification of myocardial susceptibility by CMR offers new insights into cardiac diseases. It may be able to identify cardiac involvement in patient with amyloidosis.
METHOD AND MATERIALS

89 patients with suspected cardiac sarcoidosis were investigated with FDG-PET and CMR within 2 weeks (82 same day). Patients undergoing FDG-PET followed a 24 hour low-carbohydrate diet and overnight fast. CMR included SSFP assessment of left ventricular (LV) function and LGE. Images were reviewed by 2 readers blinded to the results of the other examination. FDG-PET was considered positive if any segment (17 segment model) had an SUVmax>3.6. CMR was considered positive if any segment showed 'sarcoid-type' LGE. Patients with biopsy proven sarcoid or lung CT changes consistent with sarcoid were classified according to modified Japanese Ministry of Health & Welfare guidelines as JMHW +ve or -ve (Ohira. Eur J Nucl Med Mol Imaging 2016:43:259).

RESULTS

82 patients had biopsy proven or lung CT evidence of sarcoid. Of these, 13 met JMHW criteria and all showed myocardial FDG uptake. 10 also showed LGE on CMR. In 69 JMHW –ve patients, 20 showed myocardial FDG uptake with 8 also showing LGE. 5 patients had LGE with no myocardial FDG uptake and 44 showed neither FDG uptake nor LGE. In 7 patients with unexplained arrhythmia but no pathology or lung CT changes of sarcoid, 1 showed myocardial FDG uptake with LGE and 3 showed LGE alone. 19 patients had LV impairment, 8 were JMHW +ve (62%) and 8 JMHW –ve (12%). Patients with arrhythmia but without known sarcoid were also more likely to have LV impairment (33%).

CONCLUSION

FDG-PET detects cardiac sarcoid in all JMHW +ve patients with LGE in 77%. In JMHW –ve patients, both techniques can be positive, either together or independently. In those who only show LGE, there is often no extracardiac FDG uptake to indicate active sarcoid elsewhere. In the heart, FDG appears to show active sarcoid whereas LGE shows more advanced disease that has gone on to scar. The presence of LGE is often associated with LV impairment.

CLINICAL RELEVANCE/APPLICATION

Current literature suggests FDG-PET and CMR are equivalent in detecting cardiac sarcoidosis. This is not our experience. FDG-PET and CMR are complimentary and should be used together whenever possible.

CA261-SD-THB5

Quantification of the Cardiac Ventricular Functional Parameters: A Comparative Study between Computed Tomography and Cardiac Magnetic Resonance Imaging

Station #5

Participants
Jae Wook Lee, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Dong Hyun Yang, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Joon-Won Kang, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Tae-Hwan Lim, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hongseok Ko, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

To compare the ventricular functional parameters measured with computed tomography (CT) and cardiac magnetic resonance (CMR) imaging.

METHOD AND MATERIALS

We retrospectively reviewed one-hundred seventeen individuals (62 male, 55 female, age range, 21-80 years; median age 58 years) with cardiac disease who underwent both CT and CMR within 30 days of interval (mean 3.5 days). Volumetric analysis was performed on commercialized software products syngo.via (Siemens Healthcare Global) using contiguous multiphase CT data and cvi42 (Circle Cardiovascular Imaging) using short-axis cine CMR. Pearson correlation and Bland-Altman analyses were performed. The intra- and interobserver variability were calculated on the randomly selected patient (n=29) by means of intraclass correlation coefficient (ICC).

RESULTS

Functional parameters of left ventricle (LV) were well-correlated between CT and CMR (r=0.79 to 0.95). On the Bland-Altman analysis, CT tended to underestimate LV end-diastolic volume (EDV) and LV end-systolic volume (ESV) (LV EDV=-9.6 ± 15.6%, LV ESV=-29.9 ± 33.7%), and overestimate ejection fraction (EF) and myocardial mass (LV EF=14.2 ± 23.4%, LV mass=11.5 ± 14.4%) than CMR. Functional parameters of right ventricle (RV) were well-correlated between CT and CMR (r=0.76 to 0.90), except for moderate correlation of EF (r=0.66). RV EDV and RV ESV were overestimated by CT on the Bland-Altman Analysis (RV EDV=11.0 ± 19.3%, RV ESV=6.6 ± 28.4%). CT showed high reproducibility on both LV and RV functional parameters (intraobserver ICC; LV=0.98 to 1.00, RV=0.81 to 0.95; interobserver ICC; LV=0.97 to 0.99, RV=0.80 to 0.96) and CMR showed high reproducibility on LV functional parameters and moderate reproducibility on RV functional parameters (intraobserver ICC; LV=0.97 to 0.99, RV=0.55 to 0.81, interobserver ICC; LV=0.92 to 0.99, RV=0.59 to 0.89).

CONCLUSION

Functional parameters measured from CT and CMR generally showed good correlation, but also manifest some difference; CT tended to underestimate LV EDV and LV ESV compared to CMR, whereas overestimate LV myocardial mass, RV EDV and RV ESV. LV functional parameters were highly reproducible on both CT and CMR, whereas RV functional parameters were only highly producible on CT.

CLINICAL RELEVANCE/APPLICATION

Either CT or CMR can be used reliably when measuring cardiac ventricular functional parameters.
**Imaging Congenital Cardiac Abnormalities**

Thursday, Dec. 1 4:30PM - 6:00PM Room: S402AB

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

FDA Discussions may include off-label uses.

**Participants**
Dianna M. Bardo, MD, Phoenix, AZ, (dbardo@phoenixchildrens.com) (Moderator) Speaker, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Author, Thieme Medical Publishers, Inc

**LEARNING OBJECTIVES**
1) To review the spectrum of congenital coronary artery anomalies. 2) To specially review the hemodynamically significant coronary artery anomalies. 3) To review specific features that have important surgical implications.

**ABSTRACT**
Coronary CTA has become the standard of reference for evaluation of coronary artery anomalies. CT exquisitely depicts the origin, course and termination of complex coronary artery anomalies because of its excellent spatial resolution. Most anomalies are incidentally detected, though some present with cardiac ischemia or even sudden death, particularly in young athletes. It is important to recognize these anomalies on not only the dedicated cardiac CTA studies, but also on routine chest CT’s, as this can affect patient prognosis. This lecture will mainly focus on hemodynamically significant coronary artery anomalies such as the anomalous coronary artery from the opposite sinus of Valsalva with an interarterial or interarterial-intramural course, coronary artery fistulas and coronary artery origin from the pulmonary artery. For hemodynamically significant interarterial coronary artery anomalies, it is important to differentiate between the interarterial vs. interarterial-intramural coronary arteries as these have different surgical approaches.

**Sub-Events**

**RC703A Coronary Anomalies**

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

**LEARNING OBJECTIVES**
1) Learn the roles of echocardiography, CT and MRI in the diagnosis of congenital heart diseases. 2) Learn the imaging findings that are important in decision making process of medical and surgical management of congenital heart diseases. 3) Be familiar with the principles and tips of 3D reconstruction of CT and MRI images for surgical planning of congenital heart diseases.

**ABSTRACT**
Echocardiography is the primary imaging modality in the diagnosis of congenital heart diseases. In complex forms of congenital heart diseases, CT and MRI are required for better delineation of complicated anatomy and hemodynamics. Imaging findings should answer whether the pulmonary or systemic circulation is dependent on the patency of ductus arteriosus and whether to opt biventricular or univentricular repair. Imaging, postprocessing and image interpretation should then be tailored to facilitate the intended surgical procedures such as ventricular outflow reconstruction, intraventricular baffling, arterial switch, aortic arch reconstruction, etc. For surgical guidance, 3D reconstruction of the endocardial surface anatomy as well as conventional volume rendered cavitograms is very helpful. With computer aided design tools, surgical patches or baffles can be graphically designed for assessment of the result of the intended procedure in advance. 3D printing is also very helpful in surgical planning and training.

**RC703B Diagnosing Untreated Congenital Heart Disease**

**Participants**
Shi-Joon Yoo, MD, Toronto, ON (Presenter) Owner, 3D HOPE Medical; CEO, IMIB-CHD;

**LEARNING OBJECTIVES**
1) To recognize complex congenital heart disease on chest CT scans performed for other indications. 2) To tailor cardiac CT protocols and reconstructions to answer specific clinical questions for patients with treated congenital heart disease- specifically tetralogy of Fallot, Ebstein anomaly and transposition of the great arteries. 3) To provide information that guides therapy related to longstanding complications of congenital heart disease and its treatment.

**ABSTRACT**
Advances in treatment of congenital heart disease has resulted in prolonged survival of patients with congenital heart disease. These patients present for imaging to radiologists with general chest complaints and for dedicated cardiac imaging to resolve specific clinical questions. This lecture will focus on three complex congenital heart disease diagnoses: tetralogy of Fallot, Ebstein anomaly and transposition of the great arteries. The chest CT findings of complex congenital heart disease should be recognized by
radiologists in practice. Adults with milder spectrum complex congenital heart disease may initially be diagnosed during adulthood. Those who had successful childhood treatment often fall through the gaps in care during the transition from pediatric to adulthood. Proper recognition of these diagnoses is of great importance and radiologists who are not subspecialized in cardiac imaging have the opportunity to greatly contribute to the care of these patients. Additionally, cardiac CT is a good alternative to MRI in answering crucial questions that arise during clinical care and on echocardiography. Emphasis will be placed on indications for CT, technical tips to achieve diagnostic images and on demonstrating complications that require intervention.

**LEARNING OBJECTIVES**

1. To be familiar with the strengths and weaknesses of cardiac MRI in comparison with other imaging modalities such as echo, CT, conventional catheter angiogram.
2. To look at the role of MRI in four specific adult congenital heart diseases - tetralogy of Fallot, coarctation, d transposition.
   a. What to look for?
   b. Protocols as recommended by various guidelines.
   c. Frequency of examinations.

**ABSTRACT**

Abstract: Diagnosis and monitoring of adult congenital heart disease (ACHD) relates to 1. Monitoring post-surgical changes. 2. For pre-surgical planning. 3. For prognostication. 4. Late initial diagnosis of previously unsuspected ACHD. Transthoracic echocardiography remains the first line imaging modality in ACHD but struggles with comprehensive anatomical coverage of extra cardiac structures, optimal assessment of the right sided cardiac chambers and tissue characterization. Cardiac MRI provides useful information regarding anatomy including that of extra cardiac vascular anatomy, functional assessment particularly of the right sided cardiac chambers and valves and tissue characterization without the use of ionizing radiation. This presentation will focus on the role of CMR in three ACHD most commonly encountered in practice - coarctation, tetralogy of Fallot and transposition of the great arteries.

**Active Handout:** Mini Vithal Pakkal

SST02

Cardiac (Quantitative Imaging)

Friday, Dec. 2 10:30AM - 12:00PM Room: E450A

Participants
Seth J. Kligerman, MD, Denver, CO (Moderator) Nothing to Disclose
Bernd J. Wintersperger, MD, Toronto, ON (Moderator) Speakers Bureau, Siemens AG; Research support, Siemens AG

Sub-Events

SST02-01 Native T1 Variations after Repeated Measurements: Implication for Defining Regional Myocardial Changes Using MRI

Friday, Dec. 2 10:30AM - 10:40AM Room: E450A

Participants
Kai Lin, MD, MSc, Chicago, IL (Presenter) Nothing to Disclose
Jeremy D. Collins, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Kenichiro Suwa, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Zhanrning Fan, Beijing, China (Abstract Co-Author) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (Abstract Co-Author) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc
James C. Carr, MD, Chicago, IL (Abstract Co-Author) Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

PURPOSE
Changes of native T1 values may reflect the progression of cardiovascular diseases (CVDs). However, it can be difficult to determine whether a local change in native T1 values in the left ventricle (LV) is caused by measurement inaccuracies due to reproducibility and/or observer variability or by real changes in tissue structure as a result of improvement or deterioration of cardiovascular diseases. The aim of the present study was to establish normal T1 variation (T1v) thresholds for repeated measurements of regional T1 values using magnetic resonance imaging (MRI).

METHOD AND MATERIALS
This HIPAA compliant study was approved by the institutional review board (IRB). Eighteen healthy volunteers (38.5 ± 15.4 years [mean ± SD]; age range: 23 - 70 years; 12 male and 6 female) recruited to undergo 2 consecutive cardiac MRI scans using modified Look-Locker Inversion recovery (MOLLI) with two basal resolutions on different days to repeat T1 measurements on LV (at base, mid-ventricular and apex levels). The absolute differences (d) and standard deviations (SDs) of regional T1 values were acquired with the two scans (with basal resolutions 256 and 384) and two readers. T1v threshold (mean difference + 2SD), intra-class correlation coefficient (ICC) and coefficient of variation (CoV) were calculated on LV slices and segments.

RESULTS
T1 mapping using the MOLLI sequence was successfully performed in all 18 volunteers twice. For all participants, there was no significant difference of heart rates and blood pressure between two scans. There were totally 54 LV slices and 288 myocardial segments eligible for analysis. On a per-slice basis (n = 54), ICCs for intra-observer, inter-observer, inter-resolution, inter-study T1v were 0.988, 0.899, 0.763 and 0.6. CoVs were 0.72%, 2.39%, 3.90% and 4.28%. T1v thresholds were 22 ms, 66 ms, 118 ms and 120 ms. On a per-segment basis (n = 288), ICCs for T1v were 0.974, 0.859, 0.711 and 0.594. CoVs were 1.09%, 3.36%, 4.69% and 5.01%. T1v thresholds were 33 ms, 94 ms, 140 ms and 144 ms. See figure 1 and 2.

CONCLUSION
The regional T1v thresholds from repeated measurements found in our study demonstrate the underlying variability of the MOLLI techniques which is commonly used for myocardial native T1 quantification.

CLINICAL RELEVANCE/APPLICATION
Based on our data, we suggest not considering a regional T1v from an individual patient that is inside of T1v thresholds, as an indication of the progression of CVDs.

Awards
Student Travel Stipend Award

SST02-02 Evaluation of Radiation-induced Cardiac Injury based on Native T1 and Extracellular Volume

Friday, Dec. 2 10:40AM - 10:50AM Room: E450A

Participants
Hidenobu Takagi, MD, PhD, Morioka, Japan (Presenter) Nothing to Disclose
Hideki Ota, MD, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Rei Umezawa, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Tomoyoshi Kimura, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Keiichi Jingu, MD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Kei Takase, MD, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose

Awards
Student Travel Stipend Award
PURPOSE
To evaluate radiation-induced cardiac injury after chemoradiotherapy (CRT) for esophageal cancer using myocardial T1 and extracellular volume (ECV) fraction.

METHOD AND MATERIALS
This institutional review board-approved prospective study enrolled 26 patients (15 men, 11 women) with esophageal cancer scheduled for CRT between January 2013 and April 2015. No subjects had known cardiovascular comorbidity. Patients underwent serial cardiac MR examinations using a 3T whole body scanner before (n = 26), 0.5 years after (n = 21) and 1.5 years after (n = 15) CRT. Scan protocol included cine MR imaging, T1 mapping using modified Look-Locker inversion recovery before and after gadolinium-contrast administration and late gadolinium enhanced MR imaging. Mean T1 time in the left ventricular myocardium and blood pool were measured on both T1 maps in 4-chamber plane images (T1myo pre, T1myo post, T1blood pre and T1blood post). Regions of interest were placed on midwall of basal interventricular septum (IVS) as an irradiated area and that of the apical lateral wall as a non-irradiated area. ECV fraction was calculated using the following formula: (1 - hematocrit)(1/T1myo post - 1/T1myo pre)/(1/T1blood post - 1/T1blood pre). Ejection fraction (EF) derived from cine MR imaging, myocardial native T1 (T1myo pre) and ECV values after CRT were compared with those at the baseline as the reference using repeated measures ANOVA with Turkey's honestly significant difference test. P < 0.05 indicated statistical significance.

RESULTS
All patients completed CRT with median total radiation dose of 60 Gy (range, 50.4–66 Gy). EF was not significantly changed after CRT. On basal IVS, native T1 of 0.5 (1256 ± 33 ms) and 1.5 years (1223 ± 59 ms) after CRT were significantly higher than that of baseline (1179 ± 41 ms, p < 0.01 for both); ECV of 0.5 (32 ± 3%) and 1.5 years (28 ± 4%) after CRT were significantly higher than that of baseline (26 ± 3%, p < 0.05 for both). On apical lateral wall, no significant change was found in native T1 nor ECV after CRT.

CONCLUSION
Myocardial native T1 and ECV in basal IVS were increased after CRT. These results indicate radiation-induced subclinical myocardial injury with preserved left ventricular function.

CLINICAL RELEVANCE/APPLICATION
Native T1 and ECV can demonstrate radiation-induced subclinical myocardial toxicity in patients with esophageal cancer treated with chemoradiotherapy.

SST02-03 Effects of 24-Hour-Shift Related Short Term Sleep Deprivation on Cardiac Function: A CMR Based Study

Participants
Daniel Kuetting, MD, Bonn, Germany (Presenter) Nothing to Disclose
Andreas Feistl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Rami Hornsi, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Julian A. Luetkens, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Daniel K. Thomas, MD, PhD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Hans H. Schild, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Darius Debir, Bonn, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Sleep deprivation is known to increase blood pressure, inflammatory processes, and stress hormone secretion. This study sought to investigate the immediate effects of 24 hour shift associated sleep deprivation on radiologists.

METHOD AND MATERIALS
15 subjects (1 female, mean age 31.6 ± 2.1 years; mean EF 60.5 %) were scanned on a clinical 1.5 T CMR scanner (Philips Ingenia) before and following a 24 hour shift with an average of 3 hours of sleep. In addition venous blood and urine samples were collected from all subjects and blood pressure (BP) as well as heart rate (HR) were measured. Short axis slices as well as horizontal long axis views were acquired using standard SSFP-sequences. Standard CMR parameters for left ventricular volumes, ejection fraction and wall thickness as well as Feature Tracking derived circumferential and longitudinal strain parameters were measured.

RESULTS
Following short term sleep deprivation (average sleep duration: 182 min) significant increases in systolic (pre: 112.6 ± 12.9 mm Hg; post: 118.5 ± 14.3 mm Hg; p = 0.017) and diastolic BP (pre: 63.9 ± 12.3 mm Hg; post: 71.5 ± 7.7 mm Hg, p = 0.021), HR (pre: 66 ± 9.8 min-1; post: 71.4 ± 11.6 min-1; p = 0.002) were noted as well as peak systolic circumferential strain (PSCS; pre: -22.3 ± 2.4 %; post: -23.9 ± 2.4 %, p = 0.011) and peak systolic longitudinal strain (PSLS; pre: -21.4 ± 1.9 %*s-1; post: -23.1 ± 1.9 %*s-1, p = 0.005) were revealed. Additionally significant increases in cortisol (pre: 10.0 ± 4.4 µg/dl; post: 14.7 ± 5.7 µg/dl; p = 0.023), TSH (pre: 1.6 ± 0.5 µU/ml; post: 2.7 ± 1.0 µU/ml; p =0.002) FT3 (pre: 3.1 ± 0.98 pg/ml, post: 3.4 ± 0.5 pg/ml; p=0.039) and FT4 (pre: 0.94 ± 0.1 ng/dl, post: 1.0 ± 0.1 ng/dl; p=0.039) levels were found. In contrast, left ventricular ejection fraction, noradrenalin, glucose and insulin levels were unchanged (p = ns).

CONCLUSION
For the first time it could be shown that 24 hour shift related short term sleep deprivation leads to a significant increase in cardiac contractility, blood pressure, heart rate and stress hormone secretion.

CLINICAL RELEVANCE/APPLICATION
The clinical relevance is not yet well understood, since these effects may only be short lived and should be further studied in a larger cohort.

SST02-04 Quantitative Assessment of Left Ventricular Three-dimensional Maximum Principal Strain Using
**Cardiac Computed Tomography: Identification of Myocardial Infarction Assessed by Cardiac Magnetic Resonance Imaging**

Friday, Dec. 2 11:00AM - 11:10AM Room: E450A

**Participants**
- Takahiro Yokoi, Toon, Japan (Presenter) Nothing to Disclose
- Yuki Tanabe, Toon, Japan (Abstract Co-Author) Nothing to Disclose
- Teruhito Kido, MD, PhD, Toon, Japan (Abstract Co-Author) Nothing to Disclose
- Naoki Fukuyama, Toon, Japan (Abstract Co-Author) Nothing to Disclose
- Akira Kurata, PhD, Toon, Japan (Abstract Co-Author) Nothing to Disclose
- Ryo Ogawa, MD, Toon, Japan (Abstract Co-Author) Nothing to Disclose
- Masashi Nakamura, Toon, Japan (Abstract Co-Author) Nothing to Disclose
- Tomoyuki Kido, Toon, Japan (Abstract Co-Author) Nothing to Disclose
- Masashi Miyagawa, MD, PhD, Toon, Japan (Abstract Co-Author) Nothing to Disclose
- Teruhito Mochizuki, MD, Toon, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Myocardial strains have a potential for accurate and objective assessment of regional cardiac dysfunction. The purpose of this study was to investigate the feasibility of three-dimensional (3D) maximum principal strain (MP-strain) of left ventricle (LV) for detecting myocardial infarction (MI) assessed by late gadolinium enhancement-magnetic resonance imaging (LGE-MRI).

**METHOD AND MATERIALS**
This study population consisted of 59 patients (mean age: 65.7±9.2 years), who underwent coronary CT angiography (CTA) with retrospective ECG gated mode and LGE-MRI for evaluation of coronary artery disease. Short axial images of LV were reconstructed every 10% (0-90%) of the RR interval of the ECG signal. The MP-strain value was analyzed in the endocardium based on the 16-segment model by using prototype software algorithm (Ziosation 2, Ziosoft Inc., Tokyo, Japan). All myocardial segments were defined as normal or infarcted segments [subendocardial (LGE<50%) and transmural infarction (LGE≧50%)] by LGE-MRI. The peak endocardial MP-strain values were analyzed at a segment level, and compared between normal and infarcted segments. Diagnostic performance [sensitivity, specificity, positive and negative predictive value (PPV and NPV)] of endocardial MP-strain for detecting MI was evaluated by receiver operating characteristic (ROC) analysis.

**RESULTS**
A total of 913 segments (97%) could be assessed for MP-strain analysis. Of 913 segments, 112 segments (12%) were diagnosed as infarcted segments. The peak endocardial MP-strain at infarcted segments were significantly lower than normal segments (median: 0.28 vs. 0.64, p <0.05), and significantly decreased in order to normal, subendocardial and transmural infarction (median: 0.64 vs. 0.34 vs. 0.23, P<0.05). The peak endocardial MP-strain had the area under the curve of 0.92 (95% confidence interval (CI): 0.89-0.94). Sensitivity, specificity, and PPV and NPV (95% CI) were 86% (80-92), 85% (82-87), 44% (38-51), and 97% (96-98) using a cut-off value of 0.40.

**CONCLUSION**
Quantitative assessment of CT MP-strain is feasible for detecting myocardial infarction assessed by LGE-MRI with high diagnostic performance.

**CLINICAL RELEVANCE/APPLICATION**
The MP-strain is available for the quantitative assessment of regional cardiac dysfunction by post-processing of coronary CTA data sets without additional radiation exposure and contrast medium.

**SST02-05 Characteristics of Myocardial Scar Assessed by T1 Mapping in MI Patients: A Preliminary CMR Study**

Friday, Dec. 2 11:10AM - 11:20AM Room: E450A

**Participants**
- Chen Cui, MSc, Beijing, China (Presenter) Nothing to Disclose
- Shihua Zhao, Beijing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
LGE cannot separate fat from fibrosis in scar tissue, for both of them manifest as high signals in LGE image. The main aim of present study is to investigate if T1 mapping by MRI is able to distinguish the difference between fat deposition, fibrosis and intact myocardium.

**METHOD AND MATERIALS**
Twenty four Patients with myocardial infarction and ten healthy volunteers were studied after written informed consent was obtained. The MRI scan protocols included a series of short axis cine imaging of LV for function analysis, water-fat separation imaging, LGE im aging and T1 maps acquired by MOLLI sequence. The patients were divided into two groups depended on the presence or absence of fat in water-fat separation image. The scar tissue characteristics was determined by the results of water-fat separation and LGE image. The T1 values of the different scar areas represent fat, fibrosis and normal myocardium were compared.

**RESULTS**
The fat deposition was found in half of the patients (12 of 24). In patient with fat deposition, the distribution of fat deposition segments are identical with the LGE area. There are significant different between the T1 value of the scar area in patient with fat deposition, without fat deposition and the normal (remote) area of the patients (521±76 vs. 1001.9±50.2 vs 1171.1±109 msec).In penitent without fat deposition, we used the remote myocardium of LGE as the standard true negative for fibrosis. The area under the ROC curve is 0.917±0.062; the best cut-off value for T1 value to detect fibrosis is 1095 msec (sensitivity of 83.3%, specificity of 91.7%).

**CONCLUSION**
Native T1 value can be used to identify the tissue characteristics of myocardium scar in patient with MI without the need of contrast agents. The fat deposition areas are lower and the fibrosis is higher than intact myocardium in T1 value.

**CLINICAL RELEVANCE/APPLICATION**

The fat deposition in myocardial scars is presence in more than half of the MI patients and is associated with different kinds of cardiac events. Present study provides new insights for further prognostic study.

**SST02-06 The Influence of Adaptive Iterative Dose Reduction 3D and Temporal Averaging on Contour Sharpness of Dynamic Myocardial CT Perfusion**

**Friday, Dec. 2 11:20AM - 11:30AM Room: E450A**

**Participants**

Sarah Feger, Berlin, Germany (Presenter) Nothing to Disclose
Ahmed Shaban, MSc, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Steffen Lukas, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Bjorn Bokelmann, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
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Marc Dewey, MD, Berlin, Germany (Abstract Co-Author) Research Grant, General Electric Company; Research Grant, Bracco Group; Research Grant, Guerbet SA; Research Grant, Toshiba Corporation; Speakers Bureau, Toshiba Corporation; Speakers Bureau, Guerbet SA; Speakers Bureau, Bayer AG; Consultant, Guerbet SA; Author, Springer Science+Business Media Deutschland GmbH; Editor, Springer Science+Business Media Deutschland GmbH; Institutional research agreement, Siemens AG; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Toshiba Corporation; ; ; ; ; ; ;

**PURPOSE**

Myocardial computed tomography perfusion (CTP) allows the assessment of the functional relevance of a coronary stenosis. Dynamic CTP may be used to quantitatively analyze the absolute myocardial blood flow, but image quality is limited due to motion artefacts. Temporal averaging and iterative reconstructions were introduced to improve image quality. However, they are supposed to deteriorate image sharpness. Thus, the aim of this study was to investigate the influence of temporal averaging and adaptive iterative dose reduction 3D (AIDR 3D) on the contour sharpness of dynamic myocardial CTP.

**METHOD AND MATERIALS**

The dynamic myocardial CT perfusion datasets of 29 patients acquired at 9.5±2.0 mSv were reconstructed with filtered back projection (FBP) and strong levels of AIDR 3D. Temporal averaging without motion correction was performed as postprocessing step by combining two, three, four, six, and eight original 3D datasets. We compared the contour sharpness based on two different parameters including 4 edges of the myocardium: the distance between 25% and 75% of the maximal grey value (d) and the maximal slope between two contiguous voxels (m).

**RESULTS**

Both objective contour sharpness parameters showed the tendency to be deteriorated for strong levels of AIDR 3D compared with FBP (d=2.50 mm versus 2.27 mm; m=121.31 versus 145.24 summarized for all 4 edges; for d p=0.02 at edge 1, p.n.s.at edges 2-4 and for m p=0.04 for all edges, respectively). With increasing levels of temporal averaging contour sharpness was slightly deteriorated. Best values for contour sharpness were acquired without temporal averaging (d=2.08 mm; m=167.34). Contour sharpness was worst for strongest levels of temporal averaging (d=2.52 mm; m=117.68; comparison between lowest and highest temporal averaging level: for d p=0.17 at all edges and for m p=0.019 at edges 1,3,4 and p.n.s. at edge 2).

**CONCLUSION**

The usage of higher levels of temporal averaging without motion correction and strong levels of AIDR 3D slightly deteriorated objective contour sharpness parameters of dynamic myocardial CTP.

**CLINICAL RELEVANCE/APPLICATION**

In dynamic myocardial CTP the implementation of AIDR 3D and temporal averaging might reduce contour sharpness.

**SST02-07 Fibrosis Quantification in Hypertensive Heart Disease with LVH and Non-LVH: Findings from T1 mapping and Contrast-free Cardiac Diffusion weighted Imaging**

**Friday, Dec. 2 11:30AM - 11:40AM Room: E450A**

**Participants**

Lian-Ming Wu, Shanghai, China (Presenter) Nothing to Disclose

**PURPOSE**

To assess the extent of fibrosis and relationship between ADC value and systolic strain in hypertensive patients with left ventricular hypertrophy (HTN LVH), hypertensive patients without LVH using cardiac Diffusion weighted imaging and T1 mapping.

**METHOD AND MATERIALS**

T1 mapping was underwent in 13 HTN LVH (mean age, 56.23±3.30 years), 17 HTN non-LVH (mean age, 56.41±2.78 years), and 12 normal control subjects (mean age, 55.67±3.08 years) at 3.0T MRI using cardiac Diffusion weighted imaging and previously validated modified look-locker inversion-recovery pulse sequence and the mean ADC ECV and native T1 were determined for each subject.

**RESULTS**

HTN LVH subjects had higher native T1 (1233.12±79.01) compared with controls (1133.88±27.40) (p<0.05). HTN LVH subjects had higher ECV (0.28±0.03) compared with HTN non-LVH subjects (0.26±0.02) and controls (0.24±0.03) (p<0.05). HTN LVH subjects had higher ADC (2.23±0.34) compared with HTN non-LVH subjects (1.88±0.27) and controls (1.61±0.38) (p<0.05). A positive association was noted between LVMI and ADC (Spearman=0.450, p<0.05). However, ADC was not linearly related to an increase in...
SST02-08 Demonstration of Subclinical Myocardial Fibrosis in Patients with Primary Aldosteronism by Native T1 Time and Extracellular Volume Fraction

Friday, Dec. 2 11:40AM - 11:50AM Room: E450A

Participants
Hidenobu Takagi, MD, PhD, Morioka, Japan (Presenter) Nothing to Disclose
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Ryo Morimoto, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
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Kentaro Takanami, MD, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Kei Takase, MD, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the degree of myocardial fibrosis in patients with primary aldosteronism (PA) based on native T1 and extracellular volume fraction (ECV).

METHOD AND MATERIALS
This retrospective study included 36 PA patients (20 men, 16 women) diagnosed by experienced endocrinologists and 15 control patients (9 men, 6 women) with essential hypertension. No subjects had known cardiovascular comorbidity nor severe renal dysfunction. All patients underwent cardiac MR examinations using a 3T whole body scanner between January 2013 and March 2016. Scan protocol included cine MR imaging, T1 mapping using modified Look-Locker inversion recovery before and after gadolinium-contrast administration and late gadolinium enhanced MR imaging. Mean T1 time on left ventricular myocardium and blood pool were measured on 4-chamber plane images before and after gadolinium-contrast injection. Regions of interest were placed on the midwall of basal interventricular septum (IVS) and apical lateral wall and left ventricular chamber. ECV fraction was calculated using hematocrit and individual T1 values. Presence of late gadolinium enhancement (LGE) was evaluated. The mean values of native T1 and ECV fraction as well as the presence of LGE were compared between PA and control groups. P<0.05 indicated statistical significance.

RESULTS
The prevalence of LGE, native T1 and ECV in PA group were significantly higher than that of control group (prevalence of LGE, 44.1% vs. 6.7%, p<0.02; native T1, basal IVS, 1240±8ms vs. 1183±15ms, apical lateral, 1185±9ms vs. 1124±16 ms, p<0.01 for both; ECV, basal IVS, 29±1% vs. 26±1%, apical lateral, 30±1% vs. 26±1%, p<0.05 for both). A similar tendency was found in 19 PA patients and 14 controls who had no LGE (native T1, basal IVS, 1236±13ms vs. 1189±17ms, apical lateral, 1189±14ms vs. 1126±17ms, p<0.05 for both; ECV, basal IVS, 29±1% vs. 26±1%, apical lateral, 30±1% vs. 26±1%, p<0.05 for both).

CONCLUSION
Myocardial native T1 and ECV in PA group were significantly higher than that of control hypertensive patients. These results indicate increased myocardial fibrosis in PA patients who has no history of cardiovascular disease.

CLINICAL RELEVANCE/APPLICATION
Native T1 and ECV can assess subclinical myocardial damage in PA patients.
PURPOSE
To compare two technical approaches for CT-derived coronary functional flow reserve (cFFR) determination: a method based on computational fluid dynamics (cFFRCFD) and a machine learning algorithm (cFFRML).

METHOD AND MATERIALS
Sixty-seven coronary lesions in 58 patients (61±12 years, 64% male) who had undergone CT angiography (CTA) followed by invasive FFR were included in this single-center retrospective study. cFFR values were derived from CTA datasets on-site on a local workstation using both cFFRCFD and cFFRML based on coronary artery anatomy and ventricular mass integrated with hemodynamic parameters. Diagnostic performance of both cFFR techniques was compared and evaluated for detection of lesion-specific ischemia against visual stenosis grading on CCTA, quantitative coronary angiography (QCA), and invasive FFR as the reference standard.

RESULTS
On a per-lesion and per-patient level, cFFRML showed a sensitivity of 77% and 87%, and a specificity of 96% and 89% for detecting lesion-specific ischemia, respectively. Furthermore, cFFRCFD resulted in a sensitivity of 77% and 85% and a specificity of 91% and 88% on a per lesion and per-patient basis (p=0.89 and p=0.95, respectively). At receiver operating characteristics analysis on a per-lesion level, cFFRML (AUC 0.85) and cFFRCFD (AUC 0.84) showed significantly higher discriminatory power for detecting lesion-specific ischemia compared to CCTA (AUC 0.62) and QCA (AUC 0.69) (cFFRML, p=0.001 and p=0.03; cFFRCFD, p=0.003 and p=0.04). Also on a per-patient level, cFFRML (AUC 0.88) and cFFRCFD (AUC 0.88) performed significantly better (cFFRML p=0.003 and p=0.04; cFFRCFD p=0.003 and p=0.04) than CCTA (AUC 0.62) and QCA (AUC 0.69). Mean total processing time per-patient for cFFRML and cFFRCFD determination was 40.4±6.8 minutes and 43.7±7.2 minutes (p=0.086), respectively.

CONCLUSION
The cFFRML algorithm shows a higher specificity, with no significant difference in diagnostic accuracy for detecting lesion-specific ischemia compared to the cFFRCFD approach. Both methods outperform CCTA and QCA accuracy in the detection of flow limiting stenosis.

CLINICAL RELEVANCE/APPLICATION
While both methods provide high diagnostic accuracy in the detection of flow limiting stenosis, our data suggests that the cFFRML algorithm may be preferable over the cFFRCFD technique due to higher specificity in the objective quantification of lesion-specific ischemia.