CAE002-b

F-18 FDG PET/CT and MRI In the Diagnosis and Management of Cardiac Sarcoidosis

Education Exhibits
Location: CA Community, Learning Center

Participants
Richard Anthony R. Coulenden MD (Presenter): Nothing to Disclose
Emer Sonnex: Nothing to Disclose
Hefin Jones FRCP: Nothing to Disclose
Indrajeeet Das MBCh, MRCP: Nothing to Disclose
Jonathan Thomas Abele MD: Nothing to Disclose

TEACHING POINTS
In patients with established non-cardiac sarcoidosis, both FDG PET/CT and cardiac MRI can be used to diagnose cardiac involvement. We will learn how and why: 1. FDG PET/CT identifies active disease and can be used in both diagnosis and management. Serial PET allows assessment of response to immunosuppressive treatment. 2. Cardiac MRI identifies myocardial edema and scar. It has proven value in diagnosis but its role in monitoring disease in response to treatment is unclear. 3. Cardiac MRI provides additional value in assessment of ventricular volumes and function and maybe a helpful surrogate in monitoring treatment response. 4. FDG PET/CT and MRI are complementary techniques.

TABLE OF CONTENTS/OUTLINE

CAE004-b

Dynamic Myocardial Perfusion Imaging by 3rd Generation Dual-Source CT

Education Exhibits
Location: CA Community, Learning Center

Participants
Marisa Marjolein Lubbers MD (Presenter): Nothing to Disclose
Adriaan Coenen MD: Nothing to Disclose
Akira Kurata: Nothing to Disclose
Marcel L. Dijkshoorn RT: Consultant, Siemens AG
Koen Nieman MD, PhD: Speakers Bureau, Siemens AG Speakers Bureau, Toshiba Corporation Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, General Electric Company Research Grant, General Electric Company Research Grant, Siemens AG Speakers Bureau Siemens AG
Gabriel P. Krestin MD, PhD: Consultant, General Electric Company Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Siemens AG Speakers Bureau Siemens AG

TEACHING POINTS
After attending this educational presentation the participant should: 1. Have an understanding of the physiological background of dynamic myocardial perfusion CT and the quantification of absolute myocardial blood flow. 2. Be able to perform a myocardial CT perfusion scan, including patient preparation, scan protocol and adenosine stress infusion protocol and post-processing. 3. Be able to analyze and evaluate myocardial perfusion images and calculate the absolute myocardial bloodflow.

TABLE OF CONTENTS/OUTLINE

CAE005-b


Education Exhibits
Location: CA Community, Learning Center

Participants
Rachel Charis Brook MBBS, MA: Nothing to Disclose
Ausami Abbas MBBS (Presenter): Nothing to Disclose
Cheryl Main MBBS: Nothing to Disclose
Charles Robert Peebles MBBS: Nothing to Disclose
Stephen Harden MRCS, FRCS: Nothing to Disclose
James Stuart Shambrook MBBS: Nothing to Disclose

TEACHING POINTS
The aim of this education exhibit is to provide the reader with a comprehensive understanding of: 1. The major historical variations in surgical techniques and post-surgical anatomy seen on MRI and CT in patients with a Fontan circulation 2. How and why standard CT/CTA techniques must be adapted to appropriately image patients with a Fontan circulation 3. The potential
TABLE OF CONTENTS/OUTLINE

1. Anatomical variations of Fontan circulation seen on MRI and CT: Classical Fontan procedure Modified Fontan procedure Intra-atrial Conduit Extra-cardiac Conduit
2. Staged approach to achieving Total Cavopulmonary Fontan circulation Optimising imaging protocols for Fontan patients CT/PA techniques utilised to adequately opacify the Fontan circuit - Illustrations of Dual injection and delayed phase techniques
3. Potential complications associated with the Fontan circulation - review of imaging findings: Thromboembolic events Systemic ventricular failure Aortopulmonary collateral vessels and associated pulmonary haemorrhage Right atrial dilatation (classic fontan circulation) Liver cirrhosis Portosystemic hypertension Arterialized hepatic nodules

CAE006-b

The Role Of CT and MRI In The Diagnosis and Evaluation Of Cardiac Shunts

Education Exhibits
Location: CA Community, Learning Center

Participants
Ausami Abbas MBBS (Presenter): Nothing to Disclose
Rachel Charis Brook MBBS, MA: Nothing to Disclose
Cheryl Main BMBS: Nothing to Disclose
James Stuart Shambrook MBBS: Nothing to Disclose
Charles Robert Peebles MBBS: Nothing to Disclose
Stephen Harden MRCS, FRCR: Nothing to Disclose

TEACHING POINTS
The aim of this presentation is to educate the reader on: 1. The role of cardiac MRI (CMR) and CT in the diagnosis and differentiation of intra & extra-cardiac shunts 2. To illustrate how CMR can evaluate the functional significance of cardiac shunts 3. To demonstrate the major complications associated with cardiac shunts.

TABLE OF CONTENTS/OUTLINE
1. Demonstrate the key CMR and CT features of the common intra-cardiac shunts including: - Ostium premium, ostium secundum and sinus venosus (superior and inferior) types of atrial septal defect - Ventricular Septal Defects - Atrioventricular septal defects - Coronary sinus defects
2. Demonstrate the CMR and CT features of the common extra-cardiac shunts including: - Patent ductus arteriosus - Partial anomalous pulmonary venous drainage - Scimitar syndrome - Pulmonary arteriovenous malformations - Coronary artery fistulae
3. Demonstrate the common pattern of cardiac chamber enlargement associated with the different types of cardiac shunts 4. Demonstrate how phase contrast MRI sequences can be used to quantify the functional significance of both intra and extra-cardiac shunts 5. The major complications that can occur secondary to cardiac shunts including: - Paradoxical embolic events - Pulmonary Hypertension - Eisenmenger’s syndrome

CAE008-b

Clinical CT Cardiac Structural Anatomy Reconstructed within the Cardiac Contour: Cardiac Skeleton and Inferior Pyramidal Space

Education Exhibits
Location: CA Community, Learning Center

Participants
Shumpei Mori (Presenter): Nothing to Disclose
Tomofumi Takaya: Nothing to Disclose
Tatsuya Nishii MD: Nothing to Disclose
Atsushi K. Kono MD, PhD: Nothing to Disclose
Tatsuro Ito MD: Nothing to Disclose
Sachiko Takamine: Nothing to Disclose
Sei Fujiwara: Nothing to Disclose
Kazuhiro Sugimura MD, PhD: Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAIICHI SANKYO Group
Ken-Ichi Hirata: Nothing to Disclose

TEACHING POINTS
Profound anatomical knowledge about the three-dimensional orientation of cardiac skeleton, including interatrial septum (IAS), interventricular septum (IVS), and each valvular annulus is important to perform safe interventions. The inferior pyramidal space is the extracardiac fibro-adipose tissue extending between the atrial and ventricular musculatures. Many important structures are concentrated around or inside the inferior pyramidal space. The aims of the presentation are: 1. to demonstrate a series of clinical structural images of the IAS, IVS, each valvular annulus, and inferior pyramidal space reconstructed in combination with the cardiac contour using multidetector computed tomography; and 2. to discuss the clinical implications of findings based on accumulated insights made by pioneers.

TABLE OF CONTENTS/OUTLINE

CAE009-b

Clinical CT Cardiac Structural Anatomy Reconstructed within the Cardiac Contour: Ventricular Outflow Tract

Education Exhibits
Location: CA Community, Learning Center

Participants
Shumpei Mori (Presenter): Nothing to Disclose
TEACHING POINTS

The right and left ventricular outflow tracts are common sites of idiopathic ventricular arrhythmia. Although three-dimensional (3D) anatomical accuracy to recognize the exact site of the catheter position is integral, the fluoroscopic definition of the anatomy of the outflow tract is variable and 3D anatomical recognition within the cardiac contour seems difficult because of the morphological complexity. The aims of this presentation are: 1, to visualize the clinical structural image of the outflow tract in combination with the cardiac contour using multidetector computed tomography; and 2, to discuss the clinical implications of findings based on insights made by pioneers.

TABLE OF CONTENTS/OUTLINE

1. Left ventricular outflow tract
   1-1. Infundibular portion of the left interventricular septum
   1-2. Left ventricular free wall
   1-3. Left fibrous trigone
   1-4. Aortomitral continuity
   1-5. Right fibrous trigone
   1-6. Atrioventricular portion of the membranous septum
   1-7. Interventricular portion of the membranous septum
2. Right ventricular outflow tract
   2-1. Infundibular portion of the right interventricular septum
   2-2. Right ventricular free wall
   2-3. Free-standing subpulmonary infundibulum
   2-4. Supraventricular crest

CAE011-b

MDCT, MRI and Echocardiographic Imaging of the Pseudoaneurysms of the Mitral-Aortic Intervalvular Fibrosa (MAIVF).

Education Exhibits
Location: CA Community, Learning Center

Participants
Francisco Garcia-Morales MD (Presenter): Nothing to Disclose
Pramod Kumar Gupta MD: Nothing to Disclose
Samir Kulkarni MD: Nothing to Disclose

TEACHING POINTS

Pseudoaneurysm in the region of space spanning between the mitral valve and aortic valve, the mitral aortic intervalvular fibrosa (MAIVF) is a rare complication and its radiographic recognition is important to guide patient’s management. The purpose of this exhibit is: To illustrate the anatomy of the mitral-aortic intervalvular fibrosa (MAIVF) particularly with MDCT and MRI and the correlation with transeophageal and transthoracic echocardiography. To review the pathophysiology and causative factors in the formation of pseudoaneurysms of MAIVF. To recognize the imaging features of the pseudoaneurysms of the MAIVF and be able to recognize potentially lethal complications including compression of the coronary arteries, tamponade and fistulous tracts.

TABLE OF CONTENTS/OUTLINE

1. MDCT and MRI anatomy of the MAIVF
2. Pathophysiology and causative factors in the formation of Pseudoaneurysms of MAIVF, including endocarditis, post cardiac valve surgery, trauma.
3. Illustrated examples with
   a) MDCT, gated acquisitions, multiplanar reconstructions including cardiac planes.
   b) Cardiac MRI with contrast
   c) Supplementation with TTE and TEE images.
4. Mimics and pitfalls
5. Role of Imaging findings that support conservative imaging surveillance or surgical intervention.

CAE012-b

Mimickers of Cardiac Tumors: How to Recognize the Pretender

Education Exhibits
Location: CA Community, Learning Center

Selected for RadioGraphics

Participants
Luba Frank MD (Presenter): Nothing to Disclose
Jadranka Stojevanska MD, MS: Nothing to Disclose
Dharshan Raj Vummidi MRCP, FRCR: Nothing to Disclose
Gisela Christa Mueller MD: Nothing to Disclose

TEACHING POINTS

1. To present common and uncommon conditions mimicking cardiac tumors. 2. To address diagnostic challenges based on case by case presentation. 3. To discuss imaging features of mimickers and cardiac tumors to avoid pitfalls.

TABLE OF CONTENTS/OUTLINE

1. Introduction: Diagnostic challenges in imaging of cardiac tumors (MR, CT, echocardiography, and conventional angiography).
2. MR imaging of cardiac tumors: How we do it.
3. Imaging features of common and uncommon conditions mimicking cardiac neoplasms. a. Thrombi (atrial and ventricular) mimicking myxomas, sarcomas, and metastases. b. Valvular diseases (caseous...

CAE100

Coronary Artery Anomalies: What Do They Look Like on CCTA?

Education Exhibits

Location: CA Community, Learning Center

Participants

Gilat Grunau MD, PhD (Presenter): Nothing to Disclose
Philipp Blanke MD: Nothing to Disclose
Rekha Raju: Nothing to Disclose
Bruce Precious MD: Nothing to Disclose
Cameron John Hague MD: Nothing to Disclose
Jennifer Deryn Ellis MD: Nothing to Disclose
Jonathon Avrom Leipsic MD: Speakers Bureau, General Electric Company

TEACHING POINTS

Congenital coronary arteries anomalies are a rare and very diverse group of disorders, with variable manifestation and outcomes. The use of CCTA allows accurate depiction of these anomalies. The purpose of this exhibit is: 1. To review the normal coronary anatomy 2. Describe incidence and anatomy of coronary anomalies such as: a. Anomalous origin of coronary arteries including: Anomalous origin of the coronary artery from the pulmonary artery, single coronary artery and multiple ostia b. Anomalies of coronary artery course c. Anomalies of coronary artery termination 3. To discuss the clinical presentation, treatment and prognosis of such anomalies 4. To discuss the role of stress testing (SPECT and stress CMR) in evaluating ischemia and guiding management

TABLE OF CONTENTS/OUTLINE

1. Review of normal coronary anatomy 2. Illustration of coronary artery anomalies using sample cases with CCTA images. 3. Clinical presentation of various anomalies and diagnostic workup, including the role of stress testing 4. Prognosis and management of these anomalies, including discussion on the role of ancillary testing such as SPECT and stress CMR.

CAE101

CT-based Fractional Flow Reserve (CT-FFR) — Review of Basic Theory and How to Do

Education Exhibits

Location: CA Community, Learning Center

Certificate of Merit

Participants

Jihoon Kweon PhD (Presenter): Nothing to Disclose
Dong Hyun Yang MD: Nothing to Disclose
Young-Hak Kim: Nothing to Disclose
Joon-Won Kang MD: Nothing to Disclose
Tae-Hwan Lim MD, PhD: Stockholder, Coreline Soft, Inc

TEACHING POINTS

1. We will review a basic theory of CT-FFR focused on three dimensional modeling of coronary three and computational fluid dynamics. 2. We will provide various cases of CT-FFR with correation with CT angiography, invasive angiography, and FFR

TABLE OF CONTENTS/OUTLINE


CAE102

CT-based Myocardial Ischemia Evaluation: Quantitative Angiography, Myocardial Perfusion, and CT-FFR

Education Exhibits

Location: CA Community, Learning Center

Certificate of Merit

Selected for RadioGraphics

Participants

Hyun Jung Koo MD (Presenter): Nothing to Disclose
Dong Hyun Yang MD: Nothing to Disclose
Joon-Won Kang MD: Nothing to Disclose
Tae-Hwan Lim MD, PhD: Nothing to Disclose

TEACHING POINTS

- Non-invasive prediction of myocardial ischemia has been important issue to determine whether revascularization therapy...
Non-invasive prediction of myocardial ischemia has been an important issue to determine whether revascularization therapy performs or not in patients with stable coronary artery disease. Quantitative coronary CT angiography, myocardial CT perfusion, and CT-based fractional flow reserve (FFR) are emerging methods for evaluation of myocardial ischemia.

TABLE OF CONTENTS/OUTLINE

1. Importance of ischemia-guided coronary revascularization
   A. Brief review of recent clinical studies

2. Limitation of conventional visual analysis of coronary CTA

3. Current status of CT-based myocardial ischemia prediction
   A. Quantitative coronary CTA
   i. Plaque quantification
   B. CT myocardial perfusion
   i. Review of clinical studies
   C. CT-FFR
   i. Review of clinical studies including DISCOVER-FLOW, DeFACTO, and NXT trials

4. How to perform CT-based myocardial ischemia prediction
   A. Quantitative angiography
   i. Aggregated plaque volume
   B. CT myocardial perfusion
   i. Static vs. dynamic perfusion protocol
   ii. Imaging interpretation
   C. CT-FFR
   i. Generation of 3D model of coronary trees
   ii. Calculation of CT-FFR using computational fluid dynamics

5. Typical cases and pitfalls of each technique

CAE103

Dilated Coronary Arteries: Review of Multimodality Imaging and Management

Education Exhibits
Location: CA Community, Learning Center

Participants
Varaha Tammisetti MD (Presenter): Nothing to Disclose
Daniel Ocazionez MD: Nothing to Disclose
Girish S. Shroff MD: Nothing to Disclose
Rajeev Fernando MD: Nothing to Disclose
Catalin Loghin MD: Nothing to Disclose

TEACHING POINTS

1. To review the definition, etiology, and pathophysiology of coronary artery dilation, aneurysm, and ectasia.
2. To illustrate multimodality imaging including anatomic appearance on Coronary CTA, Coronary Catheter angiogram, and functional imaging to assess perfusion and coronary flow reserve prior to management.
3. To discuss complications and individualized approach to management.

TABLE OF CONTENTS/OUTLINE

1. Definition of coronary artery dilation/aneurysm
2. Etiology and pathophysiology
3. Typical Imaging appearances on multiple modalities including anatomic appearance on Coronary CTA, Coronary Catheter angiogram and role of functional imaging to assess perfusion and coronary flow reserve prior to management.
4. Cases per etiology including Atherosclerosis, Congenital, Inflammatory disorders including Kawasaki disease, Takayasu’s arteritis, Connective tissue disorders, Infectious, drug-related, traumatic and iatrogenic.
5. Complications
6. Individualized approach to management

CAE106

MRI in Myocardial Infarction: Ischemia-reperfusion Injury — Imaging Endpoints with Prognostic Value

Education Exhibits
Location: CA Community, Learning Center

Participants
Marta Rodriguez Alvarez (Presenter): Nothing to Disclose
M Carmen Saborido MD: Nothing to Disclose
Beatriz Baltar Nieto MD: Nothing to Disclose
Pablo Pazos: Nothing to Disclose
Amadeo Arango MD: Nothing to Disclose
Ana Maria Afonso: Nothing to Disclose

TEACHING POINTS

We describe and review CMRI features in myocardial infarction. Evaluate CMRI endpoints with clinical and prognostic implication, with focusing on ischemia-reperfusion injury.

TABLE OF CONTENTS/OUTLINE

We review MRI findings of myocardial infarction, specially focusing on patients with AMI and reperfusion therapy. We evaluate area at risk, infarct size, salvaged myocardium and reperfusion injury and assess cardiac function and volumes. T2* CMR detected myocardial edema, which is an adjuvant salvage and surrogate endpoints for mortality in the setting of myocardial infarction. Regions of no enhancement or maintained perfusion defects were areas of no-reflow, MO/hemorrhage. First-pass and early gadolinium enhancement techniques are more sensitive than LGE. We detected MO in patients with transmural infarcts or an affection of at least 75% of wall thickness. MRI is the best imaging technique to detect the presence of hemorrhage. Infarct size, transmural infarction and persistent MO are strong predictors of adverse post-infarct remodeling over other clinical parameters. MRI is especially adequate to study and follow up myocardial infarcts and its potential complications.

CAE109

4D Flow MRI — Spring into the Future of Congenital Heart Imaging

Education Exhibits
Location: CA Community, Learning Center

Participants
Raluca Gabriela Saru MD (Presenter): Nothing to Disclose
Koen Nieman MD, PhD: Speakers Bureau, Siemens AG Speakers Bureau, Toshiba Corporation Research Grant, Bayer AG Research Grant, General Electric Company
Gabriel P. Krestin MD, PhD: Consultant, General Electric Company Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Siemens AG Speakers Bureau Siemens AG
Mohamed Ouhlous MD, PhD: Nothing to Disclose
Shreyas Shreenivas Vasanawala MD, PhD: Research collaboration, General Electric Company Stockholder, Morpheus Imaging, Inc
Albert Hsiao MD, PhD: Founder, Morpheus Imaging, Inc Consultant, Morpheus Imaging, Inc

TEACHING POINTS

- Become familiar with 4D Flow - how is it performed, what equipment is required, and what are the advantages and disadvantages;
- Diagnostic pitfalls;
- Example uses in congenital heart disease

TABLE OF CONTENTS/OUTLINE

1. What is four dimensional 4D Flow? 2. When is it suitable to perform 4D Flow? 3. Acquisition protocols. 4. How should we approach 4D images - Processing and quantification. 5. Pitfalls and challenging situations. 6. Case examples - clinical cases scanned with 4D Flow (normal heart and different congenital heart pathologies).

CAE110

Advanced Cardiac Magnetic Resonance Imaging and Treatment Techniques for Right Ventricular Outflow Tract Reconstruction

Education Exhibits
Location: CA Community, Learning Center

Participants
Shobhit Madan MD, MPH (Presenter): Nothing to Disclose
Arush Kalra MBBS, MS: Nothing to Disclose
Sameh Tadros MD, MSc: Nothing to Disclose

TEACHING POINTS

A 70° curvature is observed in post-Right Ventricular Outflow Tract Reconstruction (RVOTR) patients leading to a malfunctioning tri-leaflet biologic homograft. We demonstrate a novel polytetrafluoroethylene (PTFE) bi-valve conduit for optimal performance in a 70° post RVOTR curvature setting. PTFE is a bio-inert material superior to conventional biologic options with minimal risk of calcium deposition, thrombosis, and immune based rejection.

TABLE OF CONTENTS/OUTLINE

Pathophysiology
- Congenital pulmonary artery (PA) stenosis occurs either in isolation or associated with other congenital heart diseases such as Tetralogy of Fallot, Truncus Arteriosus, pulmonary atresia and Transposition of Great Vessels

Advanced Cardiac MRI
- Advanced cardiovascular magnetic resonance imaging (cMRI) and magnetic resonance angiography (MRA) techniques with 3-dimensional and 4-dimensional image reconstructions can precisely quantify blood flow, velocity, valvular insufficiency and cardiac function required for timely patient management

Advanced Treatment
- We discuss advanced treatment strategies of RVOTR and clinical advantages of PTFE bi-valved conduit compared to tri-leaflet homograft

Future directions
- Prospective cMRI study in patients undergoing RVOTR at our institution will establish future treatment standards

CAE111

All About DORV: Double Outlet of Right Ventricle Imaging on MSCT— Spectrum of Appearances with Special Emphasis on Usefulness of 3 D Volume Rendered Imaging

Education Exhibits
Location: CA Community, Learning Center

Participants
Yashpal Rana MD (Presenter): Nothing to Disclose
MEGHA SHETH: Nothing to Disclose
Dinesh Patel MD, DMRE: Nothing to Disclose
S. Patel: Nothing to Disclose
Rajendra Napinbai Solanki MD: Nothing to Disclose
Brijesh Kaushikkumar Gajjar MD: Nothing to Disclose
Ruchit Bhupendrakumar Patel MBBS: Nothing to Disclose

TEACHING POINTS

1. Understanding spectrum of DORV and associated types of ventricular septal defect (VSD) 2. MSCT appearances of DORV spectrum with special emphasis of usefulness of 3 D Volume Rendered Imaging in pre surgical evaluation

TABLE OF CONTENTS/OUTLINE

DORV - Definition, morphological classification and associated types of VSD MSCT technique - Minimizing Radiation Dose - Importance of post processing techniques MSCT imaging appearances of different varities of DORV Usefulness of 3 D VR images in pre surgical evaluation Limitations of MSCT Summary Summary

CAE113

Bicuspid Aortopathy: Beyond the Aortic Valve

Education Exhibits
Location: CA Community, Learning Center

Participants
Tami J. Bang MD (Presenter): Nothing to Disclose
TEACHING POINTS

1. Revisit the natural history of bicuspid aortic valve (BAV). 2. Familiarize the radiologist with the phenotypic spectrum of aortopathy and other anomalies associated with BAV. 3. Discuss the role of imaging in the evaluation and management of these anomalies.

TABLE OF CONTENTS/OUTLINE


CAE114

Cardiovascular Magnetic Resonance Evaluation of Ventricular Strain in Pediatric and Congenital Heart Disease

Education Exhibits

Location: CA Community, Learning Center

Participants

Jimmy C. Lu, MD (Presenter): Nothing to Disclose
Adam L. Dorfman, MD: Nothing to Disclose
Maryam Ghadimi Mahani, MD: Nothing to Disclose
Prachi P. Agarwal, MD: Nothing to Disclose

TEACHING POINTS

1. To illustrate how strain, a measure of myocardial deformation, can quantify regional and global ventricular dysfunction and dyssynchrony.
2. To describe methods of strain measurement on cardiac magnetic resonance imaging.
3. To understand the literature on decreased strain as an early indicator of clinical outcomes in multiple cohorts of pediatric and congenital heart disease.

TABLE OF CONTENTS/OUTLINE


CAE115

Eisenmenger’s Syndrome: A Review of the Imaging Features of Underlying Congenital Heart Disease and Pulmonary Hypertension

Education Exhibits

Location: CA Community, Learning Center

Participants

Dheeraj Giri, MBBS (Presenter): Nothing to Disclose
Sumit Gupta, PhD, FRCR: Nothing to Disclose
Prajakta Abhay Pinglay, MRCP, FRCR: Nothing to Disclose
Aparna Deshpande, MBBS: Nothing to Disclose

TEACHING POINTS

1. Eisenmenger’s syndrome occurs due to irreversible chronic pulmonary hypertension which results in right to left shunt flow across a non-restrictive septal defect. 2. Septal defects may be associated with different congenital cardiac conditions. 3. Cardiac MRI is a crucial imaging tool in addition to echocardiogram and invasive angiogram. 4. Cardiac MRI is used to assess shunt fraction as well as biventricular function and volumes. 5. Parenchymal lung changes related to pulmonary hypertension and anatomy of congenital heart disease can be well demonstrated on CT.

TABLE OF CONTENTS/OUTLINE

1. An introduction to Eisenmenger’s syndrome and the associated congenital cardiac conditions. 2. A brief description of the investigations and management options. 3. An overview of the different imaging modalities used to investigate Eisenmenger’s syndrome with a focus on cardiac MRI and CT. 4. Demonstration of MR and CT imaging findings in the underlying congenital conditions including Cross-Cross heart. 5. Illustration of parenchymal CT chest findings in patients with pulmonary hypertension.

CAE116

"Exploring Beyond the Expected Four:" Role of Multislice-CT in Imaging of Tetralogy of Fallot.

Education Exhibits
TEACHING POINTS

In addition to the four basic components of tetralogy of Fallot (TOF), multislice computed tomography (CT) can be used to assess the other cardiac findings and associated anomalies in patients with TOF that are beyond the reach of echocardiogram (ECHO). The purpose of this poster is:
- To illustrate various findings and associated cardiac anomalies with multislice CT imaging in patients with TOF.
- To describe the role of multislice CT in pre and post operative assessment of patients with TOF.

TABLE OF CONTENTS/OUTLINE

COMPONENTS OF TOF: CT IMAGING OF OTHER FINDINGS AND PREOPERATIVE ASSESSMENT: Pulmonary artery assessment.
Evaluation of palliative shunts and definitive repair. ADVANTAGES: Noninvasive compared to cardiac catheterization. Can image beyond the reach of ECHO. Better demonstration of complex anatomy. LIMITATIONS: Iodinated contrast media, rapid heart rate, radiation.

CAE117

Heterotaxy Syndrome: Evaluation on Multidetector CT (MDCT) Angiography — A Comprehensive Review of Associated Anomalies Radiologist Must Know

Education Exhibits
Location: CA Community, Learning Center

Participants

Amit Kumar Verma MBBS, MD (Presenter): Nothing to Disclose
Sonali Sethi MBBS, MD: Nothing to Disclose
Richa Yadav MBBS, DMRD: Nothing to Disclose
Sabir Singh MBBS, MD: Nothing to Disclose
Ashok Kumar Sharma MD: Nothing to Disclose
Poonam Narang MBBS, MD: Nothing to Disclose

TEACHING POINTS

- Heterotaxy syndrome is a complex conglomeration of cardiac and extra-cardiac anomalies. It comprises of situs ambiguous with right or left isomerism. Knowledge of complex cardiac anomalies along with associated vascular and non-vascular thoracic and extra-thoracic anomalies is crucial for radiology reporting in surgeon’s interest. Multidetector CT angiography with radiation dose optimization can confidently define most of the cardiac and extra-cardiac anomalies.

TABLE OF CONTENTS/OUTLINE

- Embryological development of heart. Definition of terms associated with situs anomalies
- What does heterotaxy stand for?
- Role of CTA in imaging of heterotaxy syndrome: protocol and techniques for dose optimization
- Role of MDCT angiography vs MRI
- Spectrum of anomalies associated in heterotaxy syndrome: Cardiac and Extra-cardiac thoracic (Vascular / Non vascular) or Extra-thoracic
- CTA report of complex cardiac anomaly: what a surgeon is looking for?

CAE118

Imaging Cardiovascular Manifestations of Genetic Syndromes: A Pictorial Review

Education Exhibits
Location: CA Community, Learning Center

Participants

Vasant Garg MD: Nothing to Disclose
Ravi Ashwath MD: Nothing to Disclose
Prabhakar Rajiah MD, FRCR (Presenter): Institutional Research Grant, Koninklijke Philips NV

TEACHING POINTS

1. To discuss the cardiovascular manifestations of genetic syndromes and malformations. 2. To understand the role of CT and MRI in the evaluation of these abnormalities. 3. To recognize the clinical implications of the cardiovascular abnormalities.

TABLE OF CONTENTS/OUTLINE

- Genetics of syndromes affecting cardiovascular system - Cardiovascular manifestations of these syndromes - Role of MRI and CT in the evaluation of cardiovascular complications of malformations and syndromes. Description of the features, imaging findings and management of the following syndromes along with illustrations: Downs Marfan Ehler-Danlos Loeys-Dietz Williams-Beuren Noonan Turner DiGeorge Osler Rendu Weber Holt Oram Ellis Van Creveld Kears Sayre Alagille Von Recklinghausen Cogan

CAE119

MDCT Angiography for Evaluation of Imaging Spectrum of Anomalous Pulmonary Venous Connection (APVC) on 256 Slice Dual-source Scanner: Imaging Revisited
Education Exhibits
Location: CA Community, Learning Center

Participants
Sonali Sethi MBBS, MD (Presenter): Nothing to Disclose
Sunil Kumar Puri MD : Nothing to Disclose
Amit Kumar Verma MBBS, MD : Nothing to Disclose
Pallavi Aga MBBS, MD : Nothing to Disclose
Richa Yadav MBBS, DM : Nothing to Disclose
Poonam Narang MBBS, MD : Nothing to Disclose

TEACHING POINTS
1. Anomalous pulmonary venous connections are rare anomalies of pulmonary venous drainage which includes partial and total anomalous pulmonary venous connection. 2. If the common pulmonary vein fails to connect to the splanchnic plexus and / or a splanchnic plexus communication with a cardinal or umbilicovitelline vein persists, some type of TAPVC or PAPVC will occur. 3. Clinical presentation varies from asymptomatic to incompatibility with life. 4. Proper knowledge about anomalies, imaging technique and what a surgeon needs from a radiologist can improve the outcome.

TABLE OF CONTENTS/OUTLINE
1. Anomalous pulmonary venous connections are rare anomalies of pulmonary venous drainage which includes partial and total anomalous pulmonary venous connection. 2. If the common pulmonary vein fails to connect to the splanchnic plexus and / or a splanchnic plexus communication with a cardinal or umbilicovitelline vein persists, some type of TAPVC or PAPVC will occur. 3. Clinical presentation varies from asymptomatic to incompatibility with life. 4. Proper knowledge about anomalies, imaging technique and what a surgeon needs from a radiologist can improve the outcome.

CAE120
PE or not PE: Challenges in Assessment of Thrombi and Pulmonary Embolism (PE) in Patients with Fontan Procedure

Education Exhibits
Location: CA Community, Learning Center
Certificate of Merit
Selected for RadioGraphics

Participants
Soudabeh Fazeli Dehkordy : Nothing to Disclose
Maryam Ghadimi Mahani MD (Presenter): Nothing to Disclose
Prachi P. Agarwal MD : Nothing to Disclose
Cynthia Karfas Rigsby MD : Nothing to Disclose
Robyn Wright BA, ARRT : Nothing to Disclose
Jimmy C. Lu MD : Nothing to Disclose
Adam L. Dorfman MD : Nothing to Disclose
Rajesh Krishnamurthy MD : Research support, Koninklijke Philips NV Travel support, Koninklijke Philips NV

TEACHING POINTS
1. To describe Fontan pathway and inherent challenges in optimal pulmonary arterial opacification on CT 2. To illustrate common pitfalls in the diagnosis of pulmonary embolism and Fontan pathway thrombosis 3. To describe CT protocols aimed at providing optimal scan quality

TABLE OF CONTENTS/OUTLINE
1. Introduction 2. Staged surgical approach to Fontan procedure 3. Etiology of pulmonary arterial embolism and thrombosis in patients with Fontan palliation 4. Challenges in optimizing pulmonary arterial enhancement in these patients, (e.g. unopacified blood, timing) 5. Illustrate with case examples common pitfalls in the diagnosis of thrombi and pulmonary arterial emboli 6. Suggested techniques for obtaining optimal scans for evaluation of thrombi along the Fontan pathway and for pulmonary embolism detection. 7. Conclusion

CAE125
Comprehensive Analysis of Benign Cardiac Masses: Pathology, Imaging Appearance Spectrum on MRI with CT Correlation and Differential Diagnoses

Education Exhibits
Location: CA Community, Learning Center

Participants
Benjamin David Lack MD (Presenter): Nothing to Disclose
Giorgios Constantine Bis : Nothing to Disclose
Kostaki G. Bis MD : Nothing to Disclose
Michael Gallagher MD : Nothing to Disclose
Francis Shannon : Nothing to Disclose
Thomas-Evangelos G. Vrachliotis MD, PhD : Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is: 1. Explain how to distinguish benign cardiac neoplasms from 'pseudo masses' and malignant cardiac neoplasms. 2. Review the spectrum of imaging characteristics of benign cardiac neoplasms on CT and MRI. 3. Discuss key imaging characteristics, pathologic features, lesion location, and epidemiological factors to arrive at an appropriate differential diagnosis. 'pseudo mass' - non neoplastic lesions, normal anatomy, or normal variant anatomy which may be confused for cardiac neoplasms.

TABLE OF CONTENTS/OUTLINE
1. Epidemiology of benign cardiac masses II. Common normal anatomy, variant anatomy, and artifacts which may be confused for a cardiac masses (CT/MR artifacts, papillary muscles, pectinate muscles, Q-tip ridge, crista terminalis) III. Lesions which
may mimic cardiac neoplasms (thrombus, lipomatous hypertrophy of the interatrial septum, loculated pericardial collections, pericardial cysts, aneurysms and pseudoaneurysms) IV. Distinguishing benign from malignant cardiac neoplasms V. CT and MRI imaging of benign cardiac neoplasms (myxoma, lipoma, cardiac fibroma, papillary fibroelastoma, rhabdomyoma, paraganglioma, hemangioma, struma cordis, teratoma)

CAE126

Comprehensive Clinical and Imaging Analysis in Pulmonary Artery Sarcoma

Education Exhibits
Location: CA Community, Learning Center

Participants
- Xin Pu (Presenter): Nothing to Disclose
- Xiaoyong Huang : Nothing to Disclose
- Biao Lu MD : Nothing to Disclose
- Zhanming Fan : Nothing to Disclose

PURPOSE
To summarize the clinical and imaging characteristics of pulmonary artery sarcoma (PAS).

METHOD AND MATERIALS
Nine patients with PAS were enrolled during November 2001 to November 2012 in our hospital. The patients' data of clinical manifestation, lab test and imaging findings were analyzed retrospectively. All patients were confirmed by surgical biopsy.

RESULTS
The median age of PAS patients was 43 years old (32~67y). The clinical symptoms were unspecific, including chest distress, chest pain or syncope. The D-Dimer was normal in seven patients. LDH was elevated in six patients. Seven patients were misdiagnosed as a pulmonary embolism, and were treated with failed thrombolytic therapy. Nine patients underwent pulmonary CT angiography. Pulmonary cavity filling defects were detected in eight patients, and lobulated filling defects were bulged outward with sharp edges. One patient was found the filling defect growth along the vessel wall. The main pulmonary artery and bilateral pulmonary arteries all involved were found in six patients, and two of them were found the right pulmonary arteries occluded by the lesions. Only right pulmonary artery involved was found in one patient. Bilateral pulmonary arteries involved were in two patients. The lesions were contrast enhanced heterogeneously in all 9 patients. Metastases were detected in three patients.

CONCLUSION
PAS is a rare disease that can be presented in various clinical symptoms. Pulmonary CT angiography is an important modality to find PAS. In summary, a patient with a normal D-Dimer and ineffective anticoagulation therapy, even pre-diagnosed as pulmonary embolism, PAS should be suspected. Especially PAS should be heightened if the occupied lesion is a lobulated filling defect and obviously non-homogeneous enhanced in pulmonary CT angiography.

CLINICAL RELEVANCE/APPLICATION
Pulmonary CT Angiography is very important in the diagnose of pulmonary artery sarcoma, especially in the differential diagnosis of the PAS and Pulmonary embolism.

CAE127

MR Imaging Evaluation of Cardiac Sarcomas: Review of Our Experience

Education Exhibits
Location: CA Community, Learning Center

Participants
- Rosa Maria Ruiz Peralbo MD (Presenter): Nothing to Disclose
- Miguel Pastrana MD : Speakers bureau, Alexion Pharmaceuticals, Incs
- Miguel Angel Cavero MD : Nothing to Disclose
- Marta Alfageme : Nothing to Disclose
- Javier Segovia MD : Nothing to Disclose
- Concepcion Gonzalez MD, PhD : Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit:
1. Recognize cardiac MR as an important technique in the evaluation of cardiac sarcoma, very rare tumor with a poor prognosis that affects young patients, so requires knowledge of the radiological behavior of this lethal entity.
2. Identify cardiac MR as an advance in the study of this tumor, classically evaluated by echocardiography, for its excellent contrast resolution and multiplanar ability, allowing a functional and morphological analysis in the same study.

TABLE OF CONTENTS/OPTLINE
Sixty-three cardiac masses evaluated by cardiac MR were reviewed retrospectively since April 2006 until March 2014. Histopathological data were checked: six primary cardiac sarcomas were diagnosed. Results were contrasted with previous publications. Data were analyzed: pathologic subtypes (3 angiosarcomas, 1 myxofibrosarcoma,1 rhabdomyosarcoma and 1 leiomyosarcoma); age; sex; oncological antecedents; metastasis; administered treatments; recurrences; median survival and relevant radiological imaging cardiac MR: localization, infiltration, morphologic features, signal intensity. Cardiac MR contributes to diagnosis of cardiac sarcomas helping to improve the characterization and local extension and is a very useful tool in planning a complex and controversial treatment and thus may prolong very poor survival of these patients.

CAE128

Secondary Cardiac Masses: What’s New?

Education Exhibits
Participants
Beatriz Rodriguez Fisac (Presenter): Nothing to Disclose
Ana Belen Marin Quiles MD: Nothing to Disclose
Maria Mercedes Rodriguez: Nothing to Disclose
Diego Mauricio Angulo Henao MD: Nothing to Disclose
Sandrra Liliana Barrero: Nothing to Disclose
Laura Vidal: Nothing to Disclose

TEACHING POINTS
1. To review the location of the secondary cardiac masses and its spreading routes. 2. To correlate the findings in different imaging techniques such as multidetector computed tomography (MDCT), magnetic resonance (MR) and fluorine-18 fluoro-2-deoxy-D-glucose positron emission tomography / computed tomography (FDG PET/CT). 3. To emphasize the usefulness of FDG PET/CT in the diagnosis of intracavitary metastases and the assessment of extranodal lymphoma.

TABLE OF CONTENTS/OUTLINE
1. Pathophysiology of secondary cardiac masses - Cardiac metastases from both usual and unusual primary neoplasm - Spreading routes - Cardiac location of secondary masses 2. Imaging findings - MDCT - MR - FDG PET/CT 3. Indications 4. Summary

CAE130
Beyond Volumes and Function: Tissue Characterization in Non-ischemic Cardiomyopathies by Cardiac Magnetic Resonance Imaging

Education Exhibits
Location: CA Community, Learning Center

Certificate of Merit

Participants
Celia Pamela Corona-Villalobos MD (Presenter): Nothing to Disclose
Linda Chi Hang Chu MD: Nothing to Disclose
Kristin Porter MD, PhD: Stockholder, Pfizer Inc
Yan Zhang MD, PhD: Nothing to Disclose
Neda Rastegar MD: Nothing to Disclose
Ihab R. Kamel MD, PhD: Nothing to Disclose
Stefan L. Zimmerman MD: Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is to describe, beyond volumes and function, emerging imaging techniques and their potential diagnostic and prognostic significance in non-ischemic cardiomyopathies by cardiac magnetic resonance (CMR) imaging.

TABLE OF CONTENTS/OUTLINE
1. Review the most common clinical presentation, and imaging findings in patients with non-ischemic cardiomyopathies including Hypertrophic Cardiomyopathy (HCM) • Amyloidosis • Dilated cardiomyopathy • Arrhythmogenic right ventricular Cardiomyopathy (ARVD) • Myocarditis • Takotsubo Cardiomyopathy • Sarcoidosis • Iron overload Cardiomyopathy 2 Introduce novel MRI techniques for evaluation of non-ischemic cardiomyopathies including 4D flow phase contrast imaging, T1 mapping, T2 and T2* mapping and explain their potential significance in patient management. Outline Cardiac MR-imaging is commonly utilized in the diagnosis and prognosis of patients with non-ischemic cardiomyopathies. This exhibit provides a review of emerging imaging techniques and explains their potential utility in the clinical setting.

CAE131
Cardiac Complications of Treatment in Oncology Patients: An Imaging Review

Education Exhibits
Location: CA Community, Learning Center

Participants
Nandini Meyersohn MD (Presenter): Nothing to Disclose
Tomas Neilan MD: Nothing to Disclose
Sanjeev Francis MD: Nothing to Disclose
Brian Burns Ghoshhajra MD: Nothing to Disclose

TEACHING POINTS
1. Discuss the range of cardiac complications related to oncologic treatment including chemotherapeutic agents and radiotherapy. 2. Describe the imaging modalities used to identify cardiac complications of oncologic therapy including cardiac CT, cardiac MR, nuclear medicine studies, and cardiac ultrasound. 3. Identify characteristic imaging findings of complications of oncologic therapy on cardiac CT and cardiac MR.

TABLE OF CONTENTS/OUTLINE
1. Mechanism of cardiac complications from chemotherapeutic agents and radiotherapy 2. Epidemiology and prognosis of oncology patients with cardiac complications 3. Review of imaging findings a. Primary emphasis on cardiac CT and cardiac MR b. Correlation with findings on nuclear medicine studies and cardiac ultrasound 4. Multiple sample cases 5. Areas of current exploration and summary

CAE134
How to Diagnose Patients Who Present with Heart Failure without Coronary Artery Stenosis: Using Cardiac MRI — Minimum Essentials for Radiologists
**Education Exhibits**  
Location: CA Community, Learning Center

### Participants

**Fumiko Kimura MD, PhD (Presenter):** Stockholder, JMS Co, Ltd Research Grant, DAIICHI SANKYO Group Research Grant, Bayer AG Research Grant, Eisai Co, Ltd

**Takatomo Nakajima MD:** Nothing to Disclose

**Masahiro Takahashi MD:** Nothing to Disclose

**Toshiko Hoshi MD:** Nothing to Disclose

**Shintaro Nakano MD:** Nothing to Disclose

**Shigetoshi Nishimura MD, PhD:** Nothing to Disclose


### TEACHING POINTS

Recently, cardiac magnetic resonance (CMR) is frequently performed for patients who present with heart failure without coronary artery disease because it is mandatory to identify the underlying etiology of the heart failure. The purpose of this exhibit is 1. To review CMR imaging and underlying pathophysiological findings in patients with heart failure and without coronary artery stenosis 2. To learn how to identify etiology underlying heart failure using our decision charts with CMR 3. To learn characteristic CMR findings that should not be missed to reach diagnosis

### TABLE OF CONTENTS/OUTLINE

1. Imaging techniques of T2-weighted images and late gadolinium enhancement (LGE) 2. Pitfalls of T2-weighted images and LGE 3. Review of imaging findings in primary and secondary cardiomyopathies, including dilated cardiomyopathy, hypertrophic cardiomyopathy, myocarditis, Takotsubo cardiomyopathy, hypertensive heart disease, Loeffler's endocarditis, cardiac sarcoidosis, amyloidosis, and drug-induced cardiomyopathy. 4. Decision tree using CMR findings 5. Differential diagnosis using LGE pattern

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### CAE135

**Hypertrophic Cardiomyopathy from A to Z: Genetics, Pathophysiology, Imaging and Management**

**Education Exhibits**  
Location: CA Community, Learning Center

- **Selected for RadioGraphics**

### Participants

**Ameya Jagadish Baxi MBBS, DMRD (Presenter):** Nothing to Disclose

**Carlos S. Restrepo MD:** Nothing to Disclose

**Michael James McCarthy MD:** Nothing to Disclose

**Daniel Vargas MD:** Nothing to Disclose

**Daniel Ocazionez MD:** Nothing to Disclose

**Horacio Murillo MD, PhD:** Nothing to Disclose

**Rashmi S. Katre:** Nothing to Disclose

### TEACHING POINTS

1. To study patterns of myocardial involvement in hypertrophy cardiomyopathy (HCM) 2. To review genetics, pathophysiology and imaging findings in HCM

### TABLE OF CONTENTS/OUTLINE

HCM is a genetic cardiac disease caused by dominant mutations in sarcomere genes with remarkable heterogeneity. It causes diffuse or segmental left ventricular hypertrophy with stiffened walls and abnormal valve function. Patients can be asymptomatic or develop symptoms such as chest pain, shortness of breath, fainting, palpitation and sudden death. Noninvasive imaging plays pivotal role in detecting HCM and understanding its pathophysiology. Echocardiography is the most widely used modality for initial evaluation. But is limited by poor window and interobserver variation. MDCT offers high-quality multiplanar reconstructions and be used in patients with pacemakers. Radiation exposure and use of iodinated contrast are its short comings. It cannot depict areas of fibrosis. MRI offers multiplanar imaging, gradient analysis and assess distribution of LV hypertrophy and gives unparalleled tissue characterization thus accurately depicting areas of fibrosis manifesting as delayed enhancement. It is the imaging modality of choice for patients considered for alcohol ablation. Radiologists should be familiar with the imaging appearances of HCM and understand clinical significance.

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### CAE136

**MR Imaging of Cardiac Sarcoidosis: Spectrum of Imaging Findings and Differential Diagnosis**

**Education Exhibits**  
Location: CA Community, Learning Center

### Participants

**Tomohiro Komada (Presenter):** Nothing to Disclose

**Kojiro Suzuki MD:** Nothing to Disclose

**Hisashi Kawai:** Nothing to Disclose

**Shinji Naganawa MD:** Nothing to Disclose

### TEACHING POINTS

The purpose of this exhibit is:

1. To review enhanced site in delayed contrast enhanced MR images of cardiac sarcoidosis
2. To learn the difference between cardiac sarcoidosis and other cardiac diseases, such as ischemic cardiac disease, hypertrophic cardiomyopathy and pulmonary hypertension in cardiac MR images
TABLE OF CONTENTS/OUTLINE
Pathophysiology of cardiac sarcoidosis Diagnostic criteria for cardiac sarcoidosis Review of delayed enhanced MR images of cardiac sarcoidosis of 8 patients The segment and layer of myocardial delayed enhancement were evaluated using 17-segment model of left ventricle. Sample cases The findings of cardiac MR images in other cardiac diseases, such as ischemic cardiac disease, hypertrophic cardiomyopathy and pulmonary hypertension

CAE138
Post-mortem Imaging Findings in Deaths Due to Pericardial Tamponade Caused by Hemopericardium: How to use Post-mortem Imaging Evidence for the Assessment of a Critical Forensic Diagnosis

Education Exhibits
Location: CA Community, Learning Center

Participants
Laura Filograna MD (Presenter): Nothing to Disclose
Lorenzo Bonomo MD : Nothing to Disclose
Michael J. Thai MD : Nothing to Disclose

TEACHING POINTS
The purposes of this exhibit are: 1. To discuss the challenging forensic diagnosis of pericardial tamponade in presence of the autopsy evidence of hemopericardium. 2. To illustrate post-mortem imaging findings of pericardial tamponade due to hemopericardium 3. To assess the possibility of using post-mortem imaging evidence for the assessment of the post-mortem diagnosis of pericardial tamponade due to hemopericardium.

TABLE OF CONTENTS/OUTLINE

CAE139
Takotsubo Cardiomyopathy: Assessment with Cardiac MRI and MDCT

Education Exhibits
Location: CA Community, Learning Center
Certificate of Merit

Participants
Yeonah Kang (Presenter): Nothing to Disclose
Yeo Goon Kim MD : Nothing to Disclose
Jeong A Kim MD : Nothing to Disclose
Eun Ju Chun : Nothing to Disclose
Sang Il Choi MD : Nothing to Disclose

TEACHING POINTS
1. Cardiac MRI and MDCT can provide useful informations in the evaluation of regional wall motion abnormalities, different patterns of LV ballooning, and right ventricular (RV) involvement. 2. CMR is a unique tool for further evaluating and characterizing in patients with suspected Takotsubo cardiomyopathy 3. Cardiac MRI and MDCT may be useful to promptly distinguish Takotsubo cardiomyopathy from other acute cardiothoracic diseases including acute coronary syndrome.

TABLE OF CONTENTS/OUTLINE

CAE140
The Challenge of Non-compaction Ventricular Myocardium Diagnosis by MRI

Education Exhibits
Location: CA Community, Learning Center

Participants
Carolina Sander Reiser (Presenter): Nothing to Disclose
Jose de Arimateia Batista Araujo Filho : Nothing to Disclose
Antonio Fernando Lins de Palva : Nothing to Disclose
Vera Maria Cury Salemi : Nothing to Disclose
Marcelo Dantas Tavares de Melo : Nothing to Disclose
Lea Maria Macruz Ferreira Demarchi : Nothing to Disclose
Cesar Higa Nomura MD : Nothing to Disclose
Jose Rodrigues Parga MD : Nothing to Disclose
Luis Francisco Rodrigues Avila PhD : Nothing to Disclose
Gabriela Liberato : Nothing to Disclose
Ariane Binoti Pacheco : Nothing to Disclose
Marcus Picoral Pinto : Nothing to Disclose
Debora Yuri Moura Nakamura : Nothing to Disclose
The purpose of this exhibition is: - Review the pathogenesis of myocardial non-campaction - Review it's epidemiological importance, - Review diagnostic criteria - Review cardiac MRI criteria and findings (typical and associated)

TABLE OF CONTENTS/OUTLINE
Introduction: what is non-compaction myocardium? Epidemiology: how prevalent is this disease? Pathophisiology: explain the phenotypes, explain de pathology and what is implicated in the manifestation of this rare congenital cardiomyopathy Clinical findings: briefly describe clinical criteria Cardiac MRI findings: demonstrate imaging findings and criteria for the diagnoses of myocardial non-compaction (ratio of trabeculated/compacted myocardium) and associated findings (mainly intracardiac thrombus) Differential Diagnosis: how can we differentiate myocardial non-compaction from other myocardiopathies at cardiac MRI images

CAE141
The Challenging Diagnosis of Arrhythmogenic Right Ventricular Cardiomyopathy/Dysplasia with Cardiac MRI: Findings, Mimics and Differences between Old and New Task Force Criteria

Purpose/Aim The aim of this exhibit is to provide a diagnostic overview of arrhythmogenic right ventricular cardiomyopathy/dysplasia using cardiac-MRI, with explanation of findings, mimics and differences between old and new task force criteria. Content Organization: a) Introduction to Arrhythmogenic Right Ventricular Cardiomyopathy/Dysplasia. b) Clinical presentation of the disease. c) Role of cardiac-MRI and contraindications. d) Technical features for performing a suitable examination. e) Overview of old and new task force criteria for diagnosis. f) Imaging findings of disease. g) Diseases mimicking ARVC/D. g) Conclusions.

TEACHING POINTS
1) To know technical features for performing a suitable examination. 2) To learn old and new task force criteria for diagnosis. 3) To learn imaging findings of disease with application of the criteria.

TABLE OF CONTENTS/OUTLINE
Cardiac calcification is a common finding and it has important clinical implication. Accumulation of calcium in coronary arteries, may predict future risk of an ischemic event and can be measured on MDCT. Likewise, calcification of left ventricular wall may indicate prior myocardial infarction. Though aortic valve calcification is related with aging, it can also indicate hemodynamically significant aortic stenosis. Mitral annular calcification is generally can be incidental or associated with mitral regurgitation or stenosis, pericardial calcification may be secondary to infection, constrictive pericarditis, postsurgical changes, trauma, and mycardial infarction or idiopathic. Calcification of the pulmonary valve occurs is rare. Tricuspid valve calcification is rare and most frequently is caused by rheumatic valve disease and infective endocarditis. Calcifications are also seen in intracardiac thrombus or neoplasm like myxoma or sarcomas. Recognition and characterization these calcifications is important, and may impact patient care.

CAE144
Cardiac MRI for the Diagnosis and Monitoring of Cardiac Involvements in Rheumatic Diseases

Education Exhibits

Location: CA Community, Learning Center

Participants
Debora Yuri Moura Nakamura : Nothing to Disclose
Jacob Sessim Filho : Nothing to Disclose
Antonilides Nascimento Assuncao : Nothing to Disclose
Ismar Aquiar Marques Filho : Nothing to Disclose
Renata Ávila Cintra : Nothing to Disclose
Simone Sena Costa : Nothing to Disclose
Rodrigo Caruso Chaté MD : Nothing to Disclose
Carlos Eduardo Rochitte : Nothing to Disclose

TEACHING POINTS
1. To study the different entities causing calcification in and around the heart 2. To discuss the pathophysiology and differential diagnosis and role of MDCT in evaluating these calcifications with emphasis on clinical outcome

TABLE OF CONTENTS/OUTLINE
Cardiac calcification is a common finding and it has important clinical implication. Accumulation of calcium in coronary arteries, may predict future risk of an ischemic event and can be measured on MDCT. Likewise, calcification of left ventricular wall may indicate prior myocardial infarction. Though aortic valve calcification is related with aging, it can also indicate hemodynamically significant aortic stenosis. Mitral annular calcification is generally can be incidental or associated with mitral regurgitation or stenosis, pericardial calcification may be secondary to infection, constrictive pericarditis, postsurgical changes, trauma, and mycardial infarction or idiopathic. Calcification of the pulmonary valve occurs is rare. Tricuspid valve calcification is rare and most frequently is caused by rheumatic valve disease and infective endocarditis. Calcifications are also seen in intracardiac thrombus or neoplasm like myxoma or sarcomas. Recognition and characterization these calcifications is important, and may impact patient care.
CAE145

Causes of Left Ventricular Diastolic Dysfunction through the Lens of Imaging

Education Exhibits
Location: CA Community, Learning Center

Certificate of Merit

Participants
Ayman Hamdy Gaballah MD, FRCR (Presenter): Nothing to Disclose
Jadranka Stojanovska MD, MS: Nothing to Disclose
Eman Sabah Mahdi MD, MBChB: Nothing to Disclose
Gisela Christa Mueller MD: Nothing to Disclose
Luba Frank MD: Nothing to Disclose
Smita Patel MBBS: Nothing to Disclose
Troy LaBounty MD, FACC: Nothing to Disclose

TEACHING POINTS
To review the classification, clinical and imaging features of conditions leading to left ventricular (LV) diastolic dysfunction. To review cardiac imaging techniques (CT/MRI/echocardiography) used to evaluate patients with LV diastolic dysfunction. To discuss the clinical potential of cardiovascular imaging in diagnosing these patients.

TABLE OF CONTENTS/OUTLINE
Spectrum of causes of LV diastolic dysfunction presented as clinical cases. 1. Causes can be classified into common and un-common diseases: I. Common: • Cardiac Ischemia • Hypertension • Aging • Obesity • Aortic stenosis II. Un- common: • Infiltrative and Non- infiltrative myocardial disorders. • Pericardial disorders. 2. CT/MRI/echocardiography evaluation (protocols, imaging findings, and recent advances) will be discussed. Cardiac MRI and echocardiography are complimentary imaging modalities and are important tools for evaluation of LV diastolic dysfunction, providing assessment of myocardial morphology, function, flow velocity and tissue composition that guides clinical management. CT is considered imaging modality of choice for non-invasive delineation of coronary arteries.

CAE146

Don’t Forget the Heart! Test Your Ability to Identify Cardiac Findings on Non-gated CT

Education Exhibits
Location: CA Community, Learning Center

Participants
Abigail Victoria Berniker MD (Presenter): Nothing to Disclose
Justin Edward Mackey MD: Nothing to Disclose
Oleg Teytelboym MD: Nothing to Disclose

TEACHING POINTS
1. Many important cardiac findings can be detected on non-gated CT studies, however radiologists often overlook the heart on non-gated exams 2. Adapting a simple systematic search pattern can help radiologists miss fewer cardiac findings on non-gated CT

TABLE OF CONTENTS/OUTLINE
Goals This exhibit aims to: Highlight a simple yet comprehensive search pattern to help radiologists identify cardiac findings on non-gated CT Review the spectrum of important cardiac findings on non-gated CT through a fun, interactive, case-based quiz Background Search pattern overview ("from the inside out") Valves > Chambers > Myocardium > Vessels > Pericardium Interactive Case-Based Quiz -Valves Vegetation Calcification -Chambers Filling defect (mass, thrombus) Abnormal size Aneurysm/pseudaneurysm - Myocardium Cardiomyopathy Infarct Mass -Vessels Coronary anomalies -Pericardium Fluid Tamponade Calcification Summary Patients can present with a host of important, albeit unsuspected, cardiac pathology on non-gated CT exams. As such, radiologists should be familiar with these entities and interrogate the heart systematically on every study. 

CAE147

Essentials of Quality Metrics for an Emergency Department Coronary CTA Program at a Tertiary Medical Center: Efficiency in Registry Maintenance
Participants
Harshna Vinodbhai Vadvala MD (Presenter): Nothing to Disclose
Brian Burns Ghoshhajra MD : Nothing to Disclose
Udo Hoffmann MD : Nothing to Disclose

TEACHING POINTS
Clinical implementation of coronary CT angiography (CCTA) must be carefully managed to safely evaluate low to intermediate risk emergency department (ED) patients with chest pain. In this process we learned: • Maintaining a dedicated registry • Ensuring appropriate patient selection by referring physicians • Maintaining accuracy of CCTA interpretations • Limiting radiation exposures as well as length of stay to a reasonable level • Feedback spreads awareness and improves the service quality

TABLE OF CONTENTS/OUTLINE
In our registry we recorded variables, querying it at minimum 45 days: • Patient characteristics - age, gender, risk facts for calculating Framingham risk score and TIMI score • Scan parameters - acquisition method, heart rate, radiation dose (mSv), tube potential, and CCTA result including calcium score • Results of other downstream testing such as invasive Coronary Angiography (ICA), Single photon emission computed tomography myocardial perfusion imaging (SPECT MPI), exercise tolerance test (ETT) and echocardiography. • Disposition location plan (ED, observation unit, admission) and disposition time (ED to scanner room, CCTA reporting time, report to discharge time and total length of stay)

CAE148
Imaging of Heart Transplantation

Participants
Sumit Karia MBBS,FRCR : Nothing to Disclose
Edward Thomas Barden MRCP, FRCR : Nothing to Disclose
Katharine Tweed FRCP (Presenter): Nothing to Disclose

TEACHING POINTS
1. Illustrate important factors in pre-operative planning and utility of imaging to problem solve and risk stratify. 2. Delineate normal post operative anatomy using multidetector computed tomography (MDCT). 3. Illustrate complications of cardiac transplant using combined multi-modality approach.

TABLE OF CONTENTS/OUTLINE

CAE149
Incidental Cardiac Findings on Non-gated Computed Tomography: Pearls and Pitfalls.

Participants
Kathleen E. Carey MD (Presenter): Nothing to Disclose

TEACHING POINTS
PURPOSE/AIM: 1. Present a representative spectrum of incidental cardiovascular findings that are increasingly demonstrated on non-cardiac computed tomography. 2. Discuss potential/artifactual mimics of true pathology that can lead to unnecessary workup. 3. Present some practical tips for differentiating true cardiac pathology, and discuss appropriate "next steps" for some of the more common findings.

TABLE OF CONTENTS/OUTLINE

CAE151
Not Everything Is Thrombus! Multimodality Imaging of Intracardiac Normal Variants: A Common Source of Pitfalls

Participants
Rafael Andres Vicens-Rodriguez MD (Presenter): Nothing to Disclose
Juan Carlos Lopez-Mattei MD : Nothing to Disclose
TEACHING POINTS
1. To review the development, location, function and multimodality imaging appearance of normal intracardiac anatomic variants. 2. To discuss the main imaging differences between normal intracardiac anatomical variants and pathology.

TABLE OF CONTENTS/OUTLINE
The following outline will be done for each of the following intracardiac normal anatomical variants: Chiari network Eustachian Valve Crista terminalis Right ventricular prominent trabeculations. Moderator band False tendon in the LV Atypical papillary muscles Atrial septal aneurysm Lipomatous hypertrophy of the atrial septum Lamb’s excrescence Embryological development and function. Multimodality images and cine clips, including echocardiography, computed tomography and magnetic resonance imaging. Table/Summary. Conclusion and References.

CAE152
Rapid kV Switching Dual Energy Cardiac CT: What Can We Newly Know?

Education Exhibits
Location: CA Community, Learning Center

Participants
Yasutoshi Ohta MD (Presenter): Nothing to Disclose
Shinichiro Kitao: Nothing to Disclose
Hirotos Yunaga: Nothing to Disclose
Toshihide Ogawa MD: Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is: 1. To review the fundamentals of rapid kV switching cardiac dual energy CT (DECT) by comparison of other type of DECT. 2. To know what we can know newly from rapid kV switching cardiac DECT by comparison to conventional polychromatic CT.

TABLE OF CONTENTS/OUTLINE
Table of Contents/Outline: Fundamentals of rapid kV switching cardiac CT A. Theoretics of dual energy X-ray imaging B. Spectral imaging C. Features of DECT Review of dual energy images on cardiac CT (by comparison to conventional polychromatic CT) A. Coronary artery imaging B. Myocardial imaging (ischemic/non-ischemic) C. Plaque imaging D. Others Conclusion/summary: Cardiac radiologists unfamiliar with DECT and physicians-in-training will be able to obtain: 1) a better understanding of fundamentals of rapid kV switching cardiac DECT, 2) the knowledge of clinical usages in cardiac imaging, 3) the characteristic findings of cardiac disease evaluated using rapid kV switching DECT.

CAE153

Education Exhibits
Location: CA Community, Learning Center

Participants
Yoshie Kurita MD (Presenter): Nothing to Disclose
Kakuya Kitagawa MD, PhD: Nothing to Disclose
Mio Uno MD: Nothing to Disclose
Yoshitaka Goto MD: Nothing to Disclose
Naoki Nagasawa RT, PhD: Nothing to Disclose
Shiro Nakamori MD: Nothing to Disclose
Masaki Ishida MD,PhD: Nothing to Disclose
Hajime Sakuma MD: Research Grant, Siemens AG Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Guerbet SA

TEACHING POINTS
1. To learn how to measure myocardial extracellular volume using CT. 2. To become familiar with clinical significance of myocardial extracellular volume. 3. To understand advantages and technical challenges of CT measurement of myocardial extracellular volume.

TABLE OF CONTENTS/OUTLINE

CAE154
What Cardiac Imaging Can Add to the Etiologic Diagnosis in Survivor to Sudden Cardiac Death

Education Exhibits
Location: CA Community, Learning Center

Participants
Diego Mauricio Angulo Henao MD (Presenter): Nothing to Disclose
Beatriz Rodriguez Fisac: Nothing to Disclose
TEACHING POINTS

Sudden cardiac death (SCD) refers to the sudden cessation of cardiac activity with hemodynamic collapse, typically due to a sustained ventricular arrhythmia. This event occurs in up to 90 percent of patients with structural heart disease. It is essential that all survivors of SCD undergo a complete cardiac examination to determine the nature and extent of underlying heart disease. The standard evaluation includes: electrocardiogram, coronary angiography and echocardiography. Initial study of survivor to SDC helps to define most appropriate medical management. Cardiac magnetic resonance imaging is indicated for selected patients in whom a diagnosis is uncertain after the standard evaluation. The objective of this presentation is to analyze what cardiac imaging can add to the etiologic diagnosis of SCD on the basis of our own experience and literature review.

TABLE OF CONTENTS/OUTLINE

1. Pathophysiology of SCD
2. Review of major causes of SCD
3. Diagnostic procedure
4. Imaging findings and correlation between different techniques
   - Echocardiography
   - Coronary angiography
   - Cardiac MRI
   - Coronary angiography MDCT
5. Summary

CAE155

A Review of Pre- and Post-transcaval TAVR CT Imaging: What the Radiologist Needs to Know

Education Exhibits
Location: CA Community, Learning Center

Participants

Shehbaz Shaikh MD (Presenter): Nothing to Disclose
Nick Ryan Reeser MD: Nothing to Disclose
Thomas Kieju Song MD: Nothing to Disclose
Dee Dee Wang MD: Nothing to Disclose
Adam Greenbaum MD: Nothing to Disclose
William W O’Neill MD: Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review a novel approach in performing transarterial aortic valve replacement (TAVR) by obtaining aortic access via direct puncture of the IVC, followed by closure of the aortocaval tract with off-label use of a commercially available PDA or VSD closure device. 2. To review the indications, contraindications, early appearances, and complications associated with this new procedure. 3. To describe a step-wise approach for the radiologist to interpret pre/post-procedural imaging, including specific pre-procedural planning measurements.

TABLE OF CONTENTS/OUTLINE

1. Typical treatment options for patients with severe aortic stenosis
2. Patient selection
3. Transcaval TAVR procedure
4. Pre-procedural CT assessment (including imaging protocol, reporting worksheet, determining target entry site, etc.)
5. Expected postoperative appearances
6. Complications
7. Follow-up
8. Outcomes
9. Summary

CAE156

CT Imaging of Complications Associated with Surgical Left-ventricular Assist Devices

Education Exhibits
Location: CA Community, Learning Center

Participants

Girish S. Shroff MD (Presenter): Nothing to Disclose
Daniel Ocasionez MD: Nothing to Disclose
Bindu Akkanti: Nothing to Disclose
Pushpender Gupta MBBS: Nothing to Disclose
Arun C. Nachiappan MD: Nothing to Disclose
Varaha Tamminsetti MD: Nothing to Disclose
Daniel Vargas MD: Nothing to Disclose
David Paul Katz MD: Nothing to Disclose
Emma Cathryn Ferguson MD: Nothing to Disclose
Sandra Alice Ann Oldham MD: Nothing to Disclose
Jayeshkumar Patel: Nothing to Disclose
Manish K. Patel: Nothing to Disclose
Igor Gregoric: Nothing to Disclose

TEACHING POINTS

At the conclusion of this exhibit, participants will be able to confidently review CTs in patients with surgical left ventricular assist devices (LVADs). In this exhibit, we will: Review the normal imaging appearances of surgical left ventricular assist devices
Review complications associated with surgical left ventricular assist devices with emphasis on CT imaging of complications

TABLE OF CONTENTS/OUTLINE

Review normal imaging and positioning of surgical left ventricular assist devices (HeartMate 2 and HeartWare) Review complications of surgical LVADs with emphasis on CT imaging: device malpositioning, pocket hemorrhage, pocket and cannula infection, cannula kinking, cannula thrombosis, drive line infection, pericardial hemaotoma, and complications related to anticoagulation (eg, CNS, GI, and retroperitoneal hemorrhage)

CAE157

Heartbreak: Advanced Cardiac Devices Used to Monitor, Support, and Repair the Heart

Education Exhibits
Location: CA Community, Learning Center

Certificate of Merit
Participants
Anna Shlionsky Bader MD : Nothing to Disclose
Eric M. Bader : Nothing to Disclose
Laura Louise Avery MD : Nothing to Disclose
Jeffrey Michael Levsky MD, PhD : Nothing to Disclose
Meir Hillel Scheinfeld MD, PhD (Presenter): Nothing to Disclose

TEACHING POINTS
To correctly identify these advanced cardiac devices. To understand indications for these advanced cardiac devices and how they are placed. To recognize complications and abnormal positioning of these advanced cardiac devices.

TABLE OF CONTENTS/OUTLINE
The following devices will be discussed:
Nonvalvular structural devices:
- Amplatzer PFO/ASD closure device
- Starflex PFO/ASD closure device
- Watchman left atrial appendage occluder
- Lariat left atrial appendage closure device
- Heartnet ventricular restraint device
Cardiac conduction and monitoring:
- MRI conditional pacemaker
- Left atrial pressure sensor
- Implantable loop recorder
- LifeVest wearable defibrillator
Cardiac assist devices:
- Intraaortic balloon pump
- Thoratech IVAD
- Heartmate II LVAD
- Heartware LVAD
- Impella device
Valvular devices:
- Transcatheter Aortic Valve Replacement
- Mitral valve-in-valve
- MitraClip device
For each device the following topics will be discussed or demonstrated using imaging:
- Indications for placement.
- How the device is placed. Cine clip of placement will be included for devices which are placed using imaging guidance.
- Case(s) of the device normally positioned.
- Case(s) of the device malpositioned, when available.

CAE158
Shock through the Heart: Review of Common and Uncommon Pacemaker/Implantable Cardioverter-Defibrillators Systems
Education Exhibits
Location: CA Community, Learning Center

Participants
Ahmed El-Sherief MD (Presenter): Nothing to Disclose
Bruce Larry Wilkoff MD : Advisor, Medtronic, Inc Advisor, St. Jude Medical, Inc Advisor, The Spectranetics Corporation
Rahul Dinkar Renapurkar MD : Nothing to Disclose
Michael A. Bolen MD : Nothing to Disclose
Joseph Thomas Azok MD : Nothing to Disclose
Jason K. Lempel MD : Nothing to Disclose
Ruchi Yadav MD : Nothing to Disclose
Charles T. Lau MD : Nothing to Disclose

TEACHING POINTS
1. Recognize and correctly describe common and uncommon Pacemaker/Implantable Cardioverter-Defibrillators Systems 2. Understand the role of radiographic imaging following placement of Pacemaker/Implantable Cardioverter-Defibrillators Systems

TABLE OF CONTENTS/OUTLINE

CAE159
Cardiovascular Applications of Spectral Detector CT
Education Exhibits
Location: CA Community, Learning Center

Participants
Majid Chalian MD : Nothing to Disclose
Andrew Sher MD : Research Grant, Koninklijke Philips NV
David L. Wilson PhD : Co-owner, BioInVision Inc Research Grant, Koninklijke Philips NV
Hiram Bezerra : Nothing to Disclose
TEACHING POINTS
1) Spectral detector CT recent introduction to dual layer technology imaging. 2) This technology potentially offers advantages due to spatial and temporal registration and improved beam hardening correction due to projection domain technique. 3) The retrospective availability of spectral data enables several cardiovascular applications using this novel technology.

TABLE OF CONTENTS/OUTLINE
- Spectral dector CT using dual-layer detector technology - Physics - Phantom studies in cardiovascular imaging - Advantages of spectral detector technology - Cardiovascular applications of spectral CT with illustrations of Myocardial perfusion imaging - Qualitative and quantitative analysis of Atherosclerotic plaque characterization - Generating optimal virtual monoenergetic image for luminal depiction in coronary arteries - Virtual calcium scoring from CTA - Decreased calcium blooming artifact using monoenergetic high keV images - Metal artifact reduction with monoenergetic images - Improved coronary in-stent visualization - Generating optimal virtual monoenergetic image for luminal depiction in coronary arteries - Virtual calcium scoring from CTA - Decreased calcium blooming artifact using monoenergetic high keV images - Metal artifact reduction with monoenergetic images - Improved coronary in-stent visualization - Limitations and pitfalls

CAE160
Effective Ways of Using Iterative Reconstruction Algorithms at Cardiac CT
Education Exhibits
Location: CA Community, Learning Center

Participants
Seitaro Oda MD (Presenter): Nothing to Disclose
Daisuke Utsunomiya MD: Nothing to Disclose
Hideaki Yuki MD: Nothing to Disclose
Tomohiro Namimoto MD: Nothing to Disclose
Takeshi Nakaura MD: Nothing to Disclose
Yasuyuki Yamashita MD: Consultant, DAIICHI SANKYO Group
Shinichi Tokuyasu RT: Employee, Koninklijke Philips NV

TEACHING POINTS
1. Iterative reconstruction algorithms for CT are now widely used in clinical examinations. We demonstrate their effectiveness at cardiac CT. 2. There are various effective techniques to use iterative reconstruction algorithms for cardiac CT. They can improve the image quality and diagnostic performance, and reduce the radiation exposure and contrast material dose.

TABLE OF CONTENTS/OUTLINE
1. Principles of iterative reconstruction algorithms
   - First-generation iterative reconstruction
   - Hybrid iterative reconstruction
   - Full iterative reconstruction
2. Combined use with low tube-current techniques
   - Reduction in the radiation dose
   - Protocol optimization
3. Combined use with low tube-voltage techniques
   - Reduction in radiation exposure and contrast material dose
   - Protocol optimization
4. Combined use with a high-resolution kernel
   - Improved coronary in-stent visualization
5. Application in patients with various conditions
   - Obese patients
   - Pediatric patients
   - Patients with renal dysfunction
   - Patients with difficult venous access

CAE161
How to Perform A Successful Subtraction Coronary Computed Tomography Angiography
Education Exhibits
Location: CA Community, Learning Center

Participants
Makoto Amanuma MD (Presenter): Nothing to Disclose
Takeshi Kondo: Nothing to Disclose
Tomonari Sano: Nothing to Disclose
Tomoya Takayanagi: Nothing to Disclose
Takako Sekine: Nothing to Disclose
Shinichi Takase: Nothing to Disclose
Hideyuki Matsutani: Nothing to Disclose

TEACHING POINTS
1) Subtraction coronary computed tomography angiography (Sub-CCTA) is a novel technique to overcome the difficulties in evaluating coronary artery lumen with high-grade calcification or metallic stents. 2) While the procedure is performed with the dedicated software, acquiring high quality original images with motion is most important. 3) The higher the calcium score, the more difficult to obtain perfect subtracted images. 4) Various factors affect the subtraction of metallic stent including its material, size, and accompanying calcifications.

TABLE OF CONTENTS/OUTLINE
1. How to perform Sub-CCTA (a) Basic principle (b) Patient preparation (c) Actual procedures (d) Tips for successful procedure
2. Factors affecting successfullness of Sub-CCTA (a) Heart rate and acquisition methods (b) Image reconstruction methods (full data reconstruction vs. half data reconstruction) (c) Calcium score (d) Material and size of stents
3. Diagnostic capability
4. Clinical Cases
Impact of 320-slice Area Detector CT with Iterative Reconstruction in Cardiac Imaging

**Education Exhibits**
Location: CA Community, Learning Center

**Participants**
- Yasuyuki Kobayashi MD, PhD (Presenter): Nothing to Disclose
- Kihei Yoneyama: Nothing to Disclose
- Kazuhito Nozu MD: Nothing to Disclose
- Sou Oode MD: Nothing to Disclose
- Yasuo Nakajima MD: Nothing to Disclose

**TEACHING POINTS**
The major teaching points of this exhibit are: 1. Radiologist should know paradigm shift caused by low-dose non-helical volume scanning using area detector CT with iterative reconstruction in cardiology. 2. Iterative reconstruction is pivotal in dynamic cardiac functional assessment using area detector CT. 3. Dynamic functional assessment has great clinical impacts in cardiac imaging.

**TABLE OF CONTENTS/OUTLINE**
Principle and Techniques of Non-helical Volume Scan Using Area Detector CT - Problems of Helical scan - Benefits of Volume Scan Using Area Detector CT free of Helical Scan - Physics Properties of Helical Scan and Non-helical scan - Paradigm Shift Caused by Low-dose Non-helical Volume Scan with Iterative Reconstruction Clinical Impacts of Area Detector CT with Iterative Reconstruction in Cardiac Imaging - Super Low Dose Cardiac CT - Patients with Arrhythmia - Adult Patients Incapable of Breath Holding - Pediatrics: No sedation, Respiration - Subtraction Coronary CT Angiography for the Evaluation of Severely Calcified Lesions - Dynamic Myocardial Perfusion CT with Pharmacological Stress - Quantitative Functional Assessment (Cardiac Motion) - Valvular Assessment - Others

CAE163

Novel Quantitative Imaging Techniques for Non-contrast Enhanced Cardiac MRI

**Education Exhibits**
Location: CA Community, Learning Center

**Participants**
- Seitaro Oda MD (Presenter): Nothing to Disclose
- Daisuke Utsunomiya MD: Nothing to Disclose
- Kosuke Morita: Nothing to Disclose
- Hideaki Yuki MD: Nothing to Disclose
- Tomohiro Namimoto MD: Nothing to Disclose
- Takeshi Nakaura MD: Nothing to Disclose
- Yasuyuki Yamashita MD: Consultant, DAIICHI SANKYO Group

**TEACHING POINTS**
1. Cardiac MRI is a valuable non-invasive diagnostic tool that yields detailed images of the beating heart and facilitates accurate and reproducible quantification. We demonstrate recent advances in non-contrast-enhanced cardiac MRI.
2. Various effective MRI techniques that do not require contrast materials are available for the quantification of cardiac function.

**TABLE OF CONTENTS/OUTLINE**

CAE164

Parametric Mapping: An Emerging Tool for Myocardial Tissue Characterization

**Education Exhibits**
Location: CA Community, Learning Center

**Participants**
- Ana Capelastegui MD (Presenter): Nothing to Disclose
- Elena Astigarraga Aguirre MD: Nothing to Disclose
- Teresa Salinas: Nothing to Disclose
- Jose Juan Onaindia: Nothing to Disclose
- Sonia Velasco: Nothing to Disclose
- Rafael Coronado-Santos: Employee, Siemens AG

**TEACHING POINTS**
• To review the technical basis of myocardial parametric mapping. • To explain how to employ the sequences and how to obtain information from T1, T2 and T2* maps of myocardium. • To illustrate their applications in clinical practice. • To discuss strengths and limitations of this emerging technique

**TABLE OF CONTENTS/OUTLINE**
The following issues will be discussed and illustrated for each of the parametric maps of myocardium (T1, T2 and T2*): • Technical basis: exploring magnetic relaxation properties of myocardium. • Sequences employed to obtain the parametric maps. • Technical tips to ensure an optimal study. • Interpretation of parametric maps and integration in the cardiac magnetic resonance protocol. • Underlying myocardial abnormalities that alter the relaxation values. • Reference values of T1, T2 and T2* in normal and abnormal conditions. • Clinical applications: patients that may benefit from these techniques and clinical relevance in diagnosis, prognosis and follow-up of the pathologies. • Present status of the technique (strengths and limitations)
CAE165

The Transition to Quantitative Cardiac Imaging: Navigating Quantitative Maps—Where Do We Stand and Where Do We Go from Here?

Education Exhibits
Location: CA Community, Learning Center

Participants
- Jad Marwan Bou Ayache MD (Presenter): Nothing to Disclose
- Marcos Paulo Ferreira Botelho MD: Nothing to Disclose
- James Christopher Carr MD: Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
- Benjamin Freed: Nothing to Disclose
- Oisin Jude Flanagan MBCh, MRCP: Nothing to Disclose
- Daniel Lee: Research funded, CardiacAssist, Inc Spouse, Employee, Takeda Pharmaceutical Company Limited
- Jeremy Douglas Collins MD: Consultant, B. Braun Melsungen AG

TEACHING POINTS
1. Review the techniques for in vivo myocardial T1 and T2 quantitative imaging.
2. Summarize literature supporting the clinical utility of quantitative myocardial T1 and T2 imaging.
3. Review of clinical cases illustrating the clinical benefit of integrating quantitative T1 and T2 imaging into cardiac MRI protocols.

TABLE OF CONTENTS/OUTLINE
1. The need for quantitative imaging to supplement qualitative MRI examination.
2. T1 parametric mapping
   a) History and Background, highlighting the pitfalls of quantitative approaches on conventional delayed enhancement imaging sequences.
   b) Physical principles
   c) Review different pulse sequences for quantitative T1 imaging.
   d) Summarize the literature supporting the clinical utility of quantitative T1 imaging at cardiac MRI.
3. T2 parametric mapping
   a) History and Background, highlighting the pitfalls of qualitative interpretation of T2 weighted dark blood imaging.
   b) Physical principles
   c) Review different approaches for quantitative T2 imaging.
   d) Summarize the literature supporting the clinical utility of quantitative T2 imaging at cardiac MRI.
4. Case examples
   a) T2 quantitative imaging: myocarditis, vasculitis, infarction, takotsubo cardiomyopathy, and heart transplant rejection.
   b) T1 quantitative imaging: amyloidosis, scleroderma, endomyocardial fibroelastosis, thrombus, and HCM.

CAE166

Aortic Dissection—Telling What Needs To Be Told

Education Exhibits
Location: CA Community, Learning Center

Participants
- Veenita Kamble DMRD: Nothing to Disclose
- Barkha Keswani MD (Presenter): Nothing to Disclose
- Ravi Ramakantan MD: Nothing to Disclose
- Vidyadhar Lad MChir: Nothing to Disclose
- Abhishek A. Raut MD: Nothing to Disclose
- Sharad Maheshwari MD: Nothing to Disclose
- Tejas Harish Kapadia MBBS: Nothing to Disclose
- Jigar Aiya MBBS, DMRD: Nothing to Disclose
- Himani Vinayak Patel: Nothing to Disclose

TEACHING POINTS
A dedicated CT protocol is mandatory to optimally assess the aorta and its branches including coronaries. Stepwise assessment of aortic dissection by a simple imaging check-list/questionnaire contributes to hasten and help surgical planning.

TABLE OF CONTENTS/OUTLINE
Protocol for CT Imaging
- ECG gated coronary angiogram including thoracic aorta and
- Non-ECG gated Aortogram including iliac and femoral arteries.
1. Diagnosis? Aortic dissection v/s other causes of Acute Aortic Syndrome
2. Type? Type A:
   a) Involvement of Ascending Aorta +/- arch and descending thoracic aorta
   b) Type B: Descending aorta
   c) Location of tear
3. Extent of dissection
4. Status of true and false lumen?
5. Involvement and extension of true and false lumen into ostia and branch arteries
6. Arteries supplied by true lumen for cannulation for cardio-pulmonary bypass
7. Right Axillary/ Left Axillary/ Right Femoral/ Left Femoral
8. Danger signs? Aortic rupture - pericardial effusion, pleural effusion, para-aortic haematoma?
9. Coronaries involved? Renal malperfusion?
10. Other organ malperfusion?
11. Etiology? (Atherosclerosis/Connective tissue disorders etc)
12. Re-dissection

CAE167

Multidetector CT Angiography (MDCTA) on 256 Slice Dual-source CT Scanner for Evaluation of Developmental Anomalies of Thoracic Aorta: Imaging Revisted

Education Exhibits
Location: CA Community, Learning Center

Participants
- Amit Kumar Verma MBBS, MD (Presenter): Nothing to Disclose
- Richa Yadav MBBS, DMRD: Nothing to Disclose
- Sonali Sethi MBBS, MD: Nothing to Disclose
- Sunil Kumar Puri MD: Nothing to Disclose
- Vandana Goel MBBS, MD: Nothing to Disclose
- Poonam Narang MBBS, MD: Nothing to Disclose

TEACHING POINTS
Aortic-annulus anomalies, anomalous arch, anomalous branches and vascular loops can present with various vascular and non-vascular symptoms causing significant morbidity. Obstructive aortic anomalies can lead to differential blood pressure, cyanosis and even sudden cardiac compromise. MDCTA with optimised imaging techniques and radiation dose reduction is one of the most important diagnostic modalities giving 3D visualization of abnormal anatomy. Proper knowledge about anomalies, imaging technique and what a surgeon needs from a radiologist can improve the outcome.

**TABLE OF CONTENTS/OUTLINE**

- Embryological development of aorta
- Optimised CTA technique for evaluation of major thoracic vasculature
- Anomalies of aortic annulus and ascending aorta
- Obstructive aortic anomalies
- Aortic arch anomalies
- Anomalous arch branches
- Vascular loops
- What to look beyond aorta...

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### CAE169

**The Radiology Resident's Guide to the Evaluation of Aortic Disease: A Case-based Interactive Tutorial**

*Education Exhibits*

*Location: CA Community, Learning Center*

**Participants**

- Jesus Humberto Burboa Noriega MD (Presenter): Nothing to Disclose
- Luis Burboa Noriega MD: Nothing to Disclose
- Sergio A. Criales Vera MD: Nothing to Disclose

**TEACHING POINTS**

Purpose / aim: after the exhibit the viewer should be able to:

1. Recognize the radiologic features of the acute aortic syndrome.
2. Identify potential complications related to aortic aneurysms.
3. Describe the imaging findings associated with aortic coarctation, Takayasu's arteritis and Leriche syndrome.

**TABLE OF CONTENTS/OUTLINE**

- The cases and teaching points will be presented in a quiz format for the viewer to solve. The list of cases includes: 1. Acute aortic syndrome (dissection, intramural hematoma and penetrating atherosclerotic ulcer) 2. Aortic aneurysm 3. Aortic coarctation 4. Takayasu's arteritis 5. Leriche syndrome Key points referring to the pathogenesis, clinical presentation, treatment, prognosis, complications and differential diagnosis will also be displayed.

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### CAE170

**Acquired Cardiac Valvular Disease: For the General Radiologist— Emphasis on Chest Radiograph and CT Findings**

*Education Exhibits*

*Location: CA Community, Learning Center*

Selected for *RadioGraphics*

**Participants**

- Mark M. Hammer MD (Presenter): Nothing to Disclose
- Kareem Mawad MD: Nothing to Disclose
- Fernando R. Gutierrez MD: Nothing to Disclose
- Sanjeev Bhalla MD: Nothing to Disclose

**TEACHING POINTS**

1. Understand the physiology of valvular stenosis and regurgitation, especially as it applies to cardiac chamber size and myocardial remodeling over time.
2. Review the manifestations of the most common acquired cardiac valvular pathologies (specifically, aortic, mitral, and tricuspid disease) on the chest radiograph and on routine CT.
3. Review abnormalities of the valves themselves, such as calcification and vegetations, that can be seen on routine CT examinations and their significance.

**TABLE OF CONTENTS/OUTLINE**


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### CAE171

**Low-dose, Automated TAVR Guidance 3rd Generation Dual-source CT**

*Education Exhibits*

*Location: CA Community, Learning Center*

**Participants**

- Raluca Gabriela Saru MD (Presenter): Nothing to Disclose
- Marcel L. Dijkstra RT: Consultant, Siemens AG
- Mohamed Euhlous MD, PhD: Consultant, Siemens AG
- Gabriel P. Krestin MD, PhD: Consultant, General Electric Company
- Elise D. Pieterman: Consultant, Bayer AG
- Philip H. Pieterman: Consultant, General Electric Company
- Mohamed Euhlous, Siemens AG

Selected for *RadioGraphics*
Koen Nieman, MD, PhD: Speakers Bureau, Siemens AG Speakers Bureau, Toshiba Corporation Research Grant, Bayer AG Research Grant, General Electric Company

TEACHING POINTS
• Become familiar with TAVR procedure - how is it performed, what are the advantages and disadvantages; • Relevant aortic valve and outflow tract anatomy. • CT scanning: • Patient preparation. • Use of efficient contrast injection protocol. • Tailored acquisition protocols for patients with renal insufficiency, young age, arrhythmia. • Advantages of 3rd generation DSCT in customizing protocols. • Use, benefits and pitfalls of automatic processing tools • Diagnostic pitfalls. • Case examples.

TABLE OF CONTENTS/OUTLINE

EDE002-b
Cardiac Case of the Day
Education Exhibits
Location: NA

Participants
Moderator
Matthew D. Cham, MD: Nothing to Disclose
Javier Sanz, MD: Nothing to Disclose
Baskaran Sundaram, MBBS: Nothing to Disclose
Adam Jacobi, MD: Nothing to Disclose
Mary Margaret Salvatore, MD: Nothing to Disclose
Neil Lester, MD: Nothing to Disclose
Anastasia Louise Hryhorczuk, MD: Nothing to Disclose
Neil Malhotra, MD: Nothing to Disclose

TEACHING POINTS
1) Review the diagnosis of a specific condition by using either a single-modality or multimodality approach; identify state-of-the-art imaging and methods of treatment for various pathologic conditions; and assess new research on applications of various imaging and therapeutic modalities.

SSA02
Cardiac (Anatomy and Function)

Scientific Papers

SSA02-01
A Comparative Study of Methods for Cardiac Ventricular Volume Estimation
Xiantong Zhen, PhD (Presenter): Nothing to Disclose, Zhijie Wang: Nothing to Disclose, Ali Islam, MD: Nothing to Disclose, Mousumi Bhaduri, MD: Nothing to Disclose, Ian Chan, MD: Nothing to Disclose, Shuo Li, PhD: Employee, General Electric Company

PURPOSE
Accurate and automatic estimation of cardiac ventricular volumes, e.g., left ventricle (LV) and right ventricle (RV), is of great significance for clinical assessment of cardiac functions. Existing estimation methods can be categorized into conventional contouring-based methods and emerging direct estimation without contouring. This study comparatively investigates representative methods from each category to find out the more suitable one for cardiac ventricular volume estimation in clinical use.

METHOD AND MATERIALS
3360 2D short-axis cine MR images from 56 clinical subjects were used. Each contains 20 frames in a cardiac cycle. These images were acquired on a 1.5T scanner with fast imaging employing steady-state acquisition (FIESTA) image sequence mode, using these acquisition parameters: TR=2.98 ms, TE=1.2 ms, flip angle=30 degrees, and slice thickness=10 mm. We investigate two categories of methods: contouring-based methods including level set (LS) and graph cut (GC) and direct estimation methods without contouring including Bayesian estimation (BE) and descriptor learning (DL). The performance is evaluated by estimation error of
RESULTS

For LV, direct methods produce estimation errors of 0.037 (BE) and 0.085 (DL), and contouring-based methods yield estimation errors of 0.110 (LS) and 0.097 (GC). For RV, contouring-based methods fail to do estimation due to the geometrical complexity of RV, and direct methods can estimate for bi-ventricles, i.e., LV and RV, simultaneously with impressive results of 0.049 (BE) and 0.110 (DL) for RV. Direct estimation methods outperform contouring-based methods in terms of estimation errors and yield comparable performance with baselines (i.e., inter-observer variability) which are 0.012 and 0.018 for LV and RV, respectively.

CONCLUSION

Direct estimation methods provide more accurate estimation of cardiac ventricular volumes than contouring-based methods. Moreover, they are flexible to be used for either individual or joint volume estimation of LV and RV, while contouring based methods can only apply to a single ventricle.

CLINICAL RELEVANCE/APPLICATION

Direct estimation methods have emerged as a convenient and mature clinical tool for cardiac volume estimation which enable diagnosis of cardiac diseases to be conducted in a more efficient and reliable way.

SSA02-02

Hepatic Triglyceride Content is Associated with Left Ventricular Diastolic Dysfunction in Overweight and Obese Individuals: The NEO Study

Ralph L. Widya MD (Presenter): Nothing to Disclose, Renee De Mutsert: Nothing to Disclose, Martin den Heijer: Nothing to Disclose, Saskia le Cessie PhD: Nothing to Disclose, Frits R. Rosendaal MD: Nothing to Disclose, Wouter J. Jukema MD: Research Grant, Astellas Group Research Grant, AstraZeneca PLC Research Grant, BIOTRONIK GmbH & Co KG Research Grant, Boston Scientific Corporation Research Grant, DAIICHI SANKYO Group Research Grant, Eli Lilly and Company Research Grant, sanofi-aventis Group Research Grant, Medtronic, Inc Research Grant, Merck & Co, Inc Research Grant, Pfizer Inc Research Grant, OrbusNeich Research Grant, Novartis AG Research Grant, F. Hoffmann-La Roche Ltd Research Grant, SERVIER Research Grant, The Medicine Company Speaker, AstraZeneca PLC Speaker, BIOTRONIK GmbH & Co KG Speaker, Boston Scientific Corporation Speaker, DAIICHI SANKYO Group Speaker, Eli Lilly and Company Speaker, sanofi-aventis Group Speaker, Medtronic, Inc Speaker, Merck & Co, Inc Speaker, Pfizer Inc Speaker, OrbusNeich Speaker, Novartis AG Speaker, F. Hoffmann-La Roche Ltd Speaker, SERVIER Speaker, The Medicine Company, Jan W. A. Smit MD, PhD: Nothing to Disclose, Albert De Roos MD: Nothing to Disclose, Hildo J. Lamb MD, PhD: Nothing to Disclose

PURPOSE

To investigate the relationship between nonalcoholic fatty liver disease (NAFLD) and left ventricular (LV) diastolic function, and to what extent this association was explained by the metabolic syndrome.

METHOD AND MATERIALS

MR spectroscopy and imaging were performed to measure hepatic triglyceride content and LV diastolic heart function (E/A). Linear regression analyses were performed to study their association while adjusting for age, sex, heart rate, alcohol consumption, pack years of smoking, all components of the metabolic syndrome, abdominal visceral adipose tissue (VAT), body fat, and stratified by BMI < or ≥27 kg/m2.

RESULTS

In 747 participants aged 45-65 years, median (interquartile range) hepatic triglyceride content was 2.55 (1.30-6.06)%. A 10-fold increase in hepatic triglyceride content decreased mean E/A with -0.191 (95%CI: -0.268, -0.115) in participants with a BMI ≥27 kg/m2, but not in participants with a BMI<27 kg/m2 (β -0.065, 95%CI:-0.256,0.125). After adjustments for components of the metabolic syndrome, VAT and body fat this association slightly attenuated (β-0.094, 95%CI: -0.164,-0.023).

CONCLUSION

Hepatic triglyceride content was associated with LV diastolic dysfunction in participants with a BMI ≥27 kg/m2 while adjusting for confounding factors including the components of the metabolic syndrome and VAT. These observations suggest that NAFLD may pose an independent risk of myocardial dysfunction above and beyond known cardiovascular risk factors which are clustered within the metabolic syndrome.

CLINICAL RELEVANCE/APPLICATION

Our finding that nonalcoholic fatty liver disease is associated with diastolic heart function may be of importance for the understanding of the development of cardiovascular disease in the growing obesity epidemic.

SSA02-03

Left Atrial Appendage Morphology Differs in Patients with Suspected Cardiogenic Stroke without Chronic Atrial Fibrillation

Miika Korhonen BMBS, MSc (Presenter): Nothing to Disclose, Antti Tapani Muuronen BMedSc: Nothing to Disclose, Mika Haataja MD: Nothing to Disclose, Otso Arponen: Nothing to Disclose, Marja Hedman: Nothing to Disclose, Pekka Jakala: Nothing to Disclose, Petri J. Sipola MD: Nothing to Disclose, Pirjo
PURPOSE

Left atrial appendage (LAA) is the most typical origin for intracardiac thrombus formation when associated with atrial fibrillation (AF). There is controversy whether LAA morphology associates with increased stroke/TIA risk, and, if it does, which morphological type increases the risk most. We used cardiac computed tomography (cCT) to examine LAA morphology and volume in suspected cardiogenic stroke/TIA patients without persistent AF.

METHOD AND MATERIALS

The prospective study included 111 patients (74 males; mean age, 60 years) with suspected cardioembolic stroke/TIA without AF and 40 (21 males; mean age, 54 years) age and gender matched healthy control subjects. LAA volumes were quantified. Three observers in consensus classified LAA into four morphology types (Cactus; ChickenWing; WindSock; Cauliflower) modified with a quantitative qualifier.

RESULTS

The proportion of LAA morphology types Cactus, ChickenWing, WindSock and Cauliflower were 5.0%, 37.5%, 35.0% and 22.5% in age and gender matched stroke/TIA patients and 20.0%, 10.0%, 67.5%, and 2.5% in controls, respectively. Distribution of morphology types differed significantly (P<0.01). Stroke patients also had decreased number of LAA lobes (P<0.01). In the whole stroke/TIA population the proportions of LAA morphology types Cactus, ChickenWing, WindSock and Cauliflower were 9.0%, 23.4%, 47.7%, and 19.8%. Patients with WindSock morphology had larger LAAs (P<0.01) and over half of patients with WindSock morphology had an enlarged LAA of >5.6 mL/m2.

CONCLUSION

LAA morphology differed significantly between stroke/TIA patients and healthy control subjects. ChickenWing LAA and fewer lobes were more common in stroke/TIA patients without chronic AF.

CLINICAL RELEVANCE/APPLICATION

LAA morphologies associating with elevated stroke risk may suggest existence of paroxysmal atrial fibrillation and thus help targeting prolonged rhythm monitoring.

PURPOSE

Circumferential strain ($\varepsilon_{cc}$) increases from epicardium to endocardium in normal patients. However, evaluation of strain at the myocardial surfaces is difficult with tagged CMR, which is better suited to midwall strain analysis. CMR feature tracking is a novel technique which directly tracks motion at the myocardial borders. The purpose of this study was to test the feasibility of using feature tracking to evaluate circumferential transmural strain gradient (cTSG, the difference endocardial and epicardial $\varepsilon_{cc}$) in patients with hypertrophic cardiomyopathy (HCM).

METHOD AND MATERIALS

Subjects with a clinical diagnosis of overt HCM and their family members were invited to participate in this multi-center, prospective, cross-sectional study. Genetic testing was performed, and left ventricular hypertrophy (LVH) was assessed by echocardiography or CMR. Patients were categorized as control (mutation-/LVH-, n=30), preclinical (mutation+/LVH- , n=37), or overt (mutation+/LVH+, n=48) HCM. Mid ventricular short axis cine images were analyzed at using Multimodality Tissue Tracking software (MTT Version 6.0.4725, Toshiba Medical Systems Corporation, Tokyo, Japan).

RESULTS

Global endocardial $\varepsilon_{cc}$ was significantly increased in overt patients (-29.8% ± 6.6%) relative to preclinical (-26.6% ± 4.8%, p = -0.011) and control (-24.6% ± 4.3%, p < 0.0001). Global epicardial $\varepsilon_{cc}$ showed a decreasing trend from control to preclinical to overt. cTSG increased significantly from control(-13.7% ± 3.6%) to preclinical (-17.0% ± 4.0%) to overt (-19.2% ± 7.8%), (p < 0.01). Significant differences were observed between preclinical and control in the septum (p < 0.01), overt and preclinical anteriorly (p < 0.001), and overt and control in all segments (p < 0.0001).

CONCLUSION

CMR feature tracking is feasible in HCM, and detected an increased strain gradient between the endocardial and epicardial surfaces.

CLINICAL RELEVANCE/APPLICATION

Patients with gene positive HCM but without wall thickening (LVH-) may have subtle abnormalities in myocardial strain in early disease detected by CMR feature tracking, relative to control and overt HCM patients.
Semi-automatic Cardiac Longitudinal Strain Analysis Using Four-chamber Cine MR Imaging: Correlation with Left Ventricular Dysfunction

Masateru Kawakubo RT (Presenter): Nothing to Disclose, Michinobu Nagao MD: Research Grant, Bayer AG Research Grant, Koninklijke Philips NV, Seiji Kumazawa PhD: Nothing to Disclose, Masato Yonezawa: Nothing to Disclose, Yuzo Yamasaki MD: Nothing to Disclose, Hiroshi Honda MD: Nothing to Disclose, Akiko Suyama Chishaki MD: Nothing to Disclose, Yasuhiko Nakamura RT: Nothing to Disclose, Junji Morishita PhD: Nothing to Disclose

PURPOSE
Assessment of ventricular function with cardiac magnetic resonance (MR) imaging requires ventricular volumetry for a cardiac cycle. To reduce the time and effort, we developed a semi-automatic method that can detect the biventricular margin for four-chamber (4CH) cine MR imaging, and we performed longitudinal strain (ε) analysis to predict left ventricular (LV) dysfunction.

METHOD AND MATERIALS
In 20 patients with heart failure [mean age, 55 years; mean LV ejection fraction (LVEF), 39%], 4CH cine images were obtained using a 3-Tesla MR system. The εL was defined as the percentage of the longitudinal length at end-diastole with respect to the difference between the longitudinal length at each phase and end-diastole on 4CH cine images. The LV and right ventricular (RV) εL values were calculated semi-automatically (εL_auto) and manually (εL_manu) for a cardiac cycle. The correlation between εL_auto and εL_manu were observed in all acquired datasets and both reconstruction intervals. Intra-/interobserver variability was observed in all acquired datasets and both reconstruction intervals. Intra-/interobserver variability was lower in end-systolic vs end-diastolic reconstruction interval (0.891 vs 0.942) (sensitivity, 100%; specificity, 100% vs 100%)

RESULTS
Excellent correlations were observed between εL_auto and εL_manu (Pearson r = 0.85, 0.92 for LV, RV; p < 0.0001). Significant negative correlations between the minimum εL_auto and LVEF were observed (Pearson r = -0.75, -0.89 for LV, RV; p < 0.0001). Significant differences were found in the εL_auto between two patient groups (LV: -15.8 ± 3.0 vs. -7.2 ± 3.2%, RV: -31.9 ± 5.5 vs. -15.0 ± 3.8%; p < 0.0001). ROC analysis revealed the optimal cutoff for identifying patients with LVEF ≤ 40% (LV εL_auto = -12.0%; area under the curve, 0.96; sensitivity, 100%; specificity, 90%; RV εL_auto = -24.0%; area under the curve, 1.00; sensitivity and specificity, 100%).

CONCLUSION
The εL from our semi-automated method showed excellent agreement with that from the manual tracing and significantly correlated with LVEF. Our method predicted LV dysfunction with simple and easy measurements.

CLINICAL RELEVANCE/APPLICATION
Our proposed semi-automatic method is easy and accurate for longitudinal strain analysis, and it enables the prediction of LV dysfunction by using only one slice of 4CH cine MR imaging.

Comparison of End-diastolic versus End-systolic Cardiac-computed Tomography Reconstruction Interval in Patients prior PVI

Wieland Staab MD (Presenter): Nothing to Disclose, Jan Martin Sohns MD: Nothing to Disclose, Martin Fasshauer MD: Nothing to Disclose, Christian Sohns: Nothing to Disclose, Christina Unterberg-Buchwald: Nothing to Disclose, Joachim Lotz MD: Research Cooperation, Siemens AG

PURPOSE
Using a split-bolus single phase cardiac-CT angiography (CCTA) in patients prior PVI, CT Datasets were evaluated in left ventricular end-systolic (LVES) (39±4 % RR-interval) and left ventricular end-diastolic (LVED) (77±5 % RR-interval) cardiac cycle. Aim of the study was to investigate diagnostic accuracy of CCTA between cardiac cycles, intra-/interobserver variability’s as well as comparing acquired volumetric and diametric datasets.

METHOD AND MATERIALS
182 consecutive Patients with drug refractory AF scheduled for PVI (62.6 % male, mean age 64.1±10.2 years) underwent routine pre-procedural evaluation including TEE and CCTA for evaluation of LA/LAA anatomy and thrombus formation. Here, qualitative and quantitative analysis (using LA/LAA ratio) was performed. Volumetric measurements in LVES and LVED were carried out according to the Simpson’s method. Intra- and interobserver variability was observed in all acquired datasets and both reconstruction intervals.

RESULTS
14 out of 182 patients (7.7%) showed filling defects of the LAA in CCTA. End-systolic volumes (LA/LAA) measured in 30 patients without filling defects and all 14 with filling defects were significantly larger (p < 0.01) than in end-diastolic phase. Patients with filling defects showed significantly larger LA volumes than in patients without (193.07± 9.77 ml/m² vs 171.87 ± 26.85 ml/m²; p < 0.01). Qualitative analysis was inferior to quantitative analysis using LA/LAA Ratio (< 0.5; accuracy: 100%,88%,100%,99% vs 100%). Intra-/interobserver variability was lower in end-systolic vs end-diastolic reconstruction interval (0.942 vs 0.891).

CONCLUSION
For evaluating CCTA datasets in patients prior PVI, the LVES (39±4 % RR-interval) reconstruction interval is
recommended due to significantly larger LA/LAA volumes and lower intra-/interobserver variability's.

**CLINICAL RELEVANCE/APPLICATION**
The LVES interval is recommended for reconstructing CCTA Datasets in patients referred for pulmonary vein intervention due to significantly larger LA/LAA diameters / volumes (p< 0.01) and lower intra-/interobserver variability's.

**Right Ventricular Strain Abnormalities in Arrhythmogenic Right Ventricular Cardiomyopathy: Analysis of CMR by Feature Tracking**

**Davis M. Vigneault BS (Presenter):** Nothing to Disclose  
**Anneline S. J. M. Te Riele MD:** Nothing to Disclose  
**Cynthia James PhD:** Nothing to Disclose  
**Stefan L. Zimmerman MD:** Nothing to Disclose  
**Hugh Calkins:** Nothing to Disclose  
**Harikrishna Tandri:** Nothing to Disclose  
**David A. Bluemke MD, PhD:** Research support, Siemens AG

**PURPOSE**
Arrhythmogenic right ventricular cardiomyopathy (ARVC) is an inherited cardiomyopathy characterized by regional wall motion abnormalities of the right ventricle (RV) that are often subtle and difficult to quantify. RV Myocardial strain is poorly assessed with tagged cardiac magnetic resonance (CMR) due to the thin RV wall. We sought to determine the feasibility of RV myocardial strain analysis in ARVC patients using a novel feature tracking method.

**METHOD AND MATERIALS**
Patients with suspected ARVC and control subjects underwent horizontal long axis (HLA) and short axis (SA) cine imaging using SSFP sequences. In the HLA view, the RV was divided into subtricuspid (ST), anterior wall (AW), and apical (Ap) regions. In the SA view, the RV was divided into outflow tract (OT), free wall (FW), angle (Ang), and inferior (Inf) regions. Each region was analyzed to determine peak longitudinal and circumferential strain and strain-rate using Multimodality Tissue Tracking (MTT) software (MTT Version 6.0.4725, Toshiba Medical Systems Corporation, Tokyo, Japan).

**RESULTS**
58 subjects (19 controls, 20 preclinical ARVC [mutation+], and 19 overt ARVC [mutation+, Task Force+] patients) who had undergone cine CMR examination were enrolled in the study. The average age was 34.6 ± 16.2 years (40% women). Regional longitudinal strain and strain rate decreased in magnitude from control to preclinical to overt ARVC, though significance was only reached between overt and control (p < 0.01 for all strains / strain rates, with the exception of the apex). Strain was most abnormal in the subtricuspid region. Compared to longitudinal strain, circumferential strain and strain rate showed similar differences between groups, although more pronounced in the inferior region of the RV.

**CONCLUSION**
CMR feature tracking of the RV is feasible and may allow for quantification of regional wall motion abnormalities in ARVC.

**CLINICAL RELEVANCE/APPLICATION**
Qualitative assessment of regional wall motion abnormalities is unreliable and subject to inter-observer variation. CMR feature tracking has the potential to improve the reliability of ARVC diagnosis and detection of regional wall motion abnormalities.

**Merged Multidetector-Computed Tomography (MDCT) with Late-Enhancement and Electroanatomic Mapping (EAM) in Patients Affected by Recurrent Episodes of Ventricular Tachycardia (VT): A Point-by-Point Correlation**

**Caterina Colantoni (Presenter):** Nothing to Disclose  
**Antonio Esposito MD:** Nothing to Disclose  
**Anna Palmisano MD:** Nothing to Disclose  
**Sofia Auntunes:** Nothing to Disclose  
**Francesco Aldo De Cobelli MD:** Nothing to Disclose  
**Alessandro Del Maschio MD:** Nothing to Disclose

**PURPOSE**
Most of recurrent VT recognizes a myocardial scar substrate; an ICD-compatible imaging able to assess cardiac scars and anatomy may help to plan and guide EAM and VT ablation. Our purpose was to evaluate the feasibility and usefulness of integrating MDCT data with EAMs for VT substrate assessment and guidance of VT mapping and ablation.

**METHOD AND MATERIALS**
20 patients suffering from recurrent episodes of VT underwent MDCT before VT ablation, including an angiographic-scan and a low-energy (80kV) delayed-scan (10 minutes after high concentration contrast media). For each patient, a 3D-model of the heart (CT-3D-MODEL), representing the cardiac cavities, aortic root, left ventricular wall and myocardial scar in different colours, was obtained by the fusion of angiographic and delayed scan, separately segmented. The CT-3D-MODELS were uploaded on CARTO® system and co-registered with high-density bipolar maps using CARTO-merge. A point-by-point correlation was performed between low-voltage areas at bipolar EAM (≤1.5mV, corresponding to scar) and scars on CT-3D-MODEL, using a homemade software. 20 mm was considered the cut-off for registration-error.
RESULTS

The analysis included 24 scars, counting 15 scars in ischemic cardiomyopathy, 7 scar in non-ischemic cardiomyopathy, and 2 scar of myocardial origin. The bipolar EAMs were mapped with an overall number of 18095 points (min 71; max 2601); 11737 out of 18095 points at EAMs corresponded to scar areas on CT-3D-MODEL with 68% of overall correspondence. Analysis for patient showed a range of correlation between CT-3D-MODEL and EAM varying from 0% to 99%. A correlation between CT-3D-MODEL and EAM > 75% was found in 15 out of 20 patients, in 3 patients the correlation resulted between 50% and 75% and in 2 was < 50%. In these 2 patients the poor correlation was linked to the absence of low voltages at EAM, in one patient, and to the low quality of delayed MDCT scan, in the second case.

CONCLUSION

Cardiac MDCT with delayed scan allows an accurate assessment of scar substrate of VT in most of patient. The optimized protocol of acquisition and post-processing set-up in this study allows to obtain high resolution CT-3D-MODELs suitable for integration with EAMs on CARTO.

CLINICAL RELEVANCE/APPLICATION

The integration of CT-3D-MODELs with EAM could be useful for identification of VT substrate, potentially improving VT ablation success.

Doppler Ultrasound as an Alternative Gating Method in Cardiac Cine MRI

SSA02-09

Fabian Kording (Presenter): Nothing to Disclose, Bjorn Schoennagel MD: Nothing to Disclose, Friedrich Uberle: Nothing to Disclose, Gerhard B. Adam MD: Nothing to Disclose, Jin Yamamura MD: Nothing to Disclose

PURPOSE

Accurate synchronization of the cardiac cycle is one of the main challenges in cardiac magnetic resonance imaging. Ultrasound is not objected to magneto-hydro-dynamic effects, does not interact with the electromagnetic field of the MRI and measures the physiological motion of the heart rather than electrical activation. The purpose of this work was to evaluate Doppler ultrasound (DUS) as an alternative gating method in cardiac MRI.

METHOD AND MATERIALS

Steady-state free precession (SSFP) 2D CINE MRI in 12 healthy subjects (8 male, 4 female) was performed at 1.5 T with DUS, electrocardiogram (ECG) and pulse oximetry (POX) gating signals. Trigger reliability and variance of detected trigger time points during acquisition were computed from signals stored by the internal log function of the physiologic unit of the MRI. Quantitative analysis of image quality was assessed by calculating endocardial border sharpness (EBS), signal-to-noise (left ventricular blood) and contrast-to-noise (blood-myocardium) ratios and left ventricular (LV) function parameters.

RESULTS

No interference with the MRI electromagnetic field was observed for DUS and POX signals whereas ECG showed small T-wave elevations due to magneto-hydro-dynamic effects. Trigger variances, displaying trigger accuracy, were 48 ± 11 ms (ECG), 41 ± 12 ms (DUS) and 81 ± 35 ms (POX). Mean stroke volume for ECG, DUS and POX was 82 ± 24 ml, 83 ± 22 ml and 81 ± 27 ml yielding an ejection fraction of 59 ± 6 %, 61 ± 7 % and 59 ± 6 %, respectively. EBS for systole, diastole and as temporal mean over the cardiac cycle was 3.1 ± 0.2 / 2.6 ± 0.1 / 2.9 ± 0.2 pixel (ECG), 3.1 ± 0.2 / 2.6 ± 0.1 / 2.9 ± 0.2 pixel (DUS) and for POX gated images 3.3 ± 0.1 / 2.9 ± 0.1 / 3.1 ± 0.2 pixel. Signal-to-noise ratios for ECG and DUS were 52 ±13 and 45 ± 16 with a contrast-to-noise ratio of 39 ±10 and 34 ±12.

CONCLUSION

Synchronization of 2D CINE SSFP cardiac MRI was successfully demonstrated using DUS at 1.5 T. Quantitative analysis revealed high agreement between ECG and DUS whereas trigger accuracy and EBS were smaller for POX gating. In conclusion, DUS gating is a promising alternative gating method for cardiac MRI.

CLINICAL RELEVANCE/APPLICATION

Doppler ultrasound measures physiological motion of the heart rather than electrical activation and, hence, enables a more accurate gating, especially for higher field strength.

SSA03

Cardiac (Cardiovascular Disease)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.50
Participant:

**Moderator**
- Lisa Diethelm MD: Nothing to Disclose
- Bernd J. Wintersperger MD: Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG

**Sub-Events**

**SSA03-01**

**Predictive Value of Coronary Artery Lumen Area Quantification for Prediction of Hemodynamically Relevant Coronary Stenosis by Computed Tomography (CT) Angiography**

**Participants**
- Fabian Plank (Presenter): Nothing to Disclose
- Tobias De Zordo MD: Nothing to Disclose
- Moritz Kummang: Nothing to Disclose
- Andrea Klauser MD: Nothing to Disclose
- Werner R. Jaschke MD, PhD: Nothing to Disclose
- Gudrun Feuchtner MD: Nothing to Disclose

**Purpose**

Coronary CTA is validated to rule out coronary artery disease (CAD), however, false positive high-grade lesions result in lower sensitivity. Additional mean lumen area (MLA) measurements may increase accuracy by identifying hemodynamic relevance of a stenosis. Therefore the purpose was to evaluate the added value of MLA quantification by CTA to predict hemodynamic significance of coronary stenosis by invasive angiography (ICA) requiring coronary revascularization procedure.

**Method and Materials**

45 patients (mean age 63.9) who underwent 128- or 64-slice CTA presented with at least one high-grade stenosis (> 50%) in a proximal coronary vessel (right coronary artery (RCA), left main (LM), left anterior descending (LAD) or circumflex artery (CX)) and subsequently underwent invasive angiography (ICA). The minimal lumen area (MLA) was quantified by CT. Results were evaluated for hemodynamic relevance in ICA (defined as fractional flow reserve <0.8) and followed by percutaneous intervention or coronary bypass grafting. ROC-Analysis with stepwise testing (0.1 mm² MLA increments) was performed.

**Results**

Overall, 50 high-grade stenosis (6 RCA, 7 LM, 37 LAD) in 156 proximal segments were evaluated. Mean lumen diameter was 4.7 mm² ± 3.05. Mean MLA was 2.75 mm² (range 2.18-3.27) for high grade stenosis and 5.51 mm² (range 4.93-6.09) for no or mild stenosis. The MLA for LM was 7.13 mm², LAD 2.90 mm², CX 3.84 mm², RCA 5.13 mm². A threshold of 1.9 mm² MLA was identified as optimal cut-off, area under the curve (AUC) was 0.90 (p<0.0001). Sensitivity: 81.8% (59.7 - 94.8) and specificity: 91.04% (84.9 - 95.3). Twenty seven high-grade stenosis (>50%) in CT had no hemodynamic relevance. Of those, 24 (88.9%) lesions had MLA >1.9 mm².

**Conclusion**

A minimal lumen area cut-off of 1.9 mm² or less showed highest accuracy for prediction of significantly increased hemodynamic relevance and may add important value to CTA.

**Clinical Relevance/Application**

The added value of MLA measurements may help identify hemodynamically relevant coronary stenosis.

**SSA03-02**

**Increased Epicardial Fat Volume Is Independently Associated with Atrial Fibrillation, Atrial Fibrillation Severity and Radiofrequency Ablation Outcome**

**Participants**
- Jadranka Stojanovska MD, MS (Presenter): Nothing to Disclose
- Ella A. Kazerooni MD: Nothing to Disclose
- Barry Howard Gross MD: Nothing to Disclose
- Hakan Oral MD: Nothing to Disclose

**Purpose**

To determine whether intrathoracic fat volumes are independently associated with the presence of atrial fibrillation (AF), severity of AF and outcome of radiofrequency ablation (RFA) using logistic regression analysis.

**Method and Materials**

Institutional Review Board approval was obtained and patient consent was waived for this HIPPA-compliant retrospective study. A total of 231 patients, 169 with AF (75 with non-paroxysmal and 94 with paroxysmal) and 62 control patients, formed the study population. AF patients underwent computed tomography (CT) of the pulmonary veins and left atrium, and control patients underwent coronary CT. Intrathoracic fat volumes (extrapericardial and epicardial) were measured for both groups. Associations between presence and severity of AF and intrathoracic fat volumes were assessed using logistic regression analysis.

**Results**

The epicardial fat volume remained statistically associated with the prevalence of AF [1.01 (1.003-1.03), p=0.01], AF severity [1.008 (1.001-1.02), p=0.03], and recurrence of AF after RFA [1.009 (1.001-1.01), p=0.02] after adjustment for age, gender, and body mass index. Time to recurrence after ablation was shorter in patients who had larger epicardial fat volume than patients who did not (14± 15 days versus 22± 16 days, p=0.017). The epicardial fat volume was larger in the 78/169 AF patients (46%) who had AF recurrence after RFA compared to the 91/169 or (54%) who did not have recurrence (81 ± 47 mL versus 105 ± 56 mL, p=0.002).
CONCLUSION

Increased epicardial fat volume is associated with the presence of AF, AF severity, and higher probability of recurrence of AF after radiofrequency ablation.

CLINICAL RELEVANCE/APPLICATION

Extensive epicardial fat is associated with earlier recurrences of AF after radiofrequency ablation that potentially may reduce the transmurality of radiofrequency ablation by affecting current and impedance dynamics. Quantification of epicardial fat on pre-procedural CT scan may identify patients with AF who will benefit from catheter ablation as a definitive treatment for AF.

SSA03-03

Left Atrial Appendage (LAA) Thrombosis Exclusion with Two-phase Cardiac Computed Tomography (CT) in Patients with Atrial Fibrillation (AF): A Prospective Comparison Study with Transesophageal Echocardiography (TEE)

Daniela Di Marco MD (Presenter): Nothing to Disclose, Manuela Giglio MD: Nothing to Disclose, Francesca Besana MD: Nothing to Disclose, Sandro Sironi MD: Nothing to Disclose, Pietro Spagnolo MD: Nothing to Disclose

PURPOSE

to evaluate the diagnostic accuracy of two-phase cardiac CT in detecting left atrial appendage (LAA) thrombosis in patients with chronic atrial fibrillation referred for radiofrequency ablation using the CARTO 3 and NavX system.

METHOD AND MATERIALS

260 consecutive patients undergoing CARTO-guided radiofrequency ablation for atrial fibrillation were prospectively enrolled. All patients underwent both cardiac CT and TEE within a 3-hour period or less. Diagnostic accuracy of cardiac CT for detection of LAA thrombosis was computed using TEE as reference standard. CT scanning protocol included a standard early phase imaging to evaluate coronary arteries, pulmonary vein and LAA anatomy and a late phase imaging using prospective electrocardiographic gating 6 minutes after contrast media injection. To reduce the radiation dose, late phase imaging was limited to the left atrium and performed only when a LAA filling defect was found on early-arterial phase. Filling defects seen on added late-phase imaging as well as on early-phase imaging were categorized as thrombus.

RESULTS

TEE demonstrated spontaneous echo contrast in 48 patients and thrombus in 6 patients. In 57 patients CT demonstrated LAA early filling defects and a late-phase imaging was performed. All the 6 thrombi diagnosed on TEE were correctly identified on cardiac CT. The overall sensitivity and specificity were both 100%. The calculated radiation dose of CT examination was 3.31 mSv for early-phase imaging and 0.16 mSv for late phase imaging.

CONCLUSION

two-phase cardiac CT is a noninvasive and accurate modality for detecting LAA thrombosis and differentiating thrombus from circulatory stasis. Cardiac CT may obviate routine TEE before radiofrequency ablation.

CLINICAL RELEVANCE/APPLICATION

two-phase cardiac-CT could be a one-stop-shop examination in patients with AF before RF-ablation allowing to obtain accurate imaging of heart, pulmonary veins and exclude LAA thrombosis, avoiding TEE

SSA03-04

Corrected Coronary Opacification Difference Measured with Computed Tomography Angiography Predict Coronary In-stent Restenosis


PURPOSE

To determine whether changes in corrected coronary opacification (CCO) across stents can identify in-stent restenosis (ISR) severity compared with invasive coronary angiography (ICA) as a reference standard.

METHOD AND MATERIALS

Between September 2009 and December 2012, patients with previous stents implantation who underwent ICA for recurrent typical or atypical chest pain after coronary CT angiography (CTA) within three months were enrolled. Attenuation values of coronary lumen were measured at proximal and distal of stents and normalized to the descending aorta. Changes in CCO were calculated and CCO difference across the stent was compared with severity of ISR.
RESULTS
A total of 141 stents were assessed. 76 stents were normal, 18 stents had ISR < 50%, 28 stents had ISR 50% to 99%, and 19 stents were occluded. The median of CCO difference in group of no ISR, ISR < 50%, ISR 50% to 99%, and ISR 100% were 0.078, 0.163, 0.346 and 0.606, respectively (all P < 0.01). For stents <3mm, CCO difference of no ISR and non-obstructive ISR were significantly lower than obstructive ISR and occluded (all P <0.001). To all the stents with any ISR and stents with ISR equal or more than 50%, the accuracy of ISR diagnosed by CCO (c statistic 0.934 ± 0.023 and 0.994 ± 0.004, respectively) were significant better than that of CTA alone (c statistic 0.794 ± 0.004 and 0.692 ± 0.047, respectively) (all P < 0.01).

CONCLUSION
CCO difference across coronary stents could predict ISR severity especially obstructive ISR in stents less than 3mm diameter. The performance of ISR diagnosed by CTA improved significantly when CCO difference was taken into account.

CLINICAL RELEVANCE/APPLICATION
In patients with coronary in-stent restenosis, coronary CT angiography is able to help identify the difference of coronary attenuation and predict the severity of restenosis.

SSA03-05 Evaluation of Dynamic Features of Aortic Annulus in Patients with Bicuspid Aortic Stenosis (BAS) throughout Cardiac Cycle by Dual Source Computed Tomography (DSCT): Implications for Transcatheter Aortic Valve Implantation (TAVI)
Liqing Peng (Presenter): Nothing to Disclose, Xiao-Yi Chen: Nothing to Disclose, Jian-Qun Yu MD: Nothing to Disclose, Zhi-Gang Yang: Nothing to Disclose

PURPOSE
Bicuspid aortic stenosis (BAS) has been a relative contraindication to transcatheter aortic valve implantation (TAVI), but small series of patients with severe BAS successfully treated with TAVI were reported recently. We sought to assess the dynamic features of aortic annulus of BAS throughout cardiac cycle by dual source computed tomography (DSCT).

METHOD AND MATERIALS
Thirty-one patients (15 males and 16 females; mean age: 69.1±5.3 years, range: 60-82 years) with severe BAS who underwent retrospectively ECG-gated DSCT angiography were included. The images were reconstructed into 10 phases at 10% step of R-R interval. The image quality was evaluated with a 3-points scoring method (3 points: good image quality free of artifact; 2 points: adequate image quality for evaluation with mild artifact; 1 point: inadequate image quality due to severe artifact). Minor aortic annular diameter (AAD-min), major aortic diameter (AAD-maj), aortic annular perimeter (AAP) and aortic annular area (AAA) were measured in each phase. AAP derived AAD (AAD-PD) and AAA derived AAD (AAD-AD) were calculated using formula C = πD and s = π(D/2), respectively. The absolute and relative difference of all parameters throughout the cardiac cycle were calculated with (maximum-minimum) and [(maximum-minimum)/minimum] multiplied by 100%.

RESULTS
Best image quality was in 20%, 30%, 60% and 70% R-R intervals in the majority of patients (96.8%, 30/31) during cardiac cycle. In all patients, AAD-min, AAD-maj, AAP and AAA varied during cardiac cycle, and AAD-maj was greater than AAD-min throughout the cardiac cycle (p < 0.0001). The relative differences of AAD-min, AAD-maj, AAD-PD and AAD-AD were 19.6±12.9%, 15.7±8.0%, 9.6±6.2% and 9.8±3.1%, respectively; while the absolute difference of which were 4.0±2.5mm, 3.7±1.5mm, 2.5±0.9mm and 2.6±1.2 mm, respectively (p<0.001).

CONCLUSION
In patients with BAS, aortic annulus is oval and its shape changes during cardiac cycle. The difference of AAD-PD throughout cardiac cycle is relative smaller. Thus, AAP might be the most proper parameter for estimating aortic annulus size before TAVI. Considering image quality, mid-late systole and mid-diastole were more reliable for evaluation.

CLINICAL RELEVANCE/APPLICATION
Finding out dynamic features of aortic annulus of BAS may help precisely estimate aortic annulus size, and decrease TAVI procedure related complications.

SSA03-06 Relationship of Breast Arterial Calcification with Coronary Calcium Score and Coronary CT Angiography
Mariana Diaz-Zamudio MD (Presenter): Nothing to Disclose, Peter Jay Julien: Nothing to Disclose, Damini Dey PhD: Research support, Siemens AG, Heidi Gransar: Nothing to Disclose, Louise J. Thomson MBCHB: Nothing to Disclose, John D. Friedman MD: Nothing to Disclose, Sean Hayes MD: Nothing to Disclose, Daniel S. Berman MD: Research Grant, Lantheus Medical Imaging, Inc Research Grant, Astellas Group Research Grant, Siemens AG Speaker, Bristol-Myers Squibb Company Speaker, Covidien AG Speaker, Astellas Group Stockholder, Spectrum Dynamics Ltd Consultant, Bracco Group Consultant, FluoroPharma, Inc
PURPOSE
To determine whether breast arterial calcification (BAC) on mammography are predictive for high risk coronary calcium score (CAC) and coronary artery disease (CAD) identified by coronary CTA.

METHOD AND MATERIALS
Consecutive female patients age >45 undergoing coronary CTA and CAC scanning for clinical purposes and screening mammography within 24 months from CTA were identified. Mammography studies were reviewed by an experienced reader blinded to CT results. BAC was assessed using a semi-quantitative scale (none/mild/moderate/severe). CAC was categorized as 0, 1-99, 100-399, and ≥400 and CTA as 0, <50%, 50-69%, and ≥70% stenosis grade. All clinical and risk-factor data were collected prospectively.

RESULTS
In 204 patients included, median time between mammography and CTA was 7 months (range 0-24). Median age was 63.2 years (range 45-88). BAC was present in 43 (21%). The BAC group was older (69.6 vs 61.5, p<0.001). By CAC category, CAC 100-399 and ≥400 were more common in the BAC group (CAC 100-399: 23.2 vs 16.1%, CAC≥400: 21 vs 6.2%, p=0.01) and CAC 0 and CAC 1-99 were more common in the no BAC group (CAC 0: 47.2 vs 37.2%, CAC 1-99: 30.4 vs 18.6%, p=0.01). By multivariable analysis (including age, BMI, hypertension, diabetes mellitus, smoking history, family history) moderate/severe BAC predicted CAC≥400 (OR 4.2, p=0.03). By CTA category, 50-69% and ≥70% stenosis were more common in the BAC group (50-69%: 11.6 vs 3.2%, ≥70%: 20.9 vs 7.8%, p=0.008). CAD 0 and stenosis <50% were more common in the no BAC group (CAD 0: 47 vs 34.8%, <50%: 42 vs 32.5%, p=0.008). On multivariable analysis BAC was a predictor of 50-69% stenosis (OR 3.5, p=0.01). To assess age interaction, a sub-analysis of patients >65 (n=91) was performed. In this subgroup, age was not different between BAC and no BAC groups (73.6 vs 72.4, p=0.32); however, the presence of CAC≥400 (41.6 vs 14%, p=0.019) and ≥50% stenosis (39.4 vs 17.2%, p=0.019) remained higher in the group with moderate/severe BAC. Moderate/severe BAC persisted as a multivariable predictor of CAC≥400 (OR 8.7, p=0.007) and ≥50% stenosis (OR 4.7, p=0.012).

CONCLUSION
BAC predicts high coronary calcium scores and CAD in coronary CTA independently of age and risk factors.

CLINICAL RELEVANCE/APPLICATION
BAC identified in routinely performed mammographies could potentially be used to direct further testing to detect CAD in women.

SSA03-07
Fast Cardiac 1H-MR Spectroscopy at 3T: High Permittivity Materials Increase SNR and Reduce Data Acquisition Time
Paul de Heer MSc (Presenter): Nothing to Disclose , Maurice B Bizino : Nothing to Disclose , Andrew Webb DPHIL : Nothing to Disclose , Hildo J. Lamb MD, PhD : Nothing to Disclose

PURPOSE
Cardiac 1H magnetic resonance spectroscopy (1H-MRS) is the gold standard for non-invasive quantification of myocardial triglyceride content (MTGC) which is a key feature of cardiomyopathy in metabolic syndrome and type 2 diabetes mellitus. 1H-MRS is a challenging technique due to a low signal-to-noise ratio (SNR), and the purpose of this study was to investigate whether high permittivity pads can increase the SNR, thereby also reducing the scanning time required.

METHOD AND MATERIALS
All experiments were approved by the institutional Ethics Committee and written informed consent from all volunteers was obtained prior to the study. Twenty healthy volunteers were scanned, 8 female and 12 male, average age 30 yr. (range 19-53), average BMI of 23 kg/m2 (range 20-34). Scans were performed on a 3T Philips Ingenia. Two high permittivity pads, 2 cm thick (anterior) and 1cm thick (posterior), with dimensions 20x20x2cm were used. The spectroscopic volume-of-interest (40x15x25mm3) was planned in the interventricular septum. ECG-triggered respiratory navigated PRESS spectra were acquired without water suppression (TE 35ms, TR 8.5s, 16 averages) and with water suppression (TE 35ms, TR 3.5s, 48 averages) with and without dielectric pads. Data were phase and DC corrected, and fitted using the AMARES algorithm in jMRUI. The SNR of the TG spectra was defined as the integrated area under the (CH2)n and (CH3) peak divided by the SD of the noise taken from the last 100 points of the FID. Statistical significance of the data was tested using a double sided paired Student's t-test and was considered significant at p-values < 0.05.

RESULTS
In Fig. 1 spectra from two different volunteers and a summary Bland-Altman plot is shown. The mean lipid SNR for all volunteers was approved by the institutional Ethics Committee and written informed consent from all volunteers was obtained prior to the study. Twenty healthy volunteers were scanned, 8 female and 12 male, average age 30 yr. (range 19-53), average BMI of 23 kg/m2 (range 20-34). Scans were performed on a 3T Philips Ingenia. Two high permittivity pads, 2 cm thick (anterior) and 1cm thick (posterior), with dimensions 20x20x2cm were used. The spectroscopic volume-of-interest (40x15x25mm3) was planned in the interventricular septum. ECG-triggered respiratory navigated PRESS spectra were acquired without water suppression (TE 35ms, TR 8.5s, 16 averages) and with water suppression (TE 35ms, TR 3.5s, 48 averages) with and without dielectric pads. Data were phase and DC corrected, and fitted using the AMARES algorithm in jMRUI. The SNR of the TG spectra was defined as the integrated area under the (CH2)n and (CH3) peak divided by the SD of the noise taken from the last 100 points of the FID. Statistical significance of the data was tested using a double sided paired Student's t-test and was considered significant at p-values < 0.05.

RESULTS
In Fig. 1 spectra from two different volunteers and a summary Bland-Altman plot is shown. The mean lipid SNR for all volunteers shows an increase from 28±16 (mean±SD) to 42±24 (p=0.0001), a gain factor in SNR of 1.6±0.5 when the pads are used. The average MTGC is 0.39% without pads and 0.38% with pads, showing no significant difference.

CONCLUSION
High permittivity materials improve cardiac 1H-MR spectroscopy at 3T by increasing SNR by a factor of 1.6, resulting in better quantification and/or a reduction in acquisition time by a factor of ~2.6 (gain_SNR*gain_SNR).

CLINICAL RELEVANCE/APPLICATION
Cardiac 1H MR spectroscopy is a unique non-invasive method to assess cardiac energy metabolism. The
Computation Tomography Angiography of the Lower Extremity and Coronary Arteries by Using 256-Slice CT Prospective ECG-gated Protocol

DE XUAN  XIE (Presenter):  Nothing to Disclose,  Zhang  Jinling :  Nothing to Disclose ,  Xiao   Xigang MD :  Nothing to Disclose

PURPOSE

To investigate the possible use of a 256-slice computed tomography (CT) prospective electrocardiography (ECG)-gated wide volume scanning protocol in combined angiography of the lower extremity and coronary arteries under single contrast medium injection for patients with lower extremity peripheral arterial disease (PAD).

METHOD AND MATERIALS

A total of 34 patients with PAD underwent CT angiography (CTA) with a prospective ECG gated protocol that ensured the level of the tracheal bifurcation to the foot sole. A low-dose scanning protocol was used, the tube voltage and effective tube current were manually adjusted according to each patient’s body mass index. Image quality of coronary arteries was assessed using a four-point ranking scale, a score ≥ 2 was considered to reflect adequate diagnostic acceptability. A three-point ranking scale was used to assess the image quality of lower extremity arteries, a score ≥ 2 was considered to reflect diagnostic acceptability. Digital subtraction angiography (DSA) of the lower extremity arteries was performed on patients requiring therapeutic intervention.

RESULTS

A total of 93.07% of the coronary segments were adequate for diagnosis. 17 (50%) patients showed coronary artery stenosis ≥ 50%. A total of 95.8% of the lower extremity arterial segments were adequate for diagnosis. Twenty-eight patients underwent DSA examination, the sensitivity, specificity, PPV, NPV, and accuracy of CTA for the detection of significant lower arterial stenosis (≥50%) was 94.8%, 97.2%, 95.3%, 96.9%, and 96.3% respectively. The mean effective dose was 8.93± 3.42 mSv, which was not significantly higher than the average patient dose of 7.47 mSv reported in the literature.

CONCLUSION

Using the prospective ECG-gated wide volume CTA protocol, images of the coronary and lower extremity arteries suitable for diagnosis can be acquired simultaneously after a single injection of contrast agent. In addition to accurately diagnose PAD, the combined angiography might be used to screen for coronary heart disease in patients with PAD.

CLINICAL RELEVANCE/APPLICATION

In addition to accurately diagnose PAD, the combined angiography might be used to screen for coronary heart disease in patients with PAD.

When Is Optimal Scan Timing in Static Myocardial CT Perfusion Imaging-by Whole Heart Dynamic Scan

Yuki   Tanabe (Presenter):  Nothing to Disclose, Teruhiyo   Kido MD, PhD :  Nothing to Disclose, Takahiro   Yokoi :  Nothing to Disclose, Shintaro   Tsuruoka :  Nothing to Disclose, Naoki   Fukuyama :  Nothing to Disclose, Takuya   Matsuda :  Nothing to Disclose, Rami   Tokoyama :  Nothing to Disclose, Masashi   Nakamura :  Nothing to Disclose, Yoshiko   Nishiyama MD :  Nothing to Disclose, Tsuneo   Miyagawa MD, PhD :  Nothing to Disclose, Teruhito   Mochizuki MD :  Nothing to Disclose

PURPOSE

The purpose of this study is to investigate the optimal timing of single-phase CT perfusion (CTP) scan for differentiation of ischemic and normal myocardium.

METHOD AND MATERIALS

The study group comprised 21 patients (mean age 68.7±7.5 years) who underwent ATP-stress dynamic myocardial CTP scan and invasive coronary angiography (ICA) and stress myocardial perfusion imaging (MPI) (SPECT or cardiac MRI). All patients in this study had one or two vessels disease. Dynamic CTP (whole heart datasets over 30 consecutive heart beats in systole without spatial and temporal gaps) was acquired with prospective ECG gating. Coronary stenosis ≥ 50% was defined as positive findings in ICA, and perfusion abnormalities were defined as positive findings in MPI. In this study, the areas with ICA (-) and MPI (+) are defined as normal, the areas with ICA (+) and MPI (-) as ischemia and the areas with ICA (+) and MPI (+) as non-ischemia. Results of ICA and MPI are analyzed according to 3 vessel areas (LAD, LCX, RCA). 2 experienced radiologists visually analyzed the dynamic CTP images in reference to the results of ICA and MPI and consulted together about the optimal scan timing for differentiation of ischemic and normal myocardium. Then, “static image” at the optimal scan timing was compared with “dynamic image” in the diagnostic performance for detecting myocardial ischemia by other 2 experienced radiologists visually analyzing.

RESULTS

Normal, ischemic and non-ischemic areas were 22/63, 29/63 and 12/63 areas. As a result of qualitative assessment, the optimal scan timing could be 1.8-2.5 seconds after peak enhance time of the aorta (mean ΔCT value: 9.7±12.1 HU). 95% of all cases were included in this range. In “static CTP image”, Sensitivity, specificity, PPV and NPV were 79.3%, 76.5%, 74.2% and 81.3%. In “dynamic CTP image”, Sensitivity, specificity, PPV and NPV were 82.8%, 81.0%, 85.3% and 83.8%.
CONCLUSION
In myocardial CTP imaging, the optimal timing of single-phase scan is 1.8-2.5 seconds after peak enhance time of the aorta, which will be helpful to optimize single-phase CTP scans.

CLINICAL RELEVANCE/APPLICATION
Static CTP image by scanning at the optimal timing can decrease radiation exposure with keeping the diagnostic performance almost the same level of the dynamic CTP image.

CAS-SUA
Cardiac Sunday Poster Discussions

Scientific Posters

CA
AMA PRA Category 1 Credits™: .50
Sun, Nov 30 12:30 PM - 1:00 PM Location: CA Community, Learning Center

Participants
Moderator
Pal Suranyi MD, PhD : Nothing to Disclose
Moderator
Scott Robert Akers MD, PhD : Nothing to Disclose

Sub-Events
CAS172
Clinical Implementation of an Acute Chest Pain Coronary CTA Registry ED Protocol on the Heels of the ROMICAT Trials—The ED CCTA Registry at a Tertiary Medical Center (Station #1)

Brian Burns Ghoshhajra MD (Presenter): Nothing to Disclose, Harsh Va Indohbhai Vadvala MD : Nothing to Disclose, Phillip Kim : Nothing to Disclose, Thomas Mayrhofer : Nothing to Disclose, Quynh Truong MD : Research Grant, St. Jude Medical, Inc, Suhy Abbara MD : Research Consultant, Radiology Consulting Group, Mannudeep K. S. Kalra MD : Nothing to Disclose, Rajiv Gupta PhD MD : Nothing to Disclose, Garry Choy MD, MS : Nothing to Disclose, Sanjeev Francis MD : Nothing to Disclose, David Brown : Nothing to Disclose, John T. Nagurney : Nothing to Disclose, Robert A. Novelline MD : Nothing to Disclose, Laura Louise Avery MD : Nothing to Disclose, James Januzzi : Nothing to Disclose, Jeffrey Greenwald : Nothing to Disclose, Udo Hoffmann MD : Nothing to Disclose

PURPOSE
Recent randomized controlled trials have established coronary CT angiography (CCTA) as an alternative in evaluating low- to intermediate risk ED patients with acute chest pain. We report our initial clinical experience in the MGH registry and compared quality metrics with the ROMICAT (Rule Out Myocardial Infarction with Computer Assisted Tomography) II (R-II) results.

METHOD AND MATERIALS
We included patients that presented to the ED with acute chest pain and were referred for CCTA to rule out significant coronary artery disease between October 2012 and December 2013. We prospectively recorded patient demographics, risk factors, and clinical presentation, radiation dose, CCTA results, disposition, time to report, additional diagnostic testing, interventions. Medical records were reviewed at 60 days after discharge. Results were compared with the multicenter, randomized, controlled R-II trial.

RESULTS
227 patients were included (54.2% male, mean age 51.2 ± 10.6). Per CCTA 57% had no CAD (n=130), 27% had mild CAD (n=62), 7.9% had severe CAD (n=18), 1% had occlusive disease (n=3), and 0.4% had an inconclusive exam (n=1). Mean length of hospital stay and time to diagnosis were shorter but not significantly different as compared to R-II (21.3 ± 46.6 hours vs. 23.2 ± 37 hours; p=.59 and 9.6 ± 9.7 hours vs. 10.4 ± 12.6 hours; p=.35, respectively). Median time from CCTA to report was 54 minutes. When compared to the R-II trial, estimated effective dose (mean, mSv) was significantly lower (4.3 ± 2.8 mSv vs. 6.2 ± 3.8 mSv; p<.01) respectively, primarily achieved via more frequent prospective ECG triggering (89% vs.13%, p<.01). Invasive coronary angiography (ICA) was performed in 8%(n=18) vs.11% (n=34), nuclear myocardial perfusion imaging in 11%(n=26) vs. 10% (n=50), and exercise tolerance test in 2%(n=4) vs. 2%(n=12) patients in registry versus R-II, respectively. Importantly, the normalcy rate for ICA was lower than as compared to R-II (6% vs 20%), while no missed ACS were reported at 60 days.

CONCLUSION
Real world clinical data of early CCTA in the management of patients with acute chest pain confirm the results of the ROMICAT II trial with further reduction in radiation dose.

CLINICAL RELEVANCE/APPLICATION
Implementation of prospective CCTA protocols and strict quality metrics enabled significant reduction of radiation exposure and reduced normal ICA after CCTA while maintaining a 100% negative predictive value.
**Left Ventricular Volumes Assessed by Cardiac Magnetic Resonance as Predictors of Ventricular Remodeling (Station #2)**

**Purposes**
Heart failure is a major cause of morbidity and mortality in Acute Myocardial Infarction (AMI) survivors. Ventricular Remodeling (VR) is a major mechanism associated with the development of heart failure. Given the new therapeutic strategies in pharmacological and reperfusion techniques, it is necessary to verify the reliability of previous findings regarding the factors associated with ventricular remodeling.

**Method and Materials**
Ninety-nine consecutive patients with a first reperfused AMI were included. Magnetic Resonance Imaging (MRI) was performed between day 1 and 7 after the AMI and after 3 months, to determine the development of ventricular remodeling. Ventricular remodeling was defined as an increase >= 20% in end-diastolic volume (EDV).

**Results**
Out of the 97 patients, 23 (23.7%) had ventricular remodeling. Patients with ventricular remodeling had lower ventricular volumes at the initial MRI compared with patients without remodeling. (EDV 94.9 ± 19.1 ± 27.9 ml vs. 118.8 ml, p < 0.001; ESV 48.7 ± 17.5 vs. 62.6 ± 21.4 ml, p = 0.006; and SV 46.2 ± 10.6 vs. 56 ± 15.9, p = 0.006) The EDV was an independent predictor of ventricular remodeling.

**Conclusion**
Almost a quarter of the patients with a first reperfused AMI had ventricular remodeling. Ventricular volumes calculated at baseline cMR, where lower in patients with ventricular remodeling. EDV was an independent predictor of ventricular remodeling. Further investigation about the mechanism responsible for this phenomenon should be performed. We should have in mind that the improvement in the contemporary medical treatment can modulate the remodeling process after AMI.

**Clinical Relevance/Application**
To determine the variables that lead to ventricular remodeling after AMI that will allow to identify patients at risk to develop and prevent heart failure.

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**Comparison of Cine MRI feature Tracking and Displacement Encoding with Stimulated Echoes MRI for the Assessment of Global and Segmental Left Ventricular Strain in Patients with Acute Myocardial Infarction (Station #3)**

**Purposes**
Displacement encoding with stimulated echoes (DENSE) MRI can provide accurate quantification of myocardial strain based on displacement of myocardial tissue. The drawback of DENSE MRI is the necessity of acquiring additional image dataset in CMR study. Feature Tracking (FT) technique recently emerged as a method to quantify myocardial strain by analyzing standard cine MR images. However, accuracy of global and regional myocardial strain measured by FT has not been well established. The purpose of this study was to compare myocardial strain by FT to those derived from DENSE in patients with acute myocardial infarction (AMI).

**Method and Materials**
Twenty patients (65±13 years) with AMI underwent steady state free precession cine MRI, DENSE MRI and late gadolinium enhancement MRI on a 1.5 T MR system. Left ventricular strain maps were generated by FT analysis (cmr42) of cine MRI as well as DENSE MRI on matched 3 short-axis planes of left ventricle (basal, mid, apical). Each short axis slice was divided into 6 equal circumferential sectors. FT-derived circumferential strain was compared with that determined by DENSE MRI by adjusting cardiac phase for global and segmental level. Regional circumferential strain was compared between infarct and remote normal segments.

**Results**
Global circumferential strain determined by FT showed a good agreement with that by DENSE MRI (Pearson’s correlation coefficient 0.85, p<0.0001; bias 0.02, limits of agreement -0.03 to 0.06; coefficient of variability 16%; intra-class correlation coefficient 0.68). For segmental circumferential strain, Pearson’s correlation coefficient between FT and DENSE approaches was 0.61 (p<0.0001) with bias and limits of agreement of 0.02 and -0.07 to 0.11, coefficient of variability of 33% and intra-class correlation coefficient of 0.55. Regional circumferential strain determined by FT in infarct segments (-0.08 ± 0.05) was significantly altered when compared with that in remote normal segments (-0.15 ± 0.05, p<0.0001).

**Conclusion**
FT measurement of global circumferential strain demonstrated good agreement with DENSE MRI measurement. FT technique allows for accurate assessment of altered regional strain in patients with AMI.
CLINICAL RELEVANCE/APPLICATION

Feature tracking technique allows for the accurate assessment of circumferential strain in patients with acute myocardial infarction without increasing CMR examination time.

Knowledge based Iterative Reconstruction Technique for Left Ventricular Function Assessment: Comparison with Hybrid Iterative Reconstruction and Filtered Back Projection Techniques (Station #4)

Peiling Li MD, PhD (Presenter): Nothing to Disclose, Xu Ke MD: Nothing to Disclose, Yan Jiang MD: Employee, Koninklijke Philips NV, Ying Liu: Employee, Koninklijke Philips NV, Na Jiang: Nothing to Disclose, Yu Zhao: Nothing to Disclose

PURPOSE

To compare the accuracy of contrast computed tomography (CT) for left ventricular function assessment using different reconstruction techniques including filtered back projection (FBP), hybrid iterative reconstruction (iDose4, Philips Healthcare) and knowledge based iterative reconstruction (IMR, Philips Healthcare) with magnetic resonance imaging (MRI).

METHOD AND MATERIALS

A total of 16 patients (48.8±9.4 years, 9 male) with coronary artery disease prospectively underwent 256-MDCT and MRI (as reference standard) within 3 days. All CT images were reconstructed with FBP, iDose4 and IMR, respectively. End-diastolic volume (EDV), end-systolic volume (ESV), stroke volume (SV) and ejection fraction (EF) of left ventricular (LV) were measured on FBP, iDose4, IMR and MRI images. CT image quality assessment among different reconstruction techniques was performed by 2 independent readers according to the features of structure demarcation, sharpness, artifacts and noise using a 5-point scale. Pearson’s correlation, Bland-Altman analysis, McNemar test and paired-t test were used for statistical analysis.

RESULTS

For 256-MDCT, on average effective dose was 8.87±0.83 mSv. IMR significantly improved image quality compared to iDose4 and FBP (4.08±0.45, 3.66±0.56, 3.21±0.52, all p<0.01). There was no significantly overestimation and underestimation of EDV, ESV and EF by IMR, iDose4 and FBP compared to MRI (all p>0.05). SV was significantly overestimated by all three reconstruction techniques (FBP 98.3±19.1, iDose4 95.4±18.7, IMR 89.8±18.8 vs MRI 82.7±19.0 ml, all p<0.01), meanwhile, SV value of IMR was significantly higher than iDose4 and FBP (p=0.03, p=0.009, respectively). All three groups of CT images showed high intraclass correlation with MRI.

CONCLUSION

CT quantitative analysis for LV function assessment showed good accuracy compared with MRI. IMR techniques improved image quality and enabled SV values more close to those acquired by MRI.

CLINICAL RELEVANCE/APPLICATION

IMR may improve the accuracy of quantitative analysis for LV function assessment by improving image quality.

3D Printing of Reconstructed Cardiac CT Angiography Models to Aid in Pre-operative Assessment of Implanted Bioprosthetic Valve Size before Transcatheter Aortic Valve Replacement (TAVR) (Station #5)

Craig M. Johnson MD (Presenter): Nothing to Disclose, Christopher Taylor BS: Nothing to Disclose, Christina R. Ferraro MD: Nothing to Disclose, Randy Ray Richardson MD: Nothing to Disclose, Justin Ryan BA: Nothing to Disclose, David Frakes PhD: Nothing to Disclose, Mitchell Ross: Nothing to Disclose, Kevin Brady: Nothing to Disclose, Hursh Naik: Nothing to Disclose

PURPOSE

To assess the added value of 3D printing cardiac models of a patient’s anatomy from cardiac CTA reconstruction in the surgical planning of deployed bioprosthetic aortic valve size during TAVR.

METHOD AND MATERIALS

An initial study group of five patients with ages ranging from 55-78 years of age diagnosed with severe, symptomatic aortic stenosis underwent cardiac CTA prior to TAVR procedure. The thoracic aorta and left ventricle were evaluated using cardiac CTA by a team of radiologists, cardiologists, and cardiothoracic surgeons for assessment of technical issues related to delivery and deployment of artificial valves. The area of the aortic root was measured and the coronary anatomy and calcifications were reviewed with the multidisciplinary team. A commercially available workstation was used to reconstruct images of the left ventricle and proximal aorta. These 3D reconstructed images were then post-processed and a negative of the images was 3D printed using a clear color photopolymer. Aortic root calcifications were 3D printed on the anatomic model using a yellow dye and coronary artery anatomy was printed using a red dye. Varying sizes of the devices approved for TAVR were deployed within the 3D printed aortic models and anatomic fit was assessed based on printed aortic root anatomy, coronary anatomy, and adjacent calcific plaque. The choice of valve type and size was compared after initial geometric assessment, after trial of deploying within the 3D printed model, and with the actual valve deployed intraoperatively.

RESULTS
From the initial study group of five patients who underwent TAVR procedure, geometric analysis on cardiac CTA using calculated aortic root area correctly predicted the actual deployed valve size in three out of five patients undergoing TAVR. Using 3D printed modeling of the patient’s anatomy and pre-surgical fitting of these models using bioprosthetic valves, the multidisciplinary team correctly predicted the eventual deployed size of the artificial valve in all five patients.

**CONCLUSION**

Supplemental 3D printing of aortic models prior to TAVR adds additional value to cardiac teams in addition to computer aided geometric assessment to correctly choose the correct bioprosthesis valve fit.

**CLINICAL RELEVANCE/APPLICATION**

Radiologists can offer 3D printed models to cardiac teams based on a patient’s cardiac CTA as an additional tool for pre-operative assessment of bioprosthesis valve size to be deployed during TAVR.

**Myocardial Infarction Complications: Radiological Findings. (Station #6)**

**CAE107**

Gabriel Carlos Fernandez MD (Presenter): Nothing to Disclose, Javier Encinas MD: Nothing to Disclose, Miguel Corral: Nothing to Disclose, Maria Velasco MD: Nothing to Disclose, Marta Repolles Cobaleda: Nothing to Disclose, Sandra Baleato Gonzalez MD: Nothing to Disclose, Daniel Agueda: Nothing to Disclose

**TEACHING POINTS**

To review complications of myocardial infarction from a radiologist point of view and with particular emphasis on the imaging findings by MDCT and MRI. To learn the most relevant complications after myocardial infarcts. To show as these complications can be diagnosed by imaging. To describe the physiological effects resulting from a complication after myocardial infarction.

**TABLE OF CONTENTS/OUTLINE**

The leading cause of hospital death in patients with myocardial infarction is heart failure, either caused by severe left ventricular dysfunction or secondary to complications of myocardial infarction. Complications can be classified as: 1- mechanical: Septum rupture; papillary muscle rupture; Cardiac rupture (ventricular wall rupture); Pseudoaneurysm (contained rupture); left ventricle failure (cardiogenic shock); right ventricle failure; ventricular aneurysm; 2- Electrical or arrythmic. 3- Ischemic: Reinfarction. 4- Embolic: systemic embolism. 5- Inflammatory: early pericarditis; late pericarditis (Dressler syndrome).

**Pre- and Post-operative Imaging of the Aortic Root (Station #7)**

**CAE168**

Kate Hanneman MD (Presenter): Nothing to Disclose, D. Craig Miller: Nothing to Disclose, Michael Fischbein: Nothing to Disclose, R Scott Mitchell: Nothing to Disclose, Dominik Fleischmann MD: Research support, Siemens AG

**TEACHING POINTS**

1. Evaluation of the aortic root with ECG-gated computed tomography (CT), including multi-planar reformats and three-dimensional (3D) images, allows for accurate measurement of aortic dimensions and pre-operative evaluation of anatomy. 2. Cross-sectional imaging with CT and MRA is crucial not only in the pre-operative evaluation of patients with aortic root pathology, but also assessment of post-procedural results and complications. 3. Surgical techniques include composite valve graft (CVG), Ross procedure (pulmonary autograft), cadaveric homograft, xenograft (pig-root/Medtronic freestyle), and valve sparing aortic root repair (including a variant of the Tirone David-V reimplantation technique, V-SARR).

**TABLE OF CONTENTS/OUTLINE**

- Etiology of aortic root pathology including atherosclerosis, genetic/congenital conditions, dissection, bicuspid aortic valve, infection/inflammation • Review of surgical anatomy: sinotubular junction (STJ), sinuses of Valsalva (SOV), and aortic anulus • Normal and abnormal dimensions of the aortic root • Imaging and post-processing techniques for pre- and post-operative evaluation • Indications for aortic root repair • Surgical techniques • Post-operative imaging findings and complications • Sample cases • Review of key learning points

**What’s So Complex about Shone’s Complex Anyway? (Station #8)**

**CAE124**

Christopher J.G. Sigakis MD (Presenter): Nothing to Disclose, Carlos S. Restrepo MD: Nothing to Disclose, Cylen Javidan-Nejad MD: Nothing to Disclose, Jacobo Kirsch MD: Nothing to Disclose, Daniel Ocazionez MD: Nothing to Disclose, Daniel Vargas MD: Nothing to Disclose

**TEACHING POINTS**

1. Review the embryological pathway and phenotypical spectrum of Shone’s complex. 2. Familiarize the radiologist with the imaging findings of the four major components of Shone’s complex and associated anomalies. 3. Discuss the role of imaging in the diagnosis, follow-up and post-operative management of these patients.

**TABLE OF CONTENTS/OUTLINE**

Coronary Artery Anomalies: An Algorithmic Approach to Detection and Management (custom application computer demonstration)


TEACHING POINTS

Learn the imaging findings of coronary anomalies by interacting with an iPad application Be familiar with normal coronary anatomy in all three dimensions Answer quiz questions intended to solidify the learner's understanding of key concepts

TABLE OF CONTENTS/OUTLINE

This is a free-standing exhibit which will utilize a web-based application for interactive learning. Users will first review normal coronary anatomy via manipulation of 3D, maximum intensity projection, and multiplanar reconstruction images. Coronary anomaly cases are then presented as unknown or known cases; the below list of cases and their variations are accessible. Diagnostic criteria and management considerations are discussed for each case. A quiz reviewing the key concepts concludes the exhibit. The list of cases includes:

- Interarterial course of left main off the right coronary artery (RCA), prepulmonic course of left anterior descending (LAD) from the right cusp, retroaortic course of left circumflex (LCx) from the right cusp, interarterial course of RCA from the left cusp
- Separate origin of LAD and LCx
- Anomalous left coronary artery from the pulmonary artery (ALCAPA)
- Myocardial bridging of LAD
- Duplication of RCA
- Transseptal course of LAD
- Coronary artery fistula
- Extracardiac termination

Feasibility of Free-Breathing, GRAPPA-Based, Real-Time Cardiac Cine Assessment of Left-ventricular Function in Cardiovascular Patients at 3T (Station #1)

Zhu Xiaomei: Nothing to Disclose, Felix Schwab PhD: Nothing to Disclose, Daniel Theisen MD: Nothing to Disclose, Konstantin Nikolaou MD: Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG, Fabian Bamberg MD, MPH (Presenter): Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG Research Grant, Bayer AG Research Grant, Siemens AG

PURPOSE

To determine the feasibility of free-breathing, GRAPPA based, real-time (RT) cine 3T cardiac magnetic resonance imaging (MRI) for the assessment of left-ventricular function in a cohort of patients with various cardiac conditions as compared to conventional segmented cine imaging.

METHOD AND MATERIALS

In this prospective cohort study, subjects with cardiac conditions underwent both two RT cine sequences (high resolution [Tres: 48.8 ms, voxel: 1.9x3.1x10 mm3, R=5] and low resolution [Tres: 51.3 ms, voxel: 2.5x5.0x10 mm3, R=3]) and standard segmented cine imaging (Tres: 31.8 ms, voxel: 1.6x1.6x10 mm3, R=2) using a 3T system. Standard qualitative and quantitative parameters of left-ventricular function, including end-diastolic and end-systolic volume (EDV and ESV), stroke volume, ejection fraction, myocardial mass (MM), and wall thickness were quantified by two independent, blinded investigators. Univariate and multivariate comparisons were performed in order to identify differences and associations with patient-related factors.

RESULTS

Among 25 subjects, 24 were included in the analysis (mean age: 50.5, 67% male, 25% with cardiomyopathy). For both RT cine sequences, agreement with the segmented cine imaging with respect to detection of regional wall motion abnormality was very good (κ=0.71 and κ=0.73 for high and low resolution; respectively). RT cine derived quantitative parameters of volumes and MM were strongly correlated with segmented cine imaging (ICC: >0.72 and ICC: >0.80 for high and low resolution RT cine; respectively) but correlation for peak ejection and filling rates were moderate to poor for high (ICC: 0.33 and 0.23; respectively) and low resolution RT cines (ICC: 0.40 and 0.33; respectively). Similarly, RT cines significantly underestimated peak ejection and filling rates (>103.2±178 ml/s) while observed differences were relatively low for volumes, MM and wall thickness when compared with segmented cines. Among patient factors, heart rate was strongly predictive for deviation of
measurements ($p<0.05$).

**CONCLUSION**

Both RT cine sequences at 3T are feasible for qualitative and quantitative assessment of left ventricular function but results in significant underestimation of peak ejection and filling rates.

**CLINICAL RELEVANCE/APPLICATION**

RT GRAPPA-based cine imaging at 3T can be used in clinical patients for assessment of left ventricular function but results in significant underestimation of peak ejection and filling rates.

**CAS178**

**Clinical Utility of Prospective ECG Triggered Absolute Fixed Delay in Atrial Fibrillation Patients in the Assessment of Cardiac Structures and Coronary Anatomy (Station #2)**

Shamir Rai BSC (Presenter): Nothing to Disclose, Chesnal Dev Arepalli MD: Nothing to Disclose, Patrick McLaughlin FFR(RCSI): Nothing to Disclose, Savvas Nicolaou MD: Nothing to Disclose

**PURPOSE**

Detailed anatomic imaging of the cardiac structures is challenging in atrial fibrillation (AF) patients. Computerized tomography (CT) prospective ECG triggered absolute delay based on fixed time interval from R wave are least subjected to mis-registration and motion artifacts. A new absolute prospective ECG triggered Atrial fibrillation (AFb) algorithm with a fixed delay of 250 ms after the R wave was developed at our institute. The purpose of our study was to assess diagnostic quality of cardiac (coronary and non-coronary) and extra cardiac structures utilizing AFb algorithm.

**METHOD AND MATERIALS**

15 consecutive atrial fibrillation patients who had AFb algorithm prior to their LAA ablation procedure were identified retrospectively. Images were acquired on a second generation dual source 128 slice scanner with 110 ml of Omnipaque 350. Cardiac structures evaluation included the four chambers, mitral and aortic valves; coronary arteries (CA) and extra cardiac structures included pulmonary veins, lung parenchyma and fissures and thoracic aorta. CA evaluation was based on 17-segment model as defined by American Heart Association. Each anatomic structure was graded for image quality by two blinded independent radiologists (1, non-diagnostic; 2, decreased image quality, unlikely to be diagnostic; 3, decreased image quality with potential to be diagnostic; 4, decreased image quality but diagnostic; 5, diagnostic study).

**RESULTS**

The mean heart rate (HR) for the studies analyzed was 70 ± 19; maximum HR was 94 ± 41. Both reader 1 and reader 2 had an excellent interobserver agreement with a median score of 5 ± 0 and 5 ± 1 for cardiac structures and median scores of 5 ± 0 for non-cardiac structures.

**CONCLUSION**

AFb algorithm based on prospective ECG triggered absolute delay method at 250 ms from R wave assess the essential anatomical cardiac structures relevant to AF ablative procedure. Further, diagnostic quality coronary arteries assessment is also feasible with the AFb algorithm.

**CLINICAL RELEVANCE/APPLICATION**

In atrial fibrillation patients, optimized prospective ECG triggered absolute delay protocol can simultaneously evaluate cardiac structures including coronary arteries. This algorithm has the potential to replace the prospective ECG gated diastolic phase study that is utilized to assess the coronary arteries.

**CAS179**

**Infarct Size by Cardiovascular Magnetic Resonance with Technical Delay Enhancement as Factor prognostic in the Coronary Artery Disease (Station #3)**

Cielmar Galeana PhD (Presenter): Nothing to Disclose, Jhonatan Alejandro Vargas MMed: Nothing to Disclose, Alejandro Garcia Pena MD: Nothing to Disclose, Oskar Giovanni Lopez Espinoza MD: Nothing to Disclose, Jorge Vazquez-Lamadrid MD: Nothing to Disclose, Martha Morelos Guzman: Nothing to Disclose

**PURPOSE**

OBJECTIVE: To determine whether infarct size measured by DE-CMR has predicted involvement in patients with ischemic heart disease.

**METHOD AND MATERIALS**

METHODS: Retrospective study of sixty eight patients who underwent cardiovascular magnetic resonance between September 2004 to September 2008 referrals to suspicion or knowledge of ischemic heart disease. CMR imaging was performed using GE 1.5 T system. Steady state free precession (SSFP) cine MR images were acquired in long axis and short axis orientation. Delayed enhancement imaging was performed in the same slice locations using a segmented inversion recovery fast gradient echo sequence. Images were acquired 2-3 minutes to evaluation of the phenomenon non reflow and 10 minutes to assessment of myocardial viability after administration of 0.2 mmol/kg gadolinium contrast. Assessment is made of functional parameters including end diastolic volume (VDF), end systolic volume (ESV), left ventricle ejection fraction (LVEF) and systolic volume (SV) indexed a body surface area (BSA) presence of fibrosis, their quantification, localization and transmurality.
**RESULTS**

The average age of the study population was 65.6 years, 12% were in functional class III-IV NYHA, the mortality rate was 16.1%. The 39.7% of the segments presented delay enhancement. The percentage of infarction was significantly higher (21.6% vs. 14.4%) between survivors and the dead (p=0.01). The mayor adverse cardiac events (MACE) were presented in 90% of the group of death compared with 26% de living patients (p=0.001) in relations to survival curve that this declined by a more accelerated during the first week after the ischemic events, and 10 weeks after is slower, with a survival rate de 84% a year since the 2 ½ years of 77% the correlations between infarct size and telesistólico and diastolic volume index left ventricle and left ventricle ejection fraction (LVEF) were statistically significant with a P=<0.001

**CONCLUSION**

CONCLUSION: Infarct size measured by delay enhanced cardiovascular magnetic resonance (DE-CMR) has predicted involvement in patients with ischemic heart disease.

**CLINICAL RELEVANCE/APPLICATION**

Infarct size is related with the incidence of new cardiovascular events.

Our hyposthesis is that the bigger the size of the infarct, the outcome of the patient worsens.

**CAS180**

**Analysis of FFRCT and Blood Flow using CFD Software (Station #4)**

Masashi Takahashi RT (Presenter): Nothing to Disclose, Naohiro Yamagami: Nothing to Disclose, Satoshi Inada: Nothing to Disclose, Yue Dong: Nothing to Disclose, Hiroshi Ueda: Nothing to Disclose, Yoshio Monzen MD: Nothing to Disclose

**PURPOSE**

Fractional flow reserve (FFR) is a standard method, which give us physiological information about coronary artery disease with invasive methods. On the other hand, a new technology Fractional flow reserve computer tomography (FFRCT) by using Coronary CT angiography (CTA) can provide FFR without invasive methods. The accuracy, reliability, and feasibility for clinical application of FFR are evaluated in this study.

**METHOD AND MATERIALS**

Eight phantom models made of ABS resins with different ratio of stenosis underwent CT scan. And the three-dimensional datasets of phantoms obtained by CT scan were generated, and were analyzed by the CFD Software. The threshold for VR model was calculated by FWHM of CT value generated from profile curve on 2D image. On the liquid flowing phantom models, we compared FFRCT value from CFD software and actual measured value calculated by Pressure-Wire, in order to evaluate the accuracy of FFRCT value. Moreover, we examined hemodynamic by using Velocity, Pressure and WSS (stands for Wall shear stress, and relative to vascular events) generated by CFD analysis.

**RESULTS**

In FFR and FFRCT, an approximately equal value was provided. WSS and pressure decreased with the same rate range on the tandem lesion model which possessed two same stenosis. However, on the tandem lesion model with proximal severe stenosis, the influence of distal stenosis for whole tube WSS was small. FFR calculated from pressure wire can only evaluate the change of Pressure, however CFD analysis can observe and visualize Pressure, WSS, and Velocity.

**CONCLUSION**

FFRCT by CFD analysis is useful and it could be a standard evaluation tool for optimal PCI. The information of Pressure, WSS and Velocity could assess the hemodynamics of coronary artery and were useful to build a strategy for optimal PCI on complex lesions. Moreover, the FFRCT could predict the prognosis of coronary artery disease and be a non-invasive follow up tool after PCI.

**CLINICAL RELEVANCE/APPLICATION**

FFRCT by CFD will be useful application for coronal cardiac diagnosis.

**CAS181**

**ECG-gated aortic CT using High-pitch and Iterative Reconstruction: Dose and Image Quality—Can coronary Arteries be Simultaneously Assessed? (Station #5)**

Anne-Lise Hachulla MD (Presenter): Nothing to Disclose, Jean-Paul Marcel Vallee MD: Nothing to Disclose, Xavier Montet: Nothing to Disclose, Stéphane Noble: Nothing to Disclose, Dominique Didier MD: Nothing to Disclose

**PURPOSE**

To study dose length-products (DLP), image quality and contrast-to-noise ratio (CNR) of thoracic and abdominal gated aortic CT obtained with a high-pitch CT imaging protocol using sinogram-affirmed iterative reconstruction (SAFIRE®) or filtered back projection (FBP) algorithms.

**METHOD AND MATERIALS**
Eighty-four patients underwent gated aortic CT without B-blockers on a Somatom Definition Flash CT scanner for aortic disease with Flash protocol using a pitch of 3.2 with both SAFIRE® and FBP reconstruction algorithms. CNR between vessels and myocardium were calculated on the aorta and the coronary arteries on a 3-point scale. Two blinded readers graded subjective image quality of the aorta and the coronary arteries in 24 patients. kappa values were also calculated.

RESULTS
High-pitch acquisition protocol resulted in a DLP of 234 ±93 mGy.cm(4.2 mSv) for an acquisition of the entire aorta, with a mean heartbeat of 73 ±16 beats per minute. CNR (ascending aorta vs myocardium) was 7.3 ±2.8 and 10.6 ±4 for FBP and SAFIRE® algorithms respectively (p

CONCLUSION
ECG-gated aortic CT with high-pitch acquisition reconstructed with SAFIRE® allows better CNR than with FBP alone. Despite the lack of B-blockers, proximal and mid-segments of the coronary arteries could be evaluated in the same acquisition.

CLINICAL RELEVANCE/APPLICATION
ECG-gated aortic CT with high-pitch acquisition has the potential to reduce radiation exposure as well as to analyze the whole aorta and the coronary arteries in a single acquisition.

CAE122

**“Terrible Ts”: Five Cyanotic Congenital Heart Lesions That Every Radiologist Should Know (Station #6)**


TEACHING POINTS
To describe the five cyanotic congenital heart lesions also known as the “Terrible Ts.” Tetralogy of Fallot (TOF) Transposition of the Great Arteries (TGA) Tricuspid Atresia (TA) Total Anomalous Venous Return (TAPVR) Truncus Arteriosus 2. To illustrate the main imaging findings for each of the “Terrible Ts.” (MDCT and MRI) For diagnosis Presurgical evaluation Postsurgical evaluation 3. To describe the protocol of acquisition and technique (MDCT and MRI) in pediatric population

TABLE OF CONTENTS/OUTLINE
Pathophysiology of cyanotic heart disease Description of each of the five diseases Tetralogy of Fallot (TOF) Transposition of the Great Arteries (TGA) Tricuspid Atresia (TA) Total Anomalous Venous Return (TAPVR) Truncus Arteriosus 3. Review of the main diagnostic criteria for each of the 5 pathologies by: MDCT and MRI 4. Review of the imaging findings in temporary/palliative surgery and complete intracardiac repair by: MDCT and MRI 5. To describe the protocol of acquisition and technique in pediatric population (MDCT and MRI)

CAE129

Amyloidosis: Within the Heart and beyond (Station #7)

Sadia Choudhery (Presenter): Nothing to Disclose, Rajaa Mohammed Almestady: Nothing to Disclose, Hythem Adnan Omar: Nothing to Disclose, Yasmeen M. Butt: Nothing to Disclose, Surey Abbara: Research Consultant, Radiology Consulting Group, Nagina Malguria MBBS: Nothing to Disclose

TEACHING POINTS
The objectives are to: 1) Review primary and secondary forms of cardiac amyloidosis and their pathophysiology. 2) Present spectrum on multimodality imaging of amyloidosis and provide pathology correlation. 3) Discuss clinical management and role of imaging in amyloidosis.

TABLE OF CONTENTS/OUTLINE
1. Amyloidosis: Definition and types: Primary, secondary and localized. 2. Pathophysiology of amyloidosis and relevance to imaging manifestations. 3. Review of characteristic imaging features of amyloidosis in the heart and other organ systems: • Cardiac: Diffuse subendocardial enhancement, patchy myocardial enhancement, atrial enhancement, enhancement on both sides of the ventricular septum, early washin and washout of contrast on MRI. Inversion time(T1) of myocardium shorter than or equal to that of blood pool. • Extracardiac: Tracheobronchial: Diffuse thickening, nodules. Lungs: Interstitial disease, nodules. Brain: Cerebral amyloid angiopathy, lobar hemorrhages. Head and Neck: Calcified or noncalcified nodules, low intensity nodules on MRI, perineural enhancement. Renal: Large echogenic kidneys on ultrasound. Musculoskeletal system: Osseous erosions with low to intermediate T1/T2 soft tissue and intra-articular deposits with variable enhancement. 4. Role of imaging and significance of accurate diagnosis in treatment options.

CAE105

MR Imaging of ST-segment Elevation Myocardial Infarction (STEMI) Patients (Station #8)

Zahleen Shariff Keller (Presenter): Nothing to Disclose, Cameron Hassan: Nothing to Disclose, Alison Wilcox: Speaker, Toshiba Corporation, Christopher Lee: Nothing to Disclose, Farhood Saremi: Nothing to Disclose

TEACHING POINTS
• To learn how to protocol patients with post STEMI revascularization • To learn how to correlate MR findings with cath-based prognostic parameters • To correctly interpret MR findings in initial and follow up examinations
and exclude potential diagnostic pitfalls

**TABLE OF CONTENTS/OUTLINE**

- Definition and classifications of patients with acute coronary syndrome
- Cardiac damage analysis and indications of MRI in STEMI
- MR protocol and specific sequences
- Diagnosis of myocardial at risk in reperfused myocardium and its prognostic significance: T2WI and DWI, and controversies
- MR assessment of reperfusion injury, T2*-weighted mapping T1 mapping: microvascular obstruction, hemorrhage and their prognostic value:
- MR changes in follow up cases
- Imaging pitfall, artifacts and remedies
- Role of MR in comparison with CT, echo, and invasive catheterization

### RC103

**Quantitative Measures in Cardiac CT and MR Imaging—Do They Matter?**

**Refresher/Informatics**

**MR**

**CT**

**BQ**

**CA**

**AMA PRA Category 1 Credits ™**: 1.50

**ARRT Category A+ Credits**: 1.50

Sun, Nov 30 2:00 PM - 3:30 PM  Location: E450B

#### Sub-Events

**RC103A**

**Quantitative Assessment of the Cardiac Chambers and Its Clinical Significance**

Bernd J. Wintersperger MD (Presenter): Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG

**LEARNING OBJECTIVES**

1) Describe the approach of cardiac MR and CT in assessment of cardiac function and size. 2) Understand potential differences between various imaging strategies. 3) Understand the impact and role of cardiac size and function on treatment decisions.

**ABSTRACT**

Introduction: The cardiac performance is generally assessed by volumetric quantifications such as size and output allowing categorization and comparison of the functional status. Follow-up and changes over time may allow identification of early disease onset, may trigger specific therapies and may allow prediction of patient prognosis and general outcome. While CT and MRI providing more accurate results echocardiography remains the primary choice. The added radiation burden of cardiac CT I functional analysis has to be kept in mind and CT therefore should only be considered a 3rd line option. Methods: Most important measures of systolic cardiac function are end-diastolic volume (EDV), stroke volume (SV), ejection fraction (EF) and cardiac output/cardiac index. While clinically performed echocardiography often only provides a categorization of ventricular EF (grade 1-4) with large variations related to various geometric models that especially fail in regional dysfunction, CT and MRI allow to maintain accuracies despite underlying pathologies. In order to maintain high accuracy/lowl variability the selection of adequate imaging parameters with respect to coverage, spatial resolution and temporal resolution is required. Today's functional cardiac MR imaging is almost exclusively performed using cine SSFP methods with cardiac short axis oriented imaging for the left ventricle and short axis or transverse orientation for the right ventricle. Atrial volumetric assessment is performed rarely but might especially be of interest in patients with AV valve dysfunction or atrial sources of arrhythmia. Conclusion Based on its accuracy cardiac MR plays an increasingly important role in assessment of patients with cardiac diseases. Accurate and precise quantification of cardiac function is increasingly important in various therapy decisions.

**Active Handout**


**RC103B**

**Quantitative Assessment Cardiac Valves on MRI**

Jens Bremerich MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Apply CMR for morphometry and quantification of valvular function. 2) Compare various CMR approaches for assessment of cardiac valves. 3) Analyse flow data in stenotic or incompetent valves.

**ABSTRACT**

Introduction: Echocardiography remains first line modality for imaging cardiac valves. In specific cases, however, MR provides complementary quantitative data. Methods: Most relevant sequences for valve imaging are: 1) Black blood, 2) CineSSFP, and 3) VENCine. Black blood images are fast spin echo sequences. CineSSFP are used for quantification of valvular morphology and motion. Temporal resolution is typically 50ms for a segmented breath hold sequence but may be further shortened by means of parallel imaging or non-breath hold sequences. VENCine is an excellent tool for flow volume and velocity quantification. Volumes are relevant to calculate regurgitant fraction of incompetent valves, velocities are used to calculate degree of stenosis relying on modified Bernoulli equation. Results: Aortic regurgitation is difficult to evaluate with Echocardiography but
easily quantified on VENCine with excellent reproducibility. Regurgitant fraction is defined as \( \text{Volume antegrade} / \text{Volume retrograde} \times 100 \% \). Aortic stenosis may also be quantified with MR by measuring the opening area on CineSSFP or by measuring peak velocity in the valve on VENCine and calculation with modified Bernoulli equation (\( \Delta P = 4 \times \text{Vmax}^2 \)). Mitral regurgitation may also be quantified by MRI. Echocardiographic quantification relies predominantly on the extent of the regurgitant jet into the left atrium which is not a reliable sign on MRI, since extent of regurgitant jets depend on various sequence parameters such as field strength and echo time. Pulmonary regurgitation can also be quantified with MRI which is relevant in congenital heart disease such as after surgical repair in tetralogy of Fallot. Pulmonary stenosis, Tricuspid stenosis and regurgitation are no routine indications for MRI but are rather evaluated by echocardiography. Conclusion: Aortic regurgitation is an excellent indication for MRI, it enables accurate and reproducible quantification.

**RC103C**

**How to Quantify Valve Function on Cardiac CT**

Paul Schoenhagen MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the limited role of CT for assessment of valvular function. 2) Discuss clinical indications where anatomic and functional valvular with CT is indicated. 3) Describe data acquisition and analysis approach for valvular assessment.

**ABSTRACT**

CT is a predominantly anatomic imaging modality. Compared to predominantly functional modalities its temporal resolution is limited. Also functional/4-D imaging requires retrospective gated data acquisition and is associated with higher radiation exposure.

The role of CT for functional valvular analysis is therefore limited to few clinical scenarios, where it can provide complementary information. The strength of CT in these situations is the ability for reconstruction in the acquired 3-D/4-D volume. A prominent example is transcatheter valve replacement/implantation but also assessment of prosthetic valves

**URL’s**


**Handout:** Paul Schoenhagen

http://media.rsna.org/media/abstract/2014/14000907/second talk.pdf

**RC103D**

**4D Flow MRI Quantification?**

Christopher Jean-Pierre Francois MD (Presenter): Research support, General Electric Company

**LEARNING OBJECTIVES**

1) Describe MRI physics of 4D flow MRI. 2) Illustrate use of 4D flow MRI for basic hemodynamic function. 3) Demonstrate potential futures uses of 4D flow MRI for advanced hemodynamic analyses.

**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. Examples from valvular and congenital heart disease will be used to illustrate the use of 4D flow MRI to quantify flow velocities and volumes. Although 4D flow MRI is still very much in the early developmental phase, published data comparing 4D flow MRI to established techniques for quantifying flow will be reviewed. The future potential for 4D flow MRI to be used to non-invasively quantify more advanced hemodynamic parameters will be demonstrated. Specifically, the use of 4D flow MRI to measure pressure gradients, pulse wave velocity, wall shear stress and kinetic energy will be covered.
Sub-Events

MSMC21A  Normal Coronary Anatomy
Shawn D. Teague MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

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

MSMC21B  Coronary Artery Anomalies
Cylen Javidan-Nejad MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Using Coronary Artery CT cases to review anomalous origins of the coronary arteries

RC253

Clinical Applications of 3D Printing

Refresher/Informatics

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Mon, Dec 1 8:30 AM - 10:00 AM  Location: N229

Participants

Moderator
Shi-Joon Yoo MD : Owner, 3D HOPE Medical

Sub-Events

RC253A  Overview of 3D Imaging Acquisitions
Karin Evelyn Dill MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the concept of three-dimensional image acquisition. 2) Comprehend the importance of high quality three-dimensional image acquisition as it applies to three-dimensional printing.

RC253B  From 3D Visualization to 3D Printing
Michael Lally Steigner MD (Presenter): Speaker, Toshiba Corporation

LEARNING OBJECTIVES

1) Review the evolution of 3D image post-processing. 2) Demonstrate the current state-of-the-art of 3D post-processing. 3) Demonstrate the relationship between current 3D image post-processing and 3D printing.

RC253C  3D Printing as a Radiology Educational Tool
Amir Imanzadeh MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Demonstrate the utility of 3D printing in pediatric cardiac imaging and surgery. 2) Demonstrate the surgical anatomy of complex forms of double outlet right ventricle, congenitally corrected transposition and criss-cross or twisted heart shown in 3D print models. 3) Observe the models of the example cases in your hands.

ABSTRACT

Precise understanding of the complex morphology of the heart with congenital heart disease is crucial in surgical decision and undertaking the procedure. Most surgeons rely on the anatomy shown in echocardiograms, CT or MRI. Recent advances in computer graphic technology allows virtual demonstration of 3D anatomy in the computer screen. However, the virtual anatomy still requires surgeon's mental reconstruction and ability to discriminate between the real and the false. 3D printing ultimately provides the surgeons with the physical replicas of the heart that allows easier and accurate understanding of the anatomy,
opportunity to practice the procedure and to prepare the tailor-made implants or patches in advance, and, therefore, improves the accuracy of the surgery, shortens the procedure time, and improved the surgical outcome. This presentation will show how 3D print models facilitate understanding of complex congenital heart diseases such as atypical forms of double outlet right ventricle, congenitally corrected transposition and criss-cross or twisted heart.

URL's

http://www.brighamandwomens.org/Departments_and_Services/radiology/Research/aisl.aspx

**Role of 3D Printing in Congenital Heart Disease Surgery**

Shi-Joon Yoo MD (Presenter): Owner, 3D HOPE Medical

**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 biventricular versus univentricular repair, the replicas are of tremendous help in a binary decision. The presentation will include a few clinical cases where 3D printing played a crucial role in surgical decision making.

**3D Surgical Planning Using Printed Models: The Surgeon's Perspective (Spine and Skull)**

Donald J. Annino MD, DMD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To describe the value of 3D visualization from the surgeon’s perspective. 2) To show the role of 3D printing in current and future surgical planning. 3) To review important components of 3D models for face transplantation.

**The Impact 3D-Printing in the Imaging Environment**

Frederik Lars Giesel MD, MBA (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) History of 3D-Printing. 2) Imaging modalities and post-processing procedures to provide data surrogates for 3D-printing. 3) Concept of 3D-printing for improved clinical services. 4) Limitations and perspectives of 3D-printing in the imaging environment.

**ABSTRACT**

This presentation outlines the impact of 3D-printing in the imaging environment. Applications in the medical field are reviewed and growing clinical applications are discussed. Starting with an overview of current 3D-printing technologies including fused deposition modelling (FDM), selective laser sintering (SLS), and stereolithography (SLA) common techniques for generating 3D object models based on medical imaging are illustrated. Typically, imaging source data from different modalities are post-processed using dedicated algorithms and software in order to generate triangle mesh surface data. These surface data are usually exported to STL-files that are commonly understood by current 3D printing machines. 3D-printed objects are most often made from plastic, such as ABS, PA, or PLA, but metal or other material is even possible. Finally the presentation will demonstrate how 3D-printed objects are valuable for treatment planning, treatment procedures in several clinical subspecialties, intra-operative surgical navigation, or for prosthesis production. However, medical applications of 3D-printing are still in a very early phase but the growing awareness in the medical and non-medical field nowadays support the promising utilization and development in the very near future.
Purpose

To determine the precision of CTA aortic annulus area measurements and the impact on TAVR device selection.

Method and Materials

This retrospective study included 86 consecutive clinical TAVR screening CTAs performed on a 64-slice scanner (LightSpeed VCT, GE Healthcare) using retrospective ECG gating. A 1st year medical student (R1, after training on 10 separate CTAs), a 3D lab technologist (R2, 3 yrs experience), and a cardiothoracic radiologist (R3, 6 yrs experience) independently measured the aortic annulus in systole in a random, blinded fashion. The annular plane, containing the hinge points of all 3 valve cusps, was located using multiplanar reformats (Vitrea, Vital Images). The annular area was measured using a freely drawn contour. All measurements were repeated >2 weeks later to avoid recall bias. Bland-Altman analysis was used to assess each reader's repeatability. The difference between the 95% limits of agreement and the bias was used to estimate the measurement precision.

Results

Bias between measurements was 6 [-1.13] (R1), -3 [-11.5] (R2), and 1 [-5.7] mm². Precision was ±64 [52.76] (R1), ±70 [57.83] (R2), and ±55 [44.66] (R3) mm². The difference in precision between R2 and R3 was statistically significant (VR: 1.60 [1.04,2.46], p=0.03). Device size recommendations from the 2 measurements differed in 23% (R1), 29% (R2), and 22% (R3) of the cases and differed by more than 1 category in 2% (R1), 4% (R2), and 1% (R3) of the cases.

Conclusion

Within reader annular area measurement imprecision results in different TAVR device size recommendations ~25% of the time, even for an experienced cardiovascular CTA reader. Reports should include estimated measurement precision to aid in the interpretation of the results.

Clinical Relevance/Application

Knowing the precision of CTA-based aortic annulus area measurements is very important for multidisciplinary TAVR treatment planning. A single point estimate of the annular area may not be sufficient.
for assessing the entire aorta, from the root to the ilio-femoral run-off. A non-contrast steady-state free-precession (SSFP) sequence which has previously been shown to enable accurate aortic valve assessment was used for comparison.

METHOD AND MATERIALS

We performed non-contrast MR angiography on a 1.5T system (Avanto, Siemens) using the novel SN3D and the SSFP sequence in 6 healthy subjects. The SN3D sequence was applied to assess the aorta from its root to the ilio-femoral arteries. The parameters for the SN3D acquisitions were: FOV 220/370mm, ST 1.15mm, IM 1922, slices 192, TR 265.2ms, TE 1.5ms, and FA 90°. Both the thoracic and abdominal acquisitions were ECG gated. The parameters for the SSFP sequence were: FOV 340mm, ST 6mm, IM 1922, reconstructed phases 25, TR 39.7ms, TE 1.1ms, FA 77°, averages 3, acceleration factor 2. With SSFP only the thoracic acquisitions were ECG gated. Systolic aortic root measurements and subjective image quality (5-point scale) were obtained. Vessel diameter and area measurements down to the level of the ilio-femoral arteries were obtained from the SN3D dataset. Acquisition times were recorded.

RESULTS

The mean area-derived effective diameter in the aortic annular plane was comparable between SSFP and SN3D (26.7±0.7mm vs. 26.1±0.9mm, P=0.23). Median image quality of the aortic valve was rated slightly higher with SSFP (4 - interquartile ranges, IQR; 4-4) than with SN3D (3 - IQR, 2-4). No significant differences were observed between the diameter and area of the thoracic and abdominal aorta, and the ilio-femoral run-off (p>0.05). The acquisition time of the SN3D sequence for the whole aorta was 12.1±2.7min.

CONCLUSION

These preliminary results in healthy volunteers suggest that the proposed SN3D acquisition technique enables rapid, free-breathing assessment of the aortic root, the aorta and the ilio-femoral arteries without the administration of contrast medium.

CLINICAL RELEVANCE/APPLICATION

The features of the proposed SN3D sequence appear well suited to address the requirements for TAVR procedural planning in a population which frequently suffers from renal insufficiency and dyspnea.
LEARNING OBJECTIVES

1) Review the role of MDCT and TEE for annular sizing and device selection. 
2) Discuss the role of pre-procedural CT in identifying patients at risk of TAVR related complications such as coronary occlusion and annular rupture.
3) Discuss the evolving role of MDCT to help guide transcatheter valve in valve procedures.

Cardiac CT is able to evaluate coronary artery disease with high diagnostic accuracy and provide comprehensive information regarding structural heart disease. Due to its ability to reconstruct 3-dimensional images with submillimeter isotropic resolution, cardiac CT is a uniquely suited tool for planning and appropriate selection of coronary and non-coronary interventional procedures. The detailed characterisation of coronary geometry and plaque morphology might improve the evaluation of bifurcation lesions and provide important information regarding selection of CTO PCI technique. The application of computational fluid dynamic simulation in CT datasets provides novel avenues in PCI planning through virtual stenting and post-stenting CT-derived computed fractional flow reserve (FFRCT) assessment. Other structural heart interventions might benefit from CT planning, like the evaluation of left atrial appendage, paravalvular leak and atrial or ventricular septal defects in patients candidate for closure devices.

PURPOSE
Reduce the iodine load required for CT TAVI planning by acquiring the ECG-gated aortic root volume and the non-gated aortoiliac scan within the same single contrast media bolus injection.

METHOD AND MATERIALS
50 patients (60% women, 83yo ±7) were prospectively included and underwent TAVI planning with a second-generation 320-row CT scanner. The aortic root was acquired in volume mode using retrospective ECG-gating (100kV, 0.275s rotation time, 2 beats maximum) and immediately followed by a non-gated CAP aortic ultra-fast helical acquisition (100kV, 0.275s rotation time, pitch=0.813), all within a single bolus of 40 to 70mL of Iohexol 350mgI/mL. Image quality of both cardiac and aortic acquisitions was independently assessed by two radiologists on a qualitative five-point scale, and HU enhancement measured in the aorta and the iliac arteries to calculate the signal to noise (SNR) and contrast to noise ratios (CNR). These qualitative and quantitative results were compared to 24 procedures (62% women, 84yo ±5) previously performed on a 64-row scanner with a conventional two-step protocol using two contrast media boluses. Qualitative results were analyzed by a Kruskal-Wallis nonparametric test and quantitative data were compared using a Mann-Whitney test. A p<0.05 was considered significant.

RESULTS
Mean iodine load was commonsensically significantly lower in the 320-row group (23.1g±3.6 vs 43.2g ±8, p<0.01). Image quality of the ECG-gated aortic root and the CAP aorta were equivalent (respectively 4.9 and 4.7 vs 4.4 and 4.9, p=0.05). Mean HU enhancement was similar (388 vs 400, p=0.4) while mean noise was significantly lower (24.5 vs 28.5, p<0.01), leading to a slightly improved SNR and CNR (16.3 and 13.9 vs 14.7 and 12.5, p=0.34 and 0.57). Radiation dose was significantly lower for both the ECG-gated acquisition (547mGy.cm vs 800, p<0.01) and the whole-body aortic scan (487mGy.cm vs 785, p<0.01).

CONCLUSION
Second-generation 320-row CT scanner enables a 47% reduction of the iodine load in TAVI planning, by subsequently acquiring the ECG-gated aortic root and the CAP aorta within a single contrast media bolus injection, while maintaining excellent aortoiliac arterial enhancement and lowering radiation dose.

CLINICAL RELEVANCE/APPLICATION
TAVI planning with subsequent acquisition of the ECG-gated aortic root and the non-gated whole-body aorta is possible within a single contrast media injection when using a 320-row CT.
**PURPOSE**

In vivo geometric analysis of the normal human aortic root is lacking. The aim of this study was to obtain the comprehensive geometric data of the normal aortic root using computed tomography (CT).

**METHOD AND MATERIALS**

One hundred thirty subjects who underwent cardiac CT for atypical chest pain or health check-up were enrolled. Subjects without hypertension, diabetes, significant coronary artery disease, and cardiac valvular dysfunction were included (mean age, 51.4 years; 55 men; number of subjects in each decade - third 15, forth 20, fifth 30, sixth 21, seventh 23, and eighth 21). Mid-diastolic phase of CT images were analyzed using customized software (Omni4D). Individual volume of the aortic sinus and leaflet surface areas (LSA) of the right, left and non-coronary cusps were measured. Intercommissural (IC) distance in each aortic sinus was also investigated. All measured parameters were indexed to body surface area.

**RESULTS**

The left coronary sinus showed significantly smaller geometric parameters including sinus volume, LSA, and IC distance than the other two sinuses (left/non-coronary/right: sinus volume [ml/m2] 1.54/1.95/2.08; LSA [cm²/m²] 2.56/3.03/3.03; IC distance [cm/m²] 1.84/1.94/2.23; p <0.001). Between the right- and non-coronary sinuses, there were no significant differences other than IC distance. In the older decade of age, the volume and IC distance of all coronary sinuses showed an increasing tendency on the test for trend (p < 0.05). However, no significant difference was found in the LSA and annular area with age.

**CONCLUSION**

Detailed analysis of aortic root geometry reveals normal asymmetry in the aortic sinus and leaflet surface area. The size of left coronary sinus was smaller than the other two sinuses. The size of aortic sinus showed increasing tendency in older age group, however LSA did not changed with age.

**CLINICAL RELEVANCE/APPLICATION**

Knowledge of the normal aortic root anatomy is relevant to understand the pathophysiology of the aortic regurgitation and to improve the method of surgical aortic root reconstruction.

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**Morphology of Left Ventricular Outflow from the Left Ventricular Outflow Tract to the Sinotubular Junction: Comparison of Patients with Normal Aortic Valves to Those with Severe Aortic Stenosis**

Gilda Boroumand MD (Presenter): Nothing to Disclose, Hugh White MD : Nothing to Disclose, Praneil Patel MD : Nothing to Disclose, Ethan J. Halpern MD : Nothing to Disclose

**PURPOSE**

The shape of the left ventricular outflow tract (LVOT), aortic annulus and aortic root may impact the proper sizing of a percutaneous aortic valve replacement (TAVR). We evaluated the sphericity of left ventricular outflow with ECG-gated coronary CTA from the LVOT through the sinotubular junction in both diastole and systole.

**METHOD AND MATERIALS**

ECG-gated CTA studies were reviewed from 52 consecutive patients with normal aortic valves and 13 TAVR candidates with severe aortic stenosis and dense valvular calcification. Using a dedicated 3D workstation, orthogonal measurements of the outflow tract were obtained to define the antero-posterior (AP) and transverse diameters (short and long axis) at 4 levels: LVOT, aortic annulus, aortic root and sinotubular junction. Sphericity was defined as the ratio of the AP to transverse diameter at each level.

**RESULTS**

Analysis of variance demonstrated that both the level of the measurement and the phase of the cardiac cycle were significantly associated with sphericity (p<0.0001), while the presence of aortic stenosis was non-significant (p=0.96). Mean sphericity during diastole measured 0.61 at the LVOT, 0.77 at the aortic annulus, 0.94 at the aortic root and 1.00 at the sinotubular junction (p<0.0001 for comparison of any two adjacent levels). During systole, mean sphericity measured 0.69 at the LVOT, 0.81 at the aortic annulus, 0.93 at the aortic root and 1.00 at the sinotubular junction (p<0.0001 for comparison of any two adjacent levels). Differences in sphericity between diastole and systole were significant at the LVOT (p<0.0001) and at the aortic annulus (p=0.0061).

**CONCLUSION**

The shape of the left ventricular outflow changes from an oval at the level of the LVOT to a more circular shape at the level of the sinotubular junction. Although the entire outflow tract changes in size and sphericity during the cardiac cycle, this change is most pronounced at the LVOT, and is statistically significant only at the LVOT and aortic annulus levels. The sphericity of left ventricular outflow structures and the change in sphericity during the cardiac cycle is similar among patients with a normal aortic valve and those with severe aortic stenosis.

**CLINICAL RELEVANCE/APPLICATION**

The oval shape of the proximal left ventricular outflow is not altered by the presence of aortic stenosis and...
calcification. This shape may have important implications for the design and positioning of aortic valve implants.

**VSCA21-11**

**CT for Planning Transcatheter Aortic Valve Replacement: Accuracy for Diagnosing Obstructive Coronary Artery Disease**


**PURPOSE**

Patients referred for transcatheter aortic valve replacement (TAVR) typically undergo a CT study of the heart, aortic root and vascular access route for pre-interventional planning. In this study we evaluated the accuracy of cardiac CT, performed for TAVR planning purposes for diagnosing obstructive coronary artery disease (CAD) using coronary catheter angiography (CCA) as the reference standard.

**METHOD AND MATERIALS**

With institutional review board approval, waiver of informed consent and in HIPAA compliance we retrospectively analyzed the data of 100 consecutive TAVR candidates (61 male, mean age 79.6±9.9 years) who underwent both TAVR planning CT and CCA. The presence and degree of coronary artery stenosis was assessed at both modalities. Additionally, in patients with coronary bypass grafts these were rated as either patent or occluded. Using CCA as the reference standard, we calculated the accuracy of CT for lesion detection on a per-vessel and per-patient basis. We further analyzed the accuracy of CT for the assessment of graft patency.

**RESULTS**

Our data show that in a per-vessel/per patient analysis, CT had 94.4/98.6% sensitivity and 68.4/55.6% specificity for the detection of >50% stenosis in the native coronary arteries. Negative and positive predictive values were 94.7/93.8% and 67.0/85.7%, respectively. On CT, the per-patient sensitivity for >70% stenosis was found to be 100.0%. Furthermore, all 12 vessels on which percutaneous coronary intervention was performed were correctly identified on CT as demonstrating >50% stenosis. Finally, there was good agreement between CT and CCA regarding graft patency in 114/115 grafts identified on CCA.

**CONCLUSION**

Our study indicates that TAVR planning CT does indeed have high sensitivity and negative predictive value in excluding obstructive CAD. For prospective TAVR candidates this would suggest that an additional pre-procedural CCA study may not be required in those patients with a CT negative for obstructive CAD.

**CLINICAL RELEVANCE/APPLICATION**

Our analysis suggests a new management algorithm that would benefit the rising numbers of TAVR candidates with increases in cost effectiveness and improvements in patient safety.

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**MSMC22**

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

**Multisession Courses**

**CT VA CA CD**

AMa PRA Category 1 Credits ™: 1.75
ARRT Category A+ Credits: 2.00

**Participants**

Moderator


Moderator

Vincent B. Ho MD, MBA: In-kind support, General Electric Company

**LEARNING OBJECTIVES**

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

**Sub-Events**

**MSMC22A**

**Coronary Artery Disease I: Native Vessel Disease**

LEARNING OBJECTIVES

View learning objectives under main course title.

**Coronary Artery Disease II: Native Vessel Disease**

Smita Patel MBBS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

**Valves and Cardiac Function**

Andrew John Bierhals MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

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

SSC01

**Cardiac (Valve Disease)**

Scientific Papers

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<th>MR</th>
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AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

Mon, Dec 1 10:30 AM - 12:00 PM  Location: S502AB

Participants

Moderator
Scott Robert Akers MD, PhD: Nothing to Disclose

Sub-Events

SSC01-01

**Is the Access Path Angle in Transapical Aortic Valve Implantation a Risk Factor for the Occurrence of Postprocedural Paravalvular Leakage?**

Borek Foldyna (Presenter): Nothing to Disclose, Martin Haensig: Nothing to Disclose, Christian Luecke MD: Nothing to Disclose, David Holzhey: Nothing to Disclose, Claudia Andres: Nothing to Disclose, Matthias Gröthoff MD: Nothing to Disclose, Friedrich-Wilhelm Mohr: Nothing to Disclose, Matthias Gutberlet MD, PhD: Nothing to Disclose, Lukas H. J. Lehmkuhl MD: Nothing to Disclose

PURPOSE

To analyze the angle between left ventricular long axis and the outflow tract (ALV-LVOT) on cardiac computed tomography (CT) and to describe its impact on occurrence of paravalvular leakage (PL), fluoroscopy time and postoperative CK-MB levels in transapical aortic valve implantation (TA-AVI).

METHOD AND MATERIALS

High-risk patients with severe aortic stenosis, scheduled for TA-AVI using an Edwards-SAPIENT™ prosthesis were retrospectively included. The ALV-LVOT was measured on CT during systole and diastole as far as retrospectively gated data sets were available. The ALV-LVOT was correlated with the occurrence of PL, total fluoroscopy time and postoperative CK-MB levels. Inter-observer variability was assessed in all cases.

RESULTS

Eighty-two patients with an average age of 81.9±5.7 years were included in the study (females/males 57/25 [69.5%/30.5%]). The mean ALV-LVOTs were 61.4°±9.7° and 61.0°±10.2° during systole and diastole, respectively. There was a minimal, non-significant change in the ALV-LVOT between systole and diastole of 0.1°±4.2° (p=0.85). PL was found in 39 patients (0°=43[52.4%];I°=30[36.6%];II°=9[11.0%]). Patients with a clinically significant PL (>=II°) showed a significantly steeper mean ALV-LVOT than patients with I° or without PL (mean difference: 13.8±3.3°; p

CONCLUSION
During TA-AVI, steeper ΑLV-LVOTs were associated with significantly higher grades of PL. Thus, the ALV-LVOT might influence the selection of the transapical implantation path and could have a significant impact on designs for future stents or novel delivery devices.

**Clinical Relevance/Application**
The greater ALV-LVOTs were associated with significantly higher grades of PL and might influence the selection of the transapical implantation path.

**Diagnostic Evaluation of Prosthetic Valve Dysfunction by Multi-Detector Cardiac Computed Tomography Using Intraoperative Findings as Gold Standard**

Kongkiat Chaikriangkrai MD (Presenter): Nothing to Disclose, Dimitrios Maragiannis: Nothing to Disclose, Stephen Little: Nothing to Disclose, Mahwash Kassi: Nothing to Disclose, Sama Alchalabi: Nothing to Disclose, Sayf Khaleel bala: Nothing to Disclose, Su Min Chang: Nothing to Disclose

**Purpose**
To assess role of multi-detector cardiac computed tomography (MDCT) in evaluation of prosthetic heart valve (PHV) dysfunction using intraoperative findings as gold standard.

**Method and Materials**
We reviewed 21 cases with PHV dysfunction that underwent 22 redo valve procedures in our hospital from December 2008 to July 2013. Intraoperative findings were used as gold standard to be compared with preoperative MDCT findings as shown in the figure. The MDCT reader was blinded from intraoperative findings.

**Results**
Our series comprised of 21 cases (16 men and 5 women) with a mean age of 58 years (range 40-70). Preoperatively, there were 15 aortic PHV (11 mechanical and 4 bioprosthetic), 6 mitral PHV (4 mechanical and 2 bioprosthetic) and 1 bioprosthetic tricuspid PHV. Operative findings showed 15 PHV regurgitation and 7 PHV stenosis which were 100% correctly detected by MDCT. Etiologies included 15 PHV dehiscence, 3 pannus, 1 mixed thrombus and pannus, 1 vegetation, 1 PHV defect and 1 calcific degeneration of the PV. Ninety six percent of the etiologies of PHV dysfunction was precisely identified by MDCT except for one case with small pannus. MDCT also showed non-obstructive coronary arteries or bypass grafts in 20 studies and obstructive left anterior descending and left circumflex arteries in one patient.

**Conclusion**
MDCT is accurate for diagnosis and evaluation of etiologies of PHV dysfunction using intraoperative findings as gold standard. It also provides noninvasive assessment of coronary artery anatomy prior to the surgery.

**Clinical Relevance/Application**
MDCT is a reasonably accurate modality for evaluation of patients suspected for prosthetic heart valve dysfunction.

**Mitral Annular Evaluation with Computed Tomography in the Context of Transcatheter Mitral Valve Implantation: A New Paradigm**


**Purpose**
To define the methodology for computed tomography (CT)-based functional "D-shaped" mitral annular assessment for transcatheter mitral valve implantation (TMVI) and compare these novel measurements to traditional "saddle-shaped" mitral annular assessment.

**Method and Materials**
ECG-gated, end-diastolic CT data sets of 28 patients (mean age 72.7±10.2 years) with severe functional mitral valve regurgitation undergoing diagnostic work-up for potential minimal-invasive mitral intervention were analyzed. The annular contour was manually segmented and fibrous trigones were identified yielding annular perimeter, projected area, trigone-to-trigone (TT) distance, septal-lateral (SL) distance and annular height. The traditional saddle shaped annulus was defined including the aortomitral continuity. The functional D-shaped annulus was defined as being limited anteriorly by the TT line, excluding the aortomitral continuity. Hypothetical left ventricular outflow tract (LVOT) clearance and orthogonal projection angles were calculated.

**Results**
Projected area, perimeter and SL distance were found to be significantly smaller for the functional, D-shaped annulus than for the saddle-shaped annulus (11.2±2.7mm² vs. 13.0±3.0cm², 122.5±13.0mm vs. 136.0±15.5mm, 32.1±4.0mm vs. 40.1±4.9mm respectively, p<0.001). TT distances were identical (32.7±4.1mm). The D-shaped annulus was more planar demonstrating a reduced annular height (2.4±1.0mm vs. 10.6±1.8mm, p<0.001). Hypothetical LVOT clearance was significantly reduced for the saddle-shaped annulus, but preserved for the D-shaped annulus (10.7±2.2mm vs. 17.5±3.0mm, p<0.001). A line of perpendicularity for orthogonal views was identified. SL views were on average found at 25.5±7.7° RAO,
CONCLUSION

The historically established methodology for sizing a saddle-shaped mitral annulus appears inappropriate for TMVI, yielding significantly larger dimensions and reduced LVOT clearance compared to the functional, D-shaped annulus approach. CT-based annular assessment may aid pre-procedural sizing, ensuring appropriate patient and device selection and the derivation of appropriate co-axial angles of deployment.

CLINICAL RELEVANCE/APPLICATION

CT-based mitral annular assessment may aid pre-procedural sizing, ensuring appropriate patient and device selection and the derivation of appropriate co-axial angles of deployment in the context of TMVI.

SPECIALTY: Cardiovascular medicine

SSC01-04 Medium-term Biventricular Heart Remodeling after Percutaneous and Surgical Pulmonary Valve Implantation: A Cardiac MR Study

Francesco Secchi MD (Presenter): Nothing to Disclose, Francesca Romana Pluchinotta MD: Nothing to Disclose, Paola Maria Cannao MD: Nothing to Disclose, Gianfranco Butera: Nothing to Disclose, Massimo Lombardi MD: Nothing to Disclose, Francesco Sardanelli MD: Speakers Bureau, Bracco Group Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, Bayer AG Research Grant, IMS International Medical Scientific, Mario Carminati MD: Nothing to Disclose

PURPOSE

Percutaneous pulmonary valve implantation (PPVI) is an alternative to surgical pulmonary valve replacement (SPVR) in select patients with congenital right ventricular outflow tract (RVOT) obstruction. Objective of this study is to evaluate the medium-term impact of PPVI and SPVR on biventricular function as assessed by cardiac magnetic resonance (CMR).

METHOD AND MATERIALS

From 2008 to 2013, 33 patients (median 20 years) underwent PPVI while 16 patients (median 30 years) underwent SPVR. CMR (1.5 T) acquired before and after an average of 10 months (range 3-15) were analyzed, and post-versus pre-pulmonary valve replacement findings were compared. Cine true-FISP sequence was performed (TR/TE=45/1.5 ms, thickness 8 mm) to study the right (RV) and left ventricles (LV) function. MR angiography after administration of contrast material (0.01 mmol/kg Gd-BOPTA) was performed to define pulmonary arteries anatomy before PPVI. Wilcoxon and Pearson test was used.

RESULTS

The right ventricular end-diastolic volume index (RVEDVI, ml/m2) decreases significantly for PPVI and SPVR: from 81±37 to 68±16 (P=.030) and from 142 ± 34 to 88 ± 21 (P=.001) respectively. RV ejection fraction (RVEF, %) increased significantly in the SPVR group compared to the PPVI patients: from 46±11 to 53±9 (P=.038) and from 49 ±14 to 53 ±12 (P=.109) respectively. The left ventricular end-diastolic volume index (LVEDVI, ml/m2) increased more significantly after the procedure in the PPVI group, while changes were less evident and delayed in the SPVR patients: from 66±16 to 74±17 (P=.001) and from 61±7 to 66±12 (P=.055) respectively. Left ventricular stroke volume index (LVSVI, ml/m2) increased in both groups after PPVI and SPVR: from 38±12 to 41±11 (P=.004) and from 35±10 to 40±8 (P=.058) respectively. Finally there is an inverse correlation between the RV and LVEDVI (r=-0.014): as the RVEDVI decreased in the follow-up, the LVEDVI increased.

CONCLUSION

Alleviation of RVOT dysfunction is associated with reduction of RV volume and an improvement in global RV function, as well as positive effects on ventricular-ventricular interaction demonstrated by the increased LVSVI after the procedure.

CLINICAL RELEVANCE/APPLICATION

Medium-term follow-up showed permanent beneficial effect of pulmonary valve replacement in both groups.

SPECIALTY: Cardiovascular medicine

SSC01-05 Right Ventricular Functions Measured by Cardiac Magnetic Resonance Imaging in Patients who underwent Tricuspid Valvular Surgery: Implication for Patients Outcome

Won Jin Choi MD (Presenter): Nothing to Disclose, Dong Hyun Yang MD: Nothing to Disclose, Joon-Won Kang MD: Nothing to Disclose, Tae-Hwan Lim MD, PhD: Nothing to Disclose

PURPOSE

To evaluate right ventricular (RV) function using cardiac magnetic resonance imaging (CMRI) in patients who underwent tricuspid valvular surgery and to identify predictors of poor prognosis.

METHOD AND MATERIALS

During seven years, 842 patients underwent tricuspid valvular surgery due to moderate or severe tricuspid regurgitation. Among them, 124 patients underwent preoperative CMRI to evaluate right ventricular function. Short-axis cine MRI images were analyzed using dedicated software. Ejection fraction, end-diastolic volume, end-systolic volume, myocardial mass of both ventricles were evaluated. By reviewing electronic medical record, baseline characteristics and patient outcome data. The primary composite outcome was any cause of death,
RESULTS
Among 62 patients, the primary outcome rate was 31% (n=19) (median follow-up of 278 days; range 17 - 2120 days). In patients with positive outcome, LV mass index and RV mass index were significantly greater than patient without outcome (LV mass index, AUC 0.747, cut-off 61 g/m2; RV mass index, AUC 0.763, cut-off 27 g/m2). RV ejection fraction was significantly decreased and RV end-systolic volume index was enlarged as compared with those of control group (RV ejection fraction, AUC 0.684, cut-off 36%; RV end-systolic volume, AUC 0.700, cut-off 52ml/m2). Unadjusted Kaplan-Meier survival curves showed significantly lower survival rate in patients with large RV systolic volume and large ventricular mass index of both RV and LV.

CONCLUSION
RV function measured by CMRI may provide prognostic information in patients who underwent tricuspid valvular surgery. Measurement of both ventricular mass index and right ventricular end-systolic volume may help to identify patients with poor prognosis.

CLINICAL RELEVANCE/APPLICATION
Cardiac MRI may be used for prediction of poor prognosis in patients who underwent tricuspid valvular surgery.

SSC01-06
Multidetector-row CT Findings Six Weeks Post Prosthetic Heart Valve Implantation: Results of the IMPACT Study
Dominika Sucha MD (Presenter): Nothing to Disclose, Steven Chamuleau MD, PhD: Nothing to Disclose, Petr Symersky MD: Nothing to Disclose, Renee B.A. Van Den Brink MD, PhD: Nothing to Disclose, Bas De Mol MD, PhD: Nothing to Disclose, Willem P. Mali MD, PhD: Nothing to Disclose, Jesse Habets MD: Nothing to Disclose, Lex Van Herwerden: Research Consultant, St. Jude Medical, Inc, Ricardo P.J. Budde MD, PhD: Nothing to Disclose

PURPOSE
To present the first prospective trial in prosthetic heart valve (PHV) patients that has been performed short after PHV implantation to assess normal postoperative multidetector-row computed tomography (MDCT) reference images, image quality and detect unexpected pathology.

METHOD AND MATERIALS
All patients were prospectively included and underwent contrast-enhanced 256-slice retrospectively ECG-gated MDCT approximately six weeks after uncomplicated PHV implantation. Overall image quality was scored by two observers in best systolic and diastolic phases (1=non-diagnostic, 2=moderate, 3=good, 4=excellent). Moreover, leaflet motion, surrounding anatomy and PHV-related abnormalities were evaluated. Echocardiography was performed at the same moment as MDCT imaging.

RESULTS
Forty-six patients (mean age 64±12 yrs) with 33 mechanical (12 Carbomedics, 12 St-Jude, 5 ON-X, 4 Sorin) and 16 biological (12 Perimount, 4 Mitroflow) PHVs were imaged (mean 47±10 days postimplant). Median (range) image quality for PHVs was 3.0 (2.0-4.0) Carbomedics; 3.0 (2.0-4.0) St-Jude; 3.0 (3.0-3.5) ON-X; 2.5 (2.5-3.0) Sorin; 3.0 (2.5-4.0) Perimount; 2.5 (2.0-2.5) Mitroflow. All mechanical PHVs showed symmetrical leaflet motion. Minor postoperative findings were present in 40 patients and included moderate pericardial effusion (3/46 patients), periaortic/pericardial hematoma (3/46 patients), slight PHV angulation (3/40 aortic PHVs) and fuzziness of the periaortic fat (33/40 aortic PHVs). Unexpected pathology was found with MDCT in three cases. One showed pseudoaneurysms with severe PHV dehiscence requiring reoperation. The other concerned aspecific subprosthetic tissue and a supraprosthetic pseudoaneurysm, both requiring follow-up. The latter also revealed an unexpected relevant coronary anomaly.

CONCLUSION
Post-implantation MDCT showed overall good image quality for biological and mechanical PHVs and symmetrical leaflet motion in all mechanical PHVs. Minor postoperative findings were present in most patients and MDCT detected three cases of unexpected clinically relevant pathology requiring reoperation or follow-up. These first postoperative MDCT reference characteristics allow discrimination of normal and pathological conditions.

CLINICAL RELEVANCE/APPLICATION
Normal postoperative MDCT imaging characteristics and findings in patients with commonly implanted PHVs allow discrimination of normal and pathological conditions short after implantation and at follow-up.

SSC01-07
Evaluation of Aortic Valve Morphology at Cardiac MRI Compared to Operative Findings: Influence of Partial Leaflet Fusion on Accuracy of Pre-surgical Classification
Epicardial Adipose Tissue is Associated with Cardiovascular Performance during Exercise in Asymptomatic Women with the Metabolic Syndrome

Christopher Maroules MD (Presenter): Nothing to Disclose, Nicolle Fernandez BS: Nothing to Disclose, Susan Lakoski MD: Nothing to Disclose, Susan Matulevicius MD: Nothing to Disclose, Suhny Abbara MD: Research Consultant, Radiology Consulting Group, Alice Y. Chang MD, MSc: Nothing to Disclose

PURPOSE

Prior studies have demonstrated that epicardial adipose tissue (EAT) is significantly reduced in patients with heart failure and that lower EAT correlates with lower left ventricular ejection fraction. Other studies have demonstrated a positive correlation between EAT and insulin resistance. We sought to determine the association between EAT and cardiovascular performance during exercise among asymptomatic women with the metabolic syndrome.

METHOD AND MATERIALS

We recruited 27 asymptomatic premenopausal women with the metabolic syndrome who underwent cardiac magnetic resonance imaging (CMR) at 3 Tesla. EAT thickness was measured along the left ventricular anterior wall from a two chamber, ECG-gated cine image at end-diastole. Insulin sensitivity was calculated from a frequently sampled intravenous glucose tolerance test. Measurements of cardiovascular performance were obtained during an exercise treadmill test, including oxygen uptake (VO2). Body fat composition was determined by hydrostatic underwater weighting. Univariate analyses were performed using Spearman correlation. Adjustment for insulin sensitivity was performed using linear regression.

RESULTS

The median age of study participants was 39 (interquartile range, IQR: 34-45) years and the median body mass index (BMI) was 35 (IQR: 29-38) kg/m2. EAT positively correlated with BMI (p=0.04), waist circumference (p=0.03), and hip circumference (p=0.02), but did not correlate with percent body fat (p=0.13). EAT positively correlated with VO2 indexed to weight during steady state exercise (r=0.59, p=0.03), but not at rest or maximum effort. In linear regression models after adjusting for insulin sensitivity, EAT remained significantly associated with steady state exercise VO2 indexed to weight (p=0.01).

CONCLUSION

Among asymptomatic women with the metabolic syndrome, epicardial adipose tissue by CMR is associated with VO2 during exercise independent of insulin sensitivity.

CLINICAL RELEVANCE/APPLICATION

Depletion of epicardial adipose tissue may be a useful marker of subclinical cardiovascular disease. Future
studies should explore the role of epicardial adipose tissue as a predictor of cardiovascular risk and response to therapeutic interventions.

**Coronary Artery and Aortic Valve Calcifications Seen at Lung Cancer Screening Low-Dose CT: Clinical Meaning and Correlation with Echocardiographic Findings**

**Yoon Ki Cha MD (Presenter): Nothing to Disclose, Hee Young Lee MD: Nothing to Disclose, Kyung Soo Lee MD, PhD: Nothing to Disclose, So Hyeon Bak MD: Nothing to Disclose, Hyoun Cho MD: Nothing to Disclose, Sung Mok Kim MD: Nothing to Disclose**

**PURPOSE**

To correlate the presence and extent of coronary artery calcium (CAC) with those of aortic valve calcium (AVC), and to compare the presence and extent of CAC and AVC at low-dose ungated MDCT for lung cancer screening (LDCT) with measures at ECG-synchronized MDCT for coronary calcium score (CCS).

**METHOD AND MATERIALS**

From 2008 to 2009, 454 patients (68.1 ± 7.9 years, 420 male) underwent screening same-day LDCT (5.0-mm-section thickness) followed by CCS CT in asymptomatic patients for chest disease. In 278 patients with a CCS CT positive for AVC, CAC and AVC were quantified using Agatston scores. The severity of AS was evaluated with Doppler echocardiography using a peak velocity and a pressure gradient. The severity of AS was compared with AVC measured at LDCT.

**RESULTS**

The median CAC score was higher in individuals with combined AVC+CAC than in those with CAC only. 14.7% of individuals with AVC had CAC score >400 (extensive plaque burden). There was weak correlation or some linear tendency between CAC and AVC score (r = 0.20, p = 0.001) at LDCT. In patients with AS, Doppler echocardiography demonstrated a mean peak velocity of 2.74 ± 1.27 m/s and a mean pressure gradient of 17.45 ± 17.37 mmHg. The median AVC score at LDCT was 947.9 (interquartile range, 163.0-2924.3). The AVC score at LDCT positively correlated with the peak velocity and pressure gradient (r = 0.71 for both, p = 0.009 and p = 0.005, respectively) of the AV. All patients with severe AS had a calcium score of >3300. CAC and AVC scores from LDCT showed strong positive correlation with those from the CCS (r = 0.87, limits of agreement -533.1 to 260.58 for CAC and r = 0.88, limits of agreement -397.07 to 457.17 for AVC).

**CONCLUSION**

Weak correlation or some linear tendency is seen in CAC and AVC scores at LDCT and a close linear relation between echocardiographic parameters of severity of AS and AVC scores at LDCT is identified. Moreover, using non-gated MDCT for lung cancer screening, we can detect CAC and AVC and obtain results comparable to those obtained with dedicated ECG-gated calcium-scoring CT.

**CLINICAL RELEVANCE/APPLICATION**

LDCT for lung cancer screening, performed in high-risk smokers for lung cancer having also a potential for coronary artery disease with such smoking, should be evaluated for the presence and extent of coronary artery and aortic valve calcifications, because the LDCT technique appears to be feasible in detecting and quantifying the calcifications.
PURPOSE
The amount of coronary calcium per patient can be expressed as coronary calcium score (CCS) in computed tomography (CT). Coronary arteries can reach velocities up to 60 mm/s during the scan phase, which can influence the CCS. Also, new iterative reconstruction (IR) techniques, which allow the dose in CT to be reduced, influence the CCS. The purpose of the current study was to evaluate the influence of motion on CCS in IR CT for the high-end CT systems of four major vendors.

METHOD AND MATERIALS
A calcium hydroxyapatite-containing cylinder (198.4 mm3, 157.1 and 38.5 mg calcifications) attached to a computer controlled lever was moved in the center of an anthropomorphic thorax phantom at velocities ranging from 0-60 mm/s. An extension ring around the thorax simulated an averaged sized patient. Clinical acquisition protocols were used on Brilliance iCT (Philips), Aquilion One (Toshiba), Discovery CT 750 HD (GE) and Somatom Definition Flash (Siemens). Image reconstruction was performed with filtered back projection (FBP) and increasing levels of IR. CCS was quantified as Agatston scores with the vendor’s software.

RESULTS
For the 157.1 mg calcification the FBP CCS was 414±12, 414±13, 427±30 and 460±11 at 0 mm/s for Philips, Siemens, GE and Toshiba respectively. At 60 mm/s scores increased 64-182% to 838±88, 682±73, 1205±128 and 940±47. The highest IR level resulted in 2-5% reduced CCS relative to FBP to 820±89, 645±72, 1176±125 and 918±44. For 38.5 mg calcification FBP CCS decreased 22-65% with increasing velocity for all vendors from 100±12, 96±12, 109±10 and 120±6 at 0 mm/s to 34±23, 75±20, 83±16 and 48±20 at 60 mm/s. The highest IR level resulted in 14-42% reduced CCS relative to FBP to 29±22, 43±20, 62±17 and 35±20.

CONCLUSION
The influence of motion on coronary calcium scores (CCS) is much larger than the influence of iterative reconstruction (IR). For fast moving arteries, CCS are overestimated up to 300% for high density calcifications and underestimated up to 65% for a low density calcifications compared to the static score. The influence of IR is relatively small at 5% for high density and 42% for low density calcifications.

CLINICAL RELEVANCE/APPLICATION
Coronary calcium scores are highly depended on motion, density and CT system. The influence of iterative reconstruction is relative small.
The percentage of assessable segments in each group was more than 98%.

Between the two groups reconstructed with SAFIRE (Group A, 1.16 ± 0.18, Group B, 1.18 ± 0.18; p = 0.75).

There were no significant differences. Mean segment-based image quality scores showed no significant difference were significantly higher than FBP in both groups (all P < 0.01), except in the distal segment of LAD, where mean ED was about 0.90 mSv. Besides, there were no significant differences between the two groups in SNR and CNR. The number of asymptomatic individuals at intermediate cardiovascular risk that will undergo coronary calcium scoring examination is growing. A reduced radiation dose at constant calcium score can be achieved with iterative reconstruction in combination with lower dose.

SSC02-03

The Relationship between Instantaneous Wave-free Ratio Computed from Coronary CT Angiography (iFR-CT) and Invasively Measured Fractional Flow Reserve (FFR) in Patients with Coronary Artery Stenosis

Yue Ma (Presenter): Nothing to Disclose, Hou Yang MD: Nothing to Disclose, Yuke Wang: Nothing to Disclose, Qiyong Guo MD: Nothing to Disclose, Mei Yu: Nothing to Disclose, Yingying Hou MS: Nothing to Disclose

PURPOSE
To determine whether iFR-CT using end-diastole resting coronary CT angiography (CTA) can be used to predict the functional stenosis defined by invasive FFR measurement.

METHOD AND MATERIALS
We retrospectively examined the performance of iFR-CT versus FFR at the time of invasive angiography in 19 vessels of 15 patients who were identified as having an intermediate stenosis (diameter reduction from 50% to 70%) defined by coronary CT angiography. Patient-specific models were built by input original resting end-diastolic high-quality DICOM format coronary CTA images (usually R-R interval 75-80%) into Mimics software. The models were surfacemeshed and body-meshed, then coupled model of vessel wall and blood was established by using the finite element method. These data results were imported into ANSYS software for visualized pictures of parameter distributions. Computed iFR-CT was obtained by dividing end-diastole resting mean pressure distal to the coronary stenosis by the mean aortic pressure based on the visualized pictures. The correlation between iFR-CT and invasive FFR was determined with Spearman's rank correlation. And the diagnostic efficiency of iFR-CT for functional ischemia was evaluated with FFR as "gold standard".

RESULTS
The difference between noninvasive iFR-CT and invasive FFR was not significant (0.813±0.086 Vs 0.828±0.091, p=0.163). Correlation coefficient between iFR-CT with FFR was 0.811 (P<0.001). iFR-CT had equally good diagnostic agreement with FFR (receiver-operating characteristic area under the curve 0.92, p=0.002).

Diagnostic accuracy of iFR-CT to predict lesion-specific ischemia (FFR<0.8) was 84.2% (sensitivity: 87.5%, specificity: 81.8%, positive predictive value:77.8%, and negative predictive value: 90.0%).

CONCLUSION
iFR-CT as a noninvasive, adenosine-independent technology has a significant correlation with invasively measured FFR. iFR-CT appears to be a promising index to assess the functional ischemia of coronary stenosis.

CLINICAL RELEVANCE/APPLICATION
Computed tomography-derived instantaneous wave-free ratio (iFR-CT) is a novel noninvasive, adenosine-independent technology that can be used for patients with coronary artery disease (CAD) to assess functional stenosis.

SSC02-04

Ultra Low Tube Voltage (70kV) FLASH Scan with Low Contrast Volume Injection Protocol for Dual-source CT Coronary Angiography: Image Quality and Radiation Exposure

Jian Cao MD: Nothing to Disclose, Yining Wang MD (Presenter): Nothing to Disclose, Lu Lin MD: Nothing to Disclose, Lingyan Kong MD: Nothing to Disclose, Yan Yi: Nothing to Disclose, Jiuhong Chen MD, PhD: Employee, Siemens AG, Zhengyu Jin: Nothing to Disclose

PURPOSE
To investigate the application of ultra low tube voltage (70kV) for coronary artery CT angiography (CTA) with low contrast volume and injection flow rate on dual-source CT (DSCT) equipment with integrated circuit (IC) detector.

METHOD AND MATERIALS
Thirty patients with body mass index (BMI) no more than 25 kg/m2 were scanned using high pitch (3.4) and prospectively ECG-triggering CCTA protocol on DSCT. All patients were given β-blocker before examination in order to make the mean heart rate lower than 70 bpm. All patients were randomly divided into two groups: the injection flow rate and volume of contrast for Group A was 4.0 mL/s and 32 mL (350 mgI/mL); those for Group B were 4.0 mL/s and 50 mL (350 mgI/mL), respectively. Tube voltage of both groups was 70 kV. The raw data were reconstructed with both FBP and sinogram affirmed iterative reconstruction (SAFIRE). The differences of SNR, CNR, noise, CTDIvol, effective dose (ED) and segment-based image quality (1-4, excellent to non-assessable) between the two groups were compared.

RESULTS
There were no significant differences in age, BMI or heart rate between the two groups (all P>0.05). Radiation exposure (CTDIvol and ED) between the two groups showed no significant difference (all P>0.05), and the mean ED was about 0.90 mSv. Besides, there were no significant differences between the two groups in SNR and CNR. By means of SAFIRE, the image noise decreased and CNR and SNR increased significantly (all P < 0.001). And the contrast CT value, SNR and CNR of each coronary artery segment reconstructed with SAFIRE were significantly higher than FBP in both groups (all P < 0.01), except in the distal segment of LAD, where there were no significant differences. Mean segment-based image quality scores showed no significant difference between the two groups reconstructed with SAFIRE (Group A, 1.16 ± 0.18, Group B, 1.18 ± 0.18; p = 0.75). The percentage of assessable segments in each group was more than 98%.
CONCLUSION

For patients with normal BMI, the use of tube voltage as 70kV with SAFIRE technique in DSCT equipped IC detector is feasible. And both the contrast injection flow rate and volume can be much lower.

CLINICAL RELEVANCE/APPLICATION

For patients with BMI no more than 25 kg/m\(^2\) and mean heart rate of less than 70 bpm, the CCTA of ultra low tube voltage (70kV) and low contrast volume (4.0 mL/s, 32 mL) with high pitch scanning protocol is feasible.

Total Coronary Plaque Volume by Coronary CT Angiography: Relationship between Plaque Burden and Risk Factors

Karen Rodriguez (Presenter): Nothing to Disclose, Veit Sandfort MD: Nothing to Disclose, Puskar Pattanayak MBBS, FRCT: Nothing to Disclose, Shenghan Lai: Nothing to Disclose, Davis M. Vigneault BS: Nothing to Disclose, Marissa Mallek: Nothing to Disclose, Andrew Sams: Nothing to Disclose, Christopher Sibley: Nothing to Disclose, David A. Bluemke MD, PhD: Research support, Siemens AG

PURPOSE

The relationship of calcium score (CAC) and risk factors has been determined. The purpose of this study is to assess the relationship between total coronary plaque burden (including noncalcified plaque) and cardiovascular risk factors as assessed by coronary CTA.

METHOD AND MATERIALS

149 subjects were recruited in this ongoing, prospective study designed to evaluate the effect of HMG-CoA reductase inhibitors on atherosclerosis progress. Eligible subjects were >55 years of age, eligible for statin therapy, and had no known history of cardiovascular disease. Coronary artery imaging was performed using contrast enhanced CT angiography with a 320-detector row scanner. Images were analyzed using QAngioCT software v2.0.5 (Medis Medical Imaging Systems, Netherlands) using a lumen attenuation adaptive algorithm. Coronary wall thickness was evaluated in the total coronary artery tree for vessels > 2 mm diameter. Plaque index was defined as plaque volume divided by coronary length. Noncalcified plaque burden was defined as the sum of fibrous and fibrous fatty plaque.

RESULTS

The average age was 66±6.5 years (38% women). Median coronary artery calcium was 65 (IQR 1-253). In univariate analysis, total plaque index was greater in men than women (42.7±10.6 vs 34.1±8.6 mm\(^2\), p=0.004). In multivariate analysis controlling for all risk factors but CAC, total plaque index was higher in men than women (standardized β=10.6; p=0.001) and in patients with higher BMI (β=0.5; p=0.001). In multivariate analysis, noncalcified plaque index was significantly correlated with LDL (β=0.05, p=0.01) and diabetes (β=4.0, p=0.04) but not with BMI (p=0.28).

CONCLUSION

Body mass index is a major determinate of total plaque burden as assessed by coronary CT angiography, independent of calcium score. LDL and diabetes, but not BMI, were also associated with greater noncalcified plaque burden.

CLINICAL RELEVANCE/APPLICATION

Total coronary plaque burden by CTA may provide additional and independent prognostic information beyond traditional risk factors. BMI is an important modifiable risk factor.

Influence of Dose Reduction on Calcium Scores in Iterative Reconstructed CT: A Multivendor Dynamic Phantom Study

Niels R. van der Werf: Nothing to Disclose, Martin J. Willemink MD: Nothing to Disclose, Bronislaw Abramiuc: Nothing to Disclose, Tineke Petra Willems MD, PhD: Nothing to Disclose, Tim Leiner MD, PhD: Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group, Marcel Greuter PhD (Presenter): Nothing to Disclose

PURPOSE

The dose in coronary calcium scoring (CCS) can be reduced with respect to filtered back projection (FBP) using iterative reconstruction (IR) in computed tomography (CT). However, the influence of dose on depiction of coronary calcium in moving coronary arteries in IR CT is still unknown. Therefore, the purpose of the current study was to evaluate the influence of dose on CCS in IR CT for high-end CT scanners of the four major vendors with moving calculations.

METHOD AND MATERIALS

Two calcifications of equal volume (198.4 mm\(^3\)) but different mass (157.1, and 38.5 mg) were used in an anthropomorphic thorax phantom at a velocity of 20 mm/s. An extension ring was placed around the thorax phantom to resemble a medium sized patient. Vendor recommended clinical protocols were used. Subsequently dose was reduced by 80%. The phantom was scanned five times with a small translation on Brilliance iCT (Philips), Aquilion One (Toshiba), Discovery CT 750 HD (GE) and Somatom Definition Flash (Siemens). CCS was quantified as Agatston scores with vendor software.
RESULTS
For the 157.1 mg calcification full dose FBP resulted in CCS of 500±45, 442±14, 529±55 and 717±31 for Philips, Siemens, GE and Toshiba respectively. At 80% reduced dose CCS was 625±96, 552±21 and 665±36 and 710±30. Using IR CCS decreased with 7-15% to 527±54, 476±19, 614±29 and 639±27. For the 38.5 mg calcification full dose FBP resulted in CCS of 102±12, 99±15, 100±7 and 112±10. At 80% reduced dose CCS was 265±41, 157±11, 148±9 and 187±15. Using IR CCS decreased with 34-58% to 110±48, 90±5, 97±8 and 85±7.

CONCLUSION
Dynamic coronary calcium scores are overestimated up to 157% at 80% reduced dose, which can be compensated for up to 58% using iterative reconstruction, depending on calcification density and CT system.

CLINICAL RELEVANCE/APPLICATION
Dose reduction in CT results in overestimated calcium scores and thereof overestimated patient's risk estimates which can be compensated for by using iterative reconstruction.

SSC02-07
Total Coronary Plaque Volume: Reproducibility Using CCTA
Puskar, Pattanayak MBBS, FRCR (Presenter): Nothing to Disclose, Karen Rodriguez: Nothing to Disclose, Davis M. Vigneault BS: Nothing to Disclose, David A. Bluemke MD, PhD: Research support, Siemens AG

PURPOSE
Both hard (calcium) and soft plaque can be readily assessed to determine the overall volume of coronary plaque using MDCT. However to date, the scan-rescan reproducibility of plaque volume has not been previously reported.

METHOD AND MATERIALS
A total of 30 coronary arteries and 82 segments were analyzed for ten volunteer subjects (mean age, 63.7). Within a short period (mean, 20 days), study subjects (mean age 63.7) underwent baseline and repeat coronary CT angiography (CCTA) on a 320 detector scanner. CTA images were analyzed for calcium and noncalcified plaque using Medis QAngio semi-automated software. A second reader interpreted the follow-up CT. Total and plaque subtype amounts indexed by segment length were measured. Plaque quantification was optimized using both standard and "narrow vessel wall thickness" setting settings using an adaptive algorithm that adjusted for coronary lumen density.

RESULTS
Mean radiation dose per scan was 4.5msv. Total plaque burden had good intra-observer reproducibility (Intra-class Correlation Coefficient, ICC: 0.84). Total plaque indexed by length showed excellent inter-observer reproducibility (ICCs 0.98 to 0.99). Fibrous fatty and necrotic core plaque had good intra-observer (ICCs 0.74 and 0.78) and inter-observer reproducibility (ICCs 0.96 and 0.83). Fibrous plaque was poorly reproducible (ICCs 0.03 and 0.65 for intra- and inter-observer measurements).

CONCLUSION
Calcified plaque has excellent reproducibility and correlates highly with Agatston calcium scores. Scan-rescan reproducibility was very good for plaque indexed by length, fibrous fatty and necrotic core plaque. Only fibrous plaque is poorly reproducible.

CLINICAL RELEVANCE/APPLICATION
Total coronary plaque volume by coronary CT angiography shows very good scan-rescan reproducibility. This measure should be useful as a patient centered index of atherosclerosis for clinical trials and therapy.

SSC02-08
Coronary Artery Calcification on Low-dose Computed Tomography: Comparison of Agatston and Ordinal Scores
Yu Htwe MD (Presenter): Nothing to Disclose, Matthew D. Cham MD: Nothing to Disclose, Rowena Yip MPH: Nothing to Disclose, Artit C. Jirapatnakul PhD: Nothing to Disclose, David F. Yankelevitz MD: Research Grant, AstraZeneca PLC Royalties, General Electric Company, Claudia I. Henschke MD, PhD: Nothing to Disclose

PURPOSE
To compare the Ordinal Scores with the Agatston Scores obtained on non-gated low-dose CT scans

METHOD AND MATERIALS
636 asymptomatic participants (women 416, men 220, mean age 55 years) had low-dose CT screening scans. Each participant was graded as to the extent of coronary artery calcification (CAC) in the 4 arteries (left main, left anterior decending, circumflex and right) and received a Ordinal Score between 0 and 12. Standard software was used to obtain the Agatston Score, but it could not be obtained on 5 participants, reducing the total number for evaluation of 631. Each participant was classified into 1 of 3 Ordinal Score Categories (0, 1-3, 4-12) and 1 of 3 standard Agatston Score Categories (0, 1-400, 400+).
RESULTS

The Ordinal Score of 0 was in agreement with the Agatston Score of 0 in 440 (70%) of the 631 participants, the Ordinal Score of 1-3 was in agreement with the Agatston Score of 11-400 in 78 (12%) participants, and the Ordinal Score of 4-12 was in agreement with the Agatston Score of 400+ in 21 (3%) participants. Thus there was agreement in 539 (85%) of the 631 participants. In 36 of the remaining 92 participants, the Agatston Score was 0 because the calcifications that were actually present were too small to meet the criteria of acceptance by the Agatston software. The remaining 56 (9%) of the 631 participants differed only by 1 category. Overall, the Ordinal Score Categories showed excellent agreement (weighted kappa of 0.83- 95% CI: 0.79-0.88) with the Agatston Score Categories.

CONCLUSION

The use of the Ordinal Score is readily obtained on low-dose CT scans. It shows excellent agreement with the Agatston Score and is thus useful for risk stratification of coronary artery disease.

CLINICAL RELEVANCE/APPLICATION

It is important to provide information obtained from low-dose CT scan about coronary artery disease by providing either the Ordinal or Agatston Scores.

Influence of a Novel Motion Correction Algorithm on Quality and Interpretability of Images of 64-detector Coronary CT Angiography among Patients Grouped by Heart Rate

Haruhiko Machida MD (Presenter): Nothing to Disclose, Xiao Zhu Lin MD: Nothing to Disclose, Rika Fukui: Nothing to Disclose, Yun Shen PhD: Employee, General Electric Company Researcher, General Electric Company, Isao Tanaka: Nothing to Disclose, Eiko Ueno MD: Nothing to Disclose, Takuya Ishikawa: Nothing to Disclose, Etsuko Tate: Nothing to Disclose, He Qing Wang MSc: Nothing to Disclose

PURPOSE

To retrospectively investigate the influence of use of a novel motion correction algorithm (MCA) on quality and interpretability of coronary CT angiography (CCTA) images among patients grouped by heart rate (HR).

METHOD AND MATERIALS

We divided 105 patients who underwent 64-detector CCTA into 6 groups based on their average HRs (25 with average HR ≤ 59 bpm; 23, 60-64 bpm; 23, 65-69 bpm; 13, 70-74 bpm; 14, 75-79 bpm; and 7, ≥ 80 bpm), and 2 readers independently evaluated quality of axial images of the left main trunk, anterior descending artery, circumflex artery, and right coronary artery (RCA) reconstructed with and without the MCA at 75% of the R-R interval in patients with average HR ≤ 64 bpm and at 40% (systole) and at 75% (diastole) in patients with HR ≥ 65 bpm. For each different HR group and cardiac phase, per-vessel and per-segment image quality regarding motion artifacts was visually graded using a 5-point scale and compared using Wilcoxon signed rank test, and percentages of interpretable image quality (scores, 3-5) were compared between images reconstructed with the MCA at the diastole with HR of 65-79 bpm and at the systole with HR of 70-79 bpm (the higher or more extensive HR group, respectively) and without the MCA at the diastole with average HR ≤ 64 bpm (the reference group) using chi-square test. We assessed inter-reader agreement of image quality scores by segment using k-statistics. P < 0.05 was considered statistically significant.

RESULTS

Use of the MCA significantly improved image quality and interpretability in all groups, providing similar or better per-vessel (92-100% or 96-100% versus 88-100%) and per-segment interpretable quality (98% or 99% versus 97%) in the higher or more extensive HR group, respectively, compared to the reference group without significant difference except for the more extensive HR group (P = 0.008 for the RCA, 0.0002 for all segments). The inter-reader agreement was excellent (κ = 0.965).

CONCLUSION

Quality and interpretability of images of CCTA reconstructed with the MCA were similar or better in patients with average HR ≤ 79 bpm than those of the reference group.

CLINICAL RELEVANCE/APPLICATION

Use of a novel MCA may increase the upper limitation of HR to 79 bpm for use with step-and-shoot scan and reasonably reduce radiation dose compared to retrospectively-gated helical scan.

CAS-MOA

Cardiac Monday Poster Discussions

Scientific Posters

AMA PRA Category 1 Credits™: .50
Mon, Dec 1 12:15 PM - 12:45 PM Location: CA Community, Learning Center

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**CAS182**

**An Attempt to Bring Forward the Start Time of Scan of Delayed Myocardial Enhancement (Station #1)**

Ryutaro Matsuura MSc (Presenter): Nothing to Disclose, Yuichi Omura: Nothing to Disclose, Sachiko Goto, PhD: Nothing to Disclose, Yoshiharu Azuma, PhD: Nothing to Disclose, Nahoko Simada: Nothing to Disclose, Shuhei Sato, MD, PhD: Nothing to Disclose, Seiji Tahara: Nothing to Disclose

**TEACHING POINTS**

We have to shorten inspection time in order to decrease patient's physical burden. Early image is applicable to diagnosis.

**TABLE OF CONTENTS/OUTLINE**

**Background**

We attempted to bring forward the start time of scan in delayed myocardial Gd enhancement in cardiac MRI. The term of whole examination was shortened by bringing forward the start time and therefore a patient's physical burden must decrease. Evaluation Cardiac MRI was performed in patients with old myocardial infarction (OMI), dilated cardiomyopathy (DCM), hypertrophic cardiomyopathy (HCM), cardiac sarcoidosis, and others. 20 patients (female:10, male:10) ranged in age from 18 to 82 years participated in this study. We evaluated the images by the delayed times of 5 and 10 minutes using Phillips Achieva 1.5T. As evaluation criteria, CNR (contrast to noise ratio) and enhanced volume were employed, visual assessments were performed by 2 radiologists using image viewers. Wilcoxon signed rank test was performed to compare CNR. Discussion About visual assessments, 18 patients were able to be diagnosed by the images delayed time 5 minutes. As a result of CNR and enhanced volume ratio, the significant difference was not accepted. Conclusion Our results show the images with delayed time of 5 minutes available for diagnosis. The physical burden to a patient is also mitigated.

**CAS183**

**Cardiac Enzyme Peaks and Pro-BNP at Admission could Predict Presence of Microvascular Obstruction at Cardiac Magnetic Resonance in Patients with ST-Elevation Myocardial Infarction. (Station #2)**

Anna Damascelli MD (Presenter): Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose, Antonio Esposito MD: Nothing to Disclose, Giulia Benedetti: Nothing to Disclose, Paolo Guido Camici: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose

**PURPOSE**

Microvascular obstruction (MVO) may occur in patients with ST-Elevation Myocardial Infarction (STEMI) after percutaneous revascularization and it has been associated with a negative outcome. We evaluated the relationship between admission cardiac markers' levels and MVO assessed by Cardiac Magnetic Resonance (CMR).

**METHOD AND MATERIALS**

We enrolled 58 consecutive STEMI patients admitted to our ER. Patients were treated with primary percutaneous coronary intervention (PCI) and underwent CMR (1.5 T) within 5 days from the event. Blood samples were taken before any drug administration and before PCI. Troponin-T (TnT), CK, CK-MB and pro-brain natriuretic peptide (NT-pro-BNP) were quantified. The CMR criteria of MVO were the presence of a subendocardial lack of signal within areas of enhancement in FFP-sequences and/or in early and late-enhancement sequences (5 and 15 minutes after gadolinium administration). The presence of a hypointense region within the hyperintense area of edema on STIR sequences was considered as a marker of hemorrhage. MVO and hemorrhage were quantified as a percentage of left ventricle myocardial mass.

**RESULTS**

We compared patients (age 60±10 yrs; 51 male) with and without MVO (38 and 20 respectively) and patients with and without hemorrhage (20 and 38 respectively) for cardiac markers' levels. TnT, CK and CK-MB peaks were significantly higher in patients with MVO (p<0.001) and there was a significant correlation between enzymatic levels and MVO extent (p<0.001). TnT, CK, and CK-MB peaks were also significantly higher in patients with hemorrhage (p<0.001) and we found a significant correlation between enzymatic levels and hemorrhage extent (TnT: p=0.021; CK: p=0.005 and CKMB: p=0.004). At the multivariate analysis only CK-MB resulted as an independent predictor of MVO (p=0.007). ROC curve analysis showed that patients with CK-MB ≥123 ng/ml have a higher risk of MVO after PCI (sensitivity: 94%; specificity: 84%; AUC: 0.93). Patients with MVO and hemorrhage also showed a higher level of pro-BNP (p=0.02 and p=0.017).

**CONCLUSION**

These preliminary data suggest that CK-MB peaks could predict the risk of MVO in STEMI patients before PCI procedure.

**CLINICAL RELEVANCE/APPLICATION**

MVO after PCI in STEMI patients has been associated with a negative outcome; cardiac enzyme at admission could predict MVO occurrence and may help in prevent it.

**CAS184**

**Potential Role of T1 and T2 Mapping Sequences in the Diagnosis of Acute Myocarditis (Station #3)**
PURPOSE

Evaluate the potential role of T1 and T2 mapping sequences in the diagnosis of acute myocarditis (AM)

METHOD AND MATERIALS

15 patients with suspicion of AM and 16 control subjects were included an explored on a 1.5T MR. Pre contrast T1 and T2 shortened modified look-locker inversion recovery and STIR T2 sequences were acquired in a mid ventricular short-axis (SA) section and in the four-chamber (4C) section. Cine SSFP, first pass and LGE sequences were also acquired. Mean myocardial T1, T2 and STIR T2 signal intensity (SI) were calculated from manual contouring of the short axis section. The same parameters were measured independently for lateral and interventricular septum (IVS), both on the SA and the 4C sections. Number and location of positive segments were noticed on LGE sequence. A non parametric test was used to compare data.

RESULTS

Mean number of involved segments on LGE was 5±1.5 with a systematic involvement of mild lateral left ventricular wall in patients. Mean myocardial T1, T2 and STIR T2 SI were in the same range (P=NS) between patients (998±52 ms, 53.0±5 ms and 173±47, respectively) and subjects (969±47 ms, 50.8±4 ms and 173±47, respectively). Myocardial T1 and T2 of patients were significantly (P<0.05) higher in the lateral wall, on the SA section (1016 ± 58 and 54 ± 8 ms, respectively for T1 and T2) and on the 4C section (1023 ± 65 and 54 ± 6 ms, respectively for T1 and T2), in comparison to control subjects (957 ± 45 and 49 ± 3 ms respectively for T1 and T2 on the SA section, and 937 ± 43 and 49 ± 3ms respectively for T1 and T2 on the 4C section). STIR T2 SI in the lateral wall was in the same range (P=0.3) between patients and control subjects: 176 ± 50 vs. 148 ± 48 on the SA section and 170 ± 59 vs. 159 ±43 on the 4C section, respectively for patients and control subjects. T1, T2 and STIR T2 SI of the IVS were in the same range between patients and subjects (data not shown).

CONCLUSION

T1 and T2 were increased in the lateral wall in case of AM in comparison to control subject. T2 mapping seems to be more efficient than STIR T2 sequence for detection of local edema in the lateral wall.

CLINICAL RELEVANCE/APPLICATION

Pre contrast mapping sequences can detect myocardial lesions of AM and could increase diagnostic accuracy of this disease, especially in case of contraindication to contrast medium injection.
When a stent/prosthesis is implanted within the aortic root, the covered portion of the stent must terminate below the coronary artery origins. The distance between the aortic annulus and the origins of the coronary arteries is not accurately assessed on axial images, but can be measured in long axis on a 3D workstation. The mean height of the coronary artery origins is 1.5cm above the aortic annulus.

**Cardiac Magnetic Resonance Imaging in Patients with Acute Chest Pain, Elevated Cardiac Troponin Values and Normal Angiograms (Station #6)**

Marcin Pawel Basiak MD (Presenter): Nothing to Disclose, Marek Nikodem Konopka MD, PhD: Nothing to Disclose, Maria Dzubinska-Basiak MD: Nothing to Disclose, Damian Kawecki MD, PhD: Nothing to Disclose, Ewa Nowalany-Kozielska MD, PhD: Nothing to Disclose, Boguslaw Okopien MD, PhD: Nothing to Disclose

**PURPOSE**

Acute coronary syndrome with normal coronary arteries in coronary angiography is an important issue in modern cardiology. The aim of this study is to evaluate the usefulness of cardiac magnetic resonance imaging in patients with elevated values of markers of myocardial infarct and unobstructed coronary arteries in coronary angiography imaging.

**METHOD AND MATERIALS**

Study group consisted of eleven patients with elevated troponin values and completely normal arteries in coronary angiography. Four patients had upper respiratory tract infections during previous two weeks. CMR study was performed for 10 days from cardiac episode using a 1.5 T scanner with a dedicated cardiac coil before and after administration of contrast media include assessing left ventricular ejection fraction, the presence of edema or delayed enhancement. Segments of the left ventricle was divided according to the AHA guidelines.

**RESULTS**

Cardiovascular magnetic resonance imaging revealed myocarditis features in 6 (54.5%) patients, two patients - the characteristics of transmural scar and three patients had normal results. Positive correlation was observed between ischemic changes and values of troponin and CK-MB. In the group of patients with myocarditis features mean LVEF was 56.7%, swelling was detected in 2 patients and delayed contrast enhancement in 5 patients. The results were compared with echocardiographic study.

**CONCLUSION**

CMR study is a useful diagnostic method in modern cardiovascular radiology. It provides valuable information especially in patients with unexplained cause of cardiac events and can be done at an early period after the stabilization of the clinical condition of the patient.

**CLINICAL RELEVANCE/APPLICATION**

Early CMR is valuable in the evaluation of the differential diagnoses and to exclude myocardial abnormalities in patients with uncertain aetiology.

**Low Dose CT Angiography for Pre-procedural Assessment of Patients Undergoing TAVI (Station #8)**

Sara Kruglick Floyd MD (Presenter): Nothing to Disclose, Olga Buzdygan: Nothing to Disclose, Marcos Paulo Ferreira Botelho MD: Nothing to Disclose, Timothy J. Carroll PhD: Nothing to Disclose, Ronan Conroy: Nothing to Disclose, Sukit C. Malaisrie MD: Nothing to Disclose, Jeremy Douglas Collins MD: Consultant, B. Braun Melsungen AG, James Christopher Carr MD: Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

**PURPOSE**

CT angiography (CTA) is required prior to Transcatheter Aortic Valve Implantation (TAVI), in order to accurately size the aortic valve and ensure that the pelvic vessels are sufficiently large to accommodate vascular access. Due to advanced age and associated vascular disease, many TAVI patients suffer from chronic kidney disease and are thus at increased risk of contrast induced nephropathy (CIN). We hypothesize that diagnostic pre-procedural planning can be obtained using a low dose contrast CTA protocol, thereby reducing the risk of CIN.

**METHOD AND MATERIALS**

A consecutive series of 65 CTA examinations, performed on a dual source 64 slice CT scanner (Siemens Definition), were retrospectively identified for patients being considered for TAVI. The cases were divided into low dose (≤90ml contrast) groups. Quantitative analysis of image quality was calculated by measuring signal to noise (SNR) and contrast to noise (CNR) at 10 pre-determined anatomic sites in the thoracic and abdominal aorta. Qualitative image analysis was determined by two blinded physician reviewers, independently rating each site on a 1-5 Likert scale, with respect to image quality, diagnostic confidence, SNR and CNR. Results between the low dose and standard dose groups were compared using a weighted kappa statistic.

**RESULTS**

Quantitatively, SNR and CNR were lower in the low dose group compared to the standard dose group (SNR 17.7
compared to 35.8, CNR 14.8 compared to 30.7). For image quality, the low dose group scored 3.67 on average compared to 3.88 in the standard dose group. Average diagnostic confidence scores were 3.96 for low dose compared to 4.26 for standard dose. Average qualitative CNR was 3.65 for low dose compared to 3.79 for standard dose. The weighted kappa statistic was 0.5873, indicating a moderate degree of agreement between reviewers.

CONCLUSION
Low dose CTA had lower image quality but acceptable diagnostic confidence compared to standard dose CTA. In patients with renal compromise, low dose CTA may be a safer alternative in pre-procedural TAVI planning.

CLINICAL RELEVANCE/APPLICATION
CT angiography (CTA) is required for pre-procedural assessment of aortic stenosis patients prior to Transcatheter Aortic Valve Implantation (TAVI). Low dose CTA may be a safer alternative.

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CARDIAC MRI ASSESSMENT OF PATIENTS WITH LEFT VENTRICULOPLASTY (STATION #1)

Mariana Rodriguez Masi: Nothing to Disclose, Irene Martin Lores MRCS: Nothing to Disclose, Ana Bustos: Nothing to Disclose, Beatriz Cabeza MD: Nothing to Disclose, Jose Juan Gomez: Nothing to Disclose, Joaquin Dominguez Ferreiros MD, PhD (Presenter): Nothing to Disclose

PURPOSE
To assess cardiovascular magnetic resonance (CMR) imaging findings in patients with ischemic heart disease and ventricular aneurysm who underwent left ventriculoplasty repair.

METHOD AND MATERIALS
Data were retrospectively gathered on 21 patients (17 men and 4 women, mean age 63 ± 10 years) with diagnosis of ventricular aneurysm secondary to ischemic heart disease undergoing left ventriculoplasty repair between January 2007 and March 2013. The following data were evaluated in preoperative and postoperative CMR studies: quantitative analysis of left ventricular ejection fraction (LVEF), left ventricular end-diastolic (LVEDV) and end-systolic (LVESV) volume index, presence of valvular disease and intracardiac thrombi. The time between surgery and postoperative CRM studies was 3 - 24 months.

RESULTS
Postoperative CMR studies were performed in 12 of the 21 patients included in the study. Statistically significant differences were found in the diagnostic and postoperative LVEF, LVEDV and LVESV values. EF showed a median increase of 10% (IQR 2-15) (p = 0.003). The LVEDV showed a median decrease of 38 ml/m2 (IQR 18-52) (p = 0.006) and the LVESV showed a median decrease of 45 ml/m2 (IQR:12-60) (p = 0.008). 57% of patients had mitral insufficiency and 24% had intracardiac thrombi.

CONCLUSION
Cardiac MRI is a reliable non-invasive technique for the evaluation and management of patients with ischemic heart disease that are candidates for left ventriculoplasty. In this study, a significant postoperative improvement in LVEF, LVEDV and LVESV was demonstrated. Patients who benefited most from the operation were those with higher preoperative left ventricular volumes.

CLINICAL RELEVANCE/APPLICATION
Cardiac MRI is a reliable technique for the pre and postsurgical evaluation of patients with ventricular aneurysm due to ischemic heart disease who are candidates to left ventriculoplasty.

PRELIMINARY STUDY OF MYOCARDIAL PERFUSION DEFECTS IN ISCHEMIC HEART DISEASE PATIENTS USING SPECTRAL CT IMAGING (STATION #2)

Qian Li MSc (Presenter): Nothing to Disclose, Guan Hanxiong MD: Nothing to Disclose, Liu Xiaoyu MD: Nothing to Disclose

PURPOSE
To evaluate the capability and application value of spectral CT imaging in diagnosing Ischemic heart disease.

METHOD AND MATERIALS
Fifty consecutive patients with cardiodynia were prospectively enrolled to undergo enhanced spectral CT imaging. Iodine-base material decomposition images were obtained for the arterial phase and 1-minute delay...
phase. According to the result of ECG and CCTA, the 50 cases were divided into three group: group A (with normal myocardium), group B (with myocardial ischemia), and group C (with myocardial infarction). Iodine density (ID) in the area of LAD branch supplying myocardium was measured on the iodine-base images for each patient. The iodine density values were further normalized to that of the thoracic aorta to obtain normalized iodine density (NID) for myocardium.

RESULTS

In this study there were 20 patients (group A) with normal myocardium, 18 patients (group B) with myocardial ischemia, and 12 patients (group C) with infarction. The ID for group A was statistically higher than group C (18.90±2.15 vs. 13.50±3.73) (P<0.05). The NID for group A was statistically higher than group B (0.57±0.06 vs. 0.47±0.05) (P<0.05). It isn’t significant correlation between of coronary artery stenosis and myocardial iodine content.

CONCLUSION

Spectral CT imaging with iodine-based material decomposition image provided a new method to detect myocardial ischemia or infarction from the normal myocardium. It’s no significant correlation between the degree of stenosis and myocardial ischemia. Spectral CT first-pass perfusion of ischemic heart disease, can assess myocardial activity can be identified by iodine content and standard iodine content of normal myocardial ischemic myocardium and normal myocardium. Gemstone CT first-pass myocardial perfusion can be used in clinical diagnosis of ischemic heart disease, and qualitative and quantitative analysis and evaluation. 10-minute delayed scan did not see a marked enhancement of the infarcted myocardium, delayed scanning time needs to be extended, in order to achieve the identification of ischemic myocardium and myocardial infarction.

CLINICAL RELEVANCE/APPLICATION

Gemstone CT first-pass myocardial perfusion can be used in clinical diagnosis of ischemic heart disease, and qualitative and quantitative analysis and evaluation.

CAS195

Ventricular Wall Motion Assessment in Coronary CTA during Acute Chest Pain: Radiation Dose Expense Savings of Prospectively ECG Triggered Protocol (Station #3)

Harshna Vinodhbai Vadvala MD (Presenter): Nothing to Disclose, Brian Burns Ghoshhajra MD: Nothing to Disclose, Phillip Kim: Nothing to Disclose, Thomas Mayrhofer: Nothing to Disclose, Udo Hoffmann MD: Nothing to Disclose

PURPOSE

Ventricular function and wall motion assessment has been shown to increase the diagnostic sensitivity of coronary CT angiography (CCTA) for acute coronary syndrome. CCTA using prospective ECG-triggering can result in a significant radiation exposure reduction (as high as 79%) versus retrospective ECG-gating, yet maintain comparable diagnostic image quality. Prospectively ECG-triggered scans performed with sufficient additional phases (i.e. "padding") can allow cine images for functional assessment, albeit at a slightly increased radiation exposure. We compared the relative radiation expense of a prospective functional assessment versus a retrospectively ECG-gated functional assessment in the ED setting.

METHOD AND MATERIALS

We retrospectively evaluated ED CCTA scans that included wall motion assessment between October 2012 and January 2014. All scans were conducted on 128-slice dual source scanner using automated tube current and voltage modulation, but using two distinct modes of ECG synchronization (prospectively ECG-triggered with additional functional phases [PTFN] and retrospectively ECG-gated with aggressive tube current modulation [RGTM] protocols). Body-mass index (BMI), heart rate, method of ECG synchronization, radiation exposure, and functional interpretation results were noted. Radiation expense between the two ECG synchronization methods was compared.

RESULTS

111 scans were performed with cardiac function assessment reported. 87(78%) were acquired with PTFN and n=24(22%) with RGTM and the average BMI of the two cohorts were similar (29.7 vs.29.6 kg/m2, p=0.83). The PTFN cohort had slower heart rates compared to RGTM cohort (67 vs. 81 beats per minute, p<0.001). The overall median effective radiation dose estimate in PTF and RGTM were 3.5 mSv and 5 mSv, respectively (p=0.0186 using Wilcoxon rank sum test). Scans with abnormal function (n=8) such as hypokinesis/akinesis (n=6), dyskinesis (n=1) and hyperkinesis (n=1) were diagnosed in PTFN, however no abnormal function was diagnosed in RGTM.

CONCLUSION

Prospectively ECG-triggered CCTA with additional functional phases yielded wall motion and ventricular functional assessment at a radiation expense significantly lower than RGTM in a similar cohort.

CLINICAL RELEVANCE/APPLICATION

Ventricular wall motion and functional assessment is particularly of interest in ED population, where radiation exposure is a concern, but the incremental value of functional assessment is well known.

CAS193

Usefulness of Cardiac CT for Comprehensive Assessment of Bicuspid Aortic Valves: A comparison with Transthoracic Echocardiography (Station #4)

Gee Hyun Kim (Presenter): Nothing to Disclose, Sung Min Ko: Nothing to Disclose, Meong Gun Song: Nothing to Disclose

PURPOSE

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To assess usefulness of comprehensive cardiac CT study to investigate the BAV morphology and the associated valvular and ascending aorta abnormalities.

**METHOD AND MATERIALS**

This retrospective study included 250 patients (66 women, mean age 51.6±14.6 years) diagnosed BAV based on CT or surgical findings. All patients underwent both transthoracic echocardiography (TTE) and CT. BAV morphology was classified according to the Sievers terminology (cusp orientation and presence or absence of a raphe). Planimetric measurements of aortic valve area (AVA) and regurgitant orifice area (ROA) on CT were compared with TTE. The ascending aortic dimensions were measured by CT at four different levels (annulus, sinuses of Valsalva, sinotubular junction, and tubular portion). The ascending aorta was assigned to normal, dilated mid-ascending, dilated root, and combined dilated root and mid-ascending type according to the segment of the aorta predominantly involved in dilatation (diameter>4 cm).

**RESULTS**

BAV phenotype and presence of a raphe on CT were accurate with operative findings in 197 of 208 patients (94.7%). Anterior-posterior orientation of BAV was present in 155 (62%) and raphe in 151 (60.4%) patients. There was excellent agreement (k=0.84) between CT and TTE for detecting valve dysfunction (n=237). CT detected 76 of 94 (82.8%) patients with aortic regurgitation, 77 of 78 (98.7%) patients with aortic stenosis, and 47 of 75 (62.6%) patients with combined stenosis and regurgitation. CT-derived AVA (1.07±0.35 cm²) correlated well (r=0.78) with TTE-derived (0.90±0.33 cm²). Quantification of ROA by CT (0.61±0.59 cm²) was correlated well with the grade of aortic regurgitation by TTE (r=0.70). Seventy (28%) patients had a normal aortic root, 72 (29%) had the mid-ascending type, 32 (13%) had the dilated root type, and 76 (30%) had the combined dilated root and mid-ascending type. Aortic regurgitation was frequently accompanied with normal, dilated root, and combined types, aortic stenosis with normal and mid-ascending types, combined aortic stenosis and regurgitation with mid-ascending and combined types. Aortic dilatation was found in 9 (69%) patients with normal valve function.

**CONCLUSION**

CT allows comprehensive assessment of valvular morphology, phenotype, and function and ascending aorta morphology in patients with BAV.

**CLINICAL RELEVANCE/APPLICATION**

Comprehensive assessment of bicuspid aortic valve (BAV) provided by CT is valuable for treatment decision-making.

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**CAS194**

**Additive Diagnostic Value of Coronary MRA in the Stress Cardiac MR Protocol Including Stress Myocardial Perfusion MRI and Late Gadolinium Enhanced MRI for the Detection of Coronary Artery Disease (Station #5)**

Masaki Ishida MD,PhD (Presenter): Nothing to Disclose, Mio Uno MD: Nothing to Disclose, Ryohei Nakayama PhD: Nothing to Disclose, Yoshihata Goto MD: Nothing to Disclose, Tatsuro Ito MD: Nothing to Disclose, Motonori Nagata MD, PhD: Nothing to Disclose, Yasutaka Ichikawa MD: Nothing to Disclose, Kaoru Dohi: Nothing to Disclose, Kakuya Kitagawa MD, PhD: Nothing to Disclose, Hajime Sakuma MD: Research Grant, Siemens AG Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Guerbet SA

**PURPOSE**

Stress cardiac MR study including stress perfusion and late gadolinium enhanced (LGE) MRI provide accurate detection of myocardial ischemia and infarction, while coronary MRA allows for morphological assessment of luminal narrowing in coronary artery disease (CAD). However, additive diagnostic value of coronary MRA in stress cardiac MR study in not well known. The purpose of this study was to evaluate if addition of coronary MRA can improve the diagnostic performance of stress cardiac MR study in detecting significant CAD.

**METHOD AND MATERIALS**

We prospectively studied 87 patients with suspected CAD (age, 69±11 years) who were scheduled catheter coronary angiography (CAG). Patients underwent cardiac MRA including stress perfusion MRI, LGE MRI and coronary MRA using 1.5T MR imager and 32 channel coils. Two observers assessed stress perfusion MRI and coronary MRA separately using 4-point scale in each coronary territory. Stress-induced hypo-perfusion observed in the absence of LGE was considered abnormal on perfusion MR images. Consensus binary reading by two observers was performed separately. Luminal narrowing of >50% was considered to be significant on CAG.

**RESULTS**

On vessel-based analysis in all 261 coronary arteries, the areas under ROC (AUC) of stress perfusion MRI was 0.759 for observer 1 and 0.761 for observer 2. These AUCs were significantly improved by adding coronary MRA (0.861 for observer 1, p=0.001 and 0.831 for observer 2, p=0.019). The sensitivity and specificity on patient-based analysis for predicting significant CAD were 78% and 66% by stress perfusion MRI alone and 90% and 79% by side-by-side assessment of stress perfusion MRI and coronary MRA. In 227(87%) coronary arteries without previous stent implantation, the sensitivity and specificity on vessel-based analysis for detecting significant CAD were 33% and 91% by LGE MRI, 76% and 88% by stress perfusion MRI, 89% and 89% by coronary MRA and 93% and 89% by combined assessment of stress perfusion MRI and coronary MRA, respectively.

**CONCLUSION**

On vessel-based analysis in all 261 coronary arteries, the areas under ROC (AUC) of stress perfusion MRI was 0.759 for observer 1 and 0.761 for observer 2. These AUCs were significantly improved by adding coronary MRA (0.861 for observer 1, p=0.001 and 0.831 for observer 2, p=0.019). The sensitivity and specificity on patient-based analysis for predicting significant CAD were 78% and 66% by stress perfusion MRI alone and 90% and 79% by side-by-side assessment of stress perfusion MRI and coronary MRA. In 227(87%) coronary arteries without previous stent implantation, the sensitivity and specificity on vessel-based analysis for detecting significant CAD were 33% and 91% by LGE MRI, 76% and 88% by stress perfusion MRI, 89% and 89% by coronary MRA and 93% and 89% by combined assessment of stress perfusion MRI and coronary MRA, respectively.
The results in this study demonstrate that addition of coronary MRA in stress cardiac MR study can provide excellent diagnostic performance for the detection of CAD.

**CLINICAL RELEVANCE/APPLICATION**

Performing coronary MRA in a comprehensive stress cardiac MR protocol is highly valuable for more accurate detection of coronary artery disease.

**CAS192**

**Viral Myocarditis in Patients with Suspected Acute Coronary Syndrome and Normal Coronary Arteries—Value of Cardiac Magnetic Resonance (Station #6)**

Marcin Pawel Basiak MD (Presenter): Nothing to Disclose, Damian Kawecki MD, PhD: Nothing to Disclose, Marek Nikodem Konopka MD, PhD: Nothing to Disclose, Lukasz Buldak: Nothing to Disclose, Maria Dziubinska-Basiak MD: Nothing to Disclose, Ewa Nowalany-Kozielska MD, PhD: Nothing to Disclose, Boguslaw Okopien MD, PhD: Nothing to Disclose

**PURPOSE**

Acute coronary syndrome with normal coronary arteries is a serious diagnostic challenge. A number of different conditions can present with symptoms similar to ACS: chest pain, electrocardiographic changes and elevated levels of markers of myocardial damage. The aim of this study is to evaluate the usefulness of cardiac magnetic resonance imaging in patients with elevated values of markers of myocardial damage, CRP and unobstructed coronary arteries in coronary angiography imaging.

**METHOD AND MATERIALS**

Study group consisted of 21 patients with elevated troponin values, CRP and completely normal arteries in coronary angiography. Ten patients had severe upper respiratory tract infection during previous two weeks. CMR study was performed for 12 days from cardiac episode using a 1.5 T scanner with a dedicated cardiac coil before and after administration of contrast media include assessing left ventricular ejection fraction, the presence of edema and delayed enhancement. Segments of the left ventricle were divided according to the AHA guidelines.

**RESULTS**

In 14 patients (66.6%), the final diagnosis was acute myocarditis. In all these cases, DCE was observed in subepicardial and middle segments of the myocardium. Four patients - the characteristics of transmural scar and three patients had normal results. Patient with normal CMR had tendency towards lower levels of peak troponin, peak creatine kinase MB and CRP than patients with diagnostic CMR. In patients with myocarditis delayed enhancement zone correlated with CRP and troponin levels. After identifying the pathogen tests proved that most of the inflammation was caused by Parvovirus B19, part Herpesviridae and one patient was suspected as Borrelia burgdorferi (Lyme disease).

**CONCLUSION**

CMR study is a useful diagnostic method in modern cardiovascular radiology. It provides valuable information especially in patients with unexplained cause of cardiac events and can be done at an early period after the stabilization of the clinical condition of the patient.

**CLINICAL RELEVANCE/APPLICATION**

The clinical presentation of acute myocarditis can be similar to that of ACS. The presence and distribution of DCE on CMR are of great help in establishing a diagnosis.

**CAS197**

**4D Flow MRI: Analysis of Blood Flow in Valve-Sparing Aortic Root Replacement with an Anatomically Shaped Sinus Prosthesis (Station #8)**

Thekla Helene Oechtering MD (Presenter): Nothing to Disclose, Michael P Beldoch: Nothing to Disclose, Carl Frederik Hons: Nothing to Disclose, Malte Sieren: Nothing to Disclose, Claudia Schmidtke: Nothing to Disclose, Peter Hunold MD: Speaker, Bayer AG Speaker, Koninklijke Philips NV, Hans-Hinrich Sievers MD: Royalties, B. Braun Melsungen AG, Joerg Barkhausen MD: Nothing to Disclose, Alex Peter Frydrychowicz MD: Nothing to Disclose

**PURPOSE**

To evaluate blood flow characteristics in a novel "sinus prosthesis", a valve-sparing aortic root prosthesis with anatomically shaped sinuses (Uni-Graft® W SINUS, Braun) in comparison to healthy volunteers by means of 4D flow MRI.

**METHOD AND MATERIALS**

13 patients after valve-sparing aortic root replacement with sinus prosthesis ("SP", 1f, 54±14y) and 13 age-matched healthy volunteers ("Vol", 11f, 55±6y) were included in this HIPAA-compliant study after approval of the ethics committee and written informed consent. MRI scans were conducted at 3T (Philips Achieva) using a retrospectively ECG-gated 4D Flow sequence with respiratory gating. Flow characteristics were analyzed using GTFlow (v2.1.4, GyroTools) applying streamlines and particle traces to the acquired time-resolved flow field color-coded according to the measured velocity. Presence and extent of secondary flow patterns (vortices, helices) in the aortic sinuses and aorta were graded on a 0-3 scale. Aortic geometry (form, curvature angle at distal anastomosis, diameter, and length) and hemodynamic parameters in 5 planes were assessed.
RESULTS

Presence and extent of sinus vortices were similar between groups: vortices in at least 2 sinuses, vortex size small or medium in 91% of SP, 99% of Vol, tendency towards larger vortices in SP; analysis of datasets with aliasing ongoing (n=6). Regarding geometry, SP patients showed mostly cubic and gothic aortic arches (8/13 and 3/13) whereas Vol presented mostly with a round arch (11/13), substantiated by steeper aortic curvature (SP 102±22°, Vol 84±15°, p<0.05). Patients revealed a longer thoracic aorta (SP 25.0 ± 0.8cm; Vol 22.4 ± 0.7cm; p<0.05) and more secondary flow patterns in the ascending aorta (AAO) than volunteers (SP 1.3±0.5, Vol 0.4±0.5, p<0.05) accompanied by decreased stroke volumes and left ventricular ejection fraction (SP 57.8±7.3%; Vol 65.4±2.8%; p<0.05).

CONCLUSION

Near-physiological flow characteristics were observed in the sinuses of the sinus prosthesis. The increase of secondary flow patterns in the AAO in patients may be explained by altered aortic geometry due to graft implantation, pointing towards the need for anatomically curved prostheses potentially mitigating unphysiological aortic curvatures.

CLINICAL RELEVANCE/APPLICATION

4D Flow MRI reveals near-physiological sinus flow in sinus prostheses and an increase in aortic flow patterns that may be reduced by curved prostheses affecting aortic curvature to a lesser extent.

How to Identify High Risk Coronary Plaque on CCTA: Experience from ROMICAT-II (hardcopy backboard)

Kristine Ghemigian BA (Presenter): Nothing to Disclose, Stefan Puchner MD: Nothing to Disclose, Pal Maurovich-Horvat MD: Nothing to Disclose, Udo Hoffmann MD: Nothing to Disclose, Maros Ferencik MD: Nothing to Disclose, Michael Tse-Yin Lu MD: Nothing to Disclose

TEACHING POINTS

The goals of this exhibit are to: 1. Teach how to evaluate high risk coronary plaque features on CCTA with correlation to ex vivo histology 2. Review evidence for high risk plaque features as predictors of future cardiac events

TABLE OF CONTENTS/OUTLINE

A. Beyond stenosis: CCTA’s unique role as the only noninvasive imaging test to assess high risk plaque features B. CCTA high risk plaque features with correlation to ex vivo histology C. How to identify high risk plaque features on CCTA 1. Low attenuation 2. Positive remodeling 3. Spotty calcium 4. Napkin ring sign D. High risk plaque features for the prediction of major adverse cardiac events: Literature review and experience from ROMICAT II

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

Multisession Courses

MSMC23

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

Participants

Moderator
Harold Ira Litt MD, PhD: Research Grant, Siemens AG Research Grant, Heartflow, Inc
Moderator
U. Joseph Schoepf MD: Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, Siemens AG

Sub-Events

MSMC23A

Pulmonary Veins and Pericardium
Jacob Kirsch MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

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

MSMC23B

Coronary Artery Disease III: Native Vessel Disease
Elliot K. Fishman MD (Presenter): Research support, Siemens AG Advisory Board, Siemens AG Research
LEARNING OBJECTIVES

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

ABSTRACT

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

SSE03

Cardiac (Acute Chest Pain)

Scientific Papers

CT CA

AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Mon, Dec 1 3:00 PM - 4:00 PM  Location: S502AB

Participants

Moderator  Frandics Pak Chan  MD, PhD :  Nothing to Disclose
Moderator  James Christopher Carr  MD :  Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
Moderator  Albert De Roos  MD :  Nothing to Disclose

Sub-Events

SSE03-01  Effectiveness and Cost-Effectiveness of ED Discharge Strategies for Acute Chest Pain – Expansion of the ROMICAT II Trial

Alexander   Goehler  MD,PhD (Presenter):  Nothing to Disclose,  Thomas   Mayrhofer :  Nothing to Disclose,  Amit   Pursnani  MD :  Nothing to Disclose,  Heidi   Lumish :  Nothing to Disclose,  Cordula   Barth :  Nothing to Disclose,  John T   Nagurney :  Nothing to Disclose,  Benjamin   Chow  MD :  Research Grant, General Electric Company Support, TeraRecon, Inc,  Quynh   Truong  MD :  Research Grant, St. Jude Medical, Inc,  G. Scott   Gazelle  MD, PhD :  Consultant, General Electric Company Consultant, Marval Biosciences Inc,  Udo   Hoffmann  MD :  Nothing to Disclose

PURPOSE

Coronary computed tomographic angiography (CCTA) is a viable strategy for evaluating acute chest pain in the Emergency Department (ED); however, the long-term health and economic outcomes associated with its improved detection of coronary artery disease (CAD) remain unclear.

METHOD AND MATERIALS

We developed a Markov model to compare 30-day and lifetime health and economic outcomes of four competing strategies for evaluation of acute chest pain in the ED: 1) early CCTA, 2) standard of care as observed (SOC) in the Rule Out Myocardial Infarction Using Computed Coronary Angiography (ROMICAT) II trial 3) an expert consensus strategy (guidelines) and 4) an expedited ED protocol with early discharge and diagnostic testing on an outpatient basis. Input parameters included ROMICAT II trial, Ottawa chest pain cohort data and the published literature. The model was validated by closely simulating management as observed in ROMICAT II.

RESULTS

The model predicted length of stay (in hours) of 30.6 for SOC, 23.4 for CCTA, 30.9 for guidelines and 12.3 for expedited discharge. The total associated costs were $4,145, $4,491, $4,064, and $4,064, respectively. Assuming a prevalence of obstructive CAD of 6.3%, SOC correctly identified 43 of 62 patients (68%), CCTA 62 of 63 patients (98%), guidelines 47 of 63 patients (75%), and expedited discharge 29 of 63 patients (46%), with respective revascularization rates of 3.7%, 5.2%, 4.0%, and 2.6%. Over the lifetime, this resulted in quality adjusted life years (QALYs) of 22.95, 23.01, 22.92, 22.92 with lifetime costs of $6,700, $6,900, $6,600, and $4,950, respectively. These differences in QALYs and costs translate into an incremental cost-effectiveness ratio of $37,000/QALY for CCTA versus expedited discharge, with both other strategies being dominated (i.e. inferior).

CONCLUSION

Though CCTA is associated with greater early testing and revascularization rates, it is cost-effective in the
long-term because the benefits of earlier treatment of obstructive CAD outweigh the increase in testing. With about 6 million patients presenting with chest pain to the ED per year, CCTA could result in a gain of about 0.5 million QALYs.

**CLINICAL RELEVANCE/APPLICATION**

This comparative effectiveness analysis demonstrates the dominance of CCTA over alternate strategies in ED triage, offering further support for the expansion of coverage for this service by CMS.

### SSE03-02

**Cardiac Magnetic Resonance Imaging in Patients with Acute Chest Pain, Elevated Cardiac Troponin Values and Normal Angiograms**

Marcin Pawel Basiak MD (Presenter): Nothing to Disclose, Marek Nikodem Konopka MD, PhD: Nothing to Disclose, Maria Dziubinska-Basiak MD: Nothing to Disclose, Damian Kawecki MD, PhD: Nothing to Disclose, Ewa Nowalany-Kozielska MD, PhD: Nothing to Disclose, Boguslaw Okopien MD, PhD: Nothing to Disclose

**PURPOSE**

Acute coronary syndrome with normal coronary arteries in coronary angiography is an important issue in modern cardiology. The aim of this study is to evaluate the usefulness of cardiac magnetic resonance imaging in patients with elevated values of markers of myocardial infarct and unobstructed coronary arteries in coronary angiography imaging.

**METHOD AND MATERIALS**

Study group consisted of eleven patients with elevated troponin values and completely normal arteries in coronary angiography. Four patients had upper respiratory tract infections during previous two weeks. CMR study was performed for 10 days from cardiac episode using a 1.5 T scanner with a dedicated cardiac coil before and after administration of contrast media include assessing left ventricular ejection fraction, the presence of edema or delayed enhancement. Segments of the left ventricle was divided according to the AHA guidelines.

**RESULTS**

Cardiovascular magnetic resonance imaging revealed myocarditis features in 6 (54.5%) patients, two patients - the characteristics of transmural scar and three patients had normal results. Positive correlation was observed between ischemic changes and values of troponin and CK-MB. In the group of patients with myocarditis features mean LVEF was 56.7%, swelling was detected in 2 patients and delayed contrast enhancement in 5 patients. The results were compared with echocardiographic study.

**CONCLUSION**

CMR study is a useful diagnostic method in modern cardiovascular radiology. It provides valuable information especially in patients with unexplained cause of cardiac events and can be done at an early period after the stabilization of the clinical condition of the patient.

**CLINICAL RELEVANCE/APPLICATION**

Early CMR is valuable in the evaluation of the differential diagnoses and to exclude myocardial abnormalities in patients with uncertain aetiology.

### SSE03-03

**Acute Chest Pain CT: Should We Scan the Entire Chest or Only the Heart?**

Cane Hoffman (Presenter): Nothing to Disclose, Felix G. Meinel MD: Nothing to Disclose, Alex Justin Lewis MD: Nothing to Disclose, Aleksander Krazinski: Nothing to Disclose, James Spearman: Nothing to Disclose, U. Joseph Schoepf MD: Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, Siemens AG

**PURPOSE**

In patients with acute chest pain, it is debated whether CT angiography of the entire chest in a 'triple-rule-out' (TRO) fashion versus a dedicated coronary CT angiogram limited to the heart provides the greatest benefit. The aim of this study was to determine the prevalence and nature of pathologies found above the level of the carina in TRO CT studies and their association with the patient’s chest pain episode.

**METHOD AND MATERIALS**

A total of 163 TRO studies in patients referred from the emergency department for evaluation of acute chest pain were analyzed. Studies were reviewed to assign the location of all findings to above or below the level of the carina. Coronary artery stenosis was graded as mild, moderate or severe. Moderate and severe stenosis was considered a potential cause of the patient's acute chest pain. The freency and nature of findings above and below the carina was recorded.

**RESULTS**

Among the 163 CT studies, coronary artery stenosis likely to be an etiology of the patient’s chest pain was...
found in 23 cases (14.1%). There were 3 studies which demonstrated pulmonary emboli (1.8%) none of which were isolated to above the carina. No cases of aortic dissection were observed. There were 7 hiatal hernias, 5 aortic aneurysms, 4 pericardial effusions, 3 pleural effusions, 1 aortic stenosis, and 1 malignant origin of the right coronary artery. Likely causes of chest pain were identified in 30% of cases. Of the pathologies found above the carina there were 11 cases with thyroid abnormalities, 7 cases with lung nodules, 5 cases with an aberrant right subclavian artery, 3 cases with pneumonia, 3 cases with apical lung scarring, 3 cases with lymphadenopathy, 1 thymic hyperplasia, and 1 finding of likely healed tuberculosis. A total of 21.5% of studies revealed minor pathology above the carina, none of which was considered to be of immediate critical importance for patient management.

**CONCLUSION**

In patients with acute chest pain, CT findings above the carina are mostly incidental and non-explanatory for the patients' symptoms. The significance and effect of such findings on patient management, outcome and down-stream resource utilization are uncertain.

**CLINICAL RELEVANCE/APPLICATION**

Compared to a CT angiogram limited to the heart (below the level of the carina), a TRO protocol of the entire chest rarely reveals findings that are immediately contributory in patients with acute chest pain.

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**SSE03-04**

**Evaluation of Coronary Stents with Coronary CT Angiography: Comparison of Knowledge Based Iterative Reconstruction and Filtered Back Projection (FBP) Techniques**

Ling-Ling Gu: Nothing to Disclose, Hong Yu MD, PhD: Nothing to Disclose, Shiyan Liu PhD: Nothing to Disclose, Yan Jiang MD (Presenter): Employee, Koninklijke Philips NV

**PURPOSE**

To evaluate the benefit of knowledge based iterative reconstruction (IMR, Philips Healthcare) for coronary CT angiography in patients with coronary stents.

**METHOD AND MATERIALS**

23 patients with 19 coronary stents were studied with a retrospective ECG-gated helical technique using 256-MDCT scanner. Image data were reconstructed with both FBP and IMR techniques. Image quality (IQ) and diagnostic confidence (DC) were evaluated by two radiologists blindly using a three-point scale (1[poor] to 3 [excellent]), the results and in-stent assessable lumen, artificial lumen narrowing were compared between IMR and FBP reconstructions using paired-t test. Artificial lumen narrowing = (nominal stent diameter - visible lumen diameter) / nominal stent diameter

**RESULTS**

Image quality was significantly better for IMR images compared to FBP images (2.14±0.65 vs 1.71±0.46; P<0.01). In-stent assessable lumen measured on IMR images were larger than those measured on FBP images (2.46±0.60mm vs 2.16±0.62mm, p=0.01). Artificial lumen narrowing was reduced by IMR versus FBP (24.7±10.0 vs 34.3±9.4, p<0.01)

**CONCLUSION**

IMR improves image quality and diagnostic confidence of coronary CT angiography in patients with stents, and contributes to a more accurate assessment of the in-stent lumen.

**CLINICAL RELEVANCE/APPLICATION**

IMR improves image quality and diagnostic confidence of coronary CT angiography in patients with stents, and contributes to a more accurate assessment of the in-stent lumen.

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**SSE03-05**

**Concordance vs. Discordance in ED Chest Pain Imaging: An Evaluation of CCTA versus Additional Downstream Testing**

Harshna Vinodbhai Vadvala MD (Presenter): Nothing to Disclose, Phillip Kim: Nothing to Disclose, Udo Hoffmann MD: Nothing to Disclose, Brian Burns Ghoshhajra MD: Nothing to Disclose

**PURPOSE**

Coronary CT angiography (CCTA) is a well-established but relatively recent method for evaluation of acute chest pain in emergency department (ED) patients at low to intermediate risk for acute coronary syndrome (ACS). Traditional tests includes exercise tolerance test (ETT), nuclear imaging (SPECT-MPI), stress echocardiography and invasive coronary angiography (ICA). Each test carries its own risks, benefits and diagnostic profile. We evaluated results of CCTA as well as a second testing modality at our tertiary center's chest pain program to discern patterns of aggregate

**METHOD AND MATERIALS**

Patient records for all acute chest pain patients undergoing CCTA during a 17 month period (of our clinical registry) were queried. Results were considered positive at a threshold of moderate stenoses (≥50% luminal narrowing) at CCTA, ICA, or any result deemed potentially ischemic (i.e. artifacts were excluded) by ETT and SPECT. Results were stratified by CCTA results, per worst stenosis. CCTA exams followed up by ICA were also
comparing for accuracy, including the use of fractional flow reserve (FFR), when available.

RESULTS

263 patients underwent CCTA during the study period, with 52 patients undergoing a second imaging procedure or ETT (20%). The most common downstream testing was with SPECT (n=32, 66%), followed by ICA (n=20, 38%), ETT (n=5, 10%), and both SPECT and ICA (n=4, 8%). For moderate or greater stenoses, disagreement rate for CCTA vs. SPECT was 78% (n=14), CCTA vs. ETT was 100% (n=1) and CCTA vs. ICA was 10% (n=2). Amongst the discordant cases of CCTA vs. SPECT n=2 (14%) patients, both with positive CCTA and negative SPECT underwent subsequent ICA showing severe stenosis (i.e. ICA agreement with CCTA). For CCTA vs. ICA patients, 75% (n=3) cases with moderate CCTA stenoses were discrepant with ICA result (2 were deemed mild and 1 as severe). FFR was performed in 3 cases with results of 0.88, 0.81 and 0.67 with latter two undergoing stenting. However no CCTA vs. ICA discrepancy was noted for severe stenosis and occlusion cases. There were no missed ACS events.

CONCLUSION

CCTA in ED patients results in downstream testing in a minority of cases. We observed highest agreement with anatomic testing (ICA), and lower agreement with physiologic testing (SPECT and ETT).

CLINICAL RELEVANCE/APPLICATION

Practitioners and imagers may find this information useful when interpreting test results in the context of an ED population being evaluated for ACS.

SSE03-06

Incremental Clinical Utility of Stress Nuclear Myocardial Perfusion Imaging (MPI) in Patients with Stenotic but Non-occlusive Disease as Diagnosed by CCTA Criteria


PURPOSE

In low-intermediate coronary artery disease (CAD) risk patients with a negative EKG and normal troponin levels, CCTA demonstrates a 95-99% negative predictive value allowing it to safely exclude CAD-related cardiogenic chest pain. However, the suboptimal positive predictive value (50-90%) typically results in recommending noninvasive stress testing for "borderline obstructive" 50-69% diameter stenoses. We aim to evaluate the incremental clinical utility of stress nuclear myocardial perfusion imaging (MPI) in patients with 50-69% and 70-99% stenoses by CCTA criteria.

METHOD AND MATERIALS

In this retrospective study, 1000 patients who presented to the ED with symptoms of ACS were evaluated using 64- or 320-detector row ECG-gated CCTA. Patients with obstructive 50-70% diameter stenoses on CCTA were recommended to obtain a follow-up stress test (typically nuclear MPI) to exclude stress-induced ischemia. Patients receiving MPI within one month of their CCTA were included in the study. We identified 100 such patients and performed a chart review of the MPI results. Note, none of the patients had significant pre-procedure ECG findings at rest or troponin elevation at the time of either CCTA or pre-nuclear stress test.

RESULTS

In 100 patients, (ages 32-89; males 59, females 41), 95% of the patients with intermediate risk of ACS on CCTA were identified to have a completely normal nuclear stress test (i.e. asymptomatic and no ECG changes). All these patients were noted to have less than 70% stenosis as measured on CCTA. 5% of patients had positive stress test (defined as ST-depression +/- symptoms) and all of these patients were noted to have greater than 70% stenosis. 4/5 of these patients had LAD involvement, 3/5 had LCX and 2/5 had RCA involvement.

CONCLUSION

Patients with intermediate coronary artery stenosis without complete occlusion have been a conundrum for physicians; the dilemma being whether to observe or proceed with further work up. Our study shows that patients with intermediate risk of ACS should be recommended to have follow-up nuclear stress test if CCTA reveals coronary vessel occlusion of 70% or greater. Patients with coronary vessel occlusion of less than 70-percent can be observed with continued clinical management of modifiable risk factors.

CLINICAL RELEVANCE/APPLICATION

Patients with coronary vessel occlusion of less than 70-percent on CCTA can be observed with continued clinical management of modifiable risk factors.
SSE04-01  
**Anomalous Coronary Arteries: Analysis of Clinical Outcome Based upon Arterial Course and Surgical Intervention. Is Bypass Grafting Beneficial for an Older Adult with an Interarterial Coronary Course?**

Robert Layser MD (Presenter): Nothing to Disclose, Michael Savage MD: Nothing to Disclose, Ethan J. Halpern MD: Nothing to Disclose

**PURPOSE**
An anomalous coronary artery with an interarterial "malignant" course (IAC) is a recognized cause of sudden death in children and young adults. Coronary bypass grafting (CABG) is often recommended, especially for a left coronary IAC. However, the largest published review evaluated 54 subjects with an IAC and failed to demonstrate a long-term benefit from CABG (Krasuki et al. Circulation 2011;123(2):154-62). Given the increasing number of older adults with an IAC seen on coronary CT angiography (cCTA), we evaluated the association of IAC +/- CABG with subsequent cardiac events in adults over age 40.

**METHOD AND MATERIALS**
Retrospective review of cCTA and conventional arteriograms from our institution identified 155 patients (ages 40-91, mean 64.5 years) with an anomalous coronary artery origin from the opposite coronary sinus, including 70 patients with an IAC (mean age: 63 years). Chart review provided a mean follow-up time of 5 years. Outcome data was evaluated for hard outcomes (myocardial infarction or cardiac death) and soft outcomes (persistent angina).

**RESULTS**
Although the severity of coronary disease as assessed by the number of vessels with >50% stenosis was lower among patients with vs without an IAC (0.86 vs 1.07 diseased vessels per patient, chi square for trend, p=0.3), the frequency of CABG was higher among those with an IAC (21/70) 30% vs without an IAC (15/85) 17.6%. The frequency of hard outcomes was similar among those with an IAC (12/70) 17.1% vs those without an IAC (15/85) 17.6% (p=0.44). Among patients with an IAC, the frequency of hard outcomes was similar with CABG (4/21) 19% vs without CABG (8/49) 16.3% (p=0.74). The frequency of soft events among patients with an IAC was also similar with CABG (9/21) 42.9% vs without CABG (17/49) 34.7% (p=0.59). Extent of coronary disease was the only significant predictor of outcome on multivariate regression (presence of IAC, CABG and left vs right IAC were not significant, p>0.4).

**CONCLUSION**
The frequency of both hard and soft outcomes among adult patients with anomalous coronary arteries was not significantly related to the presence of an IAC or to the history of CABG. No benefit was documented from CABG in our patients with an IAC.

**CLINICAL RELEVANCE/APPLICATION**
As an increasing number of older adults with an IAC are identified with cCTA, it is important to recognize that CABG does not have a proven benefit for the treatment of anomalous coronary arteries in the older adult patient.

SSE04-02  
**256-Slice Coronary CT Angiography in Patients with Atrial Fibrillation: Optimal Reconstruction Phase and Image Quality**

Hideaki Yuki MD (Presenter): Nothing to Disclose, Seitaro Oda MD: Nothing to Disclose, Keiichi Honda: Nothing to Disclose, Akira Yoshimura: Nothing to Disclose, Kazuhiro Katahira: Nothing to Disclose, Yasuyuki Yamashita MD: Consultant, DAIICHI SANKYO Group, Daisuke Utsunomiya MD: Nothing to Disclose, Tomohiro Namimoto MD: Nothing to Disclose, Takeshi Nakaura MD: Nothing to Disclose, Kenichiro Hirata: Nothing to Disclose, Masafumi Kidoh: Nothing to Disclose

**PURPOSE**
The purpose of this study was to assess the optimal reconstruction phase and the image quality of coronary CT angiographs obtained on a 256-slice CT scanner in patients with atrial fibrillation (AF).

**METHOD AND MATERIALS**
We acquired 256-slice coronary CT angiographs of 60 consecutive patients with AF (45 men and 15 women; age 72.1 ± 8.1 years) and 60 controls (43 men and 17 women; age 67.1 ± 9.9 years) in sinus rhythm. The images were reconstructed in 2% steps in all parts of the cardiac cycle (R-R interval). Two experienced radiologists determined the optimal reconstruction phase with the fewest motion artifacts and scored the motion artifacts of each coronary artery segment to determine the ability to assess each segment. Pearson’s correlation analysis was performed to compare the quality of images obtained at the mean heart rate (HR) of the controls and
under conditions of HR variability in the AF patients.

RESULTS

The average HR and the HR variability during scanning were 70.3 bpm ± 15.9 and 15.4 bpm ± 6.9 in the AF patients; 60.1 bpm ± 12.9 and 1.4 bpm ± 1.1 in the controls. There was a significant difference in the average and the variable HR. In 45 of the 60 AF patients (75%), the optimal reconstruction phase window was the end-diastolic phase (90-99% of the R-R interval), in 7 (11.7%) it was during the end-systolic phase (30-49% window), and in 6 (10%) it was during the mid-diastolic phase (70-89% window). In 53 of the 60 controls (88.3%) the optimal reconstruction phase was mid-diastole; it was end-systole in 4 (6.7%). There was a significant difference in the frequency of the optimal reconstruction phases between the AF patients and the controls but not in the visual scores for image quality and the number of assessable coronary segments. We observed no significant correlation between the mean HR and the visual image quality score. In AF patients there was a significant correlation between HR variability and the visual image quality scores.

CONCLUSION

The optimal reconstruction phase window in most patients with AF was end-diastole (90-99% of the R-R interval); the images had fewer motion artifacts and were of better diagnostic quality.

CLINICAL RELEVANCE/APPLICATION

End-diastolic phase reconstruction shows fewer motion artifacts compared to the other cardiac phase reconstruction in three-fourths of patients with AF.

SSE04-03

Initial Experience of Intelligent Boundary Registration in Coronary CTA

Yan Xing PhD, MD (Presenter): Nothing to Disclose, wen ya liu : Nothing to Disclose, Cunxue Pan PhD : Nothing to Disclose, Gulina Azhati : Nothing to Disclose, Jun Dang : Nothing to Disclose, jing jing LI : Nothing to Disclose, Haiting Ma : Nothing to Disclose, Yan Wei Wang MD : Nothing to Disclose

PURPOSE

To investigate the feasibility of a novel intelligent boundary registration (IBR) technique to align stair-step artifacts in coronary CT angiography (CCTA).

METHOD AND MATERIALS

Twenty-one consecutive CCTA exams with varying degrees of coronary artery stair-step artifacts were retrospectively processed with IBR technique on workstation (Advantage Windows 4.6; GE Healthcare). Two observers evaluate stair-step artifacts on IBR on and off images on per-segment basis defined by the 15-segment American Heart Association (AHA) guidelines. The severity of stair-step artifacts was graded with a 5-point grading scale (1. severe, complete discontinuity of the proximal and distal portions of the coronary artery; 2.moderate, discontinuity >50% of the artery diameter; 3.slight, discontinuity 25%-50% of the diameter; 4minimal, discontinuity <25% of the diameter; and 5.no stair-step artifact). Images scored 1 or 2 were considered non-assessable. Comparisons of variables were performed with Wilcoxon rank sum test and McNemar test.

RESULTS

A total of 50 stair-step artifacts were found (35 Right Coronary Artery, 12 Left Coronary Artery, 3 Left Circumflex Artery). Images with IBR on processing were rated as significantly higher image scores versus those with IBR off (Average Image score: 4.42 ±1.13 vs 2.94 ±1.10); (Z=5.681, P=0.000). Stair-step artifacts were fully corrected (Image score = 5 with IBR) in 70% (35/50) of all segments. Images with IBR off processing were rated as significantly higher non-assessable segments versus those with IBR on (Non-assessable rate: 34% vs 10% ); (χ2=8.392, P=0.004).

CONCLUSION

This novel IBR technique is feasible to reduce the severity of stair-step artifacts and increase assessable segments in CCTA.

CLINICAL RELEVANCE/APPLICATION

The use of IBR technique may reduce the number and severity of stair-step artifacts in CCTA, potentially increasing diagnostic confidence.

SSE04-04

Gadofosvest Trisodium for 100% Navigator Efficiency Coronary Magnetic Resonance Angiography at 3 Tesla

Fabio Raman BS (Presenter): Nothing to Disclose, Mark Allan Ahlman MD : Nothing to Disclose, Jianing Pang : Nothing to Disclose, Debiao Li PhD : Nothing to Disclose, David A. Bluemke MD, PhD : Research support, Siemens AG

PURPOSE

Coronary magnetic resonance angiography (MRA) at 3T suffers from imaging inconsistencies compared to 1.5T despite the use of gadolinium-based contrast agents (GBCAs). Gadofosveset Trisodium (Ablavar®, Lantheus Medical Imaging), with its high relaxivity and long intravascular residence time, offers greater potential over standard GBCAs to improve evaluation of the coronary arteries. The purpose of the study was to evaluate the diagnostic potential of a 0.06 mmol/kg dose of Gadofosveset compared to a standard clinical dose of 0.03 mmol/kg, using a free-breathing whole-heart coronary MRA protocol with (1.0 mm)3 spatial resolution and
100% navigator efficiency. The injection protocol was optimized for the prolonged pharmacokinetics of Gadofosveset.

METHOD AND MATERIALS

Thirty-eight contrast enhanced CMR scans were performed in 19 subjects [4 (21.1%) male; 29.5 ± 7 years; BMI=25.8 ± 6 kg/m2] on a 3.0T Verio Siemens scanner, using an inversion-prepared spoiled gradient-echo sequence. The two scans were separated by a 30-60 day interval, using dosages of either 0.06 mmol/kg or 0.03 mmol/kg of Gadofosveset. Signal-to-noise ratios (SNR) and contrast-to-noise ratios (CNR) were measured. Qualitative AHA quality scores were evaluated in 11 subjects. Pairwise, Student's t-test and Wilcoxon rank test were performed for quantitative and qualitative assessment (MedCalc Software v12.2.1, Mariakerke, Belgium).

RESULTS

Both SNR and CNR were greater in the coronary arteries for double- over single-dose of Gadofosveset (21.2 ± 9.5 vs. 13.3 ± 5.4 and 12.3 ± 8.6 vs. 7.9 ± 4.6, respectively, p<0.001). Individual coronary arteries demonstrated greater SNR enhancement for 0.06 mmol/kg vs. 0.03 mmol/kg for the LMS (18.7 ± 8.5 vs. 10.9 ± 4.9, p<0.001), LAD (24.4 ± 9.0 vs. 15.1 ± 4.3, p=0.001), LCX (16.3 ± 4.6 vs. 11.3 ± 3.5, p=0.005), and RCA (25.4 ± 11.7 vs. 16.1 ± 6.7, p=0.003). CNR comparisons revealed similar results. Qualitatively, a similar number of main and branch vessels were identified by two reviewers.

CONCLUSION

Double dose of Gadofosveset shows improvement in coronary arterial enhancement over standard clinical dose. Patient studies are required to validate its diagnostic efficacy.

CLINICAL RELEVANCE/APPLICATION

Because of the small size of the coronary arteries, improved diagnostic quality of MRA is necessary in order to further develop a viable alternative to CT in the evaluation of coronary artery disease.

SSE04-05

Comparative Assessment of Image Quality for Coronary CT Angiography Using 3 Iodinated Contrast Agents with Different Iodine Concentrations: A Randomized European Multicenter Trial

Filippo Cademartiri MD, PhD (Presenter): Speakers Bureau, Bracco Group Consultant, Guerbet SA Speakers Bureau, Guerbet SA, Jean-Francois Paul MD, PhD: Investigator, F. Hoffmann-La Roche Ltd, Francois H. Laurent MD: Nothing to Disclose, Hans-Christoph Richard F. Becker MD, PhD: Speaker, Bracco Group Speaker, Bayer AG Speaker, Guerbet SA Speaker, Siemens AG Consultant, Amgen Inc, Andrea Laghi MD: Speaker, Bracco Group Speaker, Bayer AG Speaker, Koninklijke Philips NV, Stephan Achenbach MD: Research Grant, Siemens AG Research Grant, Bayer AG Research Grant, Abbott Laboratories Speaker, Guerbet SA Speaker, Siemens AG Speaker, Bayer AG Speaker, AstraZeneca PLC Speaker, Berlin-Chemie AG Speaker, Abbott Laboratories Speaker, Edwards Lifesciences Corporation

PURPOSE

To demonstrate the non-inferiority in diagnostic efficacy of iobitridol (Xenetix® 350) compared to iopromide (Ultravist® 370) and iomeprol (Iomeron® 400) when used for coronary CT scans.

METHOD AND MATERIALS

Multi-center, randomized, double blind, prospective, non-inferiority phase IV trial including 468 patients with suspected coronary artery disease (CAD) and scheduled for coronary CT angiography. The primary endpoint was the CT scan evaluability for CAD diagnosis in terms of quality and interpretability of images. It was based on the full evaluation by 2 off-site independent readers of 18 coronary segments for each patient. Secondary endpoints comprised both efficacy assessment (mainly image quality, stenosis assessment, and signal quantification) as well as safety assessment, in terms of clinical and electrographic tolerance.

RESULTS

Out of the 452 patients completed for the primary analysis, the totality of 18 coronary segments were evaluable in 92.1% of patients from the iobitridol group, versus 94.6 and 95.4% in the iomeprol and iopromide groups respectively. The non-inferiority of iobitridol for the CT evaluation of CAD was statistically demonstrated (p<0.05). Mean image quality was good to excellent for each of the 3 contrast media. No relevant differences were observed for other secondary endpoints between the 3 groups, despite the fact that the amount of iodine (in g) injected was significantly different between the 3 groups: 27.8±3.4 (iobitridol), 29.3±3.8 (iopromide) and 31.7±3.8 (iomeprol), p<0.001. Eventually, the good general safety profile of products was confirmed.

CONCLUSION

Coronary CT angiography using Xenetix® 350 is non-inferior to more concentrated contrast agents regarding image quality and evaluability while the amount of iodine required can be significantly reduced.

CLINICAL RELEVANCE/APPLICATION

Coronary CT angiography using Xenetix® 350 is non-inferior to more concentrated contrast agents regarding image quality and evaluability while the amount of iodine required can be significantly reduced.

SSE04-06

Comparison of Image Quality between Knowledge Based Iterative Reconstruction and Filtered Back Projection Techniques in Evaluation of Severe Calcified Vessels with Coronary CT Angiography

Ling-Ling Gu: Nothing to Disclose, Hong Yu MD, PhD: Nothing to Disclose, Shiyuan Liu PhD: Nothing to Disclose, Yan Jiang MD (Presenter): Employee, Koninklijke Philips NV

PURPOSE
To compare the image quality of coronary CT angiography with severely calcified vessels between knowledge based iterative reconstruction (IMR, Philips Healthcare) and traditional filtered back projection (FBP) techniques.

**METHOD AND MATERIALS**

43 consecutive patients (27 male and 16 female; mean age 57.3 years) with Agatston scores of at least 400 were scanned with a retrospective ECG-gated helical technique using a 256-MDCT scanner. Image data were reconstructed with both FBP and IMR techniques. Image quality evaluation was performed by two radiologists blindly according to the following features: lumen edge sharpness, contrast between vessels and surrounding tissue, blooming artifacts from calcified plaques, overall diagnostic confidence, using a five-point scale (1 [poor] to 5 [excellent]). The subjective scores and image noise were compared by using paired-t test.

**RESULTS**

IMR was better than FBP in lumen edge sharpness and vessel to surrounding tissue contrast (p<0.01). Blooming artifacts from plaques were reduced by IMR compared to FBP (p<0.01). There was no difference in overall diagnostic confidence between IMR and FBP images. Noise was reduced significantly by IMR (p<0.01).

**CONCLUSION**

By enhancing lumen edge sharpness and vessel to surrounding tissue contrast, while reducing blooming artifacts, IMR may improve the diagnostic accuracy of coronary CT angiography for severely calcified vessels.

**CLINICAL RELEVANCE/APPLICATION**

By enhancing lumen edge sharpness and vessel to surrounding tissue contrast, while reducing blooming artifacts, IMR may improve the diagnostic accuracy of coronary CT angiography for severely calcified vessels.
long term complications of treated and untreated congenital heart disease. 3) Describe CT techniques for imaging adults with congenital heart disease. 4) Demonstrate morphologic changes in the heart and great vessels in untreated, palliated and corrected congenital heart disease.

MSMC24C  
Coronary Artery Disease IV: Native Vessel Disease and Arterial and Venous Bypass Grafts
Gautham P. Reddy MD (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.

RCC25  
Precision Medicine through Image Phenotyping

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 exacting and intersects 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.

Sub-Events
RCC25A  
Imaging Biomarkers Meet Informatics: The Personalized Medicine Construct
Ella A. Kazerooni MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
View abstract under main course title.

RCC25B  
Lung Nodules: Combining Population and Patient Specific Data to Inform Personalized Decision Making
Eliot L. Siegel MD (Presenter): Research Grant, General Electric Company Speakers Bureau, Siemens AG Board of Directors, Carestream Health, Inc Research Grant, XYBIX Systems, Inc Research Grant, Steelcase, Inc Research Grant, Anthro Corp Research Grant, RedRick Technologies Inc Research Grant, Evolved Technologies Corporation Research Grant, Barco nv Research Grant, Intel Corporation Research Grant, Dell Inc Research Grant, Herman Miller, Inc Research Grant, Virtual Radiology Research Grant, Anatomical Travelogue, Inc Medical Advisory Board, Fovia, Inc Medical Advisory Board, Toshiba Corporation Medical Advisory Board, McKesson Corporation Medical Advisory Board, Carestream Health, Inc Medical Advisory Board, Bayer AG Research, TeraRecon, Inc Medical Advisory Board, Bracco Group Researcher, Bracco Group Medical Advisory Board, Merge Healthcare Incorporated Medical Advisory Board, Microsoft Corporation Researcher, Microsoft Corporation

LEARNING OBJECTIVES
1) Describe how data from a clinical trial can be repurposed as a decision support tool. 2) List some of the
potential techniques that can be utilized to predict likelihood of a malignant nodule from the NLST database. 3) Explain how the Fleischner Guidelines can be personalized utilizing data from NLST and PLCO. 4) Detail the implications for lung screening trials of having access to NLST and PLCO data. 5) Demonstrate how a healthcare enterprise can create their own local reference database using information from their own patient population.

ABSTRACT

The era of personalized/precision medicine offers the potential to utilize patient and lesion specific data to personalize screening and diagnostic work-up, diagnosis, and treatment selection to a particular patient to optimize effectiveness. Although recently, the emphasis has been on utilization of genomic data in personalized medicine, there is a ‘gold mine’ of useful data in previously conducted clinical trials as well as patient medical electronic records that, until now, gone largely untapped. The purpose of this presentation is to describe how the screening, diagnosis, and treatment of lung nodules can be personalized utilizing data from the NLST and PLCO clinical trials and how the Fleischner Guidelines and screening criteria for lung cancer can be modified according to the characteristics of an individual patient and individual nodule. The presentation will also include ways in which a facility can collect local data on their own patients to supplement these reference databases with experience from their own patient population.

RCC25C  Managing Cardiovascular Care through Image Phenotyping Combined with Patient Level Data
John Jeffrey Carr MD, MS (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.

SPDL31  RSNA Diagnosis Live™: Body, Cardiac, MSK, Neuro, ENT Potpourri

Special Courses

AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 0
Tue, Dec 2 7:15 AM - 8:15 AM  Location: E451B

Participants
Adam Eugene Flanders MD (Presenter):  Nothing to Disclose
Sandeep Prakash Deshmukh MD (Presenter):  Nothing to Disclose
Christopher Geordie Roth MD (Presenter):  Author, Reed Elsevier

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.

RC303  Adult Structural and Congenital Heart Disease (An Interactive Session)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM  Location: E353C

Sub-Events

RC303A  Systematic Approach to CT Interpretation in Congenital Heart Disease
Suhny Abbara MD (Presenter):  Research Consultant, Radiology Consulting Group

LEARNING OBJECTIVES

1) To understand the systematic segmental approach to congenital heart disease. 2) To recognize the CT specific imaging findings that relate to each step in the segmental approach to congenital heart disease.

RC303B  Tailoring CT Scan Acquisitions to Specific Indications
LEARNING OBJECTIVES

1) To understand the different indications for cardiac CT, including calcium scoring, coronary CT angiography, electrophysiology procedural planning, structural heart disease interventions (including TAVR), congenital heart disease, myocardial evaluation, and mass workup. 2) To review the differences between various available equipment, and how available equipment might affect a given protocol. 3) To review basic protocols for each of the above exam types, and review specific features of each exam type. 4) To review the advantages and disadvantages of individualized settings within each of the above protocols.

**Imaging of Cardiac Shunts**

Harold Ira Litt MD, PhD (Presenter): Research Grant, Siemens AG Research Grant, Heartflow, Inc

LEARNING OBJECTIVES

1) Describe MR imaging methods for detection and quantification of intra and extracardiac shunts. 2) Describe CT imaging methods for detection and quantification of intra and extracardiac shunts. 3) Plan an optimized protocol for CT or MR imaging of shunts.

**Role of MRI in Adult CHD Management**

Gautham P. Reddy MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the indications for MRI in the management of adults with congenital heart disease. 2) To discuss the advantages and drawbacks of MRI performed to assess morphology and function. 3) To compare the role of MRI to other imaging modalities. 4) To review imaging of specific anomalies such as tetralogy of Fallot, coarctation of the aorta, transposition of the great arteries, and single ventricle physiology.

CTA from Head to Toe (How-to Workshop)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 8:30 AM - 10:00 AM Location: E260

Participants

Moderator
Alison Wilcox MD : Speaker, Toshiba Corporation

Sub-Events

**Cardiac CT- Pre, Peri and Post Procedural Management**

Bonnie Garon MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review preprocedural patient preparation including appropriate patient selection, beta blockade, contraindications and alternatives beta blockers. 2) Discuss how to manage nonstandard patients (atrial fibrillation, pacemaker, young adults). 3) Periprocedural issues including vasodilation, continued heart rate control, and breathholding requirements. 4) Image acquisition including radiation dose reduction techniques, technique choice, and post CABG patient. 5) Postprocedural complications include contrast reactions and their management.

ABSTRACT

Cardiac CTA involve slightly more preparation than the standard CT acquisition. Heart rate control is the most important aspect that needs to be addressed prior to the patient arriving in the radiology department. Periprocedural issues mostly involved how to optimize technique while having the lowest radiation dose especially in the new age of dose reduction. Almost as important as heart rate management is how to treat postprocedural complications especially contrast reactions. This presentation will discuss these aspects and include treatment options as well as their alternatives.

**TEVAR/EVAR- Pre, Post and Periprocedural Evaluation**

Alison Wilcox MD (Presenter): Speaker, Toshiba Corporation

LEARNING OBJECTIVES
1) What are some clinical indications for acute aortic imaging. 2) What are some CT parameters that can aid in various diagnosis? 3) What are some of common complications seen in TEVAR and EVAR? 4) What are the important measurements and vessel variants that help guide surgical approach. 5) New suggestions for type B management. 6) What are some imaging problems and pitfalls and some methods to assist. 7) Briefly discuss TAVR acquisition.

**ABSTRACT**

The acute aorta is part of a syndrome of diseases affecting the aorta with significant overlap of findings and clinical presentations. Clinically the diagnosis is difficult as there is overlap between patients with suspected coronary disease, pulmonary embolism and acute aortic syndrome. In the past several years, minimally invasive surgery with Thoracic Endovascular Aortic Repair (TEVAR) or Endovascular Aortic Repair (EVAR) have become increasingly popular. The images choices include gated vs non gated studies, non-contrast imaging, and delayed imaging. The literature is mixed on how and when to use these modalities. The complications of these procedures is often complex and subtle as well. Knowledge of these vascular complications is imperative for patient management. In addition, these patients often have significant atherosclerotic disease elsewhere that might be limiting factors for stent placement, including renal insufficiency. Newer scanners and imaging techniques can reduce radiation dose, and limit the amount of contrast delivery to preserve renal function while preserving image quality. TAVR is an example of another minimally invasive technique gaining popularity that has imaging challenges. Again, newer scanning techniques with limited contrast delivery can provide excellent image quality while limiting radiation dose and preserving renal function.

**Peripheral CTA—A How-to**

Ilya Lekht MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Enhance knowledge of normal and abnormal coronary and cardiac anatomy, with an emphasis on differentiating benign from significant variants. 2) Demonstrate the spectrum of non-atherosclerotic congenital and acquired diseases that may affect the coronary arteries. 3) Demonstrate the spectrum of non-atherosclerotic congenital and acquired diseases that may affect the heart.

**ABSTRACT**

A variety of non-atherosclerotic conditions are detectable on cardiac CT scans, including diseases of the heart, and disease processes which may affect the coronary arteries, or other vascular structures. Cardiac CT has a number of unique advantages in detecting non-atherosclerotic conditions, including congenital and acquired diseases. The focus of this presentation will be non-atherosclerotic conditions of the coronary arteries and of the heart. Variants of normal and abnormal anatomy of the coronary arteries will be discussed, including tips for identifying when coronary anatomic variants are significant. Acquired, non-atherosclerotic diseases of the coronary arteries will also be discussed. This presentation will also discuss the spectrum of non-atherosclerotic diseases of the heart which may be detected at cardiac CT, including congenital and acquired valvular and cardiac diseases. At the end of this exhibit, the viewer will have a better appreciation for abnormal coronary and cardiac anatomy and the broad spectrum of non-atherosclerotic cardiovascular diseases which may be seen at cardiac CT.

**MSES32**

**Essentials of Cardiac Imaging**

**Multisession Courses**

CT CA

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

Tue, Dec 2 10:30 AM - 12:00 PM  Location: S100AB

**Sub-Events**

**MSES32A**

**Cardiac Devices: Appearance on Imaging**

Karin Evelyn Dill MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Learn the indications for cardiac support devices used in current clinical practice. 2) Understand the surgical placement of cardiac devices in order to determine appropriate positioning by imaging. 3) Recognize abnormalities of cardiac devices.

**ABSTRACT**

There are many cardiac support devices currently in use. As radiologists, it is imperative that we are familiar with the indications, appropriate placement and postions of such devices. Working as part of a multidisciplinary team, we are the front line imagers of these devices, often the first physicians to view the patient by imaging after device placement. Therefore, it is our responsibility to accurately interpret the images and confidently communicate abnormalities with referring clinicians. This presentation will review the most common cadiac
Evaluation of Adult Congenital Heart Disease with CT

Satinder Pal Singh MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the expanding role of MDCT in evaluation of adult CHD with several illustrative cases. CT provides excellent anatomic information about intra and extra cardiac anomalies and any complications related to palliative or corrective surgery done in early childhood. Retrospective gated CT is also helpful in evaluation of right ventricle function especially in the presence of hardware.

ABSTRACT

Advances in surgical technique and perioperative care have significantly improved the success rate and life expectancy in congenital heart disease (CHD). Echocardiography remains the primary imaging method though it can be limited by lack of adequate acoustic windows and suboptimal depiction of the extra cardiac vasculature, which can be important in the postoperative evaluation. Multidetector computed tomography (MDCT), because of wide availability, short acquisition time, high spatial resolution, improved temporal resolution and isotropic imaging, is an attractive alternative method. The radiation exposure from CT can be limited by choosing appropriate protocol based on the clinical question and use of lower kVp, mAs, iterative reconstruction, high pitch imaging and limiting FOV to the desired anatomy. MDCT is playing an increasingly important role in the postoperative imaging and surveillance of patients with congenital heart disease with its unique capabilities to characterize anomalies and complications that may be difficult to evaluate with other technique. CT provides objective and accurate morphologic and functional information and is very useful for detecting extracardiac abnormalities. When performed with ECG-gating, CT provides useful information about coronary arteries, valves, complex cardiac morphology, and cardiac function, especially in patients with previous surgery, the details of which are unknown. A thorough understanding of the normal anatomy, morphologic features of congenital heart diseases, knowledge of the details of surgical procedures and their complications are essential for choosing optimal CT protocol and accurate CT interpretation. A sequential segmental approach should be used in evaluating morphologic features, during the review of CT images obtained in patients with congenital cardiac defects and in postoperative adult patients.

Myocardial Perfusion in Clinical Care

Matthijs Oudkerk MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the clinical relevance of myocardial perfusion in terms of diagnosis and prognosis. 2) Compare the differences between test characteristics of the applied imaging modalities. 3) Identify and tailor the pre-test probability of the patient population to the imaging modality. 4) Interpret the diagnostic validity of the test outcome per imaging modality.

ABSTRACT

Contrary to coronary angiography, FFR or CCTA, myocardial perfusion imaging (MPI) is the only method to demonstrate myocardial ischemia. It reflects the final result of the effects of coronary flow impairment due to stenosis or obstruction together with compensatory flow through communicating coronary vessels and flow through collaterals. Therefore it is the ultimate proof for haemodynamically relevant coronary flow impairment. While different modalities for MPI have different diagnostic accuracy, the overall accuracy to diagnose hemodynamically significant coronary artery disease (CAD) is good. Analysis of MPI results in clinical setting is mostly performed by visual evaluation of presence and pattern of hypoenhancement of the myocardium during first pass of intravenously injected contrast or tracer. This method relies on the existence of regions with normal perfusion as reference, which limits its accuracy in cases of multi-vessel disease or balanced ischemia. Quantitative methods capable of solving this limitation were first established in PET, where time-resolved acquisition of the first-pass of tracer uptake and direct quantification of tracer concentration from PET attenuation were developed. With these characteristics, tracer kinetic modeling can be applied to produce independent quantitative estimates of perfusion in stress and rest, known as absolute perfusion measures or biomarkers. The added clinical value of PET over relative and visual perfusion analysis has been demonstrated. With recent technological advances in MRI and CT imaging, these techniques are receiving increased attention for evaluation of myocardial perfusion biomarkers. State-of-the-art MRI and CT have better spatial and temporal resolution compared to PET. MRI and CT also have wider possibilities for integration into current clinical workup for CAD due to their wider availability and increasing clinical role in comprehensive diagnosis of CAD.

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Cardiac (TAVR and Other Interventions)

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SSG02

Cardiac (TAVR and Other Interventions)

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The Impact of Calcium Volume and Distribution in Aortic Root Injury Related to Balloon-Expandable Transcatheter Aortic Valve Replacement

**Purpose**
We sought to further delineate the impact of calcium volume and distribution on aortic root injury using a new method of detailed quantitative calcium analysis.

**Method and Materials**
33 patients from 16 centers experiencing aortic root injury were compared to consecutive control of 156 patients without root injury. Quantitative calcium analysis using patient-specific calcium detection thresholds and detailed 3-dimensional regional analysis on contrast-enhanced pre-TAVR MDCT scans was performed. Calcium quantified volumetrically in relation to the three aortic cusps in three regions: 1) aortic valve/sinus of Valsalva calcium (from the aortic annulus to the left coronary ostia), 2) overall left ventricular outflow tract (LVOT) calcium (from the aortic annulus and 10 mm into the left ventricle) and 3) high LVOT/subannular calcium (from the aortic annulus and 2 mm into the left ventricle).

**Results**
Median (interquartile range) overall LVOT and high LVOT/subannular calcium volumes were higher in the rupture group 74 (5-326) mm³ vs. 4 (0-63) mm³ (p<0.0001), and 29 (3-66) mm³ vs. 0 (0-9) mm³ (p<0.0001). No difference between groups in aortic valve/sinus of Valsalva calcium volume, 848 (390-1138) mm³ vs. 546 (296-976) mm³ (p=0.09). High LVOT/subannular calcium volume was more predictive of aortic root injury than overall LVOT calcium volume, (AUC) of 0.78 (95% confidence interval [CI]: 0.70-0.87) vs. 0.71 (95% CI: 0.61-0.81) (p=0.002). Aortic valve/sinus of Valsalva calcium volume did not predict aortic root injury (AUC: 0.57; 95% CI: 0.48-0.70). High LVOT/subannular calcium underneath the non-coronary cusp was significantly more predictive of aortic root injury (AUC: 0.81; 95% CI: 0.72-0.90) compared to calcium underneath the right cusp (AUC: 0.67; 95% CI: 0.58-0.77; p=0.02), or the left cusp (AUC: 0.65; 95% CI: 0.55-0.75; p=0.02). Prosthesis oversizing >20% (likelihood ratio test p=0.048) and redilatation (likelihood ratio test p=0.009) significantly improved prediction of root injury by high LVOT/subannular calcium.

**Conclusion**
High LVOT/subannular calcium volume, particularly located below the non-coronary cusp, is more predictive of aortic root rupture than overall LVOT calcium. Prosthesis oversizing >20% and redilatation augments the impact of high LVOT/subannular calcium on the risk of root injury.

**Clinical Relevance/Application**
These findings may help identify patients at risk of aortic root injury during balloon-expandable TAVR.
CONCLUSION
Optimal clinical performance of CoreValve and SAPIEN XT appears to be reached with different degrees of device oversizing. An individualized-device-approach during TAVR, utilizing a specific device for a specific annulus size, enabling favorable degree of oversizing, may improve clinical outcomes. This approach should be further validated in future trials.

CLINICAL RELEVANCE/APPLICATION
An individualized-device-approach during TAVR, utilizing a specific device for a specific annulus size, enabling favorable degree of oversizing, may improve clinical outcomes.

SSG02-03
Effect of Annular Calcification on Area and Perimeter Measurements in Systole and Diastole: Implications for Device Sizing

PURPOSE
CT based sizing has been shown to reduce paravalvular leak following transcatheter aortic valve replacement (TAVR). However there is conflicting data on the extent of annular dynamism throughout the cardiac cycle. The objective of the current study is to assess the degree of variability of aortic annular measurements in systole and diastole using MDCT and to evaluate the impact on device sizing.

METHOD AND MATERIALS
In this retrospective, multicenter analysis, ECG-gated retrospective CT data of 357 patients were analyzed. Aortic annulus dimensions were assessed on systolic and diastolic reconstructions by planimetry and using a smoothing algorithm not previously described, yielding values for both area and perimeter. Extent of annular calcification was graded using a semi-quantitative 4-point scale (0-3). Hypothetic device sizing was performed by area and perimeter.

RESULTS
There was an overall significant difference between systolic and diastolic reconstructions in both perimeter and area measurements (perimeter 3.52%, p<0.0001; area 7.98%, p > 0.0001), however these measurements lost statistical significance with increasing LVOT calcification (grade 2 and 3 LVOT calcium for both perimeter and area). Diastolic measurements would result in a smaller valve in 82 cases by area and 78 by perimeter with one perimeter case which diastole would recommend a larger valve using Vancouver guidelines for area and Kasel for perimeter.

CONCLUSION
Annular dimensions are subject to dynamic changes throughout the cardiac cycle, resulting in changes to the cross-sectional area, perimeter and subsequently derived diameters. This has implications for accurate valve sizing. The dynamic changes become less significant with increasing calcium burden in the LVOT.

CLINICAL RELEVANCE/APPLICATION
Clinically significant changes in both annular area and perimeter are seen between systolic and diastolic phase cardiac CT imaging acquisitions. Utilisation of diastolic phase images for either perimeter or area derived measurements would result in a change of valve size in a substantial number of patients which could result in increased complications. The change in measured valve parameters appears less significant with increasing LVOT calcification.

SSG02-04
Underestimation of Effective Aortic Orifice Area after TAVR due to LVOT Ellipticity – Impact on Patient-prosthesis Mismatch Classification
PURPOSE
To define the influence of left ventricular outflow tract (LVOT) geometry on calculation of the effective orifice area (eOA) and classification of patient-prosthesis mismatch (PPM) after transcatheter aortic valve replacement (TAVR).

METHOD AND MATERIALS
86 patients (52 male, mean age 82.1±7.6 years, mean BSA 1.9±0.22) status post TAVR underwent both transthoracic echocardiography and contrast enhanced cardiac computed tomography. LVOT dimensions were assessed by means of planimetry on systolic CT reconstructions with subsequent calculation of an area-derived LVOT diameter. EOA was calculated according to the continuity equation, based on transaortic measurements by continuous-wave Doppler and LVOT measurements obtained by pulsed-wave Doppler (EOATTE). In addition, a modified EOA was calculated using the area-based LVOT diameter by CT (EOACT). Moderate and severe PPM were defined as an indexed EOA (iEOA) 0.85 cm²/m² and 0.65 cm²/m², respectively. Postprocedural aortic valve area (AVA) was assessed by TEE planimetry.

RESULTS
Mean LVOT diameters were 2.4±0.3mm by TTE and 2.0±0.2mm by CT (p<0.001). Mean EOATTE was significantly lower (1.7±0.4cm²) than EOACT (2.4±0.7cm², p<0.001). By iEOATTE, 20 patients (29%) were graded as moderate PPM and 4 (6%) as severe PPM. By iEOACT, PPM grade was reclassified in 21 patients, with 4 patients (6%) graded as moderate PPM and no patients (0%) graded as severe PPM. Postprocedural AVA was significantly higher than EOATTE (p<0.001) but similar to EOACT (p=n.s.).

CONCLUSION
LVOT ellipticity and subsequent underestimation of true LVOT dimensions by TTE results in lower calculated eOA values and high frequencies of estimated PPM after TAVR. Cardiac computed tomography allows for individual correction of the calculated eOA and reclassification of the PPM grade.

CLINICAL RELEVANCE/APPLICATION
Information provided by cardiac computed tomography can be used for individual correction of the calculated eOA and reclassification of the PPM grade.

SSG02-05
Low kV MDCT Angiography for Transcatheter Aortic Valve Implantation (TAVI) Planning: Image Quality and Radiation Dose Exposure

Fabrizio Del Buono MD : Nothing to Disclose , Davide Ippolito MD : Nothing to Disclose , Cammillo Roberto Giovanni Leopoldo Talei Franzesi : Nothing to Disclose , Pietro Andrea Bonaffini MD : Nothing to Disclose , Davide Fior MD (Presenter): Nothing to Disclose , Sandro Sironi MD : Nothing to Disclose

PURPOSE
To evaluate image quality and radiation dose exposure of low-kV (100KV) CT angiography (CTA) in patients candidate to Transcatheter Aortic Heart Valve Implantation (TAVI), in comparison with standard CT angiography protocol.

METHOD AND MATERIALS
A total of 49 patients (18 males; mean age 83.8 years, range 78-90 years), candidate for TAVI, were prospectively enrolled in this study and examined with 256-row scanner (iCT, Philips) with 80mL of iso-osmolar contrast medium volume (350mgI/mL). Twenty-eight patients (group A; 8 males;mean age 83.6 years,range 78-89 years) were evaluated using low-KV (100kV) retrospective ECG-gated protocol, with automated tube current modulation, while 21 patients (group B; 10 male;mean age 84.3 years,range 81-90 years) underwent a standard CTA study (120kV;retrospective ECG-gated protocol;automated tube current modulation). Overall image quality was evaluated using a 4-point scale (4 excellent, 3 good, 2 acceptable, 1 low). Vascular enhancement(HU) was then assessed in each patient by manually drawing on axial arterial images multiple regions of interest (ROIs) in lumen of aortic root, ascending aorta, arch, descending and abdominal aorta, common and external iliac arteries. The radiation dose exposure of both groups, in terms of dose-length product (DLP, mGy*cm), was calculated and all data were compared and statistically analyzed.

RESULTS
On low-kV protocol significant higher mean attenuation values were achieved in all the measurements (aortic root 347±19.78 HU; external iliac arteries 305±18.36 HU) as compared to the standard kV protocol (aortic root 269±23.91 HU; external iliac arteries 226±11.64 HU). There were no significant differences in the image quality evaluation in both groups (groupA 3.7 vs groupB 3.8). Mean DLP of groupA was significantly lower (mean DLP 1600mGy*cm) than in groupB (mean DLP 2044mGy*cm), with an overall radiation dose reduction of 22%.

CONCLUSION
Low-kV CTA protocol permits to correctly perform TAVI planning with high quality images and significant reduction of radiation dose exposure, as compared to standard CTA protocol.

CLINICAL RELEVANCE/APPLICATION
SSG02-06  Computed Tomography Evaluation of Subvalvular Soft Tissue in Patients Who underwent Valve Replacement Surgery during Immediate Postoperative Period

Sangik Park MD (Presenter): Nothing to Disclose, Dong Hyun Yang MD: Nothing to Disclose, Joon-Won Kang MD: Nothing to Disclose, Tae-Hwan Lim MD, PhD: Nothing to Disclose

PURPOSE

Subvalvular soft tissue (pannus) formation has been known to be a cause of high transvalvular gradient and necessitate reoperation of valvular replacement. There was lack of data regarding the prevalence of subvalvular pannus during immediate postoperative period. This study aimed to evaluate prevalence and hemodynamic significance of subvalvular pannus in computed tomography (CT) during immediate postoperative period in patients who underwent valve replacement surgery.

METHOD AND MATERIALS

During two years, 1057 patients underwent cardiac valve replacement surgery. Among them 203 patients (mean age, 58; 131 men) underwent ECG-gated cardiac CT within 30 days from operation (aortic valve=180, mitral valve=26, tricuspid valve=3, pulmonary valve=1). Presence of subvalvular pannus was evaluated using multiphase cardiac CT images in dedicated workstation. Hemodynamic parameters such as transvalvular pressure gradient and peak velocity of transaortic flow were evaluated using echocardiography and compared them between patient with and without pannus formation. Valve type- and size-matched comparison between pannus and non-pannus groups were done to evaluate the hemodynamic significances of pannus. Geometric profiles of mechanical valves including diameter of valve and opening angle were evaluated.

RESULTS

Subvalvular pannus was identified in 31 of the 210 valves (14.8%). Among them, 30 were in the aortic location, while the other one was in the mitral location. The mean length, maximal thickness, and involvement angle of pannus were 11.3 mm ± 4.4, 3.1 mm ± 1.2, and 54.8° ± 19.3, respectively. Echocardiographic measurements of peak velocity (pannus group vs. non-pannus group, 2.4 m/s vs. 2.3 m/s, p=0.665), maximum pressure gradient (24.0 mmHg vs. 22.7 mmHg, p=0.5297), and mean pressure gradient (12.6 mmHg vs. 11.9 mmHg, p=0.4671) across the prosthetic aortic valve did not show a significant difference statistically.

CONCLUSION

Even in immediate postoperative period, subvalvular pannus was not uncommon in this retrospective study group. However, the extent of subvalvular pannus seemed to be small as compared with results of previous study. Patients with subvalvular pannus during immediate postoperative group showed insignificant hemodynamic parameters on echocardiography as compared with non-pannus group.

CLINICAL RELEVANCE/APPLICATION

Cardiac CT was feasible method to demonstrate subvalvular pannus in patients with prosthetic cardiac valve.

SSG02-07  Clinical Impact of Valsalva Sinus Distensibility in Aortic Stenosis: Quantification by 256-slice Coronary CT Angiography

Yamato Shimomiya (Presenter): Nothing to Disclose, Michinobu Nagao MD: Research Grant, Bayer AG Research Grant, Koninklijke Philips NV, Satoshi Kawanami MD: Research Grant, Koninklijke Philips NV, Masato Yonezawa: Nothing to Disclose, Yuzo Yamasaki MD: Nothing to Disclose, Hiroshi Honda MD: Nothing to Disclose, Shinya Takarabe RT: Nothing to Disclose, Masatoshi Kondo: Nothing to Disclose, Hiroshi Hamasaki: Nothing to Disclose, Takashi Shirasaka BS: Nothing to Disclose, Masayuki Tachibana: Nothing to Disclose, Yasuhiro Nakamura RT: Nothing to Disclose

PURPOSE

When treating aortic stenosis (AS), accurate aortic valve area (AVA) measurement is critical for appropriate patient selection and successful transcatheter aortic valve implantation. CT could detail the AVA shape and length, but it is limited by motion and calcification artifacts. Therefore, we propose a new objective index to determine the AS severity.

METHOD AND MATERIALS

A total 33 patients (mean age, 78 years) diagnosed with AS who underwent surgical aortic valve replacement and ECG-gated 256-slice coronary CT angiography and echocardiography were retrospectively reviewed. In addition, 12 patients (mean age, 65 years) with no cardiac disease history or coronary stenosis on CT were enrolled as controls. The valsalva sinus distensibility (VD) index was defined the ratio between the Valsalva sinus area (mm2) and the minor axis of aortic annulus (mm) at end-systole using multiplanar reconstructed CT. The volume of valve caps measuring >800 Hounsfield units was designated as the calcium volume (mm3) at end-diastole. Severe AS was defined as an AVA <0.75 mm2.

RESULTS

The VD index was significantly lower in the AS patients than in the controls (34 ± 6 vs. 41 ± 4, p = 0.0005). ROC analysis revealed a 39 optimal VD index for identifying AS patients with a 0.85 C-statistics, 79% sensitivity, and 93% specificity. In 33 patients with AS, the VD index was significantly lower in patients with an AVA <75 mm2 than those with an AVA >75 mm2 (31 ± 5 vs. 37 ± 7, p < 0.05). ROC analysis identified a 34 optimal VD index for identifying AS patients with an AVA < 75 mm2, 0.75 C-statistics, 78%
sensitivity, and 70% specificity.

**CONCLUSION**

Decreased Valsalva sinus distensibility is a characteristic feature of AS. The VD index may enable an accurate assessment of aortic stenosis in calcified valve caps.

**CLINICAL RELEVANCE/APPLICATION**

Valsalva sinus distensibility is an objective measurement for AS severity and is useful in therapeutic planning of transcatheter aortic valve implantation.

**Accuracy of Semi Automated Workflow in Reconstruction of CT Angiography prior to Transcatheter Aortic Valve Implantation**

**PURPOSE**

To evaluate the accuracy of semi-automated reconstruction workflow in the evaluation of CT-angiography of patients candidate to Transcatheter Aortic Valve Implant (TAVI) in comparison with manual reconstruction performed by an experienced radiologist.

**METHOD AND MATERIALS**

We retrospectively evaluated the whole body CT-angiography of 35 consecutive patients who underwent TAVI procedure comparing the manual measures of aortic root and peripheral vessels with the measures obtained with a semi automated workflow provided on a off line workstation (iNtuition, Terarecon Inc. Santa Clara USA). The reconstruction time within the two groups was registered.

**RESULTS**

A good correlation between the two methods (P > 0.05) was observed. The reconstruction time was significantly lower (P < 0.05) with the automated workflow.

**CONCLUSION**

The semi-automated reconstruction workflow for TAVI patients is accurate and reliable and simplify a complex procedure in easy small steps, significantly reducing the post processing time.

**CLINICAL RELEVANCE/APPLICATION**

The semi automated reconstruction workflow allows to optimize the clinical management of the TAVI patients, reducing the post processing complexity and the reconstruction time.

**Use of Computed Tomographic Angiography to Determine Extent of Danger Zone for Phrenic Nerve Injury during Left Atrial Ablation Therapy**

**PURPOSE**

A complication of left atrial ablation therapy for atrial fibrillation is injury to the right phrenic nerve (RPN). The location of the RPN is estimated during the ablation procedure by attempted electrical excitation of the RPN from multiple locations inside the left atrium. Locations where excitations are captured by the RPN are assumed to be in close proximity to the path of the RPN. This determines a danger zone where ablation lesions are at risk of causing RPN injury. The purpose of this project is to determine the size of this danger zone from Computed Tomographic Angiography (CTA) datasets.

**METHOD AND MATERIALS**

In 19 consecutive patients undergoing left atrial ablation therapy, the path of the RPN was estimated by electrical excitation of the RPN at 10mA and 50mA from different points at the endocardial surface the left atrium. Palpation of diaphragm contraction was used to determine whether there was capture or non-capture of the excitation by the RPN. After the procedure, the 3D path of the RPN was identified and segmented from CTA datasets using either visualization of the RPN or the right pericardiophrenic artery. The segmented RPN was then merged with the cardiac ablation dataset, and minimal distance of each electrical excitation site to the path of the RPN was determined and correlated with capture or non-capture of each electrical excitation by the RPN.

**RESULTS**

The mean distance between the RPN and the electrical excitation sites at 50mA was 15.5 ± 5.9mm for captured sites vs. 19.0 ± 7.2mm for non-capture sites (p

**CONCLUSION**

There is good correlation between minimal distance between the left atrial electrical excitation site and the RPN and capture versus non-capture of the electrical excitation by the RPN. This data helps determine the size of the danger zone around the path of the RPN where ablation lesions at different intensities are at risk of affecting the RPN and causing possible injury.

**CLINICAL RELEVANCE/APPLICATION**

CTA is often performed before ablation therapy to assess pulmonary vein anatomy. In addition, radiologists can
also identify the path of the RPN from CTA datasets, and use this information to describe the extent of a danger zone around which ablation lesions could injure the RPN.

Reproducibility and Detectability of the Coronary Artery Calcium Score using Thinner Slices and Iterative Reconstruction at 320-detector CT (Station #1)

Chikako Fujioka RT (Presenter): Nothing to Disclose, Yoshinori Funama PhD: Nothing to Disclose, Kazushi Yokomachi RT: Nothing to Disclose, Masao Kiguchi RT: Nothing to Disclose, Fuminari Tatsugami: Nothing to Disclose, Kazuo Awai MD: Research Grant, Toshiba Corporation Research Grant, Hitachi Ltd Research Grant, Bayer AG Research Consultant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd, Minoru Ishifuro: Nothing to Disclose

PURPOSE

While 3.0-mm-thick slices are commonly used for calcium scoring at cardiac CT, the results vary widely and small calcium deposits can go undetected due to the partial volume effect. Using thinner slices reduces this effect but increases the image noise. Positing that the use of 0.5-mm-thick slices and adaptive iterative reconstruction (IR) reduces both the image noise and the partial volume effect and yields reproducible calcium scores at cardiac CT, we compared results obtained with 3.0-mm-thick slices and with 0.5-mm-thick-slices plus IR.

METHOD AND MATERIALS

We scanned a cardiac CT calibration phantom (QRM, Germany) that featured different calcium hydroxyapatite concentrations on a 320-detector CT scanner (Aquilion One, Toshiba) with prospective ECG-triggering. We scanned the phantom 5 times and reconstituted images from same-row data. We applied 4 IR strength levels (weak, mild, standard, and strong; adaptive iterative dose reduction 3D: AIDR-3D; Toshiba) to the images of 0.5-mm-thick slices, calculated the Agatston scores on a workstation, and compared the variation coefficients to evaluate reproducibility and calcium detectability among the scans.

RESULTS

The average Agatston score for 3.0- and 0.5-mm slices without a filter was 808 and 768; it was 749, 724, 714, and 721 for 0.5 mm slices with weak, mild, standard, and strong IR, respectively. The total mean variation coefficient of the Agatston score for 3.0- and 0.5 mm slices without IR was 5.4 and 2.9; for 0.5 mm slices with weak, mild, standard, and strong IR it was 3.6, 2.1, 2.2, and 2.5%. The detection efficiency for small calcium deposits on 3.0- and 0.5-mm slices without a filter was 53- and 100%; for 0.5-mm slices with weak, mild, standard, and strong IR it was 100-, 100-, 100-, and 83%.

CONCLUSION

Using 0.5 mm-thick slices and IR reduced variations and improved detection for calcium scoring at cardiac CT.

CLINICAL RELEVANCE/APPLICATION

The use of 0.5-mm thick-slices and iterative reconstruction yielded higher reproducibility and calcium detectability for coronary artery calcium scoring without an increase in the radiation dose.
PURPOSE
Recent studies report decreased procedural success in ablation therapy of atrial fibrillation (AF) when cryoballoon ablation is applied to pulmonary vein (PV) ostia with an overly non-circular, oval shape. We used cardiac CT data of a large patient cohort to evaluate whether this also holds true for an approach using wide circumferential radiofrequency ablation (WACA).

METHOD AND MATERIALS
We evaluated data of 260 patients with AF who had undergone WACA. All patients routinely underwent 30 day holter-ECG to assess procedural success as well as cardiac dual-source CT to exclude post-procedural complications. PV measurements were performed in a plane perpendicular to the center-line of each PV at 10mm from the junction of the PV and the left atrium. The ovality index was calculated for all PVs and was defined as follows: 2x (maximal diameter-minimal diameter)/(maximal diameter+minimal diameter).

RESULTS
The minimal index of ovality in patients with AF recurrence was 0.20±0.10 for the left superior PV (LSPV), 0.23±0.14 for the left inferior PV (LIPV), 0.19±0.10 for the right superior PV (RSPV), and 0.17±0.10 for the right inferior PV (RIPV). In successfully treated patients without recurrence of AF the minimal ovality index was 0.20±0.16 for LSPV, 0.27±0.16 for LIPV, 0.19±0.11 for RSPV, and 0.18±0.12 for RIPV. The maximal index of ovality was 0.43±0.19 for LSPV, 0.47±0.20 for LIPV, 0.40±0.15 for RSPV, and 0.41±0.15 for RIPV for patients with no AF recurrence. For patients with recurrence of AF the maximal ovality index was 0.43±0.14 for LSPV, 0.45±0.17 for LIPV, 0.40±0.14 for RSPV, and 0.42±0.17 for RIPV. There were no significant differences in the minimal or maximal ovality indices between the two patient groups (p>0.05).

CONCLUSION
While previous studies have described an important impact of PV ovality on clinical outcome after cryoballoon ablation, we did not find a significant influence of the PV ovality index on ablation success when using WACA as the ablation strategy. Accordingly, the ovality index may aid in selecting the most promising ablation technique for the individual patient’s anatomy.

CLINICAL RELEVANCE/APPLICATION
Pre-procedural assessment of the PV ovality index might serve to guide the selection of an individualized ablation approach that maximizes the chances for therapeutic success.

CAS200

Determination of Myocardial Triglyceride Content in Patients with Fabry Disease: A 3T 1H-Magnetic Resonance Spectroscopy Study (Station #3)

Bernhard Petritsch (Presenter): Nothing to Disclose, Andreas Max Weng : Nothing to Disclose, Tobias Gassenmaier MD : Nothing to Disclose, Julian Donhauser MD : Nothing to Disclose, Tobias Gassenmaier MD : Nothing to Disclose, Meinrad Johannes Beer MD : Research Consultant, Shire plc, Herbert Koessler PhD : Research support, Siemens AG, Dietbert Hahn MD : Nothing to Disclose, Thorsten Alexander Bley MD : Nothing to Disclose, Michael Horn : Nothing to Disclose

PURPOSE
In Fabry disease progressive deposition of sphingolipids in different organs has been reported. High-field 1H-MR-spectroscopy (MRS) allows non-invasive determination of myocardial lipid content. This study investigates the role of myocardial steatosis in the complex pathomechanism of Fabry cardiomyopathy.

METHOD AND MATERIALS
In 30 patients (18 female, 12 male; 39 ± 13 years [range 17-61 years]) with genetically proven Fabry disease, myocardial triglycerides were quantified by 1H MRS (respiratory motion compensated, ECG triggered) in vivo using a 3 T scanner (Magnetom TRIO, Siemens Sector HealthCare, Germany). Single-voxel-spectroscopy was performed with and without water suppression. The voxel was positioned in the interventricular septum using a four-chamber and short-axis orientation at end systole to avoid signal contamination by epicardial fat. Two triglyceride peaks were measured (methylene groups at 1.3 ppm, methyl groups at 0.9 ppm) relative to the resonance from tissue water at 4.7 ppm. The myocardial lipid content was expressed as triglycerides-to-water ratio (%). In addition left ventricular (LV) mass and ejection fraction (EF) were assessed by MRI. 30 healthy volunteers without a history of cardiac or metabolic disease served as control group.

RESULTS
In all patients 1H spectra were successfully acquired. In Fabry patients the mean triglyceride-to-water ratio was 1.24% (min. 0.1%; max. 6.2%). The control group showed a significantly decreased lower (p=0.01) triglyceride-to-water ratio of 0.46% (min. 0.1%; max. 2.0%). Compared to healthy controls, LV mass (mean ± standard deviation; 127 ± 27 g) tended to be higher in Fabry patients (156 ± 66.5 g) (p<0.05). Mean EF was similar in both groups (65 % in Fabry patients vs. 63 % in controls).

CONCLUSION
High-field 1H-MR-spectroscopy using 3T scanners allows non-invasive assessment of myocardial lipid content in Fabry patients. In this patient collective we observed a significantly elevated myocardial triglyceride content. This finding warrants further studies with larger patient groups, especially concerning sub-group analysis of LE positive and negative Fabry patients.

CLINICAL RELEVANCE/APPLICATION
Besides data regarding functional and morphological alterations MRS delivers new insights into myocardial lipid metabolism in Fabry patients. This circumstance might help to further optimize the therapy for this rare disease.

**CAS201**

**Does New Image Enhancement Technology Provide a Substantial Radiation Dose Reduction for Patients in Percutaneous Coronary Interventional Procedures? (Station #4)**

Amber J. Gislason-Lee MSc (Presenter): Research funded, Koninklijke Philips NV, Claire Keeble MSc: Nothing to Disclose, Michael Lupton: Nothing to Disclose, David Barmby: Nothing to Disclose, Andrew Graham Davies MSc: Philips Healthcare, the Netherlands

**PURPOSE**

Recent releases of interventional X-ray equipment have seen innovations in image processing employed by manufacturers to reduce patient dose in applications such as vascular imaging. Philips’ ClarityIQ combines anatomy-specific X-ray optimization with real-time image noise reduction algorithms to reduce patient dose in interventional cardiac imaging. A Clarity system was recently installed in our local cardiac catheterization laboratories; the aim of this study was to investigate whether the Clarity system reduced patient procedure dose (yet not increase procedure duration) in percutaneous coronary interventions (PCI).

**METHOD AND MATERIALS**

Previously collected patient dose data from the cardiac catheterisation labs was analysed by a statistician; sample size calculations showed that a minimum of 100 patients from each of two labs would be required for comparison. Patient procedure details were recorded for 130 PCI patients from the Clarity lab and 140 PCI patients from a Philips Xper (previous generation) lab in the same cardiology department. The Wilcoxon statistical test, which does not require equal numbers in each group, was used to compare median values from the two interventional X-ray systems.

**RESULTS**

The medians of total patient procedure dose were 2181 and 6060 cGy cm² from the Clarity and Xper systems respectively. Clarity median total patient doses were 1354 cGy cm² from fluoroscopy and 827 cGy cm² from digital image acquisition. Xper median total patient doses were 2734 cGy cm² from fluoroscopy and 3327 cGy cm² from acquisition. The Wilcoxon test showed strong statistical significance in these differences in total patient dose, at the 5% significance level (p << 0.001 in all cases). The median total fluoroscopy time [min:sec] was 12:39 for the Clarity system and 11:47 for the Xper system.

**CONCLUSION**

The total patient procedure dose for PCI patients was 64% lower in the Clarity cardiac catherization lab than the Xper lab. Corresponding differences in total digital image acquisition and fluoroscopy doses were 50% and 75%. There was no statistically significant difference in total fluoroscopy time between the two labs.

**CLINICAL RELEVANCE/APPLICATION**

Substantial radiation dose savings can be realised for high dose cardiac interventional procedures by using state of the art X-ray equipment with innovative image processing; routine patient procedure data was used.

**CAS202**

**Detection of Coronary Artery Anomaly in Patients with Complex Congenital Heart Disease by Dual-source CT (Station #5)**

Zhaoping Cheng MD (Presenter): Nothing to Disclose, Ximing Wang PhD: Nothing to Disclose

**PURPOSE**

To explore the clinical usefulness of coronary artery anomaly (CAA) in patients with complex congenital heart disease (CHD) by low-dose dual-source CT (DSCT) angiography.

**METHOD AND MATERIALS**

We reviewed 615 consecutive patients with complex CHD who underwent DSCT angiography (CTA) from 2008 to 2012. According to the ultrasonic results, a total of 312 patients (age range 0.9-33yrs; male 170) with tetralogy of Fallot or double outlet right ventricle or pulmonary artery atresia were retrospectively included. Scans were divided by acquisition mode into 3 groups: retrospective electrocardiogram (ECG)-triggered spiral, prospective ECG-triggered, and prospective ECG-triggered high-pitch spiral scans. The subjective image quality was evaluated on a four-point scale by two radiologists. Radiation dose values were calculated. Interobserver agreement in subjective image quality grading was assessed by using kappa statistics. The scan groups were compared with the use of the Kruskal-Wallis test. A P value < 0.05 was considered statistically significant.

**RESULTS**

The incidence of CAA was 8%(25/312). CAA was involved in 8%(14/176)patients with tetralogy of Fallot, 8.3%(67/72)patients with double outlet right ventricle, 7.8%(564)patients with pulmonary artery atresia. Thirty of 312 studies were nondiagnostic (9.6%). In 76%(1925)of the patients, the anomalous vessels were crossing the right ventricular outflow tract (RVOT). The average subjective image quality score was 2.9±0.9 (1-4). The score in high-pitch group was significantly lower than that in another two groups. Two radiologists made good agreement (k=0.72). Retrospective ECG-triggered scans had a median dose of 1.45 mSv, prospectively ECG-triggered scans had a median dose of 0.69 mSv, and prospectively ECG-triggered high-pitch spiral scans had a median effective dose of 0.35 mSv. The difference between groups was statistically significant (P
CONCLUSION
DSCT angiography is a reliable diagnostic method for the assessment of CAA with complex CHD; in contrast, low-dose prospectively ECG-triggered DSCT scans are the best choice.

CLINICAL RELEVANCE/APPLICATION
The course and origin of coronary arteries can be reliably assessed in children by using DSCT angiography imaging to shorten or avoid invasive coronary artery imaging in the catheterization laboratory.

Cawi 203
Influence of Cardiac Motion on Stent Visualization in Third Generation Dual-source CT: In Vitro Evaluation of 13 Coronary Stents in a Pulsating Phantom Heart Model (Station #6)

PURPOSE
To evaluate the influence of cardiac motion during coronary CT angiography on coronary stent visualization in a third generation dual-source CT scanner.

METHOD AND MATERIALS
13 coronary stents (diameter 3.0 mm) were implanted in plastic tubes filled with contrast (density 350 HU) and attached to a phantom heart model. This phantom model was an elastic, contrast filled, anatomic heart model made of silicone, driven by a pump for pulsatile flow, resulting in alternating expansion and contraction of the phantom, comparable to a beating heart in humans. The phantom’s expansion rate was 74/min and an ECG simulator was connected to the scanner for a corresponding ECG signal. Scans were performed in an orientation parallel to the scanner’s z-axis and acquired in a retrospectively ECG-gated cardiac spiral (collimation 96x0.6 mm, tube voltage 120 kVp, 340 mAs tube current). Evaluation was performed using a medium-sharp (Bv49) convolution kernel optimized for vascular imaging at a static phase at maximum expansion, and at maximum motion, defined as midway between maximum expansion and contraction. Axial reformations of all stents were used for evaluation (window width 1500 HU, center 300 HU).

RESULTS
Mean visible stent lumen was significantly higher in the static phase of the phantom model with 65.6 ± 5.7 % (range: 54.4 - 76.7%) compared to 60.8 ± 4.4% (range: 51.1 - 66.7%) at maximum motion (p < 0.001). Mean in-stent attenuation was 346 ± 29 HU (range: 311 - 405 HU) in the static phase and 397 ± 66 HU (range 268 - 549 HU) at maximum motion. This difference with more realistic, i.e. closer to the actual contrast density of 350 HU, attenuation values in the static phase also proved to be significant (p = 0.004). Attenuation in the un-stented tube did not differ between standstill and motion (p = 0.48).

CONCLUSION
Stent lumen visualization is still impaired by cardiac motion in third generation dual-source CT scanners, but visible lumen diameter is only mildly affected and remains at an acceptable level in this in vitro setting. CTA may therefore be a valid method for detecting in-stent restenosis even in patients with higher heart rate or arrhythmia.

CLINICAL RELEVANCE/APPLICATION
Motion artifacts are a challenge in coronary CT angiography. Increased temporal resolution of upcoming CT scanners may allow sufficient evaluation of coronary stents even during cardiac motion phases.

CAE 150
Magnetic Resonance Imaging of the Papillary Muscles: Normal Anatomy, Variants and Abnormalities (Station #7)
Nicholas L. Fulton MD: Nothing to Disclose, Prabhakar Rajiah MD, FRCR (Presenter): Institutional Research Grant, Koninklijke Philips NV

TEACHING POINTS
1. To understand the anatomy and variations of papillary muscles 2. To discuss the role of MRI in the evaluation of papillary muscle abnormalities 3. To illustrate the several abnormalities that is seen in papillary muscles. 4. To understand the significance of papillary muscle anatomy in hypertrophic cardiomyopathy, LV partitioning device placement, etc.

TABLE OF CONTENTS/OUTLINE
• Papillary muscle anatomy- vascular supply • Anatomical variants of papillary muscle- Accessory muscles • Role of CT/MRI in evaluation (Cine imaging, delayed enhancement, tagging, perfusion) • Description and illustration of the following abnormalities Parachute mitral valve, parachute like asymmetric mitral valve Shone complex Hypertrophic cardiomyopathy LVOT obstruction by papillary muscle Anomalous insertion, apical displacement, Hypermobile muscle Papillary muscle dysfunction Infarction Rupture Mitral incompetence due to papillary abnormalities Calcification Benign Neoplastic masses- Fibroelastoma, myxoma, rhabdomyoma Malignant neoplastic masses- Metastases, sarcoma, lymphoma Non neoplastic masses- Thrombus Accessory muscle mimicking thrombus Anatomy for LV partitioning device.

CAE 121
Surgical Management of Anomalous Origin of Coronary Artery from the Opposite Sinus: What Every Surgeon Should Know before Operating on a Coronary Anomaly—The Role of Cardiac Radiologist (Station #8)
TEACHING POINTS

Patients with a coronary artery arising from the wrong sinus are susceptible to ischemia and sudden death. Surgical correction is indicated in all patients with coronary insufficienty and in asymptomatic patients with high-risk morphologic abnormalities. ECG-gated multidetector row computed tomography is superior to conventional angiography in delineating the ostial origin and proximal path of an anomalous coronary artery and detects atherosclerotic disease coexisting with the anomaly. The purpose of this exhibit is: -to describe the diagnostic clues to detect the anomalies of high risk: interarterial course, intramural course, slit-like ostium and angulation abnormalities and severe atherosclerotic disease coexisting with the anomaly. -to provide a morphology-based surgical management protocol.

TABLE OF CONTENTS/OUTLINE

1. Classification of the course of anomalous coronary artery arising from wrong sinus. 2. Diagnostic clues to detect the anomalies of high risk: interarterial course, intramural course, slit-like ostium and angulation abnormalities and severe atherosclerotic disease coexisting with the anomaly. 3. Surgical procedures including coronary artery reimplantation, pulmonary translocation, bypass grafting, unroofing and fenestration, and 4. Morphology-based surgical management protocol.

Cardiac/Thoracic MRI in Patients with Implantable Cardiac Devices: What the Radiologist Needs to Know (hardcopy backboard)

William McGarry MD (Presenter): Nothing to Disclose, Jeremy Douglas Collins MD: Consultant, B. Braun Melsungen AG

TEACHING POINTS

The purpose of this exhibit is to review imaging considerations for cardiac/thoracic MRI in patients with implanted cardiac devices. The safety of cardiac/thoracic MRI in these patients, absolute contraindications, and techniques to improve image quality will be covered through a review of the relevant literature and the experience at our institution.

TABLE OF CONTENTS/OUTLINE

There is an increasing volume of information in the literature touting the safety of cardiac/thoracic MRI in patients with implanted cardiac devices. Although several FDA approved devices have been designated MR conditional, none of these are approved for imaging with the device in the isocenter of the magnet. Despite this, cardiac/thoracic MRI studies are being safely performed in many academic centers. This educational exhibit will cover three important aspects of cardiac/thoracic MRI in patients with implanted cardiac devices. First, the safety of imaging patients with these devices will be discussed with a review of the relevant radiology literature. Absolute and relative contraindications to cardiac/thoracic MRI in these patients will then be discussed. Techniques to improve image quality on these exams will be covered with a discussion of SAR considerations. Finally, we will review our institution's protocol for performing cardiac MRI/thoracic MRI.

Finding the Optimal Dose Reduction and Iterative Reconstruction Level for Coronary Calcium Scoring: A Within Patients Analysis (Station #1)

Martin J. Willemink MD (Presenter): Nothing to Disclose, Adriana Maria den Harder BSC: Nothing to Disclose, Wouter Foppen MD: Nothing to Disclose, Hendrik M. Nathoe MD, PhD: Nothing to Disclose, Pim A. De Jong MD, PhD: Nothing to Disclose, Ricardo P.J. Budde MD, PhD: Nothing to Disclose, Tim Leiner MD, PhD: Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group

PURPOSE

To find the maximally acceptable radiation dose reduction for accurate coronary calcium scoring (CCS).

METHOD AND MATERIALS

This prospective HIPAA compliant study was approved by our local institutional review board. Fifteen patients (9 men, mean age 56.8±6.8 years) underwent 4 calcium scoring computed tomography (CT) scans in a single session. Image acquisition was performed with a 256-slice CT system (iCT, Philips Healthcare) at routine, 40%-reduced, 60%-reduced and 80%-reduced doses. A fixed tube voltage of 120 kVp was applied and radiation dose was reduced by lowering tube current. Raw data were reconstructed with standard filtered back projection (FBP) and iterative reconstruction (IR, iDose4 levels 1, 4 and 7). Agatston scores were assessed with commercially available validated software (Heartbeat CS).
RESULTS
Effective dose values were 0.85±0.07, 0.51±0.04, 0.33±0.05, and 0.17±0.01 mSv, respectively. Routine dose acquisitions with FBP resulted in Agatston scores of 0 (N=3), 1-10 (N =4), 11-100 (N =5), 101-400 (N =2), and >400 (N =1). At 40%-reduced dose FBP acquisitions, 2 subjects (13.3%) were reclassified into higher categories with FBP and IR. 1 subject (6.7%) had false negative scores with IR levels 4 and 7. At 60%-reduced dose FBP acquisitions, 3 subjects (20%) were reclassified into higher risk categories and 1 subject (6.7%) had a false negative score. At this dose level, IR resulted in only 1 reclassification (6.7%) to a higher category and 3 reclassifications (20%) to lower categories, under which 2 false negatives. At 80%-reduced dose FBP acquisitions, 3 scans (20%) were not interpretable due to overwhelming noise artifacts and 6 scans (40%) were incorrectly reclassified. With IR, all scans were interpretable. IR levels 4 and 7 resulted in less reclassifications, 3 subjects (20%) were reclassified into lower categories including 2 false negatives (13.3%).

CONCLUSION
This within-patients analysis showed that 80%-reduced dose FBP resulted in non-interpretable scans or reclassifications in 60% of subjects, which decreased with IR to 20%. Therefore, CCS may be done at 0.17 mSv with medium to high IR levels. However, results should be validated in a larger population.

CLINICAL RELEVANCE/APPLICATION
Coronary calcium scoring at a radiation dose as low as 0.17 mSv may be possible with medium to high iterative reconstruction levels.

**CAS206**

**Correlation of Cardiac MRI Derived MAPSE, TAPSE, Ventricular Function and T2 Star in Children with Iron Overload (Station #3)**

Deepa Prasad MBBS, MD (Presenter): Nothing to Disclose, Anna Marie West BS : Nothing to Disclose, apurva bansal MBBS : Nothing to Disclose, Ravi Ashwath MD : Nothing to Disclose

**PURPOSE**

It has been well established that cardiac MRI (CMR) T2 Star (*) is a useful technique to evaluate myocardial iron concentration by the use of gradient echo. T2* has been shown to correlate well with left ventricular ejection fraction (LVEF) in these patients. Functional quantification of ventricles is time consuming. Echo derived mitral and tricuspid annular plane systolic excursion (MAPSE and TAPSE) are quick and easily reproducible parameters, which have been shown to be good surrogates of LV and RV function in adult patients. CMR derived MAPSE and TAPSE have not been studied sufficiently in the pediatric population. The purpose of this study is to demonstrate correlation between MAPSE, TAPSE, ventricular function and T2 * in children with myocardial iron overload.

**METHOD AND MATERIALS**

A retrospective study of 37 patients with transfusion dependent anemia was performed. LVEF and RVEF were obtained from short axis cine images utilizing 1.5 T CMR scanner. T2* was obtained by the use of single breath hold, multiecho acquisition with a constant TR. MAPSE and TAPSE were derived from cine images obtained from ventricular long axis views. All the above parameters were analyzed to assess correlation using Spearman's correlation, r >0.3 and P < 0.05 were considered significant.

**RESULTS**

A linear moderate positive correlation was noted between LVEF and MAPSE (r=0.42, P< 0.05). T2* showed linear positive correlation with LVEF (r=0.34, P<0.05) but no correlation with MAPSE. However, in the group with T2* <35 msec, there was a linear positive correlation noted between T2 star and MAPSE (R=0.34, P<0.05). There was no correlation between T2*, RVEF and TAPSE.

**CONCLUSION**

MAPSE correlates with T2*< 35 msec and LVEF, and it could prove to be a sufficient surrogate for LV function assessment and potentially replace the time consuming LVEF assessment by CMR in a selective group of children with iron overload.

**CLINICAL RELEVANCE/APPLICATION**

MAPSE correlates well with LVEF and can potentially replace the time consuming LVEF estimation by CMR in patients with iron overload.

**CAS207**

**The Role of Various Imaging Modalities in the Placement of AICDs in Patients with Low LVEF (Station #4)**

Raj Pulin Shah MD, MBA (Presenter): Nothing to Disclose, Electra Veson Kaloudis MD, MPH : Nothing to Disclose, Christopher Pickett MD : Nothing to Disclose

**PURPOSE**

In the setting of discordant LVEF data, a growing use of Cardiac MRI (CMR), and a lack of randomized control trial data using MRI to assess LVEF prior to ICD implants, we wish to assess patterns of clinical use of CMR and risk assessment before ICD placement.

**METHOD AND MATERIALS**
This study contained a survey, which addressed clinical guidelines and standard of care practices; American board-certified cardiologists our geographic area participated in the voluntary study, which took approximately 10 minutes to complete.

RESULTS

33 cardiologists participated in the survey; when given a clinical scenario of a hypertensive patient with ischemic cardiomyopathy, NYHA class II symptoms and disparate LVEF readings: 30% on echocardiogram, 35% on myocardial perfusion, and 45% on cardiac MRI, in other words, meeting criteria for ICD by echocardiogram and myocardial perfusion but not CMR, there was no consensus on appropriateness of ICD implant amongst our surveyed cardiologists. 42% stated that they would recommend ICD placement, and equal number said that they would not recommend an ICD. 15% would refer the patient to an electrophysiologist for further evaluation. When given the same scenario, but a non-ischemic cardiomyopathy, and disparate LVEF readings, our surveyed cardiologists became less likely to refer for ICD. 30% of cardiologists stated that they would recommend ICD placement, whereas 46% said that they would not. 15% would refer the patient to an electrophysiologist for evaluation, and 9% would further stratify risk.

CONCLUSION

In this group of surveyed cardiologists, although 97% most frequently used echocardiogram in their practices to assess LVEF (in patients with ischemic and non-ischemic cardiomyopathy), less than half chose to give weightage to its result when discrepant nuclear stress test and CMR results were available. Although there is no randomized control trial to support the use of MRI in assessing LVEF prior to the placement of ICD implants, clinicians are sometimes relying on its results. With a lack of consensus amongst practitioners on how to manage discrepant LVEF data, there is a potential for variable implementation of guideline-supported treatment with primary prevention ICDs.

CLINICAL RELEVANCE/APPLICATION

Baring consensus statement from governing societies on how to extrapolate CMR derived LVEF to vulnerable populations, we expect that this will continue to be an area of clinical uncertainty.

CAS208

Noncompaction Cardiomyopathy: Left Ventricular Systolic Dysfunction is not Correlated to Non-compacted Myocardium Extent on Cardiac Magnetic Resonance (Station #5)

Nicola Galea MD : Nothing to Disclose, Marco Francone MD : Speakers Bureau, Bracco nv, Valentina Sorrentino : Nothing to Disclose, Vincenzo Noce MD : Nothing to Disclose, Giovanni Barchetti : Nothing to Disclose, Giuseppe Cannavale MD : Nothing to Disclose, Iacopo Carbone MD (Presenter): Nothing to Disclose, Carlo Catalano MD : Nothing to Disclose

PURPOSE

Non-compaction cardiomyopathy (NCC) is characterized by uncompleted myocardial compaction. Our purpose was to correlate the morphological features of NCC with the impairment of left ventricular (LV) contractile function using Cardiac Magnetic Resonance (CMR).

METHOD AND MATERIALS

Fifteen patients with echocardiography diagnosis of NCC performed a CMR study using a 1.5T MR unit, cineMR b-SSFP and late enhancement (LE) sequences after Gadobenate dimeglumine administration. Compacted myocardial mass (CMM), non-compacted myocardial mass (NCMM), non-compacted to compacted myocardial mass ratio (NC/C mass ratio), non-compacted to compacted myocardial thickness ratio (NC/C ratio), number of affected LV segments (nNC) were analysed and correlated to left ventricular volumes, ejection fraction (EF), peak filling rate (PFR) and peak ejection rate (PER). Pearson correlation test was performed.

RESULTS

The mean values of NC/C mass ratio, NC/C ratio and number of affected segments were respectively 0.4, 2.6 and 9.9. No significant correlations were found between NC/C mass ratio both PER (p: 0.10), FE (p: 0.15) and PFR (p: 0.25), and between nNC and PER (p: 0.14). NC/C ratio showed no significant correlation with PER (p: 0.21), FE (p:0.54) and PFR (p: 0.17).

CONCLUSION

In NCC contractile dysfunction entity, expresed by reduction of PER and EF, is not directly related to the increase of NC/C ratio or with changes in NC/C mass ratio. Further index of structural abnormality should be considered to characterize disease severity.

CLINICAL RELEVANCE/APPLICATION

The current diagnostic criteria for “non-compaction cardiomyopathy” determine an overdiagnosis of this still poorly understood disease with an increasing alarm in subjects with one of the non-pathological anatomical variants. According to our results the increase of structural morphological alteration does not cause “per se” higher degree of functional impairment, therefore the diagnostic criteria should be further discussed.

CAS209

Quantification of Coronary Artery Stenosis with 320-Row CT Angiography in a Moving Heart Phantom: Comparison with Quantitative Coronary Angiography (Station #6)

Petra Kozma (Presenter): Nothing to Disclose, Marc Dewey MD : 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
Accuracy of computed tomography angiography (CTA) for coronary stenosis quantification has been reported to be poor when compared with the reference gold standard quantitative coronary angiography (QCA).

METHOD AND MATERIALS

A moving heart phantom with non-calcified coronary stenoses of different size (25, 50, and 75%) as well as different shapes (D-shaped, concentric, and eccentric) were imaged using 320-row CTA. Image acquisition parameters were: 80, 10, and 120 kVp with tube currents of 100, 250, and 500 mA. Reconstructions included both iterative reconstruction (IR) and standard FBP. The same vessels were examined using QCA (without simulated heart motion) in the projection showing the worst view of all stenoses as the reference standard.

RESULTS

CTA at 120 kVp, 100 kVp, 80 kVp and 500 mA, 250 mA and 100 mA showed very good agreement and correlation with QCA for coronary stenosis quantification. Tube current modulation did not have an overall significant effect on stenosis quantification with both reconstructions at all tube voltage levels (p>0.05, ANOVA). No significant difference was found between the limits of agreement comparing results with 120 kVp, 100 kVp and 80 kVp (p=0.05, F-test). Also no significant difference was found comparing the limits of agreement between IR and FBP with 120 kVp and 100 kVp (p=0.05 for both), with 80 kVp slightly narrower limits of agreement were shown with IR than with FBP (p=0.04). Through all stenoses no significant over- or underestimation was shown comparing manual stenosis quantification in CTA and QCA with both IR and FBP at 120 kVp, 100 kVp and 80 kVp (p>0.05 for all, t-test).

CONCLUSION

In a moving heart phantom, 320-row CTA had very good agreement with QCA for stenosis quantification. Additionally using IR with adjusted scan parameters can further reduce effective radiation dose and may even improve diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

These results indicate a potential clinical use of most recent generation CT scanners also for quantification of coronary stenosis and implicate the use of IR with adjusted scan parameters.

CAE142

"Bands, Chords, Tendons and Membranes in the Heart" (Station #7)

Ameya Jagadish Baxi MBBS, DMRD (Presenter): Nothing to Disclose, Carlos S. Restrepo MD: Nothing to Disclose, Daniel Vargas MD: Nothing to Disclose, Daniel Ocazionez MD: Nothing to Disclose, Horacio Murillo MD, PhD: Nothing to Disclose, Rashmi S. Katre: Nothing to Disclose, Sina Tavakoli MD: Nothing to Disclose, Cylen Javidan-Nejad MD: Nothing to Disclose

TEACHING POINTS

1. Study accessory bands within cardiac chambers and differentiate them from normal muscular bands, accessory chordae tendineae and papillary muscles
2. Discuss pathological bands and membranes affecting heart
3. Illustrate imaging appearance of these conditions on MDCT and MRI

TABLE OF CONTENTS/OUTLINE

- The number, size and morphology of chordae tendineae and papillary muscles is variable. Accessory bands may be asymptomatic incidental findings or can be associated with congenital heart diseases. Their radiological appearances is similar to that of normal muscular bands. However at times they may be pathological and can cause with hemodynamic alterations with adverse clinical implications. They can restrict mobility and cause outlet obstruction. Ruptured accessory chordae tendineae can cause regurgitation. Echocardiography, CT scan and MRI can be used for evaluation of accessory bands. Radiologists should know the advantages and limitations of each imaging modality. They should be familiar with the imaging appearances of these bands and understand their clinical significance. In this educational exhibit, we discuss: Introduction • Anatomy and anatomic variants • Accessory bands, chords, tendons and membranes in the Heart • Pathological conditions • Cross-sectional imaging findings and role of imaging • Clinical implications • Conclusion

CAE133

Heart and Lungs in Pulmonary Hypertension: What Cardio-Thoracic Magnetic Resonance Imaging Can Offer for Patient Management (Station #8)

Monda Lotfy Shehata MD (Presenter): Nothing to Disclose, Christian Olaf Schoenfeld MD: Nothing to Disclose, Jan Hinrichs MD: Nothing to Disclose, Julius Renne MD: Nothing to Disclose, Oleg Teytelboym MD: Nothing to Disclose, Frank K. Wacker MD: Research Grant, Siemens AG Research Grant, Pro Medicus Limited, Marius Hoeper: Nothing to Disclose, Jens Vogel-Claussen MD: Nothing to Disclose

TEACHING POINTS

Understand the pathophysiology of pulmonary hypertension (PH) and its effect on right ventricular (RV) remodeling and interventricular dependence. Familiarize the reader with the cardiopulmonary imaging findings in PH patients. Understand the current role of cardiothoracic magnetic resonance (CMR) in evaluation of the cardiopulmonary unit in PH. Identify novel diagnostic and prognostic markers provided by CMR for PH management and monitoring.

TABLE OF CONTENTS/OUTLINE

1. Definitions
2. Updated classification of pulmonary hypertension
3. Pathophysiology focusing on pulmonary vascular remodeling, RV adaptive mechanisms and interventricular dependence in the setting of RV overload and its effect on clinical course.
4. Diagnostic workup of pulmonary hypertension.
5. Practical considerations for CMR in PH patients including indications and protocol tailoring.
6. Illustration of imaging findings of PH on CMR including:
   - Biventricular global and regional function changes.
   - Assessment of RV remodeling, scarring and perfusion alterations.
   - Assessment of interventricular dependence.
   - Pulmonary vascular remodeling and flow alterations.
   - Pulmonary perfusion changes in different types of pulmonary hypertension.
7. CMR imaging markers and their prognostic value in patient management and monitoring.

SSJ03

ISP: Cardiac (Congenital Heart Disease)

Scientific Papers

AMAPRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00
Tue, Dec 2 3:00 PM - 4:00 PM Location: S502AB

Participants

Moderator
S. Bruce Greenberg MD : Nothing to Disclose
Moderator
Albert De Roos MD : Nothing to Disclose
Moderator
Laureen Marie Sena MD : Nothing to Disclose

Sub-Events

SSJ03-01

Improved Differential Pulmonary Perfusion Measurement with Highly-accelerated 4D-PC MRI

Tashfeen Ekram MD (Presenter): Nothing to Disclose, Shreyas Shreenivas Vasanawala MD, PhD : Research collaboration, General Electric Company Stockholder, Morpheus Imaging, Inc, Marcus T. Alley PhD : Nothing to Disclose, Frandics Pak Chan MD, PhD : Nothing to Disclose, Beverley Mansfield Newman MD, MBBCh : Nothing to Disclose, Albert Hsiao MD, PhD : Founder, Morpheus Imaging, Inc Consultant, Morpheus Imaging, Inc

PURPOSE

Conventional, planar phase-contrast (2D-PC) imaging is the gold standard for non-invasive measurement of blood flow, routinely used in the assessment of structural heart disease by MRI. Nevertheless, at many institutions, nuclear perfusion scintigraphy (NPS) remains necessary for confirmation of differential pulmonary perfusion, but requires an additional exam with radiation exposure, and in younger children, prolongs cardiac anesthesia. Highly-accelerated 4D phase-contrast (4D-PC) MRI is an evolving technology that has potential to greatly simplify the congenital heart MRI examination. We hypothesized that 4D-PC may be sufficient for quantification of differential pulmonary flow.

METHOD AND MATERIALS

With IRB approval and HIPAA-compliance, we retrospectively identified patients who underwent NPS as well as a cardiac MRI with 4D-PC from October 2011 through February 2014 without major surgery between exams. A total of 26 4D-PC examinations from 25 patients (15 male, 10 female) were identified. Aortic, main and branch pulmonary flow were quantified from 4D-PC. Pearson correlation and Bland-Altman analysis were used to analyze the quantitative consistency of 4D-PC data. The same analyses were then applied to compare differential pulmonary perfusion from 4D-PC against 2D-PC and NPS.

RESULTS

There was strong consistency between aortic flow and pulmonary flow measurements obtained at the pulmonary valve or as the sum of the branch pulmonary arteries (p=0.93, 0.90). Differential pulmonary flow measurements obtained from 4D-PC and NPS largely agreed (p=0.92), while correlation between 2D-PC and NPS was more modest (p=0.74). MRI and NPS were better matched among patients without substantial pulmonary regurgitation (RF<20%, n=15) whether obtained by 4D-PC (p=0.97) or 2D-PC (p=0.94). In contrast, the presence of substantial pulmonary regurgitation (RF≥20%, n=11) more severely impacted the accuracy of 2D-PC (p=0.47) than 4D-PC (p=0.89).

CONCLUSION

Highly-accelerated 4D-PC may not only help simplify congenital cardiac MRI, but may obviate the need for a separate nuclear scintigraphic examination to confirm differential pulmonary perfusion.

CLINICAL RELEVANCE/APPLICATION
The use of highly-accelerated 4D-PC as part of a congenital cardiac MRI may obviate the need for a separate nuclear scintigraphic examination to quantify differential pulmonary perfusion.

**SSJ03-02 Utility of a Novel High Resolution 3D MRI Sequence [SPACE] for Evaluation of Congenital Heart Disease**

**Method and Materials**

SPACE sequence was performed in 20 patients (mean age, 17.6 ± 12.6 years, range: 9 month - 57 years) with either unrepaired (N=3) or post repair (n=17) congenital heart disease. There were 13 males and 7 females; 10 patients with tetralogy of Fallot, 3 with transposition of great arteries and 7 other complex CHD. All scans were performed on 1.5T or 3T Siemens scanners. Two separate observers with expertise in cardiovascular imaging scored the quality of the images for blood suppression and definition of key anatomical structures in a blinded fashion. A five grade scoring system was developed with score 1 being non-diagnostic and 5 being excellent quality diagnostic information.

**Results**

Mean of average overall quality scores for two observers was 4 ± 0.62. All overall quality scores were greater than 3. None of the studies were deemed nondiagnostic. Mean length of the SPACE acquisition time was 12.7 mins (4 - 21 mins). Typical matrix size, FOV, and slice thickness were 320 x 240, 30 x 40 cm and 1.3-1.5 mm respectively. There was no significant correlation between image quality and duration of scans. Ability of SPACE for defining borders of larger anatomical structures such as ventricles was better with mean score of 4.2 ± 0.54 compared to smaller structures, such as left main coronary artery with score of 2.1 ± 1.3 (p value <.0001). Lack of blood suppression was the limiting factor in image quality with the most common place being ascending aorta in 9 patients. However, overall blood suppression score was very good with score of 3.9 ± 0.43. There were no differences in image quality for patients under anesthesia compared to conscious patients. There was a positive correlation between the readers in overall scoring of the studies (r = 0.67, p: .0012).

**Conclusion**

The 3D SPACE dark blood sequence with near isotropic spatial resolution coupled with respiratory and cardiac gating can be feasibly performed in all age group with diagnostic image quality in all cases in this study.

**Clinical Relevance/Application**

SPACE can be used as a one-stop shop for evaluation of cardiac anatomy without contrast in complex congenital heart disease and post repair changes with superb image quality and definition.

**SSJ03-03 Quantification and Mapping of Anomalous Pulmonary Venous Flow with Highly-accelerated 4D Phase-contrast MRI and Real-time Interactive Streamline Rendering**

**Method and Materials**

With IRB approval and HIPAA-compliance, we retrospectively identified all patients with anomalous pulmonary veins who underwent quantitative cardiac MRI with 4D-PC between April, 2011 and October, 2013. 14 exams were identified (9 male, 5 female). 6 were performed at 1.5T and 8 at 3T after single-dose gadofosveset intravenous contrast. Algorithms for real-time interactive streamline visualization were integrated into in-house software. Blood flow was quantified at the outflow valves, branch pulmonary arteries, cavae, pulmonary veins, and any ASD or VSD. Pulmonary veins were mapped to their receiving atrial chamber with streamlines. The intraobserver, interobserver, and internal consistency of flow measurements were then evaluated with Pearson correlation and Bland-Altman analysis.

**Results**

Mean acquisition time was shorter at 3T (5 min) than at 1.5T (9 min), due to higher acceleration factors possible at 3T (6-8 fold versus 4-fold). Among triplicate measurements, the coefficient of variation was smallest at the aortic and pulmonary valves (4-5%), moderate in the branch pulmonary arteries (18%) and greatest at the IVC (27%). These largely agreed with single measurements from a second observer (p<0.891-0.999), depending on location and complexity of anatomy. After pulmonary veins were assigned to their receiving atrial chambers, direct measurements of shunt volume from anomalous veins and intracardiac shunts matched
CONCLUSION

With streamline venous mapping, 4D-PC MRI can provide detailed and quantitatively consistent delineation of anomalous pulmonary veins and shunt flow.

CLINICAL RELEVANCE/APPLICATION

By providing a comprehensive quantitative view of extracardiac and intracardiac flow, highly-accelerated 4D-PC may be a time-efficient alternative to conventional planar MRI for patients with complex venous flow.

SSJ03-04

Quantitative Analysis of Myocardial Fibrosis Assessed by Cardiac Magnetic Resonance in Repaired Tetralogy of Fallot: Correlation between Late Gadolinium Enhancement Amount and Clinical/Functional Data

Vincenzo Noce MD (Presenter): Nothing to Disclose, Nicola Galea MD: Nothing to Disclose, Andrea Fiorelli: Nothing to Disclose, Riccardo Rosati: Nothing to Disclose, Valentina Sorrentino: Nothing to Disclose, Marco Francone MD: Speakers Bureau, Bracco nv, Iacopo Carbone MD: Nothing to Disclose, Carlo Catalano MD: Nothing to Disclose

PURPOSE

To evaluate relationships between myocardial fibrosis amount, assessed by quantitative analysis of late gadolinium enhancement (LGE) on cardiac magnetic resonance (CMR), functional values assessed by MRI measurements and clinical data in a population of patients who underwent primary Tetralogy of Fallot repair (rToF).

METHOD AND MATERIALS

We retrospectively evaluated by CMR nineteen patients with rToF, assessing clinical status at the time of MRI scan (NYHA class, exercise tolerance, history of documented clinical arrhythmias and syncope). CMR protocol comprehended biventricular functional evaluation on Steady-state precession free sequences (SSPF) obtaining volumes, ejection fraction (EF), cardiac output, myocardial mass and filling/ejection rates for both left and right ventricles (LV, RV), in addition LGE amount after Gadolinium administration was assessed on T1-weighted images.

RESULTS

LGE was detected in 14/19 patients, localized in RV insertions points (8/14), right ventricle outflow tract (5/14) and in the RV trabeculations (2/14). Mean LGE amount was of 2.17±0.73%, standardized by myocardial mass. Study cohort was sub-divided in LGE-positive and LGE-negative groups for statistical analysis (difference between means assessed with T-student and Wilcoxon tests; correlation assessed through Pearson and Spearman coefficients). We encountered a significant correlation between LGE amount, a reduced RV ejection fraction (48.3±8.2%). p

CONCLUSION

Myocardial damage after ToF repair is frequent and is quantitatively assessable through CMR-LGE. In our population, LGE amount demonstrated a significant correlation with impairment of RV functional indexes and clinical data.

CLINICAL RELEVANCE/APPLICATION

CMR-LGE in rToF patients correlates with a worse functional-clinical status, thus it could represent a sensible follow-up tool after surgical repair.

SSJ03-05

Cardiothoracic CT and MR Guide Management in a Diverse Multi-Ethnic Cohort of Adults with Tetralogy of Fallot

Francisco Contreras BS (Presenter): Nothing to Disclose, Nishant D. Parekh MD: Nothing to Disclose, Jeffrey Michael Levsky MD, PhD: Nothing to Disclose, Nadine Chouietier: Nothing to Disclose, Linda Broyde Haramati MD, MS: Investor, OrthoSpace Ltd Investor, Kryon Systems Ltd Spouse, Board Member, Bio Protect Ltd Spouse, Board Member, OrthoSpace Ltd Spouse, Board Member, Kryon Systems Ltd

PURPOSE

To systematically examine if and how cardiothoracic CT and MRI guided management in a consecutive cohort of adults with tetralogy of Fallot (TOF) over a 10-year period at our urban, inner-city academic medical center.

METHOD AND MATERIALS

56 consecutive adults (30 men, mean age 35.26, range 18-69 years) with TOF at our inner-city academic medical center who underwent cardiothoracic imaging with CT or MRI were retrospectively identified by searching the radiology database 1/03-1/13. 77% (36/47) of patients with documented ethnicity were minorities: Black (19), multiracial (14), Asian (3). Medical charts were reviewed for surgical history, clinical presentation, indication for imaging, diagnoses and management. 84% (47/56) had one or more remote prior cardiac surgeries including transannular patch (30), infundibulectomy (24), right ventricle to pulmonary artery conduit (13) and Blalock-Taussig shunt (6). 13% (7/56) died during the follow-up period.

RESULTS

21 patients underwent chest CT for symptoms including chest pain, dyspnea, hemoptysis and cough. 35 patients underwent cardiac MRI to evaluate ventricular volumes and function, pulmonary regurgitation and
pulmonary artery flow. Imaging guided treatment in 66% (37/56) and did not alter management in the remaining 34% (19/56). Of these, 57% (21/37) underwent open or minimally-invasive surgery and 43% (16/37) received medical management. The most common surgical interventions were pulmonary valve replacement 33% (7/21) and right ventricle to pulmonary artery conduit revision 24% (5/21) for increased right ventricular volumes and worsening clinical symptoms. Medical therapy included treatment for heart failure in 75% (12/16) and pneumonia in 25% (4/16).

CONCLUSION
Cardiothoracic CT and MR imaging were valuable in guiding treatment in a multi-ethnic, diverse, inner-city cohort of adults with TOF, impacting surgical decision-making and medical management.

CLINICAL RELEVANCE/APPLICATION
Management of a multi-ethnic diverse group of adults with TOF was guided by chest CT and cardiac MR.

SSJ03-06 Cardiac Keynote Speaker: Imaging Repaired Tetralogy of Fallot—Current Practice and Future Developments
Francies Pak Chan MD, PhD (Presenter): Nothing to Disclose

Abstract
Tetralogy of Fallot (TOF) is the most common cyanotic heart disease, representing 10% of all cases of congenital heart disease. The most frequent and important clinical indication for cardiac MRI in patient with TOF is the evaluation of impending right heart failure after total surgical repair. In young patients, total repair of TOF calls for closure of the ventricular septal defect and relief of the subvalvular, valvular, supravalvular pulmonary stenosis, the latter often accomplished with transannular patch augmentation. This leaves a varying degree of pulmonary regurgitation. While most patients tolerate the additional volume load to the right ventricle, about 10% of these patients progress to right-heart failure, necessitating surgical or transvascular pulmonary valve replacement. Since all artificial valves have limited longevity and once placed they will likely require future replacement, this operation is ideally done just before irreversible RV failure. In current clinical practice, this event is estimated by ventricular sizes and ejection fractions. Cardiac MRI provides the most accurate measurements of these markers. The precise thresholds for these markers are being investigated by ongoing clinical studies.

Despite the demonstrated utility of cardiac MRI and the clinical needs to follow an increasing number of patients with repaired TOF, the availability of high-quality MRI study remains limited outside academic centers. The reasons may be traced to the high cost, the length, and complexity of the examination. These limitations are workflow related and may be ameliorated by volumetric acquisition of anatomic and flow information with 4D phase-contrast (4DPC) imaging technique. In the past few years, the performance of 4DPC in terms of acquisition time, temporal resolution, and image quality have improved significantly. Versions of 4DPC are being implemented by scanner manufacturers. User friendly, efficient software programs are becoming available for visualization and quantitative analysis of the 4DPC image data. Deployment of these technologies facilitates cardiac MRI study of patients with congenital heart disease, including TOF.
mechanisms that may provide complementary information. X-ray phase-contrast computed tomography (PCT) has demonstrated superior contrast in low absorbing materials like biological soft tissue. We hypothesized that PCT has the potential for comprehensive, improved assessment and characterization of coronary plaque in an experimental ex-vivo setting examining human coronary artery specimens using histopathology as standard of reference.

**METHOD AND MATERIALS**

Experiments were carried out at a laboratory-based set up consisting of X-ray tube (35kV), grating-interferometer and detector. Tomographic absorption and phase-shift images were reconstructed with an effective pixel size of 100 µm. PCT data was evaluated by reviewers blinded to histopathology. Sensitivity, specificity and accuracy for the detection of fibrous (FIB), lipid-rich (LIP) and calcified (CAL) tissue as well as signal intensities quantified by phase-contrast Hounsfield units (HU) were determined. Lumen, plaque and vessel area were obtained and compared to histopathology measurements.

**RESULTS**

Fifteen coronary arteries with 316 corresponding PCT and histopathology cross-sections were evaluated. Histopathology showed LIP in 30.7%, FIB in 82.9% and CAL in 56.0% segments. Plaque components were detected with a sensitivity of ≥95.9%, specificity of ≥94.5%, positive and negative predictive value of ≥88.6% and ≥94.7%, respectively. Inter-rater agreement was high with κ≥0.91. HUp were significantly different for all tissue types with 39.9±16.8 for LIP, 61.7 ± 54.6 for FIB and 447.3 ± 437.9 for CAL (p<0.001). Receiver operating characteristic curves for the differentiation of FIB and LIP demonstrated an area under the curve of 0.87 for HUp and 0.77 for conventional HU (p<0.001). PCT showed a good correlation with histopathology in lumen, vessel and plaque area measurements with a Pearson’s R of ≥0.86.

**CONCLUSION**

PCT allows comprehensive and accurate assessment of coronary atherosclerosis in an ex-vivo setting. Future studies will determine its feasibility for in-vivo applications.

**CLINICAL RELEVANCE/APPLICATION**

Currently PCT might serve as a non-destructive method for accurate ex-vivo assessment of coronary plaque in cardiovascular research.

**Image Quality and Radiation Dose of Low Tube Voltage Third Generation Dual-Source Coronary CT Angiography in Obese Patients: A Phantom Study**

**PURPOSE**

To assess the influence of tube potential on radiation dose and image quality at 3rd generation dual-source coronary CT angiography (CTA) in a phantom model simulating an obese patient.

**METHOD AND MATERIALS**

A thoracic phantom was equipped with tubular inserts containing iodine solution and water. A soft tissue-equivalent ring around the phantom simulated an obese patient. Images were acquired at tube potentials of 80, 100, 120, and 140 kV with 2nd generation dual-source CT (DSCT) and 70-150 kV (in 10 kV increments) with 3rd generation DSCT. Contrast-to-noise ratio (CNR) was calculated and CT dose index was recorded.

**RESULTS**

With 2nd generation DSCT, iodine attenuation decreased from 667 ± 4 HU at 80 kV to 315 ± 3 HU at 140 kV and image noise decreased from 56 ± 4 HU at 80 kV to 18 ± 1 HU at 140 kV. With 2nd generation DSCT, CNR was highest for 120 kV (19.0) and decreased with lower tube potential (12.0 at 80 kV) due to disproportionately increased image noise. With 3rd generation DSCT, iodine attenuation decreased from 782 ± 9 HU at 70 kV to 309 ± 4 HU at 150 kV and image noise decreased from 37 ± 4 HU at 70 kV to 17 ± 2 HU at 150 kV. With 3rd generation DSCT, 70 and 80 kV acquisitions showed a smaller increase in noise. CNRs for 3rd generation DSCT were highest for 70 and 80 kV (21.1 and 21.2, respectively). Compared to 120 kV, radiation dose was 68 % and 49 % lower at 70 kV and 80 kV, respectively.

**CONCLUSION**

Our phantom experiments indicate that the high tube power of 3rd generation DSCT can prevent the disproportionate increase in image noise, which has so far precluded the use of low tube potential CTA in obese patients. Third generation DSCT may enable performing coronary CTA at 70-80 kV in obese patients without compromising subjective and objective image quality. Compared to 120 kV, which is the currently the clinical standard for obese patients, this approach reduces radiation dose by 49-68 %.

**CLINICAL RELEVANCE/APPLICATION**

Third generation DSCT offers substantially increased tube power at low tube potential, which may enable
performing coronary CT angiography at 70-80kV in obese patients and can reduce radiation dose by 49-68%.

**SSJ04-03**

**Next Generation Coronary CT Angiography: In vitro Evaluation of 27 Coronary Stents**


**PURPOSE**

To evaluate in-stent lumen visibility of 27 modern and commonly used coronary stents (16 individual stent types, two stents at six different sizes each) utilizing a third-generation dual-source CT scanner.

**METHOD AND MATERIALS**

All stents were implanted in a plastic tube filled with contrast medium diluted to a density of 350 HU. The tube was placed in a plastic box filled with sunflower oil and contrast adjusted to a density of -70 HU to simulate the attenuation of epicardial fat. Scans were performed in an orientation parallel to the scanner's z-axis for all stents (i.e. 0°) and additionally in an orientation of 90° for stents expanded to a diameter of 3.0 mm. Two stents were evaluated in all available diameters (2.25 mm to 4.0 mm) to determine the influence of stent diameter on stent lumen visibility. Scans were acquired in a retrospectively ECG-gated cardiac spiral dual-source mode with a collimation of 96x0.6 mm, tube voltage of 120 kVp with 340 mAs tube current. Evaluation was performed using a medium-soft (Bv40), a medium-sharp (Bv49) and a sharp (Bv59) convolution kernel optimized for vascular imaging. Axial reformations of all stents were used for evaluation using a window width of 1500 HU and a center of 300 HU.

**RESULTS**

Mean visible stent lumen of stents with 3.0 mm diameter ranged from 53.3% (IQR 48.9 - 56.7%) to 73.9% (66.7 - 76.7%) depending on the kernel applied at 0°, and was highest at an orientation of 90° with 80.0% (75.6 - 82.8%) using the Bv59 kernel, strength 4. Differences between all kernels were significant with p

**CONCLUSION**

Use of third generation dual-source CT scanners enables stent lumen visibility of up to 80% in metal stents and 100% in bioresorbable stents in this in vitro setting. It may therefore be a valid method for detecting in-stent restenosis.

**CLINICAL RELEVANCE/APPLICATION**

Improved in-vitro stent lumen visibility of third generation dual-source CT scanners may allow a sufficient non-invasive method to detect or exclude in-stent restenosis in vivo.

**SSJ04-04**

**Mesenchymal Stem Cells Improve Cardiac Function after Myocardial Infarction in Rats without Long-term Survival: A Serial 7.0T MRI Study**

Xiuyu Chen (Presenter): Nothing to Disclose, Shihua Zhao: Nothing to Disclose

**PURPOSE**

Our aim was to in vivo monitoring the magnetically labeled mesenchymal stem cells (MSCs) after transplantation into infarcted rat hearts and determining the effect on cardiac function using a 7.0 T magnetic resonance imaging (MRI) scanner.

**METHOD AND MATERIALS**

Rat MSCs (male) were dual-labeled with fluorescent micron-sized particles of iron oxide (MPIO) and DM-DiI. Seven days after MI, rats (females) were randomized to injections of labeled MSCs (2x10⁶ cells/50μL) or saline (50μL) into the border zone of infarcted myocardium. MRI was used to evaluate stem cell migration, signal intensity changes and cardiac function at baseline (1 day before transplantation), 3 days, 2 weeks and 4 weeks after transplantation, respectively. At each time point after transplantation, myocardial tissue from 5~8 hearts was analyzed by postmortem analyses.

**RESULTS**

MSCs could be efficiently and safely labeled with MPIO, and multipotentiality was not affected. MR hypointensities caused by the MPIOs were detected on T2*-weighted imaging at all times after MSCs transplantation. As time progressed, the signal gradually weakened and the area shrank. By real-time polymerase chain reaction with Y-chromosome specific primers, the number of grafted MSCs in the heart decreased rapidly from 11.5% (3 days) to ~0.1% (4 weeks). At 4 weeks, double staining for iron and CD68 (resident macrophage marker) showed that most of the iron-positive cells were cardiac macrophages. This was further confirmed by transmission electron microscopy. At baseline, cardiac function measured by cine-MRI was similar between groups. By 4 weeks, ejection fractions in control hearts had significantly decreased, but this was not evident in MSC-treated hearts. In addition, MSC-treated rat hearts had significantly increased capillary density in the peri-infarct region, and lower cardiomyocytes apoptosis and collagen deposition.

**CONCLUSION**

The survival of transplanted MPIO-labeled MSCs is poor at 4 weeks after transplantation, and the MR hypointensities mainly arise from cardiac macrophage that engulfed the MPIO particles. However, MSCs attenuate left ventricular dilatation and dysfunction after MI, which may attribute to enhanced angiogenesis, inhibition of host cell apoptosis and fibrosis.

**CLINICAL RELEVANCE/APPLICATION**

our results indicate that iron oxide are not reliable marker for tracking the transplanted stem cells.
SSJ04-05  Prognostic Value of Stress Dynamic CT Myocardial Perfusion Imaging in a Multi-Center Population at Intermediate to High Cardiovascular Risk

Felix G. Meinel MD (Presenter): Nothing to Disclose, Francesca Pugliese MD, PhD: Nothing to Disclose, U. Joseph Schoepf MD: Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, Siemens AG, Ulrich Ebersberger MD: Nothing to Disclose, Carlo Nicola de Cecco MD: Nothing to Disclose, Fabian Bamberg MD, MPH: Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG Research Grant, Bayer AG Research Grant, Siemens AG, Yining Wang MD: Nothing to Disclose, Yeon Hyeon Choe MD, PhD: Nothing to Disclose, Gladys G. Lo MD: Nothing to Disclose

PURPOSE
To determine the prognostic value of stress dynamic CT myocardial perfusion imaging (CTMPI) for future major adverse cardiac events (MACE) in a multicenter population at intermediate to high cardiovascular risk.

METHOD AND MATERIALS
We analyzed data of 144 patients from 6 centers in Asia, Europe and North America who had undergone coronary CT angiography (CCTA) and CTMPI. All image acquisitions were performed on a second-generation dual-source CT system. Contrast enhanced CCTA studies were acquired at rest. In addition, CTMPI imaging was performed under vasodilator stress. CCTA data were evaluated for the presence of coronary artery stenosis (>50% luminal narrowing) on a per-vessel basis. CTMPI data were visually evaluated for perfusion defects in each vessel territory. Patient follow-up was obtained at 6, 12 and 18 months after the CT examination. The prognostic value of CT findings was assessed using Kaplan-Meier statistics and multivariate Cox proportional hazards regression.

RESULTS
During the follow-up, 40 MACE occurred (including nonfatal myocardial infarction, n=1, unstable angina, n=13, PCI, n=23, and CABG, n=3). Patients with a perfusion defect in at least one vascular territory on CTMPI were at significantly increased risk for MACE (HR 2.50, 95% confidence interval 1.34-4.65, p=0.0040). This association remained significant after adjusting for age, gender and clinical risk factors (HR 2.41, 1.28-4.51, p=0.0064) and after further adjusting for CCTA findings (HR 2.03, 1.04-3.97, p=0.0390). The number of territories with perfusion defects was strongly predictive of MACE with adjusted HRs of 1.41, 3.44 and 4.76 for 1, 2 and 3 affected territories.

CONCLUSION
Myocardial perfusion abnormalities detected by CTMPI are predictive for subsequent MACE. CTMPI provides incremental predictive value for future MACE over clinical risk factors and assessment of coronary artery stenosis at CCTA.

CLINICAL RELEVANCE/APPLICATION
CT myocardial perfusion imaging provides incremental predictive value for future adverse cardiac events over clinical risk factors and assessment of coronary artery stenosis at CCTA.

SSJ04-06  Longitudinal Changes in Hepatic Steatosis and Coronary Artery Calcification in the Elderly: A Prospective Population-based Cohort Study

Kathleen Elizabeth Jacobs MD (Presenter): Nothing to Disclose, Sharon Sudarshan Brouha MD, MPH: Nothing to Disclose, Richele Bettencourt: Nothing to Disclose, Elizabeth Barrett-Connor: Nothing to Disclose, David Sean Ansdell MD: Nothing to Disclose, Rohit Loomba MD, MSc: Nothing to Disclose

PURPOSE
To investigate the relationship between hepatic steatosis and progression of coronary artery calcium (CAC) as measured by computed tomography (CT) in the elderly.

METHOD AND MATERIALS
We conducted a prospective study of 107 participants (62 women, 45 men; mean age 67.2) with no prior history of heart disease. CT measurements of Agatston CAC scores, liver attenuation, spleen attenuation, volume of visceral adipose tissue (VAT), and volume of subcutaneous adipose tissue (SAT) were obtained at baseline and five-year follow up. Hepatic steatosis was defined as liver attenuation:spleen attenuation (L:S) ratio <1.1.

RESULTS
From baseline to five-year follow up, mean CAC score increased from 347.0 to 465.6 (t-test p<0.0001). VAT:SAT ratio also increased (p=0.01) despite stable BMI and correlated strongly with CAC score (r=0.41, p<0.0001). In contrast, L:S ratio increased from 1.19 to 1.33 (p<0.0001) with the proportion of patients with hepatic steatosis decreasing from 34% to 15% (p=0.001). No significant correlation was observed between change in L:S ratio and change in CAC score over the five-year time period.

CONCLUSION
Hepatic steatosis as defined by CT L:S ratio was not associated with CAC progression in our elderly study population. Although hepatic steatosis is thought to be a manifestation of metabolic syndrome, a well-known cardiovascular risk factor, our findings suggest age-related changes in liver adiposity independent of visceral adiposity and coronary artery disease.
CLINICAL RELEVANCE/APPLICATION

The association between hepatic steatosis and coronary artery disease is not well known. This is the first prospective study to demonstrate decreased hepatic steatosis despite CAC progression in the elderly.

RC403

Interpreting Coronary Artery CTA

Refresher/Informatics

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AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Tue, Dec 2 4:30 PM - 6:00 PM   Location: N228

Sub-Events

RC403A  Standardized Reporting of Coronary CTA
Jill E. Jacobs MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand the advantages of standardized reporting. 2) To understand the components of a standardized cardiac CT report.

RC403B  Imaging and Interpreting Re-vascularized Coronary Arteries (I: Bypass Grafts)
Smita Patel MBBS (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review the basic approach of evaluating coronary artery bypass grafts on CT. 2) To review normal surgical anatomy and pathology of coronary artery bypass graft conduits on CT.

RC403C  Imaging and Interpreting Re-vascularized Coronary Arteries (II: Stents)
Marc Dewey MD (Presenter): 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

LEARNING OBJECTIVES

1) Review the issues involved in detecting coronary in-stent restenosis by CT angiography. 2) Get an overview of the diagnostic accuracy of CT angiography for coronary stents. 3) Understand the potential advantages of iterative reconstruction and perfusion assessment by CT for stents.

URL’s

www.ct-kurs.de

Handout: Marc Dewey


RC403D  Deciphering Coronary Anomalies and Fistulas
Jonathan Dermot Dodd MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Review the basic classification of coronary anomalies and fistulas. 2) Understand the most clinically important anomalies and fistulas.
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 SPECT and physiologic/function information provided by PET. 4) Improve interpretive skills related to SPECT and PET-CT.

ABSTRACT

Camera and software technology recently has rapidly advanced, providing improved SPECT image resolution and increased counting statistics. These advancements in turn have provided the possibility of reduced-time and reduced radiopharmaceutical dose image acquisitions. Moreover, increased flexibility in imaging protocols has been realized. Future development of these methods hold promise in increasing diagnostic accuracy and expanding diagnostic applications. The addition of CT to SPECT and PET has afforded the ability to perform attenuation correction, thereby 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

**Advances in Cardiac SPECT**

E. Gordon Depuey MD (Presenter): Consultant, BioClinica, Inc Consultant, ICON plc Steering Committee, Adenosine Therapeutics, LLC

**LEARNING OBJECTIVES**

1) Understand software methods to cope with lower SPECT counting statistics in order to reduce scan acquisition time and/or radiopharmaceutical injected activity and their clinical impact. 2) Understand instrumentation advances that allow new cameras to perform SPECT with markedly reduced acquisition times and/or less radiopharmaceutical activity and their clinical impact. 3) Implement protocols that facilitate patient-centered imaging and that reduce patient radiation exposure. 4) Recognize new software methods to select appropriate patients for cardiac resynchronization therapy (CRT).

**ABSTRACT**

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 such as high resolution imaging, scatter correction, and respiratory gating increase diagnostic sensitivity. There has been an intersocietal effort to promote patient-centered imaging with a focus on appropriateness guidelines, cost-containment, radiation dose reduction, and the selection of the most appropriate imaging test and protocol to suit particular patient needs. The technical advancements described above facilitate implementation of patient-centered imaging. 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.

**Advances in Cardiac PET**

Sharmila Dorbala MBBS (Presenter): Research Grant, Astellas Group Speaker, 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.

**SPDL41**

**RSNA Diagnosis Live™: Body, Cardiac, MSK, Neuro, ENT Potpourri**
Participants
Adam Eugene Flanders MD (Presenter): Nothing to Disclose
Sandeep Prakash Deshmukh MD (Presenter): Nothing to Disclose
Christopher Geordie Roth MD (Presenter): Author, Reed Elsevier

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.

RC503
Interactive Game: Read with the Experts (Cardiac Radiology)

Refresher/Informatics

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

Participants
Moderator
Frank John Rybicki MD, PhD: Research Grant, Toshiba Corporation
Frank John Rybicki MD, PhD (Presenter): Research Grant, Toshiba Corporation
Satinder Pal Singh MD (Presenter): Nothing to Disclose
Sanjeev Bhalla MD (Presenter): Nothing to Disclose
Jacobo Kirsch MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To illustrate common cardiac pathologies encountered in noninvasive imaging. 2) To review imaging protocols designed to best depict cardiac pathology. 3) To review image post-processing tools to render cardiac imaging findings for interpretation and communication with referring clinicians. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

ABSTRACT
This session will include live reads with experts in cardiac radiology to meet the learning objectives. Specific cases and clinical scenarios will be presented to best demonstrate the pathology and the strategies for imaging and image interpretation.

URL's
http://www.brighamandwomens.org/Departments_and_Services/radiology/Research/aisl.aspx

RC524
Interactive Game: Mentored Case Approach to Pediatric Cardiovascular Disease 2: Cardiac

Refresher/Informatics

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

Participants
Rajesh Krishnamurthy MD (Presenter): Research support, Koninklijke Philips NV Travel support, Koninklijke Philips NV
Francis Pak Chan MD, PhD (Presenter): Nothing to Disclose
Laureen Marie Sena MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the morphology, treatment, and long term complications of treated and untreated congenital heart disease via an interactive mentored-case approach with audience response system. 2) Highlight appropriateness of MRI and CT with regard to technique, pitfalls, indications and critical imaging findings that affect management for common imaging scenarios, including conotruncal anomalies, single ventricle, cardiomyopathy and myocarditis. 3) Provide an opportunity for general radiologists, pediatric radiologists and cardiac imagers who have limited exposure to this area in their workplace an opportunity to refresh their pediatric cardiovascular imaging skills in a focused manner. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

SSK03
Cardiac (Coronary Artery Disease)

Scientific Papers
**Sub-Events**

### SSK03-01

**High-risk Coronary Plaque Detected by Coronary Computed Tomography Angiography Is Associated with Nonalcoholic Fatty Liver Disease Independent of Coronary Stenosis and Plaque Burden: Results from the ROMICAT II Trial**

**Stefan Puchner MD (Presenter):** Nothing to Disclose, **Michael Tse-Yin Lu MD:** Nothing to Disclose, **Ting Liu MD:** Nothing to Disclose, **Amit Pursnani MD:** Nothing to Disclose, **Brian Burns Ghoshhajra MD:** Nothing to Disclose, **Quynh Truong MD:** Nothing to Disclose, **Stephen Wiviott:** Nothing to Disclose, **Jerome Fleg:** Nothing to Disclose, **Teruhito Mochizuki MD:** Nothing to Disclose, **Hiroshi Higashino MD, PhD:** Nothing to Disclose

**PURPOSE**

To determine the association of non-alcoholic fatty liver disease (NAFLD) with the presence of advanced high-risk coronary atherosclerotic plaque as assessed by coronary computed tomography angiography (CCTA).

**METHOD AND MATERIALS**

This study was approved by the local ethics committee; informed consent was obtained. Patients randomized to the CCTA arm of the ROMICAT II trial who had both a noncontrast CT to assess calcium score and a contrast-enhanced CCTA were included. Readers assessed CCTA for the presence of atherosclerotic plaque, significant stenosis (≥50%) and high-risk plaque features (positive remodeling, low HU plaque, napkin-ring sign, spotty calcium). NAFLD was defined by hepatic steatosis on on contrast CT without evidence of clinical liver disease, liver cirrhosis and alcohol abuse. To determine the association between high-risk plaque features and NAFLD, we performed univariable and multivariable logistic regression analyses, with high-risk plaque as a dependent variable and NAFLD, traditional risk factors and extent of coronary atherosclerosis as independent variables.

**RESULTS**

Overall, 182 (40.9%) of 445 patients with both contrast enhanced and non-contrast CCTA scans had CT evidence of NAFLD. High-risk plaque features were more frequent in NAFLD than in non-NAFLD patients (59.3 vs. 19.0%, p<0.001). The association between NAFLD and high-risk plaque (odds ratio 2.21, 95% CI 1.26-3.87) persisted after adjusting for the extent and severity of coronary atherosclerosis and traditional risk factors.

**CONCLUSION**

NAFLD is associated with advanced high-risk coronary plaque independent of traditional cardiovascular risk factors and the extent and severity of coronary artery disease.

**CLINICAL RELEVANCE/APPLICATION**

Patients with NAFLD are not only more prone to develop CAD, but they are specifically more likely to develop high-risk coronary plaques.

### SSK03-02

**3-D Quantification of the Myocardial Area at Risk Using Coronary CT Angiography and Voronoi Algorithm Based Myocardial Segmentation**

**Akira Kurata (Presenter):** Nothing to Disclose, **Koen Nieman MD, PhD:** Speakers Bureau, Siemens AG Speakers Bureau, Toshiba Corporation Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, **Tsuyoshi Sakamoto RT:** Nothing to Disclose, **Gabriel P. Krestin MD, PhD:** Consultant, General Electric Company Research Grant, **Teruhito Mochizuki MD:** Nothing to Disclose, **Kido MD, PhD:** Nothing to Disclose, **Hiroshi Higashino MD, PhD:** Nothing to Disclose, **Mitsunori Abe:** Nothing to Disclose

**PURPOSE**

Quantification of myocardial ischemia has prognostic value, and is important for therapeutic decision making in patients with coronary artery disease (CAD). Voronoi’s algorithm is a mathematical algorithm that divides area (2-dimensional; 2D) or space (3-dimensional; 3-D) between pre-determined points or lines based on the shortest distance to those points/lines. This study aimed to estimate the myocardial area at risk (MAAR) using coronary computed tomography angiography (CCTA) based 3-D myocardial segmentation in comparison with stress myocardial perfusion imaging by single photon emission computed tomography (SPECT).

**METHOD AND MATERIALS**

Quantification of myocardial ischemia has prognostic value, and is important for therapeutic decision making in patients with coronary artery disease (CAD). Voronoi’s algorithm is a mathematical algorithm that divides area (2-dimensional; 2D) or space (3-dimensional; 3-D) between pre-determined points or lines based on the shortest distance to those points/lines. This study aimed to estimate the myocardial area at risk (MAAR) using coronary computed tomography angiography (CCTA) based 3-D myocardial segmentation in comparison with stress myocardial perfusion imaging by single photon emission computed tomography (SPECT).
Thirty-four patients with coronary artery disease underwent 128-slice coronary CTA, stress-rest thallium-201
SPECT and coronary angiography (CAG). CTA based MACR was defined as the sum of all CAG stenosis (>50%)
related territories (the ratio of the left ventricular volume). Using the automated quantification software
(17-segment model, 5-point scale), SPECT-MAAR was defined as the number of segment with a score above
zero as ratio to the total 17 segments by summed stress (SSS), difference (SDS) score map, and
comprehensive SPECT interpretation with either SSS or SDS best correlating the CAG findings. Results were
compared by Pearson’s correlation coefficient.

RESULTS

Forty-nine stenoses were observed in 102 major coronary territories. Mean value of CTA based MAAR was
28.3±14.0%. SPECT based MAAR was 30.1±6.1% (SSS), 20.1±15.8% (SDS) and 26.8±15.7% (comprehensive
assessment), respectively. CTA based MAAR was significantly related to SPECT based MAAR (r=0.531, for SSS;
r=0.494, for SDS; r=0.814, for comprehensive assessment, P<0.05 in each). Coronary CTA based MAAR
predicted SPECT based MAAR as reference within an error of ± 10% in 21 of 34 (61.7%, for SSS), 22 of 34
(64.7%, for SDS), and 29 of 34 (85.3%, for comprehensive assessment), respectively

CONCLUSION

Coronary CTA based Voronoi algorithm myocardial segmentation reliably quantifies SPECT based MAAR in
patients with obstructive CAD.

CLINICAL RELEVANCE/APPLICATION

3-D automated myocardial segmentation using CTCA can quantify myocardial area at risk in patients with CAD
without stress test.

SSK03-03

Clinical Usefulness of Subtraction Coronary CT Angiography for Evaluating Restenosis of Metallic
Coronary Artery Stents

Makoto Amanuma MD (Presenter): Nothing to Disclose, Takeshi Kondo : Nothing to Disclose, Tomoya Takayanagi : Nothing to Disclose, Takako Sekine : Nothing to Disclose, Tomonari Sano : Nothing to Disclose, Shinichi Takeda : Nothing to Disclose

PURPOSE

To assess the clinical usefulness of subtraction coronary CT angiography (CCTA) for evaluating restenosis of
metallic coronary artery stents.

METHOD AND MATERIALS

This study was approved by our clinical review board, and written informed consent was obtained from all
subjects. All examinations were performed using a 320-detector row MDCT scanner (Aquilion ONE ViSION
Edition, Toshiba; 0.275 sec/rot.). Patients with a history of PCI, HR < 61, and breath-hold ability > 25 sec were
selected as candidates for this study. Two sets of 3D volume data were obtained during a single breath-hold
before and after the arrival of contrast medium in the left heart system. Data were acquired by prospective
one-beat scan in the mid-diastolic phase. Volume adjustment and subtraction were performed using dedicated
software. After 2 patients with motion artifacts were excluded, 66 patients (age: 73.6±8.25 years, M/F=49/17)
with a total of 173 stents were included in the final evaluation. Luminal stenosis (>50% vs. ≤50%) was
evaluated by three experienced observers, with catheter angiography used as the reference standard. Based on
the observed changes, subtraction was judged to be effective or non-effective.

RESULTS

The number of non-assessable stents was 56 before subtraction and 4 after subtraction. When non-assessable
lesions were counted as positive stenosis, the segment base sensitivity, specificity, positive predictive value,
negative predictive value, and accuracy were 81.8%, 60.9%, 23.4%, 95.8%, and 63.6% before subtraction
and 54.5%, 93.4%, 54.5%, 93.4%, and 88.4% after subtraction, respectively. Based on comparison of the
effective group (N=49) and the non-effective group (N=124), the stent diameter was found to have the
greatest influence, with subtraction judged to be most effective for the evaluation of 2.5-mm-diameter stents
as compared with larger ones.

CONCLUSION

Subtraction CCTA was found to provide better visualization of the arterial lumen within metallic stents as well as
superior diagnostic capabilities for evaluating in-stent restenosis. Patients with 2.5-mm-diameter stents can be
considered to be good candidates for CCTA using this technique.

CLINICAL RELEVANCE/APPLICATION

Subtraction coronary CT angiography can improve diagnostic capability of coronary artery restenosis within the
metallic stents.

SSK03-04

Retrospective Evaluation of 64-Detector Row CT Angiography (CTA) Transluminal Attenuation
Gradient (TAG) for the Detection of Significant Coronary Artery Disease (CAD) Determined by
Fractional Flow Reserve (FFR)

Rani S. Sewatkar MBBS (Presenter): Nothing to Disclose, Kanako Kunishima Kumamaru MD, PhD : Nothing to Disclose
**PURPOSE**

TAG is being explored to detect functionally significant CAD. However, studies to-date have used it without adjusting for the various factors that affect its value, eg, the particular coronary artery, scan kVp, or left vs right dominance. We retrospectively evaluated TAG measured from 64-slice coronary CTA for the prediction of functionally significant CAD determined by invasive FFR in a small subset of patients avoiding the various factors that can affect its value.

**METHOD AND MATERIALS**

We included 21 consecutive patients with right-dominant coronary arteries who clinically underwent both 64-slice coronary CTA (120 kVp) and invasive FFR measurements (median time interval of the studies=27 days, IQR: 14-47, range: 4-83). Among a total of 63 major coronary arteries, FFR was measured in 18 LADs and 4 LCXs. TAG was measured in all 63 vessels and the receiver operating characteristic (ROC) area under the curve (AUC) was used to characterize the ability of TAG to predict FFR<0.8 in: a) all arteries (those with no FFR measured assumed ≥0.8), b) all arteries with FFR measured, and, c) only LADs with FFR measured.

**RESULTS**

TAG values (HU/cm) in each coronary artery independently were: -7.9±8.6 (RCA), -13.8±9.4 (LAD) and -19.3±11.9 (LCX) in vessels with no significant disease to compel FFR measurement; -15.9±10.0 (LAD) and -10.7±5.8 (LCX) in vessels with FFR≥0.8 measurements; and, -7.0±5.2 (LAD) in vessels with FFR<0.8 (Figure). As previously noted, the RCA tends to have lower TAG values than left coronaries and in this study, TAG values in RCAs were similar to those of LADs with significant stenoses. The ROC AUC to detect FFR<0.8 was 0.68 (95%CI: 0.50-0.85) when pooling all vessels; 0.81 (95%CI: 0.60-1.00) when excluding vessels with no FFR, and, 0.82 (95%CI: 0.60-1.00) in LADs with FFR measurements.

**CONCLUSION**

In this study of 64-slice coronary CTA, LADs with significant CAD defined by FFR<0.8 had a lower TAG magnitude than LADs with no significant disease. In right-dominant patients with normal coronary arteries the RCA is expected to have the lowest TAG magnitude and the LCX is expected to have the largest, so using a single cutoff of the TAG value regardless of vessel may diminish the ability of TAG to detect significant disease.

**CLINICAL RELEVANCE/APPLICATION**

Caution should be exercised when interpreting TAG values for the detection of significant coronary artery disease. Specifically, different TAG cutoffs may be required for each coronary artery.
7% of overall population studied by CTCA.

CONCLUSION

In the routine clinical practice the intra-cycle motion correction algorithm is able to improve the image quality, the overall evaluable and the diagnostic accuracy of CTCA.

CLINICAL RELEVANCE/APPLICATION

The intra-cycle motion correction algorithm is able to improve the image quality of CTCA.

SSK03-06

Performance of Turbo High-Pitch Dual-Source CT for Coronary CT Angiography: First Ex-Vivo and Patient Experience

Fabian Morsbach (Presenter): Nothing to Disclose, Sonja Gordin MD: Nothing to Disclose, Daniela Barbara Husarik MD: Nothing to Disclose, Thomas Frauenfelder MD: Nothing to Disclose, Bernhard Schmidt PhD: Employee, Siemens AG, Thomas Allmendinger: Employee, Siemens AG, Hatem Alkadhi MD: Nothing to Disclose, Sebastian Leschka MD: Nothing to Disclose

PURPOSE

To evaluate image quality, maximal heart rate allowing for diagnostic imaging, and radiation dose of turbo high-pitch dual-source coronary CT angiography (CCTA).

METHOD AND MATERIALS

In the first part, a cardiac motion phantom simulating heart rates (HR) from 60-90bpm in 5bpm-steps was scanned on 3rd generation dual-source 192-slice CT (prospective ECG-triggering, pitch 3.2; rotation time 250 msec). Subjective image quality regarding the presence of motion artifacts was interpreted by two readers on a 4-point scale (1: excellent; 4: non-diagnostic). Objective image quality was assessed by calculating distortion vectors. In the second part, 20 consecutive patients (median 50 years) undergoing clinically indicated CCTA were included.

RESULTS

In the phantom study, image quality was rated diagnostic up to the HR75 bpm, with object distortion being 1mm or less. Distortion increased above 1mm at HR of 80-90 bpm. Patients had a mean HR of 66 ± 9 bpm (range: 47-78 bpm). Coronary segments were of diagnostic image quality for all patients with HR up to 73 bpm. Average effective radiation dose in patients was 0.6±0.3mSv.

CONCLUSION

Our combined phantom and patient study indicates that CCTA with turbo high-pitch 3rd generation dual-source 192-slice CT can be performed at HR up to 75 bpm while maintaining diagnostic image quality, being associated with an average radiation dose of 0.6 ± 0.3 mSv.

CLINICAL RELEVANCE/APPLICATION

Results of this work can be translated to patients who will benefit from low dose cardiac CCTA up to heart rates of 75 bpm.

SSK03-07

CT Attenuation Feature Analysis Characterizes the Coronary Calcified Plaque in Acute Coronary Syndrome

Ming-Ting Wu MD (Presenter): Nothing to Disclose, Yi-Luan Huang MD: Nothing to Disclose, fu-zong wu: Nothing to Disclose, Chen-Wen Yen: Nothing to Disclose, Huey-Shyan Lin PhD: Nothing to Disclose, Carol C. Wu MD: Author, Reed Elsevier

PURPOSE

Many patients with acute coronary syndrome (ACS) have low Agatston score (AS). Recent study showed lower density score of coronary artery calcification (CAC) plaque tended to have higher risk of ACS. We aimed to evaluate the characteristic of plaque attenuation features of CAC in three groups: asymptomatic, stable angina pectoralis (SAP) and ASC.

METHOD AND MATERIALS

We retrospectively reviewed 159 symptomatic patients and 365 asymptomatic subjects receiving non-contrast cardiac CT in a period of 18 months; After excluding those without CAC or post intervention, 298 subjects, including ACS=41, SAP=78 and asymptomatic=159, were enrolled for analysis of CAC plaque features. Subject analysis included AS and number of plaques (Np). Plaque analysis included mean (HMEAN) and standard deviation (HSD) of attenuation per plaque. Median [min, max] was used for express and statistics.

RESULTS
Comparison of subject analysis showed the SAP group had significant higher AS (237 [1.2-2143]) and Np (9 [1-31]) than that of asymptomatic group (AS=54 [1.8-1725]; Np=3 [1-38], both P<.001), while no difference between SAP and ACS group (AS=112 [2.3-3447], Np=8 [2-36]); P>.5). Plaque analysis showed ACS had significant lower and homogenous attenuation (H\text{MEAN}=180 [147-268], H\text{SD}=31 [9.9-121]) than that of SAP (H\text{MEAN}=204 [140-343], H\text{SD}=54 [4.7-183], P = .016, .011, respectively) and that of asymptomatic (H\text{MEAN}=205 [142-359], H\text{SD}=52 [8.4-208]; P=.002, .006, respectively). While no difference between SAP and asymptomatic groups (both P>.5). ROC curves showed adding the AS on model of conventional risk factors did not improved AUC (from 0.79 to 0.83, P=0.21) in discriminating ACS from asymptomatic group; while adding plaque analysis on model of conventional risk factor plus AS significantly improved the AUC from 0.83 to 0.93 (P=.003).

CONCLUSION

In addition to lower H\text{MEAN}, smaller H\text{SD} was also an important attenuation feature of CAC plaque in ACS in this cross sectional study. With validation of a large cohort study, these plaque feature may serve as a novel biomarker to improve ACS risk stratification.

CLINICAL RELEVANCE/APPLICATION

Attenuation feature analysis of CAC plaque in addition AS can enhance the risk stratification of coronary artery disease by non-contrast cardiac CT

SSK03-08

Diagnostic Performance of Coronary CT Angiography and Quantitative Coronary Angiography to Predict Functional Significance of Intermediate Coronary Artery Stenosis

Olivier Ghekiere MD (Presenter): Nothing to Disclose, Willem Dewilde : Nothing to Disclose, Denis Hoa MD : Nothing to Disclose, Piet K. Vanhoenacker MD : Nothing to Disclose, Paul Dendale : Nothing to Disclose, Alain Longang Nchimi MD : Nothing to Disclose, Isabelle Mancini : Nothing to Disclose, Michel Bellekens MD : Nothing to Disclose, Julien Djekic : Nothing to Disclose, Thierry Couvreur : Nothing to Disclose, Tim Coolen : Nothing to Disclose

PURPOSE

To evaluate quantitative coronary angiography (QCA) and fractional flow reserve (FFR) findings in coronary arteries with diameter stenosis between 40 and 70% on coronary computed tomography angiography (CCTA), the so-called intermediate coronary artery stenosis (ICAS)

METHOD AND MATERIALS

47 patients (mean age 62±9, range 44-80;34 males) with 51 lesions with minimal lumen diameter (MLD), stenosis percentage (Ds%) at different coronary locations on CCTA prospectively underwent QCA with FFR for each ICAS. In addition, minimal lumen area (MLA), area stenosis percentage (As%), stenosis length (Ls), plaque burden and grade of calcification circumference were evaluated on CCTA by 2 experienced readers. Kappa(k) and intraclass correlation(ICC) statistics were used for agreement between the readers and between QCA and CCTA for categorical and continuous descriptors of stenosis. Receiver operator characteristics (ROC) statistics were used to evaluate the CCTA and QCA descriptors’ values for the diagnosis of hemodynamically significant (FFR < 0.8) stenosis. Bland-Altman statistics were used to assess the correlation between CCTA and QCA assessment.

RESULTS

The inter-reader concordances (k range 0.84-0.88; p < 0.05) were excellent and correlations (ICC range 0.75-0.97; p < 0.05) were significant. A significant inter-technique correlation for MLD (r=0.633, p < 0.001) and Ds% (r=0.633, p=0.04) was found between CCTA and QCA. Best predictors for hemodynamically significant stenosis were 1.35 mm MLD and 2.15 mm² MLA for CCTA and 1.1 mm MLD and 55 Ds% for QCA, with area under the ROC curve (Az) of 0.74 and 0.74, and 0.68 and 0.60 respectively.

CONCLUSION

There is a excellent interobserver correlation for the ICAS descriptors on CCTA. Futher, the correlations between CCTA and QCA for MLD and Ds% are significant, but the diagnostic values of these descriptors in predicting hemodynamically significant stenosis are equally modest.

CLINICAL RELEVANCE/APPLICATION

Anatomical assessment of ICAS at CCTA correlates well with QCA, but predicts poorly the hemodynamical significance requiring mostly further functional assessment before treatment.

SSK03-09

Influence of Motion and Dose on Calcium Scores in IMR Reconstructed CT: A Dynamic Phantom Study

Niels R. van der Werf : Nothing to Disclose, Martin J. Willemink MD : Nothing to Disclose, Bronislaw Abramiuc : Nothing to Disclose, Tineke Petra Willems MD, PhD : Nothing to Disclose, Tim Leiner MD, PhD : Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group, Marcel Greuter PhD (Presenter): Nothing to Disclose

PURPOSE

Iterative reconstruction (IR) in computed tomography (CT) enables lowering of radiation dose while maintaining image quality with respect to conventional filtered back projection (FBP). Iterative Model Reconstruction (IMR) is a model-based algorithm, which should improve image quality further than other IR methods. Because the influence of IMR on coronary calcium scoring (CCS) is still unknown, we aimed to evaluate the influence of
motion and dose on CCS in IMR reconstructed CT.

**METHOD AND MATERIALS**

In the center of an anthropomorphic thorax phantom a calcium hydroxyapatite-containing cylinder (198.4 mm³ and 157.1 mg calcification) was translated at varying speeds by a computer controlled lever. An extension ring around the thorax was used to obtain a more realistic attenuation profile. Clinical protocol parameters for medium sized patients were used for all scans with a 256-slice CT system (Brilliance iCT, Philips Healthcare). CT data were reconstructed with filtered back projection (FBP) and IMR at three increasing noise reduction levels. Images were obtained for seven velocities of the cylinder (0 to 60 mm/s) at routine dose level, and at reduced dose levels of 40 and 80%. Each position of the setup was repeated five times with small translations. CCS was quantified as Agatston scores with vendor's software.

**RESULTS**

At 0 mm/s CCS with FBP was 422±16, 428±14 and 492±18 for routine dose, 40% and 80% reduced dose, respectively. At the highest IMR level CCS reduced with 4-6% to 400±15, 408±22 and 465±19. At 60 mm/s CCS with FBP increased with 73-94% to 861±97, 826±43 and 855±80. At the highest IMR level CCS increased with 1-5% to 905±102, 854±35 and 866±87.

**CONCLUSION**

Coronary calcium scores are overestimated up to 94% due to motion. Reduced dose levels and IMR decrease scores for low velocities, but increase at elevated velocities.

**CLINICAL RELEVANCE/APPLICATION**

Coronary calcium scoring is highly influenced by motion of the coronary artery, dose levels and iterative reconstruction and might result in wrong patient's risk estimates.

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**SSK04**

**Cardiac (Myocardial Viability and Ischemia)**

**Scientific Papers**

- **MR**
- **CT**
- **BG**
- **CA**

AMA PRA Category 1 Credits ™: 1.50

ARRT Category A+ Credits: 1.50

**Wed, Dec 3 10:30 AM - 12:00 PM   Location: S504AB**

**Participants**

- **Moderator**
  - Robert C. Gilkeson MD: Research Consultant, Riverain Technologies, LLC Research support, Koninklijke Philips NV Research support, Siemens AG

- **Moderator**
  - E. Kent Yucel MD: Nothing to Disclose

**Sub-Events**

**SSK04-01**

**Validation of Stress Myocardial Perfusion Computed Tomography in Patients with Suspected Coronary Artery Disease Using Fractional Flow Reserve: Visual Assessment and Exploration of Quantitative Parameters**

- Dong Hyun Yang MD (Presenter): Nothing to Disclose
- Joon-Won Kang MD: Nothing to Disclose
- Young-Hak Kim: Nothing to Disclose
- Namkug Kim PhD: Stockholder, Coreline Soft, Inc
- Tae-Hwan Lim MD, PhD: Nothing to Disclose

**PURPOSE**

The aim of this study was to assess the diagnostic accuracy of stress-induced computed tomography myocardial perfusion imaging (CTP) by visual and quantitative analytic methods in patients with coronary artery disease (CAD).

**METHOD AND MATERIALS**

From 197 patients with suspected CAD who underwent CTP using second-generation dual-source CT, 75 who underwent coronary angiography and FFR for 210 epicardial arteries were selected for analysis. The diagnostic accuracy of visual and quantitative CTP analyses including the transmural perfusion ratio (TPR), myocardial density, and myocardial perfusion reserve index (CT density difference between stress and rest CTP images) were assessed with reference to hemodynamically significant stenosis, which was defined as FFR ≤ 0.8 or angiographically tight stenosis judged prospectively by each operator.

**RESULTS**

From 210 epicardial arteries, hemodynamically significant stenosis was observed in 86 (41%) arteries. Per-vessel sensitivity and specificity of CTP by visual assessment were 80% and 95% in all patients, 87% and 100% in those with severe coronary calcium, and 75% and 90% in those with multivessel disease, respectively. From quantitative parameters, TPR showed the most accurate diagnostic performances with an AUC of 0.759, sensitivity of 75%, and specificity of 71%. Per-vessel sensitivity and specificity of CTP by visual assessment integrated with TPR were 93% and 84%, respectively. Mean radiation dose for CTP and CTA was 6.6 and 6.0 mSv, respectively.

**CONCLUSION**
Stress myocardial CTP appears to be a feasible method for identifying inducible ischemia in patients with suspected CAD. The diagnostic accuracy of CTP may be improved if both visual and quantitative analytic results are taken into account together.

**CLINICAL RELEVANCE/APPLICATION**

Stress myocardial CTP appears to be an accurate method for identifying inducible ischemia in patients with suspected CAD, as compared with invasive FFR. An integrated approach using visual and quantitative analysis and careful modification of the imaging protocol will improve the diagnostic accuracy of CTP.

**SSK04-02 Quantification of Late Gadolinium Enhancement in Patients with Hypertrophic Cardiomyopathy in Correlation with Serum MMP9 as an Indicator of Myocardial Fibrosis**

Maxim Avanesov MD (Presenter): Nothing to Disclose, Monica Patten: Nothing to Disclose, Julia Munch: Nothing to Disclose, Peter Bannas MD: Nothing to Disclose, Dennis Saring: Nothing to Disclose, Enver Guner Tahir MD: Nothing to Disclose, Gerhard B. Adam MD: Nothing to Disclose, Gunnar Lund MD: Nothing to Disclose

**PURPOSE**

Myocardial fibrosis is associated with abnormal cardiac remodeling and a poorer prognosis in patients with hypertrophic cardiomyopathy (HCM). We aimed to quantify myocardial fibrosis in patients with HCM by Late Gadolinium Enhancement MRI (LGE-MRI) and evaluate its correlation with serum MMP9, a marker of myocardial fibrosis.

**METHOD AND MATERIALS**

LGE-MRI was performed in 51 patients (54.9±14.2 years) with HCM by use of a 1.5 Tesla scanner (Achieva, Philips). The extent of fibrosis was measured by the HeAT software in percent of total myocardium on inversion-recovery images after injection of 0.2ml/kg gadolinium and compared with serum MMP9 levels. A serum MMP9 level of >46 ng/ml was regarded as increased. This cutoff was defined as >2 standard deviations above the mean MMP9 value of 26.3 ± 9.78ng/ml obtained from 8 healthy control patients. A myocardial signal intensity >2 standard deviations above remote myocardium was regarded as LGE which was quantified in % LV area.

**RESULTS**

80.4% of all patients with HCM (41/51) showed a mean LGE of 13.3±10.3% of LV area on MR images that significantly correlated with the serum MMP9 (R²=0.397, Spearman’s ρ= 0.63, p<0.001). In all patients, the mean MMP9 level was 54.4±35.2ng/ml. The remaining 10 patients without LGE revealed a mean MMP9 level of 29.6 ± 14.2ng/ml that was significantly lower compared to the 41 patients with LGE and levels of 59.8 ± 36.2ng/ml, p =0.01. 2 of the 10 patients (20%) without LGE had increased MMP9 levels.

**CONCLUSION**

The extent of LGE significantly correlated with the serum fibrosis marker MMP9, underlying its value as indicator of myocardial fibrosis and poor outcome of patients with HCM. No patient had increased fibrosis on LGE-CMR and normal MMP9, so that an increased MMP9 makes myocardial fibrosis visible by LGE probable. 2 patients with a mismatch of LGE and MMP9 levels (no LGE, increased MMP9) might have a diffuse fibrosis that is not detectable by standard LGE-CMR.

**CLINICAL RELEVANCE/APPLICATION**

In patients with HCM the size of LGE correlates well with the serum myocardial fibrosis marker MMP9, so that increased MMP9 levels may predict the detection of LGE as well as poor clinical outcome.

**SSK04-03 T2 Star(T2*) Sequences and T2 Stir Sequences in the Evaluation of Intramyocardial Hemorrhage (IMH) in Patients with Myocardial Infarction After PCI**

Giulia Benedetti (Presenter): Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose, Anna Damascelli MD: Nothing to Disclose, Mariangela Cava MD: Nothing to Disclose, Antonio Esposito MD: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose

**PURPOSE**

Microvascular obstruction (MVO) phenomenon is a well known negative prognostic factor for STEMI pts, it is due to several factors, among them intramyocardial hemorrhage (IMH) plays an important role. IMH seems to be associated with worse infarction and adverse outcome, even if its incidence and its role need to be confirmed. Our aim was to investigate the ability to detect IMH through T2 STIR and T2*.

**METHOD AND MATERIALS**

All STEMI pts enrolled in our study underwent percutaneous coronary intervention (PCI) and CMR within 5 days from the acute event. All pts underwent a CMR examination with Late Gadolinium Enhancement sequences (LGE) and T2 STIR sequences, a subgroup underwent also T2* images. CMR criteria for MVO was the presence of a hypointense region within the infarcted area on LGE. IMH was visualized on T2 STIR and T2* as an hypointense region within the hyperintense infarcted area, in the corresponding area of MVO on LGE.

**RESULTS**
55 pts were enrolled in the study, 22 of whom underwent also T2*. Thirty-eight pts out of 55 had MVO at LGE (65%), and 18 pts of them had hemorrhage on T2 STIR (31%). In the subgroup of 22 pts who underwent T2*, 13 had evidence of MVO at LE, 8 pts showed IMH at T2 STIR, and 10 showed IMH at T2*. All pts with MVO had LGE. All pts with hemorrhage on T2 STIR had hemorrhage also at T2*, and the percentage of IMH was higher in T2* sequences than in T2 STIR (T2*: 3.09%± 2.42 ; T2 STIR: 1.00% ± 1.92). Two pts had evidence of IMH on T2* without having IMH on T2 STIR. Patients with IMH at T2 STIR had higher MVO % at LGE than pts without IMH (6.56 ± 5.01 vs 1.86 ± 2.89, p=0.001). Also pts with IMH at T2* had higher MVO % at LGE than pts without IMH (7.30 ±5.92 vs 0.75 ± 1.76, p=0.010).

CONCLUSION
Both T2 STIR and T2* sequences are reliable to detect the presence of IMH. T2* showed higher sensitivity, being able to identify more pts with IMH than T2 STIR and with more IMH %. IMH is strictly linked to MVO, and tends to occur in pts with higher MVO extension.

CLINICAL RELEVANCE/APPLICATION
T2 STIR and T2* are reliable sequences in the identification of IMH in STEMI patients.

SSK04-04
Diagnostic Accuracy of Endocardial-to-Epicardial Myocardial Blood Flow Ratio for Detecting Significant Coronary Artery Disease with Dynamic Myocardial Perfusion Dual-Source CT.

Yoshitaka Goto MD (Presenter): Nothing to Disclose, Kakuya Kitagawa MD, PhD : Nothing to Disclose, Mio Uno MD : Nothing to Disclose, Shiro Nakamori MD : Nothing to Disclose, Motonori Nagata MD, PhD : Nothing to Disclose, Masaki Ishida MD, PhD : Nothing to Disclose, Yasutaka Ichikawa MD : Nothing to Disclose, Hajime Sakuma MD : Research Grant, Siemens AG Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Guerbet SA

PURPOSE
Dynamic myocardial perfusion dual-source CT (DSCT) allows for voxel-wise measurement of myocardial blood flow (MBF) of entire LV myocardium. Although previous DSCT studies used absolute MBF in mL/100g/min as a threshold to discriminate flow-limiting coronary artery disease (CAD), absolute MBF can be variable due to multiple factors other than physiological significance of coronary stenosis. Since the endocardial layer of LV myocardium is most susceptible to ischemia, transmural perfusion ratio (TPR) of absolute MBF may be a more useful indicator of flow-limiting CAD. The purpose of this study was to compare the diagnostic performances of absolute MBF and TPR for predicting flow-limiting CAD as defined by fractional flow reserve (FFR).

METHOD AND MATERIALS
Thirty-three patients (68.2±8.5 years old; 26 males) without history of myocardial infarction underwent stress dynamic perfusion DSCT and invasive coronary angiography (CAG) within 90 days. Endo- and epicardial MBF in 16 segments were obtained from the quantitative analysis of DSCT perfusion datasets. Minimal endocardial MBF (endo-MBF) and minimal TPR within each of the LAD, LCX and RCA territory were used for analysis. Flow-limiting CAD was defined as luminal diameter stenosis of >90% on CAG or lesion with FFR of ≤0.8. Diagnostic performance of stress DSCT perfusion was assessed in 91 vessel territories after exclusion of 8 moderately (50-90%) stenosed vessels where FFR measurements were not available.

RESULTS
Territories with flow-limiting CAD (39/91, 42.9%) showed significantly lower endo-MBF and TPR than those without (endo-MBF: 65.6±23.7 vs 82.5±27.0 mL/100ml/min, p=0.0009; TPR: 0.77±0.20 vs 0.95±0.19, p<0.0001). The area under the ROC curve of TPR was significantly greater than that of endo-MBF for detecting flow-limiting CAD (0.857 vs 0.702, p=0.016). With a cut-off value of 0.902, TPR showed sensitivity of 87.7% and specificity of 82.7%.

CONCLUSION
Endocardial-to-mean epicardial ratio of absolute MBF quantified by stress dynamic DSCT perfusion demonstrated higher diagnostic performance for discriminating flow-limiting CAD compared to absolute endocardial MBF.

CLINICAL RELEVANCE/APPLICATION
Accurate assessment of hemodynamic significance of coronary artery stenosis can be achieved by stress dynamic perfusion CT with analysis of transmural perfusion ratio of absolute MBF.

SSK04-05
Adenosine-stress Dynamic Myocardial CT Perfusion Imaging for Detection of Significant Coronary Artery Stenosis: Comparison of a 128-slice Dual-source CT with Reduced Dynamic Scan Duration and 1.5-T MRI

Sung Mok Kim MD (Presenter): Nothing to Disclose, Seong-Yoon Ryu MD : Nothing to Disclose, Yoon Ki Cha MD : Nothing to Disclose, Yeon Hyeon Choe MD, PhD : Nothing to Disclose

PURPOSE
The aim of this study was to compare the diagnostic performance of adenosine-stress dynamic myocardial CT perfusion (CTP) using reduced dynamic scan duration with cardiac magnetic resonance perfusion imaging (MRP) for detection of significant coronary artery stenosis.
METHOD AND MATERIALS

This prospective study included 102 symptomatic patients (62 10 years, 77% males) with suspected coronary arteries diseases who underwent adenosine-stress dynamic perfusion imaging using a 128-slice dual-source CT and a 1.5–T MRI. Patients were randomized to dynamic CTP protocols with 30-second (n = 52) or 21-second scan duration (n = 50). Invasive coronary angiography (ICA) was performed after imaging studies. Significant stenosis was considered as ≥ 70% diameter stenosis. All estimates of diagnostic accuracy of perfusion GT and MRI were calculated using ICA as a reference standard.

RESULTS

On a patient-based analysis, the concordance of CTP and MRP interpretations was 86% (κ = 0.72). In each group, the sensitivity and specificity were as follows: CTP (21-second scan duration) - 81% and 94%, MRP - 75% and 94%; CTP (30-second scan duration) - 81% and 86%, MRP - 87% and 86%, respectively. The sensitivity and specificity of CTP and MRP were not significantly different in both protocols. CTP with shorter scan duration resulted in a 23% reduction of radiation dose compared with 30-second scan protocol (4.4 mSv vs. 5.8 mSv, P < 0.001).

CONCLUSION

Dynamic-stress CTP is comparable to MRP in the detection of significant coronary stenosis (> 70%). CTP with a shorter dynamic scan duration shows similar diagnostic accuracy compared with a standard scan duration technique and reduces radiation dose to patients in dynamic CTP acquisition.

CLINICAL RELEVANCE/APPLICATION

Dynamic CTP with shorter scan duration makes patients easier to take exam and it reduces radiation exposure. This shorter dynamic CTP protocol is recommended for widespread use in the clinical practice.

Impact of Intramyocardial Hemorrhage on LV Remodeling in Reperfused Acute Myocardial Infarction

Marc Sirol MD, PhD (Presenter): Nothing to Disclose, Raphael Dautry MD: Nothing to Disclose, Damien Logeart: Nothing to Disclose, Jean-François Deux: Nothing to Disclose, Anthony Dohan MD: Nothing to Disclose, Elie Mousseaux: Nothing to Disclose, Helene Vernhet-Kovacsik MD, PhD: Nothing to Disclose, Herve Pierre Rousseau MD: Nothing to Disclose, Philippe Alain Soyer MD, PhD: Research Consultant, Guerbet SA Research Consultant, Ipsen SA

PURPOSE

Left ventricular (LV) remodeling associated with low LV ejection fraction following reperfused acute myocardial infarction (AMI), may occur in some patients. We investigated the prognostic value of infarct size (IS), extent of microvascular obstruction (MVO) and intramyocardial hemorrhage (IMH) as assessed by comprehensive cardiovascular magnetic resonance (CMR).

METHOD AND MATERIALS

Two hundred patients underwent cardiovascular magnetic resonance at 1.5 Tesla with T2-weighted and T2* imaging and late gadolinium enhancement at 4 days +/-2 and 6 months follow-up following primary percutaneous coronary intervention for AMI. LV remodeling was defined as an increase >20% of left ventricle end-systolic volume (EDV) at follow-up.

RESULTS

All patients were analyzed. LV remodeling was observed in 67 patients (33%). 94 patients (47%) presented with Anterior AMI, 46 with Lateral (23%) and 58 with Inferior MI (29%). Mean age was 53+/-11y.o (78% male). Mean delay for reperfusion therapy was 116+/-102min. Despite identical EDV, patients with LV remodeling had lower LVEF at baseline (45%+/-7 vs 51+/-8, p<0.01), a bigger IS (42g+/-20 vs 32g+/-20; p<0.01) and MVO extent (p<0.01). By multivariate analysis, IMH (OR=2.9[1.3-6.3]) and IS (OR=3.1[1.8-12.3]) were identified as independent predictors of LV remodeling.

CONCLUSION

Presence of IMH assessed by T2* CMR significantly influences LV remodeling. IS and IMH are independent predictors of LV remodeling following reperfused AMI.

CLINICAL RELEVANCE/APPLICATION

Despite progresses in reperfusion therapy in acute myocardial infarction, some patients may evolve toward severe heart failure. Cardiac magnetic resonance imaging may be useful in detecting such patients at a very early stage after myocardial reperfusion. Infarct size and presence of intra-myocardial hemorrhage are predictive factors of LV remodeling and adverse cardiovascular events.

Comparison of Diagnostic Performance of CT Myocardial Perfusion with Rb-82 PET MPI

Joao Rodrigues Inacio MD (Presenter): Nothing to Disclose, Dwivedi Girish: Nothing to Disclose, Manuja Premaratne: Nothing to Disclose, Terry Ruddy: Research Grant, Nordion, Inc Research Grant, General Electric Company, Robert Beanlands: Nothing to Disclose, Benjamin Chow MD: Research Grant, General Electric Company Support, TeraRecon, Inc

PURPOSE

SSK04-06

SSK04-07
PURPOSE
Vasodilator contrast-enhanced MDCT Myocardial Perfusion Imaging (CT-MPI) has been used for the identification of perfusion abnormalities as a surrogate of myocardial ischemia. Rubidium 82 Positron Emission Tomography Myocardial Perfusion Imaging (Rb PET MPI) is considered the gold standard for the assessment of myocardial ischemia in CAD. Our goal was to compare the diagnostic accuracy of Rest/ Vasodilator Stress CT-MPI with vasodilator Stress/ Rest Rb PET in identification myocardial ischemia in patients with diagnosed or suspected CAD.

METHOD AND MATERIALS
CT-MPI in rest and during intravenous Dipyridamole infusion and rest/adenosine stress Rb PET MPI acquired within 30 days were performed in 45 patients. The extent and severity of perfusion defects on Rb PET-MPI were assessed: 1) qualitatively on a 5-point scale in a standard 17-segment model, and automated calculation of Summed Stress Score (SSS), Summed Rest Score (SRS), and Summed Difference Score (SDS). The extent and severity of perfusion defects on CT-MPI was visually assessed by 2 observers using the same grading scale and expressed as SRS, SSS and SDS. A SDS ≥1 in at least two contiguous myocardial segments was considered diagnostic for the presence of ischemia. CT-MPI was compared with Rb PET as the gold standard, with test comparisons performed on a per territory and per patient basis.

RESULTS
On a per-patient basis, there was moderate agreement between CT-MPI and Rb PET-MPI with a kappa of 0.44 for detection of stress perfusion abnormalities. Using Rb PET as a reference, CT MPI had 89% sensitivity (SS), 59% specificity (SP), 71% accuracy (AC), 89% negative predictive value (NPV), and 59% positive predictive value (PPV) to diagnose perfusion deficits on a per patient basis. On a per territory analysis, CT MPI had 73% SS, 66 % SP, 67% AC, 91% NPV, and 34% PPV to diagnose perfusion deficits using Rb PET as a reference standard. CT MPI versus Rb PET MPI had an area under the ROC curve (AUC) of 0.74 and 0.70 for diagnosis of ischemia on a per patient basis and per territory respectively.

CONCLUSION
Stress reversible myocardial perfusion deficit assessed by CT-MPI shows good correlation with PET-MPI in identification of myocardial ischemia.

CLINICAL RELEVANCE/APPLICATION
Stress vasodilator CT- MPI has the potential to identify and characterize coronary artery stenosis and myocardial ischemia in a single study.

SSK04-08
Cardiac Magnetic Resonance Predicts Left Ventricle Remodeling after Myocardial Infarction: The Role of Microvascular Obstruction

Anna Damascelli MD (Presenter): Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose, Antonio Esposito MD: Nothing to Disclose, Giulia Benedetti: Nothing to Disclose, Paolo Guido Camici: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose

PURPOSE
Cardiac magnetic resonance (CMR) has been recognized as the gold standard technique for in vivo evaluation of myocardial damage in patients with ST-elevation myocardial infarction (STEMI), but its role in prognostic stratification is still under investigation. Great attention has recently been directed on microvascular obstruction (MVO). The aim of this study is to evaluate how MVO impacts on left ventricle remodeling.

METHOD AND MATERIALS
This is an ongoing prospective study in which 58 consecutive STEMI patients, admitted to our ER, were enrolled. Patients were treated with PCI and underwent a first CMR study (1.5 T magnet) within 5 days from the infarction. A subgroup underwent a second CMR as well, after 6 months. The main morpho-functional CMR parameters were assessed on both CMR study. Left ventricle end-diastolic and end-systolic volume variation between the second and the first CMR (ΔEDV and Δ ESV) were used as parameters of left ventricle remodeling. The criteria for MVO were a sub-endocardial lack of enhancement on first-pass perfusion and the presence of a hypointense region, within the area of infarction, on late gadolinium enhancement (LGE) sequences.

RESULTS
A group of 16 patients (age 59±8 yrs; 15 male and 1 female) underwent both CMR studies. Patients with MVO showed a significant increase in EDV and ESV compared to patients without MVO (ΔEDV=34±32ml, p=0.004 vs ΔEDV=4.5±16ml, p=0.6 and Δ ESV=15±19 ml, p=0.018 vs Δ ESV=1±15ml, p=0.9). At regression analysis MVO, LGE and perfusion defect significantly correlated with ΔEDV (MVO%: p<0.001; R-square=0.72; LGE%: p=0.006, R-square=0.42; perfusion defect%: p=0.001; R-square=0.55 and Δ ESV (MVO%: p<0.001; R-square=0.64; LE%: p=0.03, R-square=0.3; perfusion defect%: p=0.005; R-square=0.44). Otherwise at multivariate analysis only MVO% presented a significant relation with ΔEDV (p=0.035) and Δ ESV (p=0.039).

CONCLUSION
These preliminary data suggest that MVO is involved in left ventricle remodeling after myocardial infarction with a stronger effect on left ventricle enlargement than LE.

CLINICAL RELEVANCE/APPLICATION
Determining Microvascular Obstruction and Infarct size with Steady-state Free Precession Imaging
Cardiac MRI

PURPOSE
In cardiac MRI (cMRI) injection of contrast medium may be performed prior to the acquisition of cine steady-state free precession (SSFP) imaging to speed up the protocol and avoid delay before late Gadolinium enhancement (LGE) imaging. Aim of this study was to evaluate whether a condensed clinical protocol with contrast cine SSFP imaging is able to detect early microvascular obstruction (MO) and determine the infarct size compared to the findings of LGE inversion recovery sequences.

METHOD AND MATERIALS
The study complies with the Declaration of Helsinki and was performed following approval by the ethic committee of the University of Erlangen-Nuremberg. Written informed consent was obtained from every patient. 68 consecutive patients (14 females/54 males) with acute ST-elevation myocardial infarction (STEMI) treated by percutaneous coronary revascularization were included in this study. CMRI was performed 6.6±2 days after symptom onset and MO and infarct size in early contrast SSFP cine imaging were compared to LGE imaging.

RESULTS
MO was detected in 47/68 (69%) patients on cine SSFP and in 41/68 (60%) patients on LGE imaging. In 6 patients MO was found on cine SSFP imaging but was not detectable on LGE imaging. Infarct size on cine SSFP showed a strong agreement to LGE imaging (intraclass correlation coefficient [ICC] of 0.96 for enddiastolic, p<0.001 and 0.96 for endsystolic, p<0.001 respectively). Significant interobserver agreement was found measuring enddiastolic and endsystolic infarct size on cine SSFP imaging (p<0.01).

CONCLUSION
In patients after STEMI infarct size and presence of MO can be detected with contrast cine SSFP imaging. This could be an option in patients who are limited in their ability to comply with the demands of a cMRI protocol.

CLINICAL RELEVANCE/APPLICATION
MO size is slightly overestimated on contrast enhanced cine SSFP imaging in particular in the case of larger MO areas, contrast enhanced cine SSFP imaging was able to detect all cases with MO on LGE imaging and could therefore indeed serve as a back-up if LGE imaging should not be evaluable.

SSK04-09

Cardiac MRI: Prevalence of Late Gadolinium Enhancement in Dependency on the Agatston Coronary Artery Calcium Score (Station #1)


PURPOSE
To assess the prevalence and pattern of myocardial late gadolinium enhancement (LGE) in dependency on the Agatston coronary artery calcium (CAC) score in an asymptomatic screening population.
METHOD AND MATERIALS

250 asymptomatic subjects (mean age 64±7 years) were selected from a large population-based screening study in accordance to their Agatston score (group 1: score 0, group 2: score 1-100, group 3: score 101-400, group 4: score 401-1000, group 5: score > 1000). LGE was assessed at 1.5 T. Images were evaluated by two experienced blinded observers in consensus, and in case of LGE its pattern was classified as ischemic or non-ischemic. The prevalence of ischemic and non-ischemic LGE was calculated for each CAC group. Numbering predefined CAC categories serially, we used logistic regression to calculate odds ratios (OR) with 95% confidence intervals (95%CI) for presence of LGE with increase by one CAC category. Results were adjusted for sex and age. Subjects were followed up for a median time of 1.5 years.

RESULTS

An ischemic pattern of LGE was observed in 6% (group 1: 4%, group 2: 0%, group 3: 2%, group 4: 8%, group 5: 16%), and an non-ischemic pattern in 12% (group 1: 10%, group 2: 20%, group 3: 4%, group 4: 13%, group 5: 13%) of the subjects. Statistical analysis showed a positive association between ischemic LGE and the Agatston score (OR 1.71, 95%CI 1.01-2.89, p=0.048), but no association between non-ischemic LGE and the Agatston score (OR 0.84, 95%CI 0.61-1.16, p=0.29). 3 subjects had a major adverse cardiac event (MACE; all non-lethal myocardial infarction) during follow up. All these subjects showed a non-ischemic LGE. Among those, one had only mild coronary calcifications (Agatston score 81), the other two showed distinct coronary calcifications (Agatston scores 489 and 1474, respectively).

CONCLUSION

A relatively high prevalence of LGE (especially of non-ischemic LGE) can be found in asymptomatic subjects independently from their coronary calcium score. Since we observed MACE in particular in subjects with LGE, cardiac MRI seems to be meaningful for risk stratification of asymptomatic patients.

CLINICAL RELEVANCE/APPLICATION

The assessment of structural myocardial damages by means of cardiac MRI is meaningful in risk stratification of asymptomatic patients independent from their Agatston coronary calcium score.

Coronary Risk Stratification in Asymptomatic Population: Impact of Cardiac CT (Station #2)

Damiano Caruso MD (Presenter): Nothing to Disclose, Marco Rengo MD: Nothing to Disclose, Luca Bertana MD: Nothing to Disclose, Tommaso Biondi: Nothing to Disclose, Domenico De Santis MD: Nothing to Disclose, Andrea Laghi MD: Speaker, Bracco Group Speaker, Bayer AG Speaker, General Electric Company Speaker, Koninklijke Philips NV

PURPOSE

To demonstrate the impact of cardiac CT (CTCA) in the stratification of cardiovascular risk in a population of asymptomatic patient with classic risk factors for coronary artery disease (CAD) compared to the systematic coronary risk evaluation (SCORE).

METHOD AND MATERIALS

We included 123 asymptomatic patients (97 men/ 26 women; age 51.3 ±7.2) who underwent CTCA after clinical evaluation during which a risk for cardiovascular events in 10 years with the SCORE was calculated. Calcium score was also evaluated. Three possible outcomes were hypotized: patient with no CAD, patients with non-significant coronary stenosis, and patients with significant coronary stenosis. On the basis of CACA results, we developed a simulation model to evaluate the effect on patient management.

RESULTS

The pretest risk of cardiovascular events in the asymptomatic population was 1.06%. The average value of calcium score was 56.48 ± 176.61 (moderate risk). We found 17 patients with significant coronary stenosis who underwent coronary revascularization. Over 50 patients with non-significant coronary stenosis, and patients with significant coronary stenosis. On the basis of CACA results, we developed a simulation model to evaluate the effect on patient management.

CONCLUSION

We demonstrated an hypothetical reduction of the average risk for cardiovascular events using cardiac CT.

CLINICAL RELEVANCE/APPLICATION

Better stratification of cardiovascular risk using Cardiac-CT.

Extra-Coronary Thoracic Calcification on Chest CT for Cardiac Risk Assessment: The "CT Risk" Study (Station #3)

Timm Dirrichs (Presenter): Nothing to Disclose, Tobias Penzkofer MD: Nothing to Disclose, Sebastian Reinartz MD: Nothing to Disclose, Thomas Kraus MD: Nothing to Disclose, Andreas Horst Mahnken MD: Nothing to Disclose, Christiane Katharina Kuhl MD: Nothing to Disclose

PURPOSE

Goal was to establish extra-coronary thoracic calcification (ECC) as surrogate marker for coronary-artery calcification (CAC) and coronary-heart disease (CHD) which can be evaluated in chest computed tomography.
METHOD AND MATERIALS

501 males (67 ± 8 years) with history of asbestos exposure underwent low-dose, non-cardiac-gated chest-CT for lung-cancer-screening. Qualitative (ECC prevalence) and quantitative (ECC score [ECCS]) was correlated with (a) qualitative and quantitative CAC measures; (b) prevalence of cardiovascular risk-factors, and (c) history of CHD.

RESULTS

Prevalence of ECC correlated significantly with prevalence of CAC, with cardiovascular risk-factors, and with CHD (r = 0.5; p < 0.001). ECCS was significantly higher (mean 4462 ± 8319, median 2153) in subjects with CHD (n=63) than in subjects without CHD (n=438; mean 2075 ± 3333, median 780), p<0.001. The negative predictive value (NPV) of ECC in CHD-exclusion was 99.3% (95% CI, 93.9–99.9%) with a diagnostic OR of 25.54, p < 0.001).

CONCLUSION

In this cohort of workers with asbestos exposure, ECC proved to be an independent predictor of both, CAC and CHD. ECC correlates with classical cardiovascular risk-factors and is a powerful tool to exclude subclinical CHD. ECC can be reliably evaluated in chest CT studies acquired for non-cardiac purposes (e.g. lung cancer screening), and can be used to monitor patients in whom CAC is difficult or impossible to assess e.g. after coronary-stenting or CABG.

CLINICAL RELEVANCE/APPLICATION

ECC score, calculated by summation of extra-coronary calcifications, is a useful surrogate for a subject’s CAC-level, and can also serve as direct predictor of a patient’s cardiovascular risk.

CAS213

In Vivo Measurement of Effective Atomic Number for Coronary Arterial Calcification in Non-dialysis Patients with Coronary CT Angiography by ECG-gated Single-source Dual-energy CT with Fast kVp Switching (Station #4)

Haruhiko Machida MD (Presenter): Nothing to Disclose, Isao Tanaka: Nothing to Disclose, Rika Fukui: Nothing to Disclose, Takuya Ishikawa: Nothing to Disclose, Etsuko Tate: Nothing to Disclose, Eiko Ueno MD: Nothing to Disclose, Yun Shen PhD: Employee, General Electric Company Researcher, General Electric Company

PURPOSE

Ex vivo studies have suggested hydroxyapatite (HA) as the major component of calcification in the coronary arteries (CAC). We retrospectively measured the effective atomic number (EAN) of CAC in coronary CT angiography (CCTA) images of non-dialysis patients obtained using ECG-gated single-source dual-energy CT with fast kVp switching (Gemstone Spectral Imaging [GSI] Cardiac) to identify the major component of CAC.

METHOD AND MATERIALS

For 52 consecutive non-dialysis patients who underwent CCTA by GSI Cardiac, we reconstructed monochromatic CCTA images at 65 keV with 0.625-mm slice thickness and 5-cm field of view. We measured the median EAN for CAC in regions of interest (ROIs) placed within the CAC to avoid error from partial volume averaging and calculated the average of this EAN for all the ROIs. Similarly, we placed 9 ROIs within a high purity (≥ 98%) HA pellet on the surface of a cardiac phantom to measure the mean EAN for HA. We compared the in vivo EAN for CAC with the in vitro EAN for HA and in vivo EAN previously determined by GSI for calcium oxalate monohydrate (COM, 11.2-14.4), a possible CAC component.

RESULTS

We measured the EAN for CAC in 177 ROIs from 48 non-dialysis patients (29 men, 19 women; mean age, 69 ± 9 years), since no CAC was identified in the remaining 4 patients. The average of the median in vivo EAN for CAC was 13.8 ± 0.8 (95% confidence interval, 13.7-13.9), which is near the theoretical EAN for COM (13.8) and equivalent to the in vivo EAN for COM (11.2-14.4) in 144 ROIs (81.4%). This value was lower than 11.2 in one ROI (0.6%) and higher than 14.4 in 32 ROIs (18.1%). The mean in vivo EAN for HA was 16.5 ± 0.1 (range, 16.1-16.6), similar to the theoretical EAN for HA (16.1) and higher than the EAN for CAC in all 177 ROIs (100%).

CONCLUSION

The EAN for CAC in non-dialysis patients with CCTA obtained by GSI Cardiac is often equivalent to that for COM and lower than that for HA.

CLINICAL RELEVANCE/APPLICATION

Using a pair of iodine and COM as the major CAC component, more frequently than HA, imaging of material decomposition may be useful for acquiring CAC-free CCTA by GSI Cardiac.

CAS214

T2 Mapping in Cardiac MRI based on Multi Echo Turbo Spin Echo: A New Mapping Method (Station #5)

Patrick Krumm: Nothing to Disclose, Petros Martirosian PhD: Nothing to Disclose, Tanja Zitzelsberger
CAS215

Comparison of Multi-modality Imaging for Risk Stratification of Cardiovascular Events in Asymptomatic Adults (Station #6)

Jihoon Bae (Presenter): Nothing to Disclose, Yeo Goon Kim MD: Nothing to Disclose, Jeong A Kim MD: Nothing to Disclose, Sang Il Choi MD: Nothing to Disclose, Eun Ju Chun: Nothing to Disclose

PURPOSE

To compare the prognostic value of coronary CT angiography (CCTA) compared to coronary artery calcium scoring (CACS) and carotid intimal-medial thickness (CIMT) or plaque on carotid doppler for risk stratification of cardiovascular disease (CVD) in asymptomatic adults.

METHOD AND MATERIALS

From ESCORT cohort of 5,142 asymptomatic adults, 1,577 adults (1121 male, mean age 55.9±8.5 years) who underwent carotid Doppler, CACS and CCTA were assessed for CVD (cardiac death, nonfatal myocardial infarction, unstable angina, stroke and coronary late revascularization). CIMT > 10mm or plaque at common carotid or internal carotid artery were indicated for positive carotid doppler. CCTA images were analyzed as the plaque type (noncalcified, mixed, calcified and high-risk plaque) and the degree of stenosis with per-patient (0, 1-49%, 50-69%, > 70%), per-vessel (0 to 3 vessels) and per-segment (segment stenosis score [SSS]). The prediction power for CVD at each modality were compared using area under the receiver-operating characteristic curve (AUC).

RESULTS

During of 75 ±11 months of follow-up, CHD occurred in 52 subjects (3.3%). By univariate analysis, all stenosis degree with per-patient (hazard ratio [HR], 4.37; 95% confidence interval [CI], 3.43 to 5.56), per-vessel (HR, 4.55; 95% CI, 3.52 to 5.87) and per-segment (HR, 1.42; 95% CI, 1.34 to 1.49) were associated with increased risk of CVD. Plaque type also associated with CVD, mixed or calcified plaque (HR, 15.6; 95% CI, 5.4 to 44.9), NCP (HR, 31.1; 95% CI, 10.2 to 94.4) and high risk plaque (HR, 61.3, 95% CI, 18.9 to 193.2) show incrementally increased risk (all p < 0.05). Beyond FRS (AUC 0.68), additional CIMT (0.67) did not increase the prediction for CVD. However, additional CACS (0.71) and CCTA (0.77) improved prediction for CVD.

CONCLUSION

For risk stratification of CVD in asymptomatic adults, CCTA shows incremental prognostic value over additional
CAC or CIMT with FRS.

**CLINICAL RELEVANCE/APPLICATION**

CCTA might have a potential as non-invasive imaging tool for risk stratification of cardiovascular disease in asymptomatic adults.

**CAS216**

**Hemodynamic Assessment of Pulmonary Artery on Smokers with 3.0T Phase-contrast MR Imaging: Initial Experience (Station #7)**

**Ruyi Bao MD (Presenter):** Nothing to Disclose, **Guanfu Liu MD:** Nothing to Disclose, **Zhiyong Li:** Nothing to Disclose, **Ying Ge MD:** Nothing to Disclose, **Ailian Liu MD:** Nothing to Disclose

**PURPOSE**

To quantitatively investigate pulmonary blood flow of main pulmonary artery and its changes induced by smoking with 3.0T phase-contrast MR imaging (PC-MRI).

**METHOD AND MATERIALS**

Ten smokers with smoking history more than 25 years and ten non-smokers, who all were man in middle age and had no detectable intrinsic lung and heart disease, underwent PC-MRI of main pulmonary artery. Main measurement parameters included peak positive velocity, average flow, average positive flow and distensibility on Report Card 4.0 software. We quantitatively evaluated Hemodynamic changes of pulmonary artery between smokers and non-smokers.

**RESULTS**

Average flow (62.16±8.83ml/beat) and average positive flow (65.94±9.27ml/beat) of main pulmonary artery in smokers group were significantly lower than these (86.90±9.29 and 93.30±8.07 ml/beat) in non-smokers group, (t=-3.93, p=0.02; t=-4.70, p=0.01). Meanwhile, Peak positive velocity (98.33±29.29cm/s) and distensibility (33.44±4.46) of main pulmonary artery in smokers group were also lower than these (124.33±34.29cm/s and 40.43±20.03) in non-smokers group, but there were no statistical differences between them (t=1.14, P=0.29; t=0.84, P=0.41).

**CONCLUSION**

The findings of this study suggest that PC-MRI may reflect pulmonary blood flow change induced by smoking, which is useful to quantitatively evaluate and monitor pulmonary blood flow change in smokers.

**CLINICAL RELEVANCE/APPLICATION**

A better quantitative evaluation of the pathophysiological change of pulmonary circulation induced by smoking helps to monitor pulmonary hypertension and guide smoking cessation.

**CAE104**

**Knowledge and Skills Required to Evaluate Ischemic Heart Disease by Using Artifact-free Coronary CT Angiography (Station #8)**

**Isao Tanaka (Presenter):** Nothing to Disclose, **Haruhiko Machida MD:** Nothing to Disclose, **Rika Fukui:** Nothing to Disclose, **Yun Shen PhD:** Employee, General Electric Company Researcher, General Electric Company, **Eiko Ueno MD:** Nothing to Disclose

**TEACHING POINTS**

1. To review the causes and manifestations of various artifacts in coronary CT angiography (CCTA), categorized into patient, CT equipment, and other factors.
2. To illustrate novel techniques and approaches for reducing these artifacts in CCTA.
3. To demonstrate the usefulness of these techniques and approaches for reducing these artifacts by presenting clinical cases.

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Sub-Events

**CAS217**

The Presence of Myocardial Fibrosis is a Stronger Predictor of MACE than Occurrence of Non Sustained Ventricular Tachycardia in Cases of Hypertrophic Cardiomyopathy without Obstructed Coronary Arteries (Station #1)

Hiroyuki Takaoka MD, PhD (Presenter): Nothing to Disclose, Nobusada Funabashi MD, PhD: Nothing to Disclose, Koya Ozawa MD: Nothing to Disclose, Yoshio Kobayashi: Nothing to Disclose

**PURPOSE**

To compare the value of non sustained ventricular tachycardia (VT) (NSVT) and myocardial fibrosis (MF) in risk stratification for major adverse cardiac events (MACE) in hypertrophic cardiomyopathy (HCM) patients without obstructed coronary arteries.

**METHOD AND MATERIALS**

We selected 59 consecutive HCM patients (38 male, 61±15 years), who underwent cardiac CT (Light speed 16, GE Healthcare or Aquilon One, Toshiba Medical) and 24 hours of ECG monitoring within 12 months between 2002 and 2009. Patients had no significant luminal coronary artery stenosis (>50%) on CT, or previous myocardial infarction. If a contrast defect was observed in early phase CT images of the myocardium, a late phase acquisition was added. If abnormal late enhancement was observed at a corresponding site, we diagnosed MF. NSVT was defined as ≥ 3 consecutive, premature, ventricular beats. Patients were followed for a median of 41 months after CT for MACE. MACE included cardiac death, heart failure, sustained VT (continued > 30 seconds), ventricular fibrillation and appropriate discharge of Implantable cardioverter defibrillators.

**RESULTS**

NSVT was detected in 26 patients. There was no significant difference in MACE between patients with and without NSVT (15% and 12%; P=0.98, respectively). No significant differences between HCM patients, with and without VT, were seen, at each time point and when the whole period of follow-up was compared with a Kaplan-Meier and log rank test (P=0.71). MF was detected by CT in 34 patients. Patients with MF had a higher risk of MACE (24%) than those without (0%; P=0.03). Significant differences between HCM patients, with and without MF, were also seen at each time point and when the whole period of follow-up was compared with a Kaplan-Meier and log rank test (P=0.01).

**CONCLUSION**

MF is a stronger predictor of MACE than NSVT in HCM patients without obstructed coronary arteries following a median of 41 months.

**CLINICAL RELEVANCE/APPLICATION**

Detection of focal MF on CT may be useful to predict the risk of MACE in HCM patients without obstructed coronary arteries. MACE did not occur in HCM patients without obstructed coronary arteries and MF.

**CAS218**

Predicting the Image Noise Level of the Low Kilovoltage Prospective ECG-gated CT Coronary Angiography: Quantitative Measurement of Thoracic Component versus Body Mass Index (Station #2)

Chul hwan Park MD (Presenter): Nothing to Disclose, Hyung Min Kim: Nothing to Disclose, Donghyun Hong MS: Nothing to Disclose, Tae Hoon Kim MD: Nothing to Disclose

**PURPOSE**

To evaluate the influence of quantitatively measured thoracic components on the image noise of low dose cardiac CT and compare with that of BMI.

**METHOD AND MATERIALS**

Ninety-three patients (M:F = 65: 28, mean age = 54.8 ± 8.4 years) who underwent low kVp prospective ECG-gated CTCA and low dose chest CT were enrolled and analyzed retrospectively. All CTCA was performed on a 128-slice CT scanner (Ingenuity Core 128, Philips Healthcare, The Netherlands) with an iterative reconstruction technique (iDose4). The scanning parameters were as follows: step-and-shoot axial scanning, 420-ms gantry rotation time, 100 kV, 150 mA, 64 x 0.625-mm slice collimation). The image noise of CTCA was determined by the standard deviation of the attenuation value in an ROI that was placed on the aortic root, just above the orifice of left main coronary artery. On the low dose chest CT, the areas of thoracic components were measured at the same level using auto-segmentation technique with various threshold levels as follows: Lung (Quantitatively Measured Area of Lung (QMAlung): -910 HU ~ -200 HU), Fat (QMAfat: -200 HU ~ 0 HU), Soft tissue (QMAsoft tissue: 0 HU ~ 300 HU), and Bone (QMAbone: 300 HU ~ 1000HU). The relationship between image noise and various parameters including body weight, BMI, and various QMAs were analyzed. The linear correlation coefficients between parameters and noise were compared as the indicator of the association strength.
 RESULTS

The mean image noise in the aorta root was 46.8±10.2 HU. In 93 patients, a linear correlation coefficient of BMI was 0.682 and that of QMA (Fat+Soft tissue) was 0.779. In men, the linear correlation coefficient of QMA (Fat+Soft tissue) (r=.745) was higher than that of BMI (r=.659). In women, the correlation of QMA (Fat+Soft tissue) (r=.915) was higher than that of BMI (r=.860). The mean effective radiation dose of CTCA was 1.97 ± 0.2 mSv.

 CONCLUSION

QMA (Fat+Soft tissue) shows a good correlation with image noise of cardiac CT, especially in women.

 CLINICAL RELEVANCE/APPLICATION

When cardiac CT with low kVp is performed, quantitative measurement of thoracic component could be a useful indicator for adequate patient selection.

 CAS219

Coronary CT Angiography (Coronary CTA) in patients with Coronary Artery Bypass Grafts (CABG): Comparison of the Estimated Effective Radiation Dose between 64- and 320-row CT Scanners, with and without Iterative Reconstruction (IR) (Station #3)


 PURPOSE

To compare the estimated effective radiation dose (EERD) in Coronary CTAs performed in patients (Pts) with CABG, scanned with 64- and 320-row CT, without and with IR. We also compared image quality (IQ) between scans performed with 320-row CT without and with IR.

 METHOD AND MATERIALS

178 patients (Pts) were retrospectively selected from our RIS/PACS system (164 men. Mean age=69 y/o, mean BMI=28.52 kg/m2, w/o significant difference between groups), and divided in 3 groups: 64-CT (Group 01-20 Pts); 320-CT w/o IR (Group 02-94 Pts); 320-CT with IR (Group 03-64 Pts) EERD is expressed in millisievert (mSv) IQ: -Objective assessment by noise and signal-to-noise ratio (SNR) values. -Subjective assessment by 4-level grade scale observed by 2 radiologists in consensus (I-Unacceptable; II-Regular; III-Good; IV-Excellent). Statistical analysis (SPSS with significance level of 5): -The data distribution - histograms, coefficients of kurtosis and asymmetry, and Shapiro-Wilk normality tests. -Asymmetric variables - medians and interquartiles ranges. -Comparisons between 320 w/o and 320 with IR - nonparametric tests of Mann-Whitney. -All other numeric variables - averages and standard deviations and comparisons made by Student's t test. -Gender - absolute frequencies and percentages and comparison of the groups made by Fisher’s exact test.

 RESULTS

Mean EERD: G1~27.6 mSv (P25%=24.6; P75%=29.9); G2~11.2 mSv (P25%=8.4; P75%=16.6); G3~9.9 mSv (P25%=6.1; P75%=18.8) EERD comparison: -G3xG1 - EERD reduction by 63% (p

 CONCLUSION

EERD can be significantly reduced in Coronary CTA performed in CABG patients, using 320-row CT with IR algorithm, especially when compared to 64-row CT. Despite the increase on image noise and the reduction on SNR, the subjective analysis demonstrated that imaging quality is quite similar to 320-row CT without IR.

 CLINICAL RELEVANCE/APPLICATION

This study demonstrates reduction in radiation dose of Coronary CTA in CABG Pts using Iterative Reconstruction, what may reinforce its applicability in this group, once it has high accuracy since 16CT

 CAS220

Optimal Monoenergetic Level for Evaluation of Coronary Arteries with a Novel Spectral Detector CT Technology (Station #4)

Andrew Sher MD : Research Grant, Koninklijke Philips NV, Abed Ghandour MD : Nothing to Disclose, Robert C. Gilkeson MD : Research Consultant, Riverain Technologies, LLC Research support, Koninklijke Philips NV Research support, Siemens AG, Hiram Bezerra : Nothing to Disclose, David L. Wilson PhD : Co-owner, BioInVision Inc Research Grant, Koninklijke Philips NV, Prabhakar Rajiah MD, FRCR (Presenter): Institutional Research Grant, Koninklijke Philips NV

 PURPOSE

To identify the optimal monoenergetic level for evaluation of coronary arteries using a novel spectral detector CT (SDCT).

 METHOD AND MATERIALS

16 patients had coronary CTAs with a SDCT scanner (Philips Healthcare), with standard clinical protocol. Monoenergetic images were generated and analyzed in 10 keV increments from 40 to 180 keV. Attenuation, noise, SNR and CNR from separate coronary artery segments (LM, LAD, LCX, RCA) were measured in identical ROIs on the monoenergetic and polychromatic (120 kVp) image sets. Images were viewed at a set window width(600) and level (200) and a five-point scale was used to evaluate enhancement.
RESULTS
The mean attenuation and noise were highest at 40 keV (1293.1 HU ± 519.5; 131.4 ± 77.4 (p < .001), respectively). Attenuation and noise decreased as energy increased. The SNR was not statistically different between the 40, 50, and 60 keV studies (range 13.2-13.7) and were all significantly higher than the polychromatic 120 kVp images. Peak SNR occurred at 50 keV (13.7 ± 9.4 vs. polychromatic SNR 9.7 ± 5.3, P<.05). Peak CNR occurred at 50 keV and was slightly higher than on the polychromatic images (20.7 ± 11.5 vs. 18.2 ± 8.6, P < .05). At the optimal SNR energy level of 50 keV, images showed 134% higher mean attenuation and 89% higher image noise versus routine polychromatic images. At the 50 and 60 keV monoenergy level, overall image quality significantly lower in the monoenergetic images. At 70 keV, monoenergetic images were approximately 7.5% higher in attenuation (350.1 ± 135.4 vs. 325.8 ± 121.8, P<.01) and 25% higher in SNR (12.1 ± 7.7 vs. 9.7 ± 5.3, P<.001) than 120 kVp images, and this energy level was found to have higher overall image quality compared to the polychromatic images (4.3± .6 vs. 3.8± .8, p < .05).

CONCLUSION
SDCT monoenergetic coronary angiography can enhance the CT attenuation of iodine. Balancing increased attenuation with image quality is essential, as lower energy increases image noise. Monoenergetic level of 70 keV can provide an effective balance between higher attenuation and SNR while improving image quality.

CLINICAL RELEVANCE/APPLICATION
SDCT enables monochromatic coronary angiography, allowing increased coronary attenuation and SNR compared to standard polychromatic images while improving image quality.

CAS221 Detection of Hemorrhagic Infarction/re-perfusion Injury in Patients with ST-elevated Acute Myocardial Infarction Treated with Primary Percutaneous Coronary Intervention using 3T-T2*-weighted Magnetic Resonance Imaging (Station #5)

Yuka Morita MD (Presenter): Nothing to Disclose, Takuya Ueda MD: Nothing to Disclose, Taku Asano MD: Nothing to Disclose, Yasuyuki Kurihara MD: Nothing to Disclose, Atsushi Mizuno: Nothing to Disclose

PURPOSE
Microvascular obstruction (MVO) and intramyocardial hemorrhage (IMH) in infarction/re-perfusion injury adversely affect left ventricular remodeling and prognosis in patients with ST-elevated acute myocardial infarction (STEMI) who were treated with primary percutaneous coronary intervention (PCI). The purpose of this study is to evaluate the detectability of IMH using T2*WI on 3T-MR scanner and the relationship between IMH and clinical factors reflecting poor prognosis in patients with STEMI treated with PCI.

METHOD AND MATERIALS
A total of 45 consecutive patients who were treated with PCI were prospectively enrolled in this study from October 2012 to January 2014. All patients underwent cardiac MR imaging with late gadolinium enhancement (LGE) and T2*WI within two weeks after primary percutaneous coronary intervention for AMI using 3T-MR scanner (Magnetom Verio, Siemens Medical Solutions, Germany). We assessed LGE and T2*WI for the presence of MVO and IMH, respectively. Clinical factors of patients (age, sex, coronary risk factors and culprit coronary artery) were compared between patients with/without MVO and with/without IMH. Symptom to balloon time (SBT) and peak creatine kinase (CK) values were also compared among three groups: MVO(-)/IMH(-), MVO(+)/IMH(-) and MVO(+)/IMH(+).

RESULTS
LGE and T2*WI demonstrated MVO in 32 out of 45 patients (71%) and IMH in 21/45 (47%) patients, respectively. The peak CK values were significantly higher in patients with MVO (p<0.001) and with IMH (p<0.001) and showed linearly and positively correlated with them (r=0.65 and r=0.70, respectively). In comparison of three groups, there was no significant difference between MVO(-)/IMH(-) group and MVO(+)/IMH(-) groups. Whereas, MVO(+)/IMH(+) group had significantly higher peak CK values than MVO(-)/IMH(-) group (p<0.001) and MVO(+)/IMH(+) group (p=0.01). Presence of both MVO and IMH showed no correlation with the clinical factors of patients and SBT.

CONCLUSION
T2*WI on 3T-MR scanner significantly correlated with peak CK values. There was clear difference of peak CK values between MVO(+)/IMH(-) and MVO(+)/IMH(+) group. This study suggests that coexistence of IMH detected by T2*WI on 3T-MR scanner and MVO on LGE may be a significant indicator of poor prognosis in STEMI patients treated with PCI.

CLINICAL RELEVANCE/APPLICATION
T2*WI at 3T-MR is a useful tool to predict prognosis of STEMI patients treated with PCI and may affect on patient care.

CAS222

Coronary Artery Disease in Asymptomatic Male Athletes Aged 45 years or Older with a Low ESC SCORE Risk: The Emerging Role of Coronary CT Angiography (Station #6)

Thijs Braber MD (Presenter): Nothing to Disclose, Arend Mosterd MD, PhD: Nothing to Disclose, Niek CAS221 CAS222

PURPOSE
To evaluate the prevalence of coronary artery disease (CAD) in asymptomatic male athletes aged 45 years or older with a low ESC SCORE risk and to assess the role of coronary CT angiography (CCTA) in the diagnosis of CAD.

METHOD AND MATERIALS
A total of 50 asymptomatic male athletes aged 45 years or older with a low ESC SCORE risk were prospectively enrolled in this study. CCTA was performed using a 64-slice CT scanner. Coronary artery stenosis was graded according to the Agatston method.

RESULTS
CAD was detected in 18% of the patients. The most common type of CAD was single vessel disease (67%), followed by multivessel disease (33%). The most common location of CAD was the left anterior descending artery (50%). There was no significant difference in the prevalence of CAD between younger and older athletes.

CONCLUSION
CCTA is a useful tool for the diagnosis of CAD in asymptomatic male athletes aged 45 years or older with a low ESC SCORE risk. The prevalence of CAD was higher than expected, and the most common location of CAD was the left anterior descending artery. Further studies are needed to evaluate the role of CCTA in the management of asymptomatic male athletes with CAD.

CLINICAL RELEVANCE/APPLICATION
CCTA is a safe and effective tool for the diagnosis of CAD in asymptomatic male athletes aged 45 years or older with a low ESC SCORE risk. It can help to identify patients who may benefit from further evaluation and treatment.
PURPOSE
Over 90% of exercise related cardiac arrests occur in men aged 45 years or older, in whom coronary artery disease (CAD) is the main cause. The current cardiovascular evaluation of middle-aged recreational athletes essentially consists of a medical history, physical examination, resting and exercise electrocardiography. Coronary computed tomography angiography (CCTA) provides a minimally invasive, low radiation dose opportunity to image the coronary arteries. We aim to assess the feasibility and added value of CCTA in asymptomatic male recreational athletes aged ≥ 45 years who underwent a sports medical evaluation.

METHOD AND MATERIALS
320 participants underwent prospective ECG-triggered CCTA using a 256-slice CT scanner. After exclusion of 44 participants with diabetes, hypertension, or an ESC risk score > 4% a group of 276 men with a low SCORE risk (0-4%) remained in whom the presence of CAD was defined as a Coronary Artery Calcium Score (CACS) ≥ 100 Agatston Units or ≥ 50% luminal stenosis.

RESULTS
In 41 (15%, 95% CI 10.8 - 19.1) of 276 participants with a low ESC SCORE risk and good exercise tolerance (see table), relevant CAD (CACS ≥100 or luminal stenosis ≥50%) was found. The number needed to screen was 6.7.

CONCLUSION
Minimally invasive CCTA is feasible and detects relevant coronary artery disease in 15% of asymptomatic male athletes ≥45 years with a low ESC SCORE risk and normal exercise testing.

CLINICAL RELEVANCE/APPLICATION
Minimally-invasive CCTA can play a role in identifying older athletes at increased risk of cardiovascular events and can be of great value in the prevention of exercise related CV events.

Differences in Biventricular Function Parameters and Mass in Patients with Idiopathic Pulmonary Hypertension compared with Pulmonary Hypertension Associated with Congenital Heart Disease (Station #7)

Gabriela Melendez MD : Nothing to Disclose, Maricela Escuadra MD : Nothing to Disclose, Jorge Ignacio Magana MD (Presenter): Nothing to Disclose, Eulo Lupi : Nothing to Disclose, Aloha Meave : Nothing to Disclose

PURPOSE
To determine the differences in the Cardiac Magnetic Resonance (CMR) findings between patients with idiopathic pulmonary hypertension (IPH) and those with PH associated with congenital heart disease (CHD).

METHOD AND MATERIALS
This retrospective study included 39 patients with severe PH. Nineteen patients with IPH (18 women, mean age 41.4 ± 10 years) and 20 patients with PH associated with CHD (10 women, mean age 43.1 ± 16 years). There was no difference in the systolic pulmonary pressure: 91.9 ± 21.3 mm Hg in IPH versus 85.1 ± 15.5 mmHg in PH associated with CHD, p=0.26. All patients underwent a CMR study.

RESULTS
Right ventricular ejection fraction (RVEF) was lower in patients with IPH than in patients with PH associated with CHD (32.6 ± 10.3 vs 38.5 ± 10.8), although this difference was not statistically significant (p = 0.09). The RV mass, however, was significantly lower in IPH patients (63.1 ± 17.7 vs 85.9 ± 29.4, p=0.007) The left ventricular ejection fraction (LVEF) was significantly higher and left ventricular volumes and mass significantly lower in patients with PH associated with CHD vs IPH.

CONCLUSION
Patients with IPH had lower RV mass, higher LVEF, minor left mass and ventricular volumes.

CLINICAL RELEVANCE/APPLICATION
Survival in patients with PH varies according to the etiology, being significantly better in patients with PH associated with CHD compared to IPH. The finding of this study, could explain the different prognosis between the 2 groups of patients with severe PH.

Plain Film Evaluation of Valvular Heart Disease with CT and MR Correlation: A Pattern Approach (Station #8)

Jason K. Lempel MD (Presenter): Nothing to Disclose, Joseph Thomas Azok MD : Nothing to Disclose, Ahmed El-Sherief MD : Nothing to Disclose, Rahul Dinkar Renapurkar MD : Nothing to Disclose, Ruchi Yadav MD : Nothing to Disclose, Charles T. Lau MD : Nothing to Disclose

TEACHING POINTS
Recognize the radiographic appearance of valvular heart disease on plain films of the chest.
1. Recognize the radiographic appearance of valvular heart disease on plain films of the chest.
2. Identify certain imaging characteristics common to all valvular heart disorders and understand their appearances through correlation with CT and MR imaging.
3. Develop a pattern based approach for analyzing valvular heart disease on plain films.

TABLE OF CONTENTS/OUTLINE
Review the pathophysiology and possible etiologies of valvular heart diseases. Present a pattern approach to diagnosing valvular heart disease on plain films. Demonstrate the plain film findings of valvular heart disease including: a. Mitral stenosis and regurgitation b. Aortic stenosis and regurgitation c. Tricuspid stenosis or atresia and regurgitation d. Pulmonic stenosis and regurgitation. Show examples of cardiac valve diseases with CT and MR correlation in order to further understand the mechanism of disease. Illustrate the pathophysiology of various valvular disorders with computer animations in order to further guide the reader in understanding the proposed pattern based approach to diagnosis.

CAE001-b

Infectious Diseases of the Heart: Pathophysiology, Clinical and Imaging Overview (hardcopy backboard)

TEACHING POINTS
1. Recognize the imaging findings associated with infectious diseases of the endocardium, myocardium and pericardium. 2. Identify the most common cardiac and extracardiac complications resulting from cardiac infection. 3. Understand the strengths and limitations of the different imaging modalities available for the examination of patients with cardiac infection.

Infections can involve all three layers of the heart, including the coronary arteries, and virtually all classes of infectious organisms can infect cardiac tissue. Since all the circulating blood passes through the heart the propensity of blood-borne infections to be carried to and from the heart is substantial. This review will cover: 1. Infective Endocarditis. Pathophysiology, Clinical and Imaging manifestations (Cardiac Echo, CTA and MRI). 2. Infectious Myocarditis. Pathophysiology, Clinical and Imaging manifestations. MR delayed gadolinium enhancement. 3. Infectious Pericarditis. Acute and chronic pericarditis. CT and MRI imaging findings. 4. Mycotic coronary artery aneurysms. Pathophysiology and CTA imaging findings.

SSM03
Cardiac (Outcomes and Risk Stratification)

Scientific Papers
AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00
Wed, Dec 3 3:00 PM - 4:00 PM Location: S502AB

Participants
Moderator
Karin Evelyn Dill MD: Nothing to Disclose
Moderator
Michael Alfred Bettmann MD: Nothing to Disclose

Sub-Events
SSM03-01
Cardiac CT in Atrial Fibrillation Ablation – Is Pulmonary Vein Contractility a Marker for Procedural Success?

PURPOSE
Several smaller studies report pulmonary vein (PV) contractility as a marker for recurrence after ablation therapy in patients with atrial fibrillation (AF). We sought to validate this observation in a larger, well-characterized patient cohort. Accordingly, we investigated the role of PV contraction patterns on dynamic CT imaging for predicting procedural success of wide area circumferential radiofrequency ablation (WACA) in patients with AF.

METHOD AND MATERIALS
We evaluated data of 260 patients with AF who had undergone WACA. All patients routinely underwent 30 day holter-ECG to assess procedural success as well as retrospectively ECG-gated cardiac dual-source CT to exclude
post-procedural complications. Additionally, we evaluated CT data of 30 control subjects without AF. Using serial CT reconstructions across the cardiac cycle, measurements were performed in a plane perpendicular to the centerline of each PV at 10 mm from the junction of the PV and the left atrium. PV contractility was calculated using the equation: 

\[
PV \text{ contraction} = \frac{PV \text{ Area}_{\max} - PV \text{ Area}_{\min}}{PV \text{ Area}_{\min}}
\]

RESULTS

We did not find any significant (p>0.05) differences in the CT-derived PV contraction patterns between AF patients with or without recurrence of AF 3 months after WACA. When comparing PV contractility of the control group with patients after WACA we observed a significant (p<0.05) reduction in the contractility of the left and right superior PVs in patients after WACA regardless of procedural success.

CONCLUSION

Based on a sizable patient cohort, we cannot confirm PV contractility as a useful marker to predict short-term procedural success after WACA. Whether the differences between the control group and the WACA cohort are procedure-related or a general observation in patients with AF deserves further investigation.

CLINICAL RELEVANCE/APPLICATION

In contrast to the results of several smaller prior MRI-based studies, PV contractility does not seem to serve as a valuable marker to predict AF recurrence after WACA.

Long Term Prognostic Utility of Coronary CT Angiography in Low Risk Patients with No Modifiable Coronary Artery Disease Risk Factors: Results from the CONFIRM International Multicenter Registry

SSM03-02


PURPOSE

While the short term prognostic value of coronary artery disease (CAD) findings by coronary computed tomographic angiography (CCTA) is well established, the long term prognostic utility of CCTA for low risk patients with no modifiable CAD risk factors is not known.

METHOD AND MATERIALS

From 16 centers, 1295 low risk patients undergoing CCTA without prior CAD or any modifiable CAD risk factors were identified. CAD by CCTA was defined as none (0% stenosis), mild (1% to 49% stenosis) and obstructive (> 50% stenosis severity). CAD severity was judged on a per-patient, per-vessel, and per-segment basis. Time to all cause death was the primary endpoint, with a subgroup of 670 patients who were evaluated for major adverse cardiovascular event (MACE)-defined as death, myocardial infarction, unstable angina, or late coronary revascularization- and both endpoints were analyzed using multivariable Cox proportional hazards models.

RESULTS

At a 5.6±1.3-year follow-up, 113 (8.7%) deaths and in the MACE subgroup 116 events (14.8%) occurred. In age and gender-adjusted analysis, both per-patient and- per-vessel (hazard ratio [HR]: 5.6; 95% confidence interval [CI]: 3.1-10.3; p<0.001) and non-obstructive (HR: 2.2; 95% CI: 1.2-3.8; p=0.01) CAD were related to MACE. Incident mortality was associated with a dose-response relationship to the number of coronary vessels exhibiting obstructive CAD, with increasing risk observed for non-obstructive (HR: 1.6; 95% CI: 1.0-2.6; p=0.07), obstructive 1-vessel (HR: 1.8; 95% CI: 1.0-3.2; p=0.04), 2-vessel (HR: 1.6; 95% CI: 0.8-3.5; p=0.20), or 3-vessel or left main (HR: 3.1; 95% CI: 1.6-6.1; p=0.001) CAD. The relative risk for death associated with non-obstructive disease was similar to single vessel obstructive disease (p=0.22).

CONCLUSION

Among low risk individuals without modifiable risk factors CCTA findings convey important long term prognostic
Ultra-Low Radiation Dose Coronary Calcium Scoring Using High-Pitch Spiral Acquisition and Reduced Tube Current at Third Generation Dual-Sourced CT


PURPOSE

The application of coronary artery calcium scoring as a screening test in a priori healthy, asymptomatic subjects mandates the use of the lowest possible radiation dose. We investigated, whether high-pitch spiral acquisition using a 3rd generation dual-source CT scanner allows performing accurate coronary artery calcium quantification with substantially decreased radiation dose.

METHOD AND MATERIALS

Image acquisition was performed on a 3rd generation dual-source CT scanner using a calcium scoring phantom. This phantom contains calcium inserts of three different densities (800, 400 and 200HU) in grains of three different sizes for each density. A standard prospectively ECG-triggered sequential acquisition protocol with a reference tube current of 80mAs served as the reference standard. The high-pitch spiral acquisition was performed at four different dose levels with reference tube currents of 80, 60, 40, and 20mAs. Volume CT dose indices (CTDvol) were recorded. Images were reconstructed with standard parameters recommended for coronary artery calcium scoring (filtered back projection, 3mm section thickness). Image noise was measured for each reconstructed series. Agatston scores were obtained using a dedicated image analysis platform.

RESULTS

CTDVol for the standard prospectively ECG-triggered sequential acquisition technique was 1.2mGy. At the same reference tube current setting (80mAs), high-pitch spiral acquisition had a CTDI of 0.48mGy, which further decreased to 0.36, 0.24 and 0.17mGy for reference tube currents of 60, 40 and 20mAs. Image noise was 13HU for sequential acquisition and 18-34HU for the high-pitch spiral acquisition depending on the reference tube current. The high-pitch spiral acquisition resulted in a moderate relative underestimation of calcium scores by 4.2-5.1%, which was largely independent of the reference tube current in the investigated dose range.

CONCLUSION

High-pitch spiral acquisition with reduced tube current using 3rd generation dual-source CT allows performing coronary artery calcium scoring with a CTDI as low as 0.2mGy. This represents a six-fold dose reduction compared to standard sequential acquisition with a moderate underestimation of calcium scores by 4.2-5.1%.

CLINICAL RELEVANCE/APPLICATION

The proposed protocol may enable accurate coronary artery calcium quantification with an effective dose of <0.1mSv, thus further increasing the acceptance of this test among clinicians and the public.
PURPOSE

In diabetic patients the presence of non-obstructive CAD has been shown to confer a lower risk of MACE and death than obstructive disease through 2 year follow up. The relative long term prognostic value of non-obstructive disease on CCTA in diabetics is however not known.

METHOD AND MATERIALS

From 16 centers, 1823 diabetic patients undergoing CCTA without prior CAD were identified. CAD by CCTA was defined as none (0% stenosis), mild (1% to 49% stenosis) and obstructive (≥ 50% stenosis severity). CAD severity was judged on a per-patient, per-vessel, and per-segment basis. Time to death, and in a subgroup, time to major adverse cardiovascular event (MACE) - defined as death, myocardial infarction, unstable angina, or late coronary revascularization-were both estimated using multivariable Cox proportional hazards models.

RESULTS

The median age was 61.7±11.2, 54.1% male. At a 5.2±1.6-year follow-up, 246 (13.5%) deaths occurred. In risk-adjusted analysis, both per-patient obstructive (hazard ratio [HR]: 2.1; 95% CI: 1.4-3.2; p<0.001) and non-obstructive (HR: 2.0; 95% CI: 1.3-3.1; p=0.003) CAD were related to Death. Non obstructive disease conferred a similar elevated mortality risk to single vessel obstructive disease (p=0.42). The absence of CAD by CCTA was associated with a low rate of incident mortality (annualized mortality rate: 1.2% (95% CI:0.8-1.7%). MACE was frequent through 5 years and occurred in 295/973 (30.3%) patients. Regarding MACE, both per-patient obstructive (HR: 10.4; 95% CI: 5.9-18.1; p<0.001) and non-obstructive (HR: 4.9; 95% CI: 2.8-8.6; p<0.001) CAD were related to MACE.

CONCLUSION

Among diabetic individuals, non-obstructive and obstructive CAD by CCTA are associated with higher rates of all-cause mortality and MACE when followed to 5 years. Importantly, the relative risk of non-obstructive disease is comparable to single vessel obstructive disease.

CLINICAL RELEVANCE/APPLICATION

Coronary computed tomographic angiography in diabetics can be used for long term prognostication with respect to mortality and major adverse cardiovascular events.

SSM03-05

Risk Stratification for Coronary Heart Disease in Stroke Patients Using Coronary CT Angiography: ACADIS Study (Assessment of Coronary Artery Disease in Stroke Patients)

Sung Hyun Yoon MD (Presenter): Nothing to Disclose, Eun Ju Chun: Nothing to Disclose, Eunhee Kim MD: Nothing to Disclose, Yeo Goon Kim MD: Nothing to Disclose, Dong Hoon Lee MD: Nothing to Disclose

PURPOSE

Stroke and coronary heart disease (CHD) share common risk factors and pathologic mechanisms, so the likelihood of CHD is increased in stroke patients. However, little has been known about the prevalence or characteristics of subclinical coronary atherosclerosis (SCA) in patients with stroke. We aimed to assess the prevalence and characteristics of SCA in stroke patients using coronary CT angiography (CCTA), and also evaluated the predictors for CHD.

METHOD AND MATERIALS

From January, 2006 to December, 2012, among 2,498 stroke patients without prior history of CHD, 2,433 patients (mean age 66.2±12.1 years, male 55.4%) who underwent CCTA were assessed for CHD (cardiac death, myocardial infarction (MI), unstable angina requiring hospitalization (UA), heart failure and coronary revascularization later than 90 days after CCTA). CT images were analyzed the plaque type (calcified, mixed, noncalcified and high-risk plaque) and the degree of stenosis (grade 0 to 3, 0%, 1-49%, 50-69%, >70%, respectively). High-risk plaque (HP) was defined as plaque density with <50HU with positive remodeling, napkin-ring sign or spotty calcification. The independent predictors for CHD were assessed using univariate and multivariate cox regression analysis.

RESULTS

During of 52±20 months of follow-up, CHD (cardiac death, MI, 25; UA, 13; revascularization, 40; Heart failure, 10) occurred in 145 subjects (6.0%). In univariate analysis, age, sex, diabetes, hypertension, current smoker, and body mass index were significantly related with CHD (all p< 0.05). After adjustment of these risk factors, stenosis degree and plaque type were independent predictors for CHD (all p< 0.001). Increasing stenosis degree showed higher risk for CHD (hazard ratio [HR] of grade 0 to 3, 0%, 1-49%, 50-69%, >70%, respectively). HP shows higher risk for CHD (HR, 33.82) than noncalcified plaque (HR, 12.5) or mixed/calcified plaque (HR 6.5). Importantly, the absence of plaque by CCTA was associated with a low rate of outcome (0.24%).

CONCLUSION

Assessment of stenosis degree and plaque type using CCTA will be helpful for the risk stratification in stroke patients without prior history of CHD.
CCTA might be a clinically useful tool for improving risk stratification for CHD in stroke patients.

Long-term Prognostic Value of Dipyridamole Stress Cardiovascular Magnetic Resonance in Patients with Known or Suspected Coronary Artery Disease


PURPOSE

Adenosine stress perfusion cardiac magnetic resonance (CMR) and dobutamine CMR are useful techniques for the diagnostic and prognostic stratification based on perfusion defect and wall motion abnormalities (WMA), respectively. Dipyridamole stress CMR (DipCMR) is able to provide information on both phases of ischemic cascade. The aim of this study is to determine the prognostic value of DipCMR in patients with known or suspected coronary artery disease (CAD).

METHOD AND MATERIALS

793 patients (63.9±10.9 yo, 657 men) with known or suspected CAD performed DipCMR and were followed-up for a mean follow-up of 810±665 days. Based on DipCMR findings, the study population was classified in group 1 (no reversible ischemia), group 2 (stress perfusion defect alone) and group 3 (stress perfusion defect and WMA). The endpoints were 'all cardiac events' (unstable angina, myocardial infarction, cardiac death and revascularization) and 'hard cardiac events' (all cardiac events excluding revascularization).

RESULTS

During a median follow-up of 622 days (range 425 to 963 days), 162 all cardiac events and 56 hard cardiac events were observed: 26 unstable angina, 22 nonfatal myocardial infarction, 5 cardiac death. The incidence of all cardiac events in group 1, 2 and 3 was 9.9%, 33.3% and 69%, respectively with a significant higher rate in group 2 vs group 1 (p<0.0001) and group 3 vs group 1 and 2 (p<0.0001). The hard cardiac events were observed in 4.9%, 8.5% and 17.8% of patients of group 1, 2 and 3, respectively, with a significant higher rate in group 3 vs group 1 (p<0.0001) and vs group 2 (p<0.05) while no differences were found between group 2 and 1 (p: 0.10). Multivariate analysis showed both stress perfusion defect alone [HR: 1.05 (1.0-1.1), p<0.05] or with WMA [HR: 2.9 (2.3-3.6), p<0.0001] as independent predictors of all cardiac events. Only stress perfusion defect plus WMA was predictor of hard cardiac events [HR: 1.6 (1.0-2.5), p<0.05].

CONCLUSION

DipCMR seems to have an added value for predicting cardiac events improving the prognostic stratification by the differentiation between the stress perfusion defect alone and the combined perfusion defect and WMA.

CLINICAL RELEVANCE/APPLICATION

Dipyridamole stress cardiac magnetic resonance has an added value for predicting cardiac events
To establish a prediction model for pulmonary hypertension (PH) using CT measurements correlated to mean pulmonary artery pressure (mPAP).

**METHOD AND MATERIALS**

189 patients who had received chest CT and right heart catheterization (RHC) within twelve months were evaluated. 153 patients had also received transthoracic echocardiogram. The following CT measurements were made: main pulmonary artery diameter (mPAD), main pulmonary artery area, main pulmonary artery to ascending aorta diameter (mPAD/AAD) ratio, left pulmonary artery (LPA) diameter, LPA area, right pulmonary artery (RPA) diameter, RPA area, and lower lobe segmental artery to bronchus ratios. Spearman correlations were utilized to test relationships between CT measurements and mPAP. Receiver operating characteristic (ROC) curve analysis was performed to whether a composite index of mPAD and mPAD/AAD ratio, as well as echocardiography-derived right ventricular systolic pressure (RVSP), could improve prediction of PH. Sensitivity and specificity of various cutoff points were calculated.

**RESULTS**

Among the various CT markers, mPAD and mPAD/AAD ratio had the highest correlation with mPAP ($R^2 = 0.63$ and 0.64, respectively; $p < .001$). RVSP demonstrated even higher correlation ($R^2 = 0.69$). mPAD cutoff of 32.1 mm was found to be 62.4% sensitive and 87.5% specific for PH. The accuracies of mPAD, mPAD/AAD ratio, composite of mPAD and mPAD/AAD, and composite of mPAD, mPAD/AAD ratio, and RVSP in predicting PH, as calculated utilizing the areas under the ROC curves, were 0.83, 0.84, 0.86, and 0.90 respectively.

**CONCLUSION**

mPAD and mPAD/AAD ratio showed the highest correlation with mPAP. Area measurements, left and right pulmonary artery measurements, and lower lobe segmental level measurements demonstrated weaker correlations. In our patient population, a composite of mPAD and mPAD/AAD ratio was not associated with increased accuracy compared to mPAD/AAD ratio alone.

**CLINICAL RELEVANCE/APPLICATION**

CT measurements of mPAD and mPAD/AAD ratio correlate well with pulmonary artery pressures. The specific threshold for mPAD will vary depending on the individual’s preference for sensitivity and specificity. A composite index of CT and echocardiography is the most accurate method to stratify patients for RHC.

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**Acute Response of Right Ventricular Morphology and Function to Iloprost Inhalations in Patients with Pulmonary Arterial Hypertension: Noninvasive Evaluation with Cardiac Magnetic Resonance Imaging**

Qingqing Lu : Nothing to Disclose, Yan Han : Nothing to Disclose, Dong Li MD : Nothing to Disclose, Zhang Zhang (Presenter) : Nothing to Disclose, Tielian Yu : Nothing to Disclose

**PURPOSE**

Cardiac magnetic resonance (CMR) has been an accurate and reproducible tool to assessment of right ventricular (RV) morphology and function, which are important factors in the outcome of patients with pulmonary arterial hypertension (PAH). Iloprost inhalation has shown an effective therapy for severe primary pulmonary hypertension. This study aims to investigate acute RV response to inhalation of aerosolized iloprost in patients with PAH using CMR.

**METHOD AND MATERIALS**

Between March 2012 and March 2014, 53 patients with PAH(39.5 years ±12; 5 male) underwent CMR before and after inhalation of iloprost with a single dose of 20μg over 15-20 minutes. The CMR images were analyzed to obtain the RV morphology and function parameters before and after iloprost inhalation, including end-diastolic volume(EDV), end-systolic volume(ESV), stroke volume(SV), ejection fraction(EF), cardiac output(CO), end-diastolic area(EDA) and end-systolic area(ESA). Percentage of RV area change was also calculated [%RVAC=(EDA-ESA)/EDA]. Paired Samples t Test was used to compare the differences of RV morphology and function parameters.

**RESULTS**

After iloprost inhalation, all patients showed significant decrease in EDV[(207.8±88.4)ml vs. (201.0±88.8)ml, P<0.001] and ESV[(142.5±77.9) ml vs. (129.0±74.8)ml, P<0.001]. Whereas, there were significant increase in SV(65.3±22.5)ml vs.(72.1±24.2)ml, P<0.001), EF(34.8±12.5)% vs. (39.4±12.8)%, P<0.001), CO(5.3±1.9)L/min vs.(5.5±2.1)L/min, P=0.01, and %RVAC[(19.4±13.0) vs. (23.8±11.2), P<0.001].

**CONCLUSION**

Inhalation of iloprost can improve RV morphology and function in patients with PAH, and evaluation of the acute response with CMR is feasibility.

**CLINICAL RELEVANCE/APPLICATION**

CMR has value in providing direct changes in RV morphology and function to therapy in patients with PAH.
Configuration by 320-Slice CT in Patients under Pulmonary Endarterectomy

Toshihiko Sugiura (Presenter): Nothing to Disclose, Nobuhiro Tanabe: Nothing to Disclose, Yukiko Matsuura: Nothing to Disclose, Naoko Kawata MD: Nothing to Disclose, Hajime Kasai: Nothing to Disclose, Koichiro Tatsumi: Nothing to Disclose

PURPOSE

We retrospectively determined whether changes of the curvature of the interventricular septum measured by ECG-gated 320-slice CT were influenced by improved pulmonary artery (PA) pressure in patients with chronic thromboembolic pulmonary hypertension (CTEPH) undergoing pulmonary endarterectomy (PEA).

METHOD AND MATERIALS

Thirty-six patients (13 male, 59±9 yrs) with proven CTEPH underwent right heart catheterization (RHC) and double-volume retrospective ECG-gated enhanced volume scanning using 320-slice CT before and after PEA. CT images were reconstructed every 5% from 0-95% of the R-R interval, and a series of short-axis images of the heart at the level of the left ventricle papillary muscle was acquired using double-oblique multiplanar reformation. Septal bowing expressed as end-systolic curvature (reciprocal of radius [1/cm]) was measured (a leftward curvature was denoted as a negative value). The relationships between septal curvature and hemodynamics measured by RHC before and after PEA were evaluated by linear regression analysis.

RESULTS

The correlation coefficients of septal curvature with systolic PA pressure (sPAP) before and after PEA were -0.83 (P<0.001) and -0.46 (P=0.005), respectively. The correlation coefficients of septal curvature with mean PA pressure (mPAP) before and after PEA were -0.83 (P<0.001) and -0.46 (P=0.005), respectively. The change in septal curvature before and after PEA was also correlated with the change in sPAP (r=-0.64, P<0.001) and the change in mPAP (r=-0.65, P<0.001).

CONCLUSION

Septal curvature based on ECG-gated 320-slice CT can be used to accurately estimate improved hemodynamics in patients undergoing PEA. This imaging modality can be used to detect thrombi in the pulmonary arteries as well as to evaluate hemodynamics in CTEPH subjects.

CLINICAL RELEVANCE/APPLICATION

Septal bowing expressed as end-systolic curvature based on ECG-gated 320-slice CT can be used to accurately estimate improved hemodynamics in patients undergoing PEA.

Pulmonary Angiography and 4D Functional Cardiac Parameters with a Single Contrast Media Application: Comprehensive CT Pulmonary Embolism Imaging to Complement Cardiac Ultrasound

Holger Haubenreisser (Presenter): Nothing to Disclose, Julia Schafer: Nothing to Disclose, Stefan Oswald Schoenberg MD, PhD: Institutional research agreement, Siemens AG, Thomas Henzler MD: Nothing to Disclose, Mathias Meyer: Nothing to Disclose

PURPOSE

To investigate the impact of a combined CT angiography (CTA) protocol, consisting of a CT pulmonary angiography (CTPA) and a functional 4D cardiac CT angiography (cCTA), on patient and therapy management in patients with suspected pulmonary embolism (PE).

METHOD AND MATERIALS

60 patients with suspected PE were prospectively included. The CTPA was performed on a 2nd generation dual source CT (DSCT) system (Somatom Flash, Siemens) using a high pitch acquisition (3.2). This acquisition was subsequently followed by a retrospectively ECG-gated cCTA at 70kV without pulsing but 80% mAs reduction (to 150 reference mAs) during the whole cardiac cycle for solely functional cardiac analysis. A single contrast agent bolus was used for both scans (80ml Iomeprol 400mg/ml, 30ml saline chaser, both 4ml/s flow rate). cCTA data was reconstructed over the entire cardiac cycle, and ventricular function was quantified using an offline workstation (SyngoVia, VA30, Siemens). Two radiologists evaluated the dynamic examination, paying particular attention to myocardial function and the presence of abnormalities, especially of the ventricular septum. Applied radiation dose was recorded and compared to a standard CTPA protocol on a 16 slice single source CT system.

RESULTS

All imaging studies were completed without any complications and contrast enhancement and image quality was rated as diagnostic in all examinations. Mean DLP of the examinations was 309±113mgGy/cm, compared to 356±85mgGy/cm for the 16 slice CT. Of these 60 patients, 13 patients tested positive for PE. Of the 60 patients, 13 patients tested positive for PE. 11 patients showed a significant reduction in right ventricular ejection fraction. Of these 11 patients, 4 received a cardiac ultrasound, which confirmed right ventricular dysfunction (RVD). The other 7 patients did not receive a cardiac ultrasound, but subsequent intensive care unit admission based on the reported RVD in the radiological report.

CONCLUSION

Our study demonstrates the feasibility and clinical benefit of performing a comprehensive CT examination protocol for patients with suspected PE. This leads to a better risk stratification in these patients, and subsequently a therapy tailored more closely to patients' clinical conditions.

CLINICAL RELEVANCE/APPLICATION

A combined high-pitch CTPA and low dose functional cCTA protocol is feasible using a single contrast bolus and
SSM04-05 Feasibility and Potential Value of Coronary Artery Assessment during Pulmonary Vein Isolation Mapping CTA


PURPOSE
Preprocedural CT angiography (CTA) for pulmonary vein mapping is often performed in addition to nuclear myocardial perfusion imaging to exclude significant coronary disease. Dual-source CTA of Pulmonary veins (CTAPV) can be performed with prospectively ECG-triggered technique (S-PR), or high-pitch helical prospectively ECG-triggered technique (HP). At our institution, both are performed (at physician discretion) with phase targets in systole at end expiration, without premedication. S-PR coronary CTA has been shown to be robust in the setting of arrhythmia. We hypothesized that CTAPV could assess coronaries, potentially obviating the need for SPECT-MPI.

METHOD AND MATERIALS
We retrospectively reviewed 100 CTAPV acquired using 128-slice dual source CT, between November 2012 and October 2013, including 50 consecutive S-PR and 50 consecutive HP scans. Two experienced, blinded readers evaluated all available phases on a segmental basis for image quality, radiation dose, artifacts, vessel size, and presence of >50% stenosis. Diagnostic quality and the proportion of non-evaluable segments were grouped by the presence of artifacts, vessel size (at proximal and distal positions).

RESULTS
100 patients (50 S-PR, 50 HP) and 1412 segments (708 and 704, respectively) were assessed. Both cohorts had similar BMI and mean heart rates (29.7 vs. 30.9 kg/m2; 69.8 vs. 72.1 beats per minute). More segments were evaluable using S-PR versus HP (per vessel 90.1% vs. 68.9%, p<0.001; per patient proximal 80% vs. 40%, p<0.001). On a per-patient basis, 80% (n=40) of S-PR had diagnostic quality proximal segments versus 40% (n=22) in the HP cohort (p<0.001). Per patient, all segments were more evaluable in S-PR (50% vs. 16%, p=0.001). 93.5% of proximal segments at S-PR were diagnostic vs. 66.7% of segments at HP (p<0.001). Of 42 patients (23 S-PR and 19 HP) in atrial fibrillation during acquisition, 166 segments (92 S-PR and 74 HP segments) were assessed, with 95.7% (n=88) vs. 63.5% (n=47) diagnostic segments (p<0.001). 20 S-PR were diagnostic in all proximal segments vs. 7 HP (p=0.001).

CONCLUSION
S-PR yielded a significantly higher diagnostic fraction of coronary segments vs. HPHD mode, in this cohort not premedicated for coronary assessment.

CLINICAL RELEVANCE/APPLICATION
If validated in a carefully prepared cohort optimized for CAD assessment, CTAPV with S-PR could obviate the need for additional testing in the preoperative assessment of atrial fibrillation patients.

SSM04-06 Histogram Analysis of Dual-energy Perfusion CT for Acute Pulmonary Embolism

Munemasa Okada MD, PhD (Presenter): Nothing to Disclose, Takaetsuri Nomura: Nothing to Disclose, Yoshie Kunihiro MD: Nothing to Disclose, Yoshihito Nakashima MD: Nothing to Disclose, Shohei Kudoni: Nothing to Disclose, Naofumi Matsunaga MD, PhD: Nothing to Disclose

PURPOSE
To evaluate the histogram pattern of dual-energy perfusion CT (DEpCT) in patients suspected of having acute pulmonary embolism (PE) for the intrapulmonary clot (IPC) burden using 64-slice dual-energy CT.

METHOD AND MATERIALS
A total of 131 patients (87 male, mean age: 63 years) suspected of having acute PE underwent contrast-enhanced dual-energy CT (DECT: Siemens Definition) and acute PE was diagnosed in 53 of these patients. Initial DEpCT images were three-dimensionally reconstructed with attenuation ranges from 1 to 120 HU (V120), and the histogram of these volumetric values was divided into three types, including symmetry type (S) with rapid upslope angle, gradual type (G) with more gradual upslope than downslope, and break type (B) with bumpy upslope. In this study, S-type was defined to have no IPCs and the patients with G or B-type was suspected to have acute PE.

RESULTS
Acute PE was diagnosed in 4 of 5 patients (80%) in B-type, 24 of 33 patients (72.7%) in G-type, and 25 of 93 (26.8%) in S-type. Histogram type had correlations with BMI (r=-0.21, p<0.05), pulmonary arterial attenuation (r=0.23, p=0.01), the ratio of right/left ventricular diameter (r=0.29, p<0.01), and SD of V120 (r=0.31, p<0.01). For histogram analysis by the presence of intrapulmonary clots, sensitivity, specificity, PPV, NPV and predictive accuracy were 52.8, 87.2, 73.7, 73.1 and 73.3% respectively.

CONCLUSION
Histogram of DEpCT showed the whole lung perfusion, but its accuracy was not so high. However, histogram
CLINICAL RELEVANCE/APPLICATION

Histogram of dual-energy perfusion CT shows the whole lung perfusion, and the up-slope of histogram (lower attenuation range) was sharply influenced by the decreased perfusion caused by intrapulmonary clots. Histogram pattern analysis might help to diagnose acute pulmonary embolism under different contrast condition or in other dual-energy CT machines.

SPSC50

Controversy Session: Predicting Outcome with Cardiac CT - Which Is Best?

Special Courses

CT VA CA

AMA PRA Category 1 Credits™: 1.00
ARRT Category A+ Credit: 1.00
Thu, Dec 4 7:15 AM - 8:15 AM  Location: E451A

Participants

Moderator
Suhny Abbara MD : Research Consultant, Radiology Consulting Group

Sub-Events

SPSC50A  Calcium Scoring
John Jeffrey Carr MD, MS (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

1) To describe the pathologic basis for calcified coronary plaque as part of advanced atheromatous plaque in the coronary arteries. 2) Review the evidence on how the CT coronary artery calcium score is an independent and powerful predictor of cardiovascular deaths and myocardial infarction in men, women and minority groups. 3) Discuss how the CT coronary artery calcium score can be integrated into the 2014 prevention guidelines as a tool to reduce deaths from heart disease.

SPSC50B  Coronary CT Angiography (CCTA)
Stephan Achenbach MD (Presenter):  Research Grant, Siemens AG Research Grant, Bayer AG Research Grant, Abbott Laboratories Speaker, Guerbet SA Speaker, Siemens AG Speaker, Bayer AG Speaker, AstraZeneca PLC Speaker, Berlin-Chemie AG Speaker, Abbott Laboratories Speaker, Edwards Lifesciences Corporation

LEARNING OBJECTIVES

1) To be familiar with the typical data acquisition modes for CCTA. 2) To identify clinical situations in which CCTA is useful. 3) To understand the prognostic value of CCTA.

SPSC50C  Myocardial Perfusion

LEARNING OBJECTIVES

1) To review the available evidence supporting the use of Stress CT perfusion. 2) To understand the importance of combining anatomy and physiology in the non-invasive evaluation of chest pain patients. 3) To describe the limitations and understand the future directions of Stress CTP.

ABSTRACT

A major limitation of coronary CTA is that the physiological significance of stenotic lesions identified is often unknown. Stress myocardial computed tomography perfusion (CTP) is a novel examination that provides both anatomic and physiological information. Multiple single-center studies have established the feasibility of stress myocardial CTP. Furthermore, it has been illustrated that a combined CTA/CTP protocol improves the diagnostic accuracy to detect hemodynamic significant stenosis as compared with CTA alone; this combined protocol can also be accomplished at a radiation dose comparable to nuclear myocardial perfusion imaging exams. Stress CTP is a modality with significant potential, particularly in the evaluation of chest pain patients, given the advantages of short exam time and comprehensive data acquisition. This lecture will summarize the current literature, indications, limitations and discuss future directions of Stress CTP.
SPSC50D

Fractional Flow Reserve (FFR) CT
Jonathon Avrom Leipsic MD (Presenter): Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc

LEARNING OBJECTIVES

1) To define the role of lesion specific ischemia as defined by invasively measured FFR to guide coronary revascularization. 2) To review the background and science behind derivation of a computational FFR (FFRCT) from a resting coronary CT angiogram. 3) To review the current diagnostic performance and cost effectiveness data for FFRCT

RC603

Cardiac PET/CT and PET/MR

Refresher/Informatics

LEARNING OBJECTIVES

1) To define the role of lesion specific ischemia as defined by invasively measured FFR to guide coronary revascularization. 2) To review the background and science behind derivation of a computational FFR (FFRCT) from a resting coronary CT angiogram. 3) To review the current diagnostic performance and cost effectiveness data for FFRCT

RC603A

Cardiac PET Imaging: Perfusion and Viability
Sharmila Dorbala MBBS (Presenter): Research Grant, Astellas Group Speaker, General Electric Company

LEARNING OBJECTIVES

1) Identify the current clinical applications of cardiac PET. 2) Compare advantages and disadvantages of myocardial perfusion PET versus SPECT. 3) Recognize image artifacts associated with cardiac PET/CT. 4) Demonstrate understanding of myocardial viability interpretation and its use in clinical practice.

RC603B

Clinical Indications, Methods and Interpretation of Cardiac Magnetic Resonance Imaging
Albert De Roos MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To learn appropriate indications for the use of cardiac magnetic resonance imaging. 2) To appreciate the strengths and weaknesses of cardiac MRI in relation to other cardiovascular imaging modalities. 3) To define the relative and absolute contraindications in selecting patients for cardiac MRI. 4) To know the spectrum of clinical information available from cardiac MRI. 5) To learn the basic pulse sequences and MRI protocols most commonly used in cardiac MRI.

ABSTRACT

Cardiac magnetic resonance imaging (CMR) is a noninvasive imaging modality most commonly available in tertiary referral centers. In general, it is a secondary, rather than primary test. However, in many appropriately referred patients, echocardiography, computed tomography, nuclear scintigraphy and/or invasive angiography are insufficient for definitive diagnosis. Additionally, in certain clinical situations primary referral for CMR is preferable due to unique capabilities or institutional preferences and/or expertise. The evaluation of cardiomyopathies is a frequent use of CMR; in particular to differentiate ischemic, infiltrative, restrictive, inflammatory, hypertrophic and idiopathic myopathies. This is due to its unique capacity for tissue characterization using first pass and delayed contrast enhancement and T1 and T2 sensitive pulse sequences. Another use is in pre- and post-operative evaluation of congenital heart disease, in which the ability to provide anatomic, functional and vascular information from the entire thorax is unique, and particularly advantageous in young, radiation sensitive patients. Another frequent indication is analysis of suspected intracardiac or pericardial masses, which also benefits from the anatomic flexibility and tissue characterization capabilities of this modality.

RC603C

Cardiac PET/MRI: Clinical Applications
Pamela K. Woodard MD (Presenter): Research support, Siemens AG Research support, Astellas Group Consultant, B joTRONIK GmbH & Co KG

LEARNING OBJECTIVES

1) Participants in this course will learn clinical applications of cardiac PET/MRI. 2) Participants in this course will learn potential workflows for the performance of a cardiac PET/MRI myocardial perfusion examination and in
assessments of myocardial viability.

**RC623**

Minicourse: Current Topics in Medical Physics—Nuclear Cardiac Imaging for Physicists

*Refresher/Informatics*

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AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Thu, Dec 4 8:30 AM - 10:00 AM  Location: S404CD

**Participants**

Moderator
G. Donald  Frey  PhD : Nothing to Disclose

**LEARNING OBJECTIVES**

1) The participant will understand the role of nuclear cardiology in the diagnosis of cardiac disease.  2) The participant will understand the role of the medical physicist in PET imaging of the heart.  3) The participant will understand the role of SPECT imaging of the heart.

**Sub-Events**

**RC623A**  Introduction

G. Donald  Frey  PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) The participant will have an overall orientation to the role of medical physics in nuclear cardiology.

**ABSTRACT**

This section of the course will provide an overall introduction

**RC623B**  SPECT Imaging of the Heart

Mark T. Madsen  PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand how cardiac SPECT studies are acquired.  2) Understand how cardiac SPECT studies are reconstructed and what corrections are required.  3) Understand how cardiac SPECT studies are analyzed.  4) Become familiar with cardiac SPECT instrumentation.

**ABSTRACT**

Cardiac SPECT is the most common nuclear medicine procedure and it contributes nearly 85% of the radiation dose associated with nuclear medicine imaging. In this presentation, the instrumentation and algorithms associated with cardiac SPECT will be reviewed. We begin with conventional general purpose SPECT systems that rely on parallel collimation along with the associated special purpose cardiac SPECT systems that are based on the conventional approach. Recent advances in SPECT instrumentation have made available cardiac systems that rely on novel collimation and detector systems and these will also be reviewed. SPECT reconstruction approaches will be discussed including methods for motion, scatter and attenuation correction. Commercially available resolution recovery software for improving image quality and potentially reducing patient dose will round out the presentation.

**RC623C**  PET Imaging of the Heart

Sameer  Tipnis  PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the basic physics of cardiac PET imaging and the differences with cardiac SPECT.  2) To learn the proper way of acquiring data, including ECG gating, choice of bins, list mode data acquisition.  3) To understand the factors that affect image quality.  4) To learn tips for acquiring good clinical images.  5) To understand the role of dynamic PET imaging for determination of coronary flow reserve (CFR).
**Cardiac (Dual Energy CT)**

**Scientific Papers**

**CT**

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

**Participants**

**Moderator**
U. Joseph Schoepf MD: Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, General Electric Company Research Grant, Siemens AG

**Dianna M. Ehrhart Bardo MD:** Speakers Bureau, Koninklijke Philips NV Consultant, Koninklijke Philips NV

**Sub-Events**

**SSQ02-01**

**Myocardial Extracellular Volume Fraction with Dual-energy Cardiac Computed Tomography in Cardiomyopathy: Comparison with Cardiac Magnetic Resonance Imaging**

Hye-Jeong Lee MD (Presenter): Nothing to Disclose, Dong Jin Im: Nothing to Disclose, Yun Jung Kim MD: Nothing to Disclose, Jin Hur MD: Nothing to Disclose, Byoung Wook Choi MD: Nothing to Disclose

**PURPOSE**

We evaluated the feasibility of dual-energy cardiac CT to determine extracellular volume (ECV) fraction in the assessment of cardiomyopathy with cardiac MRI as the reference standard.

**METHOD AND MATERIALS**

Study participants provided written informed consent to participate in this institutional review board approved prospective study. ECV was measured in patients with cardiomyopathy according to the modified 16-segment model using the following equations; on cardiac MRI, $ECV = (ΔR1 of myocardium/ΔR1 of blood) \times (1-hematocrit)$, where $ΔR1$ was the change in T1 relaxivity between pre and post contrast; on cardiac CT, $ECV = (ΔHU of myocardium/ΔHU of blood) \times (1-hematocrit)$, where $ΔHU$ was the overlay HU, which is the HU difference caused by iodine through material decomposition with the dual-energy technique. The paired student t-test and agreement using the intraclass correlation coefficient (ICC) for ECV measurement between cardiac CT and cardiac MRI were evaluated on per-segment and per-patient analysis.

**RESULTS**

Nineteen patients with 304 myocardial segments were evaluated. For per-segment analysis, cardiac CT demonstrated a mean overlay HU of blood that was 54.13 ± 7.57 HU and a mean overlay HU of the myocardium that was 33.46 ± 10.68 HU, with the resulting mean ECV being 35.98 ± 10.62%. The mean ECV on cardiac MRI was 35.51 ± 10.50%. There was no significant difference in mean values between cardiac CT and cardiac MRI (P = 0.105). For per-patient analysis, cardiac CT demonstrated a mean overlay HU of blood that was 54.13 ± 7.11 HU and a mean overlay HU of the myocardium that was 33.46 ± 8.54 HU, with the resulting mean ECV being 35.98 ± 8.30%. The mean ECV on cardiac MRI was 35.51 ± 8.61%. There was no significant difference in mean values between cardiac CT and cardiac MRI (P = 0.098). Also, excellent agreements were observed for ECV measurement between cardiac CT and cardiac MRI for both per-segment and per-patient analysis (ICC = 0.940 and 0.969, respectively).

**CONCLUSION**

ECV found with dual-energy cardiac CT showed excellent agreement with that found with cardiac MRI, suggesting the potential of myocardial tissue characterization with cardiac CT.

**CLINICAL RELEVANCE/APPLICATION**

ECV measurement with dual-energy cardiac CT represents a new approach toward the clinical assessment of cardiomyopathy, particularly in patients with contraindications to cardiac MRI.

**SSQ02-02**

**The Diagnostic Performance of Calcification Suppressed Coronary CT Angiography Using Rapid kV Switching Dual Energy CT**

Yasutoshi Ohta MD (Presenter): Nothing to Disclose, Hiroto Yunaga: Nothing to Disclose, Yasuhiro Kaetsu: Nothing to Disclose, Tomomi Watanabe MD: Nothing to Disclose, Shinichiro Kitao: Nothing to Disclose, Yoshiyuki Furuse: Nothing to Disclose, Kazuhiro Yamamoto: Nothing to Disclose, Toshihide Ogawa MD: Nothing to Disclose

**PURPOSE**

The aim of this study was to compare the calcification suppressed MD image with the conventional virtual monochromatic single energy CT image (VMSECT) on diagnostic performance for detecting obstructive coronary artery disease (CAD) with calcification.

**METHOD AND MATERIALS**

Sixty-nine consecutive patients suspected or known CAD prospectively underwent DECT (Discovery CT750HD, freedom edition, GE) using rapid kV switching dual energy scan (80kV, 140kV, 600mA) before elective invasive
coronary angiography (ICA). MD images (Iodine density with hydroxyapatite suppression) were generated on a workstation. Coronary artery stenosis was evaluated qualitatively by MD image and conventional CTA image using VMSECT independently. Cross-sectional arc calcium was evaluated and rated on a segment model as follows: non-calcified, mild, moderate, and severe calcification. The diagnostic performance of two methods for detecting CAD (>50% luminal diameter stenosis) was compared with ICA as reference standard.

RESULTS
A total of 440 segments containing mild (139, 32%), moderate (69, 16%), and severe (31, 7%) calcification were detected and evaluated. For all calcified segments, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) to detect >=50% stenosis were 88%, 88%, 75%, and 94%, respectively for MD image and 91%, 71%, 56%, and 95%, respectively for VMSECT image. The PPV significantly improved on MD image (p

CONCLUSION
The diagnostic performance of MD image using DECT for calcified coronary lesions was superior to VMSECT. MD image by DECT with higher PPV is suited to detect and rule out the presence of significant CAD with calcification.

CLINICAL RELEVANCE/APPLICATION
Calcium suppressed coronary CTA in material density (MD) image using rapid kV switching dual energy CT (DECT) improves diagnostic performance for detecting calcified obstructive coronary artery disease.

SSQ02-03

Dual Energy CT Myocardial Perfusion Imaging and Coronary CT Angiography for Identification of Ischemia-causing Coronary Lesions
Sung Min Ko (Presenter): Nothing to Disclose, Hweung Kgon Hwang : Nothing to Disclose

PURPOSE
To determine the diagnostic performance of stress dual energy computed tomography myocardial perfusion imaging (DECT-MPI) for identification and exclusion of coronary artery stenoses that cause ischemia.

METHOD AND MATERIALS
We performed a prospective study of consecutive patients who underwent coronary CT angiography (CCTA), DECT-MPI, invasive coronary angiography (ICA) and cardiac magnetic resonance (CMR)-MPI. DECT-MPI and CMR-MPI were evaluated for the presence or absence of myocardial perfusion defects. CCTA and ICA were evaluated for the presence or absence of anatomically obstructive stenosis, as defined by a >50% stenosis. The primary endpoint was lesion-specific ischemia on a per-patient basis, as defined by a combination of a >50% stenosis by ICA and an associated perfusion defect by CMR-MPI. In exploratory analyses, DECT-MPI and CCTA were compared directly to CMR-MPI and ICA, respectively.

RESULTS
One hundred ninety-two patients (135 men, 63.1 ± 8.0 years) comprised the study cohort. 144 (75%) patients and 257 (45%) vascular territories exhibited ischemia-causing coronary stenoses. On a vessel-based model, the sensitivity, specificity, and positive and negative predictive values to detect ischemia-causing coronary lesions was 88%, 82%, 79% and 89%, respectively for DECT-MPI and CCTA; 91%, 75%, 75% and 92%, respectively for DECT-MPI alone; and 95%, 45% 63% and 94%, respectively for CCTA alone. Area under the receiver operating characteristics curve for DECT-MPI and CCTA was higher than for CCTA alone (0.85 vs. 0.75, p = 0.001).

CONCLUSION
Combined DECT-MPI and CCTA improves the identification and discrimination of ischemia-causing coronary stenosis over CCTA alone, but compared to a combined ICA/CMR-MPI, combined CCTA/stress DECT-MPI improves the predictive value for coronary stenoses causing ischemia compared to that of CCTA but only mildly improves the diagnostic performance of stress DECT-MPI alone.

CLINICAL RELEVANCE/APPLICATION
Dual energy CT (DECT) is a novel method that allows for mapping of myocardial contrast for evaluation of myocardial perfusion. Stress DECT-MPI provides clinical benefit to patients with insufficiently evaluated coronary lesions by CCTA alone.

SSQ02-04

Dynamic Myocardial Perfusion in a Porcine Ischemia Model Using Spectral Detector CT

PURPOSE
We used a prototype spectral detector CT (SDCT) scanner (Philips Healthcare) and advanced processing for cardiac CT perfusion (CTP) in a porcine model. This scanner limits beam hardening (BH), eliminates partial scan artifacts with fast 360deg scans, and limits errors in material decomposition. Our initial studies aim at developing a methodology and determining the effect of mono-energetic (MonoE) reconstructions on quality of CTP measurements.
**METHOD AND MATERIALS**

A porcine model mimics coronary stenosis through partial occlusion of the LAD artery with a balloon catheter as adjusted with FFR measurements. Dynamic CT (120kVp/100mAs) scans were acquired at end-systole (45%RR). Projection-based MonoE images were reconstructed for energies [50,120]keV at 10keV increments. We applied 3D cubic B-spline normalized mutual-information to register reconstructed data to a common reference and created a mean CT volume. Semiautomatic segmentation of the LV myocardium was performed on the average volume and propagated across the 4D sequences. Absolute myocardial blood flow (MBF) was computed using a deconvolution-based approach.

**RESULTS**

At baseline (FFR=1), MonoE images at peak enhancement, and iodine maps gave relatively uniform values within the entire myocardium, with no obvious BH artifacts, whereas at FFR=0.7, clear deficits in the LAD regions were noticed mainly for lower keV's. Mean MBF=(100.99±26.1mL/min/100g) at FFR=1 and (31.43±13.3mL/min/100g) at FFR=0.7, which corresponds to about 69% decrease in blood flow. Qualitatively, 70keV images provide a more uniform MBF map with a high contrast between ischemic and normal tissue. This contrast depends on the keV, and we used flow-CNR (or CNR) to evaluate this dependence. Two equally sized ROI's (same for all keVs) were manually drawn in the LAD and remote areas. We computed CNR_f as: $\text{CNR}_f = \frac{\mu_{MBF}(\text{remote}) - \mu_{MBF}(LAD)}{\sigma_{MBF}(\text{remote})}$. Mean CNR_f=8.32±4.27(50keV), 7.33±3.4(70keV), and 0.94±0.52(120keV).

**CONCLUSION**

The SDCT scanner can be used to acquire high quality CTP images which are relatively artifact free. MBF decrease was only noticed in LAD territory between ischemic and baseline conditions. Flow CNR between occluded LAD and remote areas decreases for higher keVs.

**CLINICAL RELEVANCE/APPLICATION**

Adding robust cardiac CTP to coronary CTA will create a powerful non-invasive diagnostic test for cardiovascular disease and an ideal gatekeeper exam for cardiac catheterization.

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**SSQ02-05**

**Cardiac Spectral CT: Iodine Quantification and Spectral Curve of Acute Myocardial Infarction in Swine**

**P用途**

Spectral CT renewed the interest of myocardial perfusion evaluation in clinic application, such as image quality improvement by virtual monochromatic spectral (VMS) images, and iodine quantification by material decomposition. The current study was to investigate the ability of cardiac spectral CT for assessing myocardial infarction.

**METHOD AND MATERIALS**

A total of 12 swine underwent 90 minutes occlusion on distal segment of LAD by balloon angioplasty. After 4±1 days of successful acute myocardial infarction model establishment, spectral CT coronary angiogram (CTCA, Discovery CT750 HD CT FREEdom Edition scanner: GE Healthcare, Milwaukee, WI, USA) and late gadolinium-enhanced magnetic resonance (MR, Signa HDx 3.0 Tesla MR scanner, GE, Milwaukee, WI, USA) was performed to evaluate myocardial infarction. The differences of attenuation density (AD), iodine concentration, and spectral curve among different myocardial regions were observed. The infarction on late gadolinium-enhanced MR and CTCA were visually assessed for each myocardial segment on a binary scale and compared by kappa test. Diagnostic ability of CTCA to differentiate infarct segments was tested by ROC curve.

**RESULTS**

Significant differences of both AD and iodine concentration on CTCA were found among infarction, risk area and remote myocardium on all three types of image settings (70keV, high voltage, and iodine density images; p<0.05). There were also significant differences slopes of spectral curve among infarction, risk area and remote myocardium. The spectral CT and MR had almost perfect agreement (κ=0.821) in infarct segment differentiation. ROC curve showed high diagnostic accuracy of CTCA to differentiate myocardial infarct segments (sensitivity=0.813, specificity= 0.989, positive predictive value=0.981, negative predictive value=0.880 and accuracy=0.901; p<0.001).

**CONCLUSION**

The 70keV VMS with higher SNR, CNR and lower noise was preferable to assess acute myocardial infarction. AD and iodine concentration on spectral CTCA, which had a good agreement with the standard MR results, could be used to differentiate infarct myocardial segments.

**CLINICAL RELEVANCE/APPLICATION**

Spectral CTCA may have the potential ability to differentiate infarction, risk area and remote myocardium by using VMS, iodine quantification, and spectral curve in the clinics.
Correlation of Aortic Valve Calcium Score with Post-Transcatheter Aortic Valve Implantation Paravalvular Aortic Regurgitation

Bothaina Mohammed Abdulshakour (Presenter): Nothing to Disclose, Sophie Tan: Nothing to Disclose, aileen mae bathan lomarda MD: Nothing to Disclose, Foong Koon Cheah MBBCh, FRCR: Nothing to Disclose, Swee Yaw Tan MBBCh, MRCP: Nothing to Disclose

PURPOSE
In recent years, for patients with severe and symptomatic aortic stenosis, but are not suitable candidates for surgery, Transcatheter Aortic Valve Implantation (TAVI) has been recommended as a less invasive alternative to surgical aortic valve replacement (AVR). However, post-procedural paravalvular aortic regurgitation (PAR) is a common complication that can arise due to incomplete annular sealing or technical errors in valve sizing or positioning. PAR has been associated with an increase in long-term mortality post-TAVI. We would like to determine if the density distribution of calcium in the aortic valves and surrounding walls, as derived from a non-contrast CT, can predict if the patient is likely to have PAR post-TAVI.

METHOD AND MATERIALS
A total of 29 patients (12 men and 17 women; 77.2 ± 9.69 years) with severe or critical aortic stenosis by echocardiography had TAVI. They had pre-procedural assessment by non-enhanced 320 slice MDCT. The Aortic Valve Calcium (AVC) score was derived measuring the amount of calcium in the aortic valve and immediate surrounding aortic wall calculated using the Agatston schema on a Vitrea workstation. All cases are reviewed independently by a senior cardiologist and a radiologist, with final readings averaged. The degree of post-TAVI PAR was assessed using an invasive aortogram immediately after valve deployment.

RESULTS
Elevated AVC scores have a positive correlation with increasing possibility of PAR with an ROC of 0.82 (95%CI: 0.66, 0.97). Optimal corresponding sum of sensitivity and specificity to determine any grade of post-TAVI paravalvular leak was an AVC score of 3000. 7 patients out of 29 had no PAR after implantation of the valve. None of these 7 patients had a AVC greater than 3000. All patients with a AVC score of 3000 and above had at least mild paravalvular leak. A cut off point of :=3000 yielded a sensitivity of 0.68 and a specificity of 1.0. With a prevalence of 0.24, the PPV was 1.0 and the NPV was 0.9.

CONCLUSION
A high AVC score of more than 3000 predict moderate to severe PAR as complication of post TAVI procedure. Therefore, pre-operative scoring of aortic valve calcification by non-enhanced MDCT is highly recommended as predictor of PAR severity post TAVI procedure in which may support decision making for traditional surgical replacement of aortic valve.

CLINICAL RELEVANCE/APPLICATION
AVC can be determined using noncontrast CT and correlates with post TAVI PAR.

A Performance Comparison of all Different DECT Series for Assessment of Myocardial Blood Supply Using 13NH3 PET as the Reference Standard

Wenhuan Li MD (Presenter): Nothing to Disclose, Kuncheng Li MD: Nothing to Disclose, Xiaolian Zhu: Nothing to Disclose, Nan Chen MD: Nothing to Disclose, Qi Yang MD: Nothing to Disclose, Xiangying Du MD: Nothing to Disclose

PURPOSE
To identify the optimal dual energy computed tomography (DECT) series for detection of myocardial perfusion defects, by comparing all different DECT series (iodine mapping, monoenergetic series, nonlinearly blended series, linearly blended series, and 100KV series), using 13NH3 positron emission tomography (PET) as reference standard.

METHOD AND MATERIALS
This study was approved by the local ethics committee, and written informed consent was obtained from each patient. Nineteen prospectively enrolled patients, with known or high likelihood of coronary heart disease, underwent both cardiac DECT and 13NH3 PET acquisition at rest. The DECT data were reconstructed as iodine mapping, monoenergetic series, nonlinearly blended series, linearly blended series, and 100KV series. The myocardial perfusion defects on all different DECT series was visually assessed by 2 observers, using standard 17-segment model. Per-segment agreement between modalities was investigated with kappa statistics. The comparison of all different DECT series vs. PET was mainly based on receiver operating characteristic (ROC) curve analysis.

RESULTS
A total of 323 segments (100%) of all 19 patients were analyzed. Iodine mapping showed the largest area under ROC curve (AUC) (0.897±0.021, P<0.001), best correlation with 13NH3 PET (K=0.777, P<0.001), and best diagnostic accuracy (96.7% sensitivity, 88.1% positive predictive value, 95.0% negative predictive value, and 90.7% accuracy) among all different DECT series.

CONCLUSION
Iodine mapping is superior to other DECT series for the visualization of myocardial perfusion defects.

CLINICAL RELEVANCE/APPLICATION
Iodine mapping is a powerful DECT series for detecting myocardial perfusion defects and is recommended in evaluation of myocardial blood supply.

**Coronary Artery Calcium Quantification Based on Virtual Non-contrast Dual Energy CT Data Sets**

**Patricia M. Carrascosa MD (Presenter):** Research Consultant, General Electric Company, Macarena De Zan: Nothing to Disclose, Carlos Capunay MD: Nothing to Disclose, Mauro Namias MSc, MEng: Nothing to Disclose, Alejandra Deviggiano MD: Nothing to Disclose, Silvina Cipriano: Nothing to Disclose, Gaston Rodriguez Granillo: Nothing to Disclose, Javier Valdejos MD, MBA: Nothing to Disclose

**PURPOSE**

To evaluate the feasibility of using CT virtual non-contrast enhanced (VNC) series derived from dual-energy CT (DECT) imaging studies for coronary artery calcium quantification.

**METHOD AND MATERIALS**

The study was approved by the institutional review board; all patients provided written informed consent. In 60 patients, we prospectively underwent single energy non-contrast enhanced CT calcium scoring scan at 120 kV followed by coronary CT angiography performed in dual energy mode based on rapid kilovoltage switching between 80 and 140 kV, using 0.625 mm slice thickness. Both scans were carried out on a 128-slice DECT scanner (Discovery CT750 HD; GE Medical Systems). Material basis decomposition images were created for the iodine/water pair. Polychromatic images at 120 kV were generated from the material density images by thresholding water images above 1100 mg/cm³ to suppress iodine content with dedicated software which gave virtual non-contrast images in HU as a result. Both data sets were analyzed using dedicated calcium scoring software (Smart Score 4.0; GE Medical Systems). The AJ-130, the mass and the volume scores and the percentile rank for age and gender of each patient were calculated. Correlation between quantified calcium on VNC images and true non-contrast enhanced coronary artery calcium scoring images, and the percentile rank was performed by the Spearman rank order correlation coefficient.

**RESULTS**

There was excellent correlation between AJ-130, the mass score and the volume score on VNC images and the true non-contrast enhanced series (r = 0.95 (0.93 to 0.97), 0.95 (0.93 to 0.97), and 0.96 (0.94 to 0.98), respectively; p < 0.001) globally. There was also excellent agreement between Multiethnic Study of Atherosclerosis percentile ranks derived from predicted versus actual calcium scores and the percentile rankings, 0.88 (0.81 to 0.93).

**CONCLUSION**

The excellent correlation between the amounts of calcium measured on non-contrast enhanced CT calcium scoring images and VNC data derived from DECT provide an opportunity to avoid the need for a dedicated CT scan for calcium scoring.

**CLINICAL RELEVANCE/APPLICATION**

Coronary artery calcium scoring (CCS) has been shown to increase the predictive accuracy of established multivariate risk factor models and it is an independent predictor of cardiovascular events.
Do Incidental Findings Discovered on Pre-procedural CT for Trans-catheter Aortic Valve Replacement Have an Impact on Decision to Treat Aortic Stenosis?

Elham Najafpour MD (Presenter): Nothing to Disclose, Sreevathsan Sridhar MD : Nothing to Disclose, Daniel Vargas MD : Nothing to Disclose, Saman Panahipour MD : Nothing to Disclose, Alan Zajarias MD : Nothing to Disclose, Cylen Javidan-Nejad MD : Nothing to Disclose

PURPOSE

Trans-catheter aortic valve replacement (TAVR) is increasingly performed to treat severe aortic stenosis. Pre-TAVR chest, abdomen and pelvis CT frequently yields incidental findings with a potential to impact surgical planning.

METHOD AND MATERIALS

Pre-procedural CT exams of 285 consecutive patients considered for TAVR were retrospectively reviewed. Incidental findings were categorized as: Group 1) acute incidental finding needing treatment (e.g. pneumonia); Group 2) malignancy; Group 3) comorbidity (e.g. cirrhosis); Group 4) non-acute incidental finding needing further work up or follow-up; Group 5) incidental finding of no consequence. Clinical notes before and after pre-TAVR CTs were reviewed to assess which incidental finding was already known and to determine which patients underwent treatment by TAVR, traditional surgery (TS) and balloon valvuloplasty (BV). Those who were not treated based on the incidental findings discovered by CT (NT) were differentiated from those decided to not be treated due to other factors. Statistical analysis was performed using chi-square.

RESULTS

6/285 CT exams revealed no incidental findings. Most CT studies showed multiple incidental findings falling into...
several groups. Group 1: 35 incidental findings, 60% were unknown, 50% patients had TAVR, 26% TS, 9% BV and 6% NT; Group 2: 16 incidental findings, 94% were unknown, 44% patients had TAVR, 6% TS, 13% BV and 25% NT; Group 3: 284 incidental findings, 29% were unknown, 45% patients had TAVR, 25% TS, 2% BV and 4% NT; Group 4: 166 incidental findings, 45% patients had TAVR, 18% TS, 3% BV, and 4% NT; Group 5: 372 incidental findings, 44% patients had TAVR, 24% TS, 3% BV, 3% NT. Statistical analysis revealed a higher association the incidental finding of cancer with a management of no repair (p 0.0005). All other correlations had a p value > 0.05.

CONCLUSION
Incidental findings are ubiquitous on pre-TAVR CT exams. Cancer is the only incidental finding demonstrating a significant association with the decision to not perform an interventional treatment. Comorbidities which may have precluded patients from open aortic valve replacement in the past now have no significant effect upon decision to treat by TAVR.

CLINICAL RELEVANCE/APPLICATION
This study can lead to establishment of standardized reporting of incidental findings in regards to a vascular procedure (Similar to Bi-RADS).

**SSQ03-03**

Characteristics of Vulnerable Human Coronary Atherosclerotic Plaque: Phase-Contrast Imaging

Sebastian Winklhofer MD (Presenter): Nothing to Disclose, Peter Silvia: Nothing to Disclose, Verena Tischler MD: Nothing to Disclose, Fabian Morsbach: Nothing to Disclose, Moritz Werdt, von: Nothing to Disclose, Sandra Berens MD: Nothing to Disclose, Peter Modregger PhD: Nothing to Disclose, Holger Moch: Nothing to Disclose, Marco Stampaponi PhD: Nothing to Disclose, Michael J. Thali MD: Nothing to Disclose, Hatem Alkadhi MD: Nothing to Disclose, Paul Stolzmann MD: Nothing to Disclose

**PURPOSE**

Purpose of the study was to investigate into X-ray grating interferometry phase-contrast (PC) imaging for the characterization of human coronary artery plaque.

**METHOD AND MATERIALS**

PC X-ray and absorption computed tomography (CT) imaging was performed ex vivo in this institutional review board-approved study in forty human coronary artery segments using a synchrotron radiation source. Two independent readers performed qualitative analyses of image quality, plaque components, and plaque classification according to the modified American Heart Association (AHA) criteria in 38 plaques detected by histopathology, the latter serving as the reference standard. Quantitative measurements of plaque components (i.e., collagen, lipid, smooth muscle, and calcification) were performed and compared among PC and absorption images using analysis of variances (ANOVA) for repeated-measures with a post hoc Bonferroni correction.

**RESULTS**

Image quality was superior in PC images as compared with absorption imaging (P<0.001). Plaque components were detected by PC imaging without significant differences to histopathology, whereas absorption imaging detected calcifications without statistical differences only. Of the 38 detected coronary artery plaques, characterization was accurate in 33 plaques (87%) with PC; absorption imaging allowed for correct characterization of 7 plaques (13%, P<0.001). Hounsfield units (HU) of PC images were significantly different for all plaque components (pairwise P<0.05). Absorption images demonstrated significant differences (κ=0.81, P<0.001) between calcification and other plaque components, but were similar for collagen, lipid, and smooth muscle (P=1.00).

**CONCLUSION**

PC imaging allows for accurate characterization of human coronary artery plaque and quantitative assessment of plaque components, thereby outperforming absorption imaging.

**CLINICAL RELEVANCE/APPLICATION**

Phase contrast imaging may not only allow for an improved understanding of the development of vulnerable plaque but for the identification of patients at risk for myocardial infarction.

**SSQ03-04**

Low Contrast- and Low Radiation Dose Protocol in Cardiac CT: Usefulness of Low Tube Voltage and Knowledge-based Iterative Model Reconstruction Algorism

Takeshi Nakaura MD (Presenter): Nothing to Disclose, Yuji Iyama MD: Nothing to Disclose, Shinichi Tokuyasu RT: Employee, Koninklijke Philips NV, Masafumi Kidoh: Nothing to Disclose, Kazunori Harada: Nothing to Disclose, Yasuyuki Yamashita MD: Consultant, DAIICHI SANKYO Group, Naritsugu Sakaino: Nothing to Disclose, Seitaro Oda MD: Nothing to Disclose

**PURPOSE**

Low kilo-voltage (kVp) CT is well suited for low contrast and low radiation dose cardiac CT; however, increased image noise is a problem. The recent introduced knowledge-based iterative model reconstruction (IMR) dramatically reduces the image noise. We evaluated the feasibility of a low contrast-, low radiation dose protocol for cardiac CT using 80 kVp and IMR.

**METHOD AND MATERIALS**
This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. Thirty patients underwent a low contrast-, low radiation dose protocol with 80 kVp, 923 mA and prospective ECG gating. A 40% reduced contrast dose (222 mgI/kg) was delivered during 12 sec. We also enrolled 30 patients who underwent our conventional protocol with 120 kVp, 992 mA and prospective ECG gating. The 80-kVp images were reconstructed with FBP, hybrid iterative reconstruction (HIR) and IMR. We evaluated CT number, image noise and contrast to noise ratio (CNR) of ascending aorta between 120 kVp images and 80 kVp images reconstructed with FBP, HIR and IMR with the Dunnett test. We also compared noise reduction rate of HIR and IMR as compared with FBP reconstruction with the two tailed t-test. Two independent readers assessed image contrast, image noise, image sharpness, unfamiliar texture and overall image quality on a 4-point scale.

RESULTS

The estimated ED was 75% lower with the 80- than the 120 kVp protocol (1.3 mSv vs 5.3 mSv). The CT number of 80 kVp images was significantly higher than that of 120 kVp images (517.1 HU ± 64.8 vs 431.4 HU ± 51.6, p < 0.01). The noise reduction rate was significantly higher with IMR (76.2% ± 4.6) than with HIR (50.0% ± 1.5) (FBP: 119.0 HU ± 39.9; HIR: 59.4 HU ± 19.6; IMR: 27.4 HU ± 7.3) (p < 0.01). The CNR of 80 kVp images with IMR was significantly higher than that of 120 kVp images (19.8 ± 3.9 vs 13.3 ± 2.5, p < 0.01). There was no significant difference in the score of unfamiliar texture between 80-kVp images with IMR and 120-kVp images (p > 0.05).

CONCLUSION

The 80 kVp scans with the IMR yields higher image quality for cardiac CT with 75% decreased radiation dose and 40% decreased contrast dose as compared with the 120 kVp protocol with FBP reconstruction.

CLINICAL RELEVANCE/APPLICATION

The low tube voltage scan with IMR is well suited for a low contrast-, low radiation dose protocol for cardiac CT.
PURPOSE
The purpose of this study is to evaluate an optimized high-resolution MOLLI (HR-MOLLI) technique at 3T and 1.5T for RV ECV calculation in healthy volunteers.

METHOD AND MATERIALS
25 healthy volunteers (16 men, 41±14.3yrs) were scanned at 3T (MAGNETOM Skyra, Siemens AG, Healthcare Sector, Erlangen, Germany) and 19 (12 men, 46.8±12.9yrs) were scanned at 1.5T (MAGNETOM, Aera). T1 mapping was performed in the axial orientation using a HR-MOLLI technique, with an in line motion correction algorithm with T1 and T1* parametric map generation using 0.5x0.5x8mm3 voxel. The MOLLI sequence was comprised of two inversion pulses sampling T1 recovery using a 5(3)3 scheme with single shot steady state diastolic rest. Images were acquired before and 12-25 minutes after 0.2mmol/kg gadobenate dimeglumine (Multihance, Bracco Diagnostics, Monroe, NJ) infusion as a bolus. Two reviewers quantified basal and mid RV, interventricular septal, and lateral LV wall T1 values from T1 parametric maps. RV and LV ECV ranges were calculated as originally described by Jerosch-Harold et al assuming normal hematocrit values (women:0.38-0.46, men: 0.42-0.54). Global ECV values were compared using the students t-test. Intra and inter-observer variance was measured by the intraclass correlation coefficient (ICC).

RESULTS
One 3T volunteer and four 1.5T subjects were excluded due to motion blurring of the RV free wall. Table 1 shows RV and LV global ECV ranges by field strength and BP T1 estimation method. Global RV and LV ECV ranges were significantly different at 3T and 1.5T (p<0.001). Intraobserver variance for global RV and LV ECV was 0.78 and 0.92 for 3T and 0.79 and 0.79 for 1.5T respectively. Interobserver variance for global RV and LV ECV was 0.75 and 0.71 at 3T and 0.58 and 0.71 at 1.5T respectively.

CONCLUSION
This feasibility study demonstrates that HR-MOLLI can quantitate the global RV ECV fraction at both 1.5T and 3T with good intra and interobserver variance, also that blood pool T1 estimates without a look-locker correction have a significant influence on the RV and LV ECV. We also found a field strength influence on RV and LV ECV values, highlighting the need to determine field strength specific values.

CLINICAL RELEVANCE/APPLICATION
Determination of the ECV by T1 estimation using MOLLI techniques enables quantitation of diffuse myocardial fibrosis and it may be feasible to measure in the RV.

SSQ03-07

Improving the Image Quality of Coronary CTA Using a Novel Non-rigid Registration Based Motion Correction Algorithm: In Comparison with Bi-sector Reconstruction

Meng Zhang (Presenter): Nothing to Disclose, Hong Zeng MD, PhD: Nothing to Disclose, Zhongwen Lv: Nothing to Disclose, Lin Liu MD, PhD: Nothing to Disclose

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

METHOD AND MATERIALS
Coronary CTA was performed with a 64-row MDCT scanner (GE, Discovery HD750) on 123 patients with mean heart rates of 68 bpm (range:58-75 bpm). Both single sector and bi-sector multiphase reconstruction were performed to select the optimal cardiac phase for each reconstruction method. SSF reconstruction and motion correction was performed based on the optimal single sector reconstruction to generate the SSF images. The image quality was then evaluated by two blinded observers on workstation using a 5-point scale (5=excellent to 1=non-diagnostic) and the image quality of the three reconstruction methods was compared.

RESULTS
Totally 984 segments of coronary artery from 123 patients were analyzed. There was good inter-observer agreement (k=0.85). The average scores of the groups with single sector (A), bi-sector (B) and SSF (C) were 2.56±0.12, 3.01±0.23 and 3.78±0.09, respectively. On segment based analysis, the percentage of acceptable image quality no less than score 3 was 83.6%, 89.4% and 93.4%, respectively, with significant difference between groups A and C (x2=5.24, p

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

CLINICAL RELEVANCE/APPLICATION
As a new method to reduce the motion artifact of coronary artery, SSF will expand the use of ECG-gated coronary CTA.
**SSQ03-08**

**Detecting Myocardial Structural Abnormalities in Patients with the WPW Syndrome with ECG-gated Multi-detector Cardiac CT**

Kyu Ok Choe (Presenter): Nothing to Disclose, Hye-Jeong Lee MD: Nothing to Disclose, Young Joo Suh MD: Nothing to Disclose, Sae Rom Hong MD: Nothing to Disclose, Yoo Jin Hong MD: Nothing to Disclose, Young Jin Kim MD: Nothing to Disclose

**PURPOSE**

Myocardial dyskinesia in segments prematurely activated by accessory pathways has been well documented in echocardiographic studies for pediatric WPW syndrome patients. However, the long-term effects of dyskinesia to the myocardium have not been studied in depth. Therefore, our study goal was to evaluate myocardial structural abnormalities on cardiac CT in adult WPW syndrome patients.

**METHOD AND MATERIALS**

Institutional Review Board approval was obtained for this retrospective study and informed consent was waived. Of the 75 WPW syndrome patients who underwent cardiac CT from January 2006 to December 2013, 58 patients (mean age 51.8 ± 12.7 years, 62.1% male) were finally included after excluding combined cardiac disease. Clinical records including electrocardiography, electrophysiologic study, and echocardiography were evaluated. Two reviewers blindly and independently evaluated myocardial thickness and attenuation on cardiac CT retrospectively. The interobserver agreement about the presence of myocardial structural abnormality and the correspondence rate between the myocardial abnormality location and the accessory pathway location were evaluated.

**RESULTS**

For myocardial abnormality, excellent agreement (k=0.811) was obtained between the reviewers. After consensus, a total of 18 patients (31%) were found to have myocardial abnormalities; wall thinning in 17 patients, subendocardial fat attenuation in 10, and combined findings in 9. All findings were observed at the basal left ventricle. For the accessory pathways, 16 patients had the right free wall pathway, 11 had the septal pathway, and 31 had the left lateral pathway. No myocardial abnormality was observed at the right free wall pathway, and 6 patients with the septal pathway and 12 with the left lateral pathway showed myocardial abnormalities. All abnormalities (100%, 18/18) corresponded with the accessory pathway location.

**CONCLUSION**

A relatively high prevalence (31%) of myocardial structural abnormalities was observed on cardiac CT in adult WPW syndrome patients, and all abnormalities corresponded with the accessory pathway location.

**CLINICAL RELEVANCE/APPLICATION**

Wall thinning and subendocardial fat attenuation observed in WPW patients might reflect long term effects of dyskinesia and might suggest irreversible myocardial injury.

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**SSQ03-09**

**Can MRI Be Used to Assess Mechanical Dyssynchrony? The Features of Left Bundle Branch Block on MRI**

Giselle Y. Revah MD (Presenter): Nothing to Disclose, Vincent Wu BS: Nothing to Disclose, James S. Babb PhD: Nothing to Disclose, Janice Chyou: Nothing to Disclose, Leon Axel MD, PhD: Nothing to Disclose

**PURPOSE**

There is scant information about MRI of mechanical features of left bundle branch block (LBBB). Several findings have been described in the echo literature, including: septal flash (SF), early inward motion followed by outward motion of the septum once the lateral wall begins to contract; apical rocking (AR), abnormal motion of the left ventricular (LV) apex perpendicular to the LV long axis; delayed opening of the aortic valve; and delayed lateral wall contraction. This study aims to assess the MRI features of LBBB.

**METHOD AND MATERIALS**

We retrospectively identified cardiac MRIs from 43 patients with LBBB on EKG and 43 age and gender matched controls. Two cardiac radiologists assessed the MRIs for the presence of SF, AR and timing of lateral wall contraction. Timing of aortic valve opening was assessed on phase-contrast velocity flow maps and three different conventional cine planes.

**RESULTS**

According to Fisher's exact test, LBBB was significantly associated with SF and AR (p<0.0001). Since SF and AR were seen exclusively in LBBB, they showed 100% specificities and PPVs for LBBB. Using logistic regression, the delayed timing of both the lateral wall contraction and the aortic valve opening as compared to controls were significant predictors of LBBB (p<0.0001). The timing of aortic valve opening assessed on phase-contrast images had the best sensitivity (86%) and specificity (100%) in predicting LBBB, compared to conventional cine images. Among LBBB patients, 79.1% (34/43) had SF. Ejection fraction (EF) was a significant predictor of SF (p=0.041, OR= 0.93) but QRS duration was not a significant predictor of SF (p=0.437). EF was also a significant predictor of delayed opening of the aortic valve (p=0.041), in patients with LBBB. Inter-reader agreement was assessed by kappa (κ) coefficients, which showed concordant opinions between the readers in identifying SF (κ=1.0) and AR (κ=0.55). There was good inter-reader agreement in timing measurements of delayed aortic valve opening on phase-contrast (ICC = 0.90) and 3 chamber cine SSFP (ICC =0.88).

**CONCLUSION**

...
MRI can be used as an adjunct to EKG to assess patients with mechanical dyssynchrony. SF, AR and delayed opening of the aortic valve are highly specific predictors of LBBB that can reliably be detected by MRI.

**CLINICAL RELEVANCE/APPLICATION**

MRI can act as an adjunct to EKG and identify patients with mechanical dyssynchrony (LBBB), who may benefit from resynchronization therapy.

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**CARDIOVASCULAR MAGNETIC RESONANCE IN CHAGAS DISEASE: DIFFERENCES BY CLINICAL STAGES AND ITS IMPACT (STATION #1)**

**Jorge Ignacio Magana MD** (Presenter): Nothing to Disclose, **Gabriela Melendez MD**: Nothing to Disclose, **Aloha Meave**: Nothing to Disclose, **Leyli C Velasquez MD**: Nothing to Disclose, **Cynthia Romero-Aragones MD**: Nothing to Disclose

**PURPOSE**

To assess the characteristics in cardiac magnetic resonance (CMR) of Chagas disease according to the clinical stage.

**METHOD AND MATERIALS**

We analyzed forty-eight patients with positive anti-T. cruzi antibodies that underwent CMR for evaluation of late enhancement and functional ventricular parameters. Patients were divided according to the clinical stage: indeterminate (7 patients), subclinical (5 patients) and Chagas cardiomyopathy (36 patients). Chagas cardiomyopathy (CC) patients were divided according to their clinical presentation 18 patients in heart failure (HF) and 18 ventricular tachycardia (VT) patients.

**RESULTS**

Progressive increase in measurements, global LV volumes and myocardial segments with late enhancement (LE), as well as a decrease in LVEF as the clinical stage progresses was found. There was an inverse relationship between the number of segments with LE and LVEF. Patients with VT had higher LVEF and lower ventricular volumes compared with patients with HF (LVEF 38.3% vs 21.9%, p

**CONCLUSION**

A progressive increase in segments with LE and decrease in LEVF as the clinical stage progresses. Patients with VT had higher LEVF and lower EDV compared to patients with HF.

**CLINICAL RELEVANCE/APPLICATION**

Chagas disease is widely distributed in developing latin american countries. The clinical scenarios of the disease between Mexico and other countries are different, but both share fatal ventricular arrhythmias and progression to congestive heart failure. Cardiac magnetic resonance (CMR) is an excellent method that may help to establish these different scenarios and detect those at higher risk and worst outcome.

**UTILITY OF COMPUTED TOMOGRAPHY CORONARY ANGIOGRAPHY IN PATIENTS WITH HYPERTROPHIC CARDIOMYOPATHY PRESENTING WITH CHEST PAIN OR ANGINA-EQUIVALENT SYMPTOMS (STATION #2)**

**Masoud Shariat MD** (Presenter): Nothing to Disclose, **Paaladinesh Thavendiranathan MD**: Nothing to Disclose, **Elsie Nguyen MD**: Nothing to Disclose, **Bernd J. Wintersperger MD**: Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG, **Narinder S. Paul MD**: Research funded, Toshiba Corporation, **Harry Rakowski**: Nothing to Disclose, **Andrew Michael Dominic Crean MD**: Nothing to Disclose

**PURPOSE**

Assess the utility of CTCHA in the assessment of patients with HCM and anginal symptoms and compare the incidence of epicardial CAD to an age and gender matched control group.

**METHOD AND MATERIALS**

Consecutive patients with HCM referred for CTCHA over a 3 year period due to anginal symptoms (chest pain or
shortness of breath) were identified retrospectively. Age and gender matched patients without HCM referred for CTCA over a 6 months period due to similar symptoms were used as controls. Data on CAD risk factors was collected in both groups. All patients had CTCA using an Aquilion One 320 scanner. The coronary arteries were evaluated independently by 2 blinded observers and any luminal narrowing scored quantitatively as follows: > 70% = severe; 50-70% = moderate; < 50% = mild; and none. For the HCM group, results of SPECT or CMR perfusion studies as well as catheter angiograms were recorded where available.

RESULTS

Total of 91 patients with HCM and 91 controls were included. No significance difference in cardiac risk factors was present between two groups. The CTCA was of diagnostic quality in all patients. The median (inter-quartile range) calcium score was lower in patients with HCM (0 [0-50] Hu versus 2[0-189] Hu) but did not reach statistical significance (p=0.23). The incidence of moderate to severe CAD was significantly lower in patients with HCM than in controls (6.6% versus 33.0%, p

CONCLUSION

We demonstrate the use of CTCA for assessment of anginal symptoms in patients with HCM. The incidence of moderate to severe CAD was significantly lower in our HCM patients compared to our control group. Given the high incidence of false positive findings on perfusion stress studies we propose that CTCA may be a useful gatekeeper to coronary angiography in the HCM patient with anginal symptoms.

CLINICAL RELEVANCE/APPLICATION

We suggest that CTCA should be considered as a first-line investigation for HCM patients presenting with angina or anginal-equivalent symptoms.

CAS226

Study of Clinico-Epidemiological Characteristics and Analysis of the Image Findings in Cardio-MR of Cardiomyopathy for a Period of 2 Years (Station #3)

Carmen de la Torre Valdivia MD (Presenter): Nothing to Disclose, Miguel Angel Ramirez: Nothing to Disclose, Rocio Rodriguez Ortega PhD: Nothing to Disclose, Maria Isabel Padin-Martin MD: Nothing to Disclose

PURPOSE

To describe the characteristics of cardiomyopathy and to show the main radiology findings in cardio-MR, specially those important to make a differential diagnosis.

To analyze our results.

METHOD AND MATERIALS

We have reviewed all cardio-MRI studies conduced in our center in the period between January 2012 and January 2014. The studies were performed on a a General Electric® 1.5-Tesla Magnetic Resonance. Sequences performed in the study were Spin Echo single-shot seucences (HASTE), EST T1 and T2-weighted, cine-MR gradient-echo and cine-MR steady state free precession (Fiesta). Images postprocessing was performed by General Electric® Report Card. We used microsoft® excel 2010 for the statistical analysis of the obtained data.

RESULTS

During the period of our study (from January 2012 to January 2014), 201 cardiac-MRI studies were performed in our center. Most of the studies were conducted in the male gender (60.7 %), and the average age was 44 ± 19.4 years (range 9-79). 52% of these studies were made by clinical suspicion of cardiomyopathy. Hypertrophic cardiomyopathy was the most frecuent diagnosis followed dydilated cardiomyopathy. Other diagnosis were restrictive cardiomyopathy, myocarditis and non-compaction cardiomyopathy.

CONCLUSION

Cardiomyopathy is a frequent entity in our environment.

Cardio-MR study plays an important role in the early diagnosis and treatment of patients whith cardiomyopathy.

CLINICAL RELEVANCE/APPLICATION

Cardio-MR is currently considered the gold standard in the study of cardiomyopathy and cardiac motility, being particularly useful in patients with little window that dificult the valuation of the myocardium by ultrasound.

CAS228

Evaluation of Image Quality and Diagnostic Accuracy of Coronary CT Angiography in Patients with Various Body Mass Index (BMI): Comparison of Iterative and Filtered Back Projection Image Reconstruction (Station #4)

Young Jun Cho MD (Presenter): Nothing to Disclose, Keum Won Kim MD: Nothing to Disclose, Cheol Mog Hwang MD: Nothing to Disclose, Kyu Ok Choe: Nothing to Disclose, Jung Han Hwang: Nothing to Disclose

PURPOSE

To compare traditional filtered back projection (FBP) and sonogram affirmed iterative reconstruction (SAFIRE) for the evaluation of coronary CT image quality and diagnostic accuracy in patients with various body mass indexes (BMI).

METHOD AND MATERIALS
One hundred nine consecutive patients (56 men, 53 women; mean age, 57.4 ± 11; range, 20-79) with various BMI underwent both coronary CTA and coronary catheterization. The study population was divided into three groups according to BMI: normal was defined as a BMI of 18.50 to 24.99 kg/m², overweight as a BMI of 25.00 to 29.99 kg/m², and obese as a BMI ≥ 30.00 kg/m². Image data were reconstructed with both FBP and SAFIRE. Two reconstruction techniques, we evaluated subjective image quality of each coronary segmental artery using a five-point scale according to the noise severity. We also evaluated objective image quality with two reconstruction techniques by measuring CT attenuation, image noise, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) as objective parameters. Diagnostic accuracies of FBP and SAFIRE were independently evaluated by significant coronary stenoses (≥50%) in comparison of coronary catheterization as the reference standard.

RESULTS

With both reconstruction techniques, the mean subjective image quality scores in all BMI groups were significantly higher with SAFIRE image than FBP image (p = 0.000). In obese and overweight patients, the number of assessable coronary segments was increased with SAFIRE. Image noise, SNR, and CNR were also significantly improved in all BMI groups when using SAFIRE, compared with FBP. In obese and overweight patients, specificity, PPV and accuracy of each SAFIRE for the detection of significant stenosis were significantly better than those of each FBP (p = 0.001, respectively).

CONCLUSION

Compare with traditional FBP image, the SAFIRE image in obese and overweight patients seems better suited by improvement of image quality and help to decreases the requirements of coronary catheterization by decreasing the number of false positive patient.

CLINICAL RELEVANCE/APPLICATION

The SAFIRE image in obese and overweight patients seems better suited by improvement of image quality and help to decreases the requirements of coronary catheterization by decreasing the number of false positive patient.

“Heart of Brightness” – Delayed Enhancement Detection using Motion Corrected (MOCO) Phase Sensitive Inversion Recovery (PSIR) Imaging in Non-ischemic Cardiomyopathy (Station #5)

Oisin Jude Flanagan MBBCh, MRCPI (Presenter): Nothing to Disclose, Shivraman Giri PhD: Employee, Siemens AG, Bruce Spottiswoode: Employee, Siemens AG, Sven Zuehlsdorff PhD: Employee, Siemens AG, Xiaoming Bi PhD: Nothing to Disclose, Maria Carr: Nothing to Disclose, Michael Markl PhD: Nothing to Disclose, Jad Marwan, Bou Ayache MD: Nothing to Disclose, Marcos Paulo Ferreira Botelho MD: Nothing to Disclose, Jeremy Douglas Collins MD: Consultant, B. Braun Melsungen AG, Robert R. Edelman MD: Research support, Siemens AG Royalties, Siemens AG, James Christopher Carr MD: Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

PURPOSE

To improve image quality and diagnostic confidence in characterizing non-ischemic delayed enhancement (DE) sequences in all patients, including those with irregular cardiac rhythms and poor breath-holding ability.

METHOD AND MATERIALS

28 consecutive out-patients (11F, 17M age 25-84 years, mean 62.2) with possible non-ischemic cardiomyopathy were referred for cardiac MRI on a 1.5T system (MAGNETOM Aera, Siemens AG, Erlangen, Germany). Two standard PSIR sequences of free breathing single shot steady state free precession (FB single shot SSFP) and breath hold (BH) turboflash (TF) were performed as well as a prototype sequence FB MOCO SSFP. This latter sequence used respiratory motion compensation based on nonrigid image registration and motion corrected averaging to enhance SNR. The anonymized Images were independently graded by two blinded experienced cardiovascular radiologists for image quality (1 to 5), diagnostic confidence (1 to 3), the presence of DE (using a 16 segment model). Each segment was analysed for location of DE (subendocardial, midmyocardial or subepicardial) and finally for segmental artifact.

RESULTS

15 of 28 patients showed non-ischemic DE. Image quality for FB single shot SSFP, BH TF and FB MOCO SSFP were 3.80, 3.15 and 3.87 respectively. Diagnostic confidence was 2.63, 2.35 and 2.70 and the number of segments degraded by artefact was 41, 112 and 34. Total DE segments detected were 92, 119 and 112 in an approximate distribution of 68% subendocardial, 24% midmyocardial and 3% subepicardial across all three techniques.

CONCLUSION

FB MOCO SSFP had higher image quality and diagnostic confidence and less artifact than both FB single shot SSFP and BH TF. It detected more DE than FB single shot SSFP. BH TF detected the most DE but with the lowest image quality and diagnostic confidence and the most artefact. This suggests that in non-ischemic cardiomyopathy, FB MOCO SSFP is overall superior to FB single shot SSFP and superior to BH TF in the large number of cases where BH TF images are poor.

CLINICAL RELEVANCE/APPLICATION

As increasingly sicker patients undergo cardiac MRI, robust motion corrected images are needed to combat thir poor breathholding and fast or irregular rhythms. This sequence provides this and will be increasingly important.
Coronary Calcium Scores are Underestimated at a Large Body Size: A Multivendor Phantom Study (Station #6)

Martin J. Willemink MD (Presenter): Nothing to Disclose, Bronislaw Abramiuc: Nothing to Disclose, Niels R. van der Werf: Nothing to Disclose, Tineke Petra Willems MD, PhD: Nothing to Disclose, Marcel Greuter PhD: Nothing to Disclose, Tim Leiner MD, PhD: Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group

PURPOSE

Recent guidelines from the American Heart Association recommend coronary calcium scoring (CCS) with computed tomography (CT) for patients at low-to-intermediate and intermediate cardiovascular risk. Previous studies have shown that obesity is related to increased CCS. With the increasing prevalence of obesity it is essential to assess whether CCS is performed adequately in heavy patients. However, the effect of body size has not been evaluated yet on routinely used protocols of current state-of-the-art CT systems. The purpose of the current study is to evaluate the effect of body size on CCS as assessed with new-generation CT systems from the four major vendors.

METHOD AND MATERIALS

An anthropomorphic chest phantom containing 100 small calcifications (diameters 0.5-2.0 mm) was evaluated with and without an extension ring using routine protocols of state-of-the-art CT systems from four vendors. The extension ring was used to mimic a heavy patient. Image acquisition was repeated five times with small translations and/or rotations. Routine acquisition protocols for both medium and heavy patients were used. CCS was quantified as Agatston and mass scores with software from the same manufacturer as the CT systems.

RESULTS

The medium sized phantom resulted in median (interquartiles) Agatston scores of 10 (9-35), 113 (72-133), 34 (30-37) and 87 (85-89) for Philips, GE, Siemens and Toshiba, respectively. Mass scores were 4 (3-9), 18 (14-21), 8 (8-9) and 20 (20-20) mg, respectively. Adding the extension ring resulted in reduced Agatston scores for all vendors (17-86%) and mass scores for three vendors (11-86%). Median Agatston scores decreased to 9 (5-10), 16 (15-20), 27 (24-32) and 45 (29-53) units, and median mass scores increased for Philips to 4 (4-6) and decreased for the other vendors to 2 (2-4), 8 (7-8) and 10 (8-13) mg, respectively.

CONCLUSION

This multivendor phantom study showed that CCS is underestimated up to 86% at a larger body size. Therefore, a correction factor should be used for CCS of heavy patients, or image acquisition protocols should be standardized across platforms of different vendors.

CLINICAL RELEVANCE/APPLICATION

Body size is an important determinant of the coronary calcium score and may impact perceived risk for future cardiovascular events.

Reduction of Beam Hardening Artifacts for Coronary Stent by using the Cardiac Spectral Imaging at Various Heart Rates: An In Vitro Study (Station #7)

Zhang Zhang (Presenter): Nothing to Disclose, Wenjia Zhang : Nothing to Disclose, Ningnannan Zhang PhD : Nothing to Disclose, Tielian Yu : Nothing to Disclose

PURPOSE

Detection of in-stent re-stenosis using cardiac CTA is still challenging. One important obstacle is the beam hardening artifact from the high density stent, which may decrease the positive predictive value or even fail the examination. The cardiac gemstone spectral imaging (GSI) allows the synthesis of virtual monochromatic spectral (VMS) images, which may reduce the beam hardening artifact. The purpose of this study was to explore the reductions of beam hardening artifacts by using different energy levels of VMS at various heart rates.

METHOD AND MATERIALS

Totally 5 different types of coronary stents (internal diameter: 3.10±0.55mm; strut thickness: 0.12±0.04mm) were placed in a pulsating cardiac phantom (ALPHA 1-VT PC, Fuyo Corporation, Japan). The cardiac GSI scans were acquired on a single-source dual-energy spectral CT scanner (Discovery CT750 HD CT FREEdom Edition scanner, GE Healthcare, Milwaukee, WI, USA). All the spectral imaging data were analyzed with GSI viewer to reconstruct the VMS images (40-140 keV). The Artifact Index (AI) was measured for each keV level data set.

RESULTS

On stationary condition, the AI of the polychromatic axial scan with standard reconstruction was 115.92 ± 34.86, while the AIs of VMS were 62.07 ± 18.67, 42.29 ± 12.72, 35.33 ± 10.62, 27.95 ± 8.41, 17.87 ± 5.37, 8.12 ± 2.44, 5.73 ± 1.72 on 40-100 keV by interval of 10 keV, respectively (p<0.005). There were significant differences of AIs between the VMS and polychromatic images (p<0.001). AIs above 80 keV decreased significantly than the others (p<0.005). Similar results were also found in the other heart rates (AI in 60 bpm: 81.46 ± 24.46 for polychromatic images, 54.12 ± 16.29 in 40 keV, 13.68 ± 4.11 in 80 keV; AI in 70 bpm: 19.34 ± 5.92 for polychromatic images, 59.55 ± 17.93 in 40 keV, 6.33 ± 1.92 in 80 keV).
CONCLUSION

VMS images with high energy level (i.e., >80keV) can apparently reduce the beam hardening artifacts for coronary stent in various heart rates.

CLINICAL RELEVANCE/APPLICATION

The spectral CTA could effectively reduce the artifact, and may have the potential to show a clear inner-lumen for the patient with coronary stent in clinic.

Applicability and Benefits of an In-house Rapid Prototyping 3D Printer in Cardiac Imaging Departments (Station #8)

Phillip Kim (Presenter): Nothing to Disclose, Harshna Vinodbhai Vadvala MD: Nothing to Disclose, Brian Burns Ghoshhajra MD: Nothing to Disclose

TEACHING POINTS

Commercially available Rapid Prototyping (RP) printers, such as Makerbot (Brooklyn, NY) Replicator 2X used in this study, produce accurate 3D analogs The use of a RP printer in-house has several potential benefits such as fast turnaround time (aortic root with coronaries:<12hrs, entire aorta:<20hrs vs. at least >24 hours from third party vendors), cost efficient, and protection of patient data from third parties 3D models of both normal and diseased cardiac structures can be used as teaching tools for patients, technologists, trainees, and other healthcare workers

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CAS-THB

Cardiac Thursday Poster Discussions

Scientific Posters

CA

AMA PRA Category 1 Credits ™: .50

Thu, Dec 4 12:45 PM - 1:15 PM  Location: CA Community, Learning Center

Sub-Events

CAS231

Evaluation of a Novel Adaptive Detector Collimation for Prospectively ECG-triggered Sequential Cardiac CT with a 192-slice Third-generation Dual-source CT (Station #1)

Ralf W. Bauer MD (Presenter): Research Consultant, Siemens AG Speakers Bureau, Siemens AG, Julian Lukas Wichmann MD: Nothing to Disclose, Thomas Allmendinger: Employee, Siemens AG, Thomas Josef Vogl MD, PhD: Nothing to Disclose, Josef Matthias Keri MD: Research Consultant, Siemens AG Speakers Bureau, Siemens AG

PURPOSE

To investigate the impact of a novel adaptive detector collimation on dose parameters and accurateness of scan length adaptation at prospectively ECG-triggered sequential cardiac CT with a new wide-detector third-generation dual-source CT.

METHOD AND MATERIALS

Ideal scan lengths for human hearts were retrospectively derived from 103 triple rule out examinations. These measures were entered into the new scanner operated in prospectively ECG-triggered sequential cardiac scan mode with three different detector settings: a) adaptive detector collimation b) fixed 64 x 0.6 mm collimation c) fixed 96 x 0.6 mm collimation. Differences in effective scan length and its deviation from the ideal scan length and dose parameters (CTDvol, DLP) for 120, 100, 90 and 70 kV were documented.

RESULTS

The ideal cardiac scan length could be matched by the adaptive detector collimation in every case while the mean scanned length was +15.4% with the 64 x 0.6 mm and +27.2% with the 96 x 0.6 mm collimation longer. While the DLP was almost identical between the adaptive and the 64 x 0.6 mm collimation (83 vs. 89 mGycm at 120 kV), it was +62.7% and therefore significantly higher with the 96 x 0.6 mm collimation (135 mGycm).

CONCLUSION
CONCLUSION

The adaptive detector collimation for sequential acquisition allows adjusting the scan length as accurate as this can only be achieved with a spiral acquisition. This technique is further indispensable with a 57.6 mm wide detector in order to keep patient exposure low where otherwise patient dose would significantly increase with the traditional step-and-shoot mode.

CLINICAL RELEVANCE/APPLICATION

A novel adaptive detector collimation ensures accurate z-axis coverage and is crucial to keep exposure parameters at the lowest level with third-generation cardiac step-and-shoot dual-source CT.

CAS232

Value of Multi-detector Computed Tomography Angiography in Study of Coronary Artery Elasticity (Station #2)

Kaiyuan Xu (Presenter): Nothing to Disclose, Lei Gong MD: Nothing to Disclose, Xing Chen: Employee, Toshiba Corporation, Xuelin Zhang PhD: Nothing to Disclose

PURPOSE

To explore the value of multi-detector computed tomography angiography in evaluation of coronary artery elasticity by measuring and calculating coronary artery elastic parameters.

METHOD AND MATERIALS

Multi-detector computed tomography angiography was performed in 86 patient s from September 2012 to October 2013. Diameter changes of 344 segment of coronary artery in the systolic and diastolic phases were measured by CT coronary angiography. Correlations between coronary artery elastic parameters and pulse pressure and mean arterial pressure were analyzed, and correlations between coronary artery compliance and systolic blood pressure were analyzed, including the left main artery, left anterior descending artery, left circumflex artery and right coronary artery.

RESULTS

Coronary artery compliances in the various branches were different and \( P=0.001 \) ( \( P<0.05 \)) in the Friedman Test, coronary artery compliances and pulse pressure and mean arterial pressure were negatively correlated. Coronary artery compliances and systolic blood pressure were negatively correlated ( \( P<0.05 \)). The remaining coronary artery elastic parameters and pulse pressure and mean arterial blood pressure were less relevant.

CONCLUSION

Multi-detector computed tomography angiography can be used as an effective means of measuring coronary lumen. Coronary artery compliance can reflect the elasticity of normal coronary vessel walls.

CLINICAL RELEVANCE/APPLICATION

Multi-detector computed tomography angiography can be used as an effective means of measuring elasticity of normal coronary vessel walls.

CAS233

Visual and Quantitative Evaluation of Lumen Stenosis and Diameter with Known Dimensions Using Coronary Computed Tomography Angiography by 320-row Detector CT: Effect of Iterative Reconstruction Assessed By Pulsating Cardiac Phantom (Station #3)

Kazuhiro Nozu MD (Presenter): Nothing to Disclose, Yasuyuki Kobayashi MD, PhD: Nothing to Disclose, Sou Oode MD: Nothing to Disclose, Yasuyoshi Ogawa RT: Nothing to Disclose, Kiyoko Tateishi: Nothing to Disclose, Yukihisa Ogawa: Nothing to Disclose, Yasuo Nakajima MD: Nothing to Disclose

PURPOSE

Coronary computed tomography angiography (CTA) is useful for detecting coronary disease and is clinically performed worldwide. However, the radiation dose is crucial. The application of an iterative reconstruction (IR) algorithm can help decrease the noise, result in radiation dose reduction. However, IR has been reported to have a noise-free appearance with an unusually homogeneous attenuation. This study aimed to investigate the effect of IR on visual and quantitative evaluation of lumen stenosis and diameter with known dimensions using coronary CTA by 320-slice area detector CT.

METHOD AND MATERIALS

We used the pulsating heart phantom (HR 40bpm) with acrylic coronary vessel phantoms (FUYO, Tokyo, Japan) and 320 slice CT (Toshiba, Nasu, Japan). Acrylic coronary vessel phantoms with precisely drilled stenosis of mild (25%), moderate (50%), and severe (75%) grades were studied using 320-slice MDCT. Image acquisition was optimized, and images were reconstructed by using filtered back projection (FBP) and AIDR 3D (weak/mild/standard/strong). Stenosis was evaluated visually by blinded expert readers using a four-grade image quality score (IQS), and lumen diameter was quantitatively assessed by using automated lumen contour detection software (Ziosoft, Tokyo, Japan).
RESULTS
IQS was significantly increased in AIDR 3D compared with FBP. AIDR 3D algorithms improved the image quality to a diagnosable level when the SD was less than 45HU in FBP. With quantitative assessment, the error between the real and measured diameter using automated software in AIDR 3D was significantly smaller than that in FBP (AIDR 3D mild; p=0.028, standard; p=0.004, strong; p<0.001). The association between the error and strength of AIDR 3D was significant (p<0.001).

CONCLUSION
AIDR 3D algorithms can reduce a noise, and improve image quality and quantitative accuracy, compared with FBP.

CLINICAL RELEVANCE/APPLICATION
AIDR 3D algorithms can reduce a noise, and improve image quality and quantitative accuracy, compared with FBP, results in radiation dose reduction.

Low Contrast- and Low Radiation Dose Protocol in Cardiac CT: Usefulness of Low Tube Voltage and Knowledge-based Iterative Model Reconstruction Algorism (Station #4)

Findings
- Low kilo-voltage (kVp) CT is well suited for low contrast and low radiation dose cardiac CT; however, increased image noise is a problem. The recently introduced knowledge-based iterative model reconstruction (IMR) dramatically reduces the image noise. We evaluated the feasibility of a low contrast-, low radiation dose protocol for cardiac CT using 80 kVp and IMR.

METHOD AND MATERIALS
This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. Thirty patients underwent a low contrast-, low radiation dose protocol with 80 kVp, 923 mA and prospective ECG gating. A 40% reduced contrast dose (222 mgI/kg) was delivered during 12 sec. We also enrolled 30 patients who underwent our conventional protocol with 120kVp, 992 mA and prospective ECG gating. The 80-kVp images were reconstructed with FBP, hybrid iterative reconstruction (HIR) and IMR. We evaluated CT number, image noise and contrast to noise ratio (CNR) of ascending aorta between 120 kVp images and 80 kVp images reconstructed with FBP, HIR and IMR with the Dunnett test. We also compared noise reduction rate of HIR and IMR as compared with FBP reconstruction with the two tailed t-test. Two independent readers assessed image contrast, image noise, image sharpness, unfamiliar texture and overall image quality on a 4-point scale.

RESULTS
The estimated ED was 75% lower with the 80- than the 120 kVp protocol (1.3 mSv vs 5.3 mSv). The CT number of 80 kVp images was significantly higher than that of 120 kVp images (517.1 HU ± 64.8 vs 431.4 HU ± 51.6, p < 0.01). The noise reduction rate was significantly higher with IMR (76.2% ± 4.6) than with HIR (50.0% ± 1.5) (FBP: 119.0 HU ± 39.9; HIR: 59.4 HU ± 19.6; IMR: 27.4 HU ± 7.3) (p < 0.01). The CNR of 80 kVp images with IMR was significantly higher than that of 120 kVp images (19.8 ± 3.9 vs 13.3 ± 2.5, p < 0.01). There was no significant difference in the score of unfamiliar texture between 80-kVp images with IMR and 120-kVp images (p > 0.05).

CONCLUSION
The 80 kVp scans with the IMR yields higher image quality for cardiac CT with 75% decreased radiation dose and 40% decreased contrast dose as compared with the 120 kVp protocol with FBP reconstruction.

CLINICAL RELEVANCE/APPLICATION
The low tube voltage scan with IMR is well suited for a low contrast-, low radiation dose protocol for cardiac CT.

Extracellular Volume Fraction and Noncontrast T1 Mapping using 1.5-T Cardiac MRI in AL Cardiac Amyloidosis (Station #5)

Findings
- The aims of the study was to assess the potential role of extracellular volume fraction (ECV) and noncontrast T1 mapping for detection of cardiac involvement in patients with primary amyloid light-chain (AL) amyloidosis.

METHOD AND MATERIALS
This study included 26 AL amyloidosis patients (56 ± 9 years, 14 males) with cardiac involvement based on...
histologic analysis, who underwent 1.5-T CMR including precontrast and postcontrast T1 mapping (shortened modified look-locker inversion recovery [ShMOLLI] sequence) and late gadolinium enhancement (LGE) imaging from October 2011 to November 2013. ECV and pre T1 values were analyzed with all parameters of LV function measured in CMR and two-dimensional transthoracic echocardiography. Additionally, ECV and pre T1 values were further studied by categorizing the patients by well-known prognostic parameters including NT-pro BNP (threshold = 1800pg/mL) and serum free light chain difference (threshold = 18mg/dL): group I, no elevation of two parameters; group II, elevation of one of those two parameters; and group III, elevation of both parameters.

RESULTS
As ECV increased, LV ejection fraction decreased (CMR, r = -0.625, P < 0.001; echocardiogram, r = -0.543, P = 0.004) and normalized LV mass index increased (CMR, r = 0.494, P = 0.010). In addition, ECV was negatively correlated with diastolic dysfunction parameters such as e’ (r = -0.474, P = 0.014), and deceleration time (r = -0.625, P < 0.001). However, pre T1 mapping was only correlated with normalized LV mass index (r = 0.446, P = 0.022). In comparison of categorized patient's groups, pre T1 mapping appeared higher in the group with worse prognostic parameters [1023.2 ms (1059.4-1132.6), 1141.9 ms (1109.4-1166.7), and 1169.2 ms (1133.1-1201.1) in group I, II, and III, P=0.047]. Meanwhile, ECV appeared more prominently higher in the group with worse prognostic parameters [0.44 (0.40-0.50), 0.56 (0.52-0.58), and 0.59 (0.56-0.67), P=0.004].

CONCLUSION
ECV correlates well with the prognostic markers of AL amyloidosis as well as with left ventricular systolic and diastolic function. Further studies are needed to assess the prognostic significance of ECV elevation.

CLINICAL RELEVANCE/APPLICATION
ECV is potentially more sensitive for detecting early disease than LGE imaging and elevated ECV may represent a direct marker of cardiac amyloid load.

CAS236

Improve the Image Quality of Prospective ECG-gated Coronary Computed Tomography Angiography with Snapshot Freeze Technique (Station #6)

Gulina  Azhati (Presenter):  Nothing to Disclose , Wenya  Liu :  Nothing to Disclose , Haiting  Ma :  Nothing to Disclose , Yan  Xing  PhD, MD :  Nothing to Disclose , Cunxue  Pan  PhD :  Nothing to Disclose , Jun  Dang :  Nothing to Disclose , Jing jing  Li :  Nothing to Disclose , Yan Wei  Wang  MD :  Nothing to Disclose

PURPOSE
To access the value of snapshot freeze (SSF) technique in prospective ECG-gated coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS
20 patients with suspected coronary heart disease underwent prospectively ECG gated CCTA. All of the CCTA images were reconstructed by both standard (STD) and SSF motion correction. 75%R-R interval were choses as the central phase for the reconstruction. With a standard 16-segment model in accordance with the SCCT Guidelines, two experienced radiologists evaluated image quality with Likert 4-point score. The image quality and interpretability were assessed on per-segment, per-artery and per-patient level. Comparisons of variables were performed between STD and SSF reconstructions with paired Wilcoxon rank sum test and paired Chi-square test.

RESULTS
For 20 patients(mean age 55.7±10.2 years; male 14, female 6), the mean heart rate was 60.0±7.1 beats/min. SSF reconstructions showed higher interpretability than STD reconstructions on per-segment level [96.1%(272/283) vs 90.8%(257/283),P=0.011], but there were no significant difference on per-patient level [95%(19/20) vs 80%(16/20),P=0.210] and per-artery level [96.3%(77/80) vs 90%(72/80),P=0.211]. Image qualities were higher with the use of SSF than STD reconstructions on per-patient level (3.3±0.4 vs 2.9±0.6,P<0.001) and LAD (3.3±0.5 vs 3.0±0.6,P=0.001), LCX (3.4±0.4 vs 3.1±0.7, P<0.001), RCA (3.0±0.8 vs 2.6±0.8,P=0.003), but similar on LM (4.0±0.0 vs 3.8±0.7,P=0.180). Image quality was higher on segment 1,2,3,4,7,8,9,11,13 and 15 with the use of SSF versus STD reconstructions on per-segment level.

CONCLUSION
SSF could improve the image quality and interpretability in patients undergoing CCTA with prospective ECG-gating.

CLINICAL RELEVANCE/APPLICATION
SSF could improve the image quality of CCTA.Because of the reduction of motion artifacts, it could not only increase the rate of diagnosis but also reduce the influence of heart rate.

The Spectrum of Tetralogy of Fallot with Advanced Cardiovascular Imaging, CT and MRI, before Intervention, with Palliation and after Definitive Repair (Station #7)

Bryan E  Ashley  MD (Presenter):  Nothing to Disclose , Anthony Marcus  Hlavacek  MD :  Investigator, Siemens AG Research Grant, Siemens AG , David  Gregg  MD :  Nothing to Disclose , U. Joseph  Schoepf  MD :  Research Grant, Bracco Group Research Grant, Bayer AG Research Grant, General Electric Company Research
TEACHING POINTS

1. TOF encompasses a wide spectrum of abnormalities beyond the classic findings of RVH, PS, VSD and Overriding Aorta, including subvalvar RVOT stenosis, branch pulmonary artery stenoses and aneurysms, aortopulmonary collaterals and airway complications. 2. The postoperative appearance is variable depending on disease severity and surgical technique. 3. What quantitative parameters and imaging findings need to be reported by radiologists.

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RC703

Cardiac Perfusion Imaging with MR and CT

Refresher/Informatics

RC703A

FFRCT

Jonathon Avrom Leipsic MD (Presenter): Speakers Bureau, General Electric Company Speakers Bureau, Edwards Lifesciences Corporation Consultant, Heartflow, Inc Consultant, Circle Cardiovascular Imaging Inc

LEARNING OBJECTIVES

1) Discuss the current evidence supporting FFR guided revascularization. 2) Provide an overview of the technical background of Fractional Flow Reserve derived from a resting coronary CT angiogram. 3) Review the data validating FFRCT for the detection and exclusion of lesion specific ischemia by invasive FFR.

RC703B

Adenosine Stress/Rest CT


LEARNING OBJECTIVES

1) To review the available evidence supporting the use of Stress CT perfusion. 2) To understand the importance of combining anatomy and physiology in the non-invasive evaluation of chest pain patients. 3) To describe the limitations and understand the future directions of Stress CTP.

ABSTRACT

A major limitation of coronary CTA is that the physiological significance of stenotic lesions identified is often unknown. Stress myocardial computed tomography perfusion (CTP) is a novel examination that provides both anatomic and physiological information. Multiple single-center studies have established the feasibility of stress myocardial CTP. Furthermore, it has been illustrated that a combined CTA/CTP protocol improves the diagnostic accuracy to detect hemodynamic significant stenosis as compared with CTA alone; this combined protocol can also be accomplished at a radiation dose comparable to nuclear myocardial perfusion imaging exams. Stress CTP is a modality with significant potential, particularly in the evaluation of chest pain patients, given the advantages of short exam time and comprehensive data acquisition. This lecture will summarize the current literature, indications, limitations and discuss future directions of Stress CTP.

RC703C

MRI

Matthijs Oudkerk MD, PhD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) Understand that perfusion MRI can be implemented in every radiology department. 2) Learn how to differentiate normal from abnormal perfusion of the myocardium. 3) Compare the performance of perfusion MRI with other imaging modalities. 4) Identify indications and patient populations for perfusion MRI.

ABSTRACT

Adenosine stress MR myocardial perfusion imaging has a proven high sensitivity and negative predictive value for the detection of myocardial ischemia. High diagnostic accuracies are reached in patient groups with relatively high prevalence of disease in studies combining rest-stress perfusion and delayed contrast enhancement. For the subgroup of patients with a history of myocardial infarction these elaborate protocols or different stress MR imaging methods are probably most appropriate. In relatively lower risk patients, those without known myocardial infarction, less comprehensive protocols are effective to guide further work-up and therapy choice. In lower-risk patient groups examined by adenosine stress-only perfusion MR imaging the number of purely diagnostic coronary angiographies (CAG's) can be reduced and almost ruled out.

URL's

www.cmi-nen.nl

RC803

Imaging Nonischemic and Ischemic Disease of the Myocardium

Refresher/Informatics

RC803A

MRI and CT of Cardiac Masses

Phillip Matthew Young MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review role of MR and CT in assessing cardiac masses. 2) To highlight the potential for detection, characterization, staging, and guiding surgical decision making with cardiac MR and CT through clinical cases. 3) To review some practical tips and tricks to keep in mind when imaging these challenging cases.

RC803B

Infiltrative Diseases (Amyloid, Hemochromatosis Fabrys, Sarcoid)

Kristopher W. Cummings MD (Presenter): Research Consultant, Biomedical Systems Research Consultant, Medtronic, Inc

LEARNING OBJECTIVES

1) Understand the role of cardiac MR in the evaluation of infiltrative cardiomyopathy. 2) Describe typical patterns and locations of MR late gadolinium enhancement associated with various types of infiltrative disease. 3) Explain the role of noncontrast MR in the evaluation for myocardial iron deposition.

RC803C

Non Infiltrative Non-ischemic Cardiomyopathies (HCM, Noncompaction, ARVD, Myocarditis, Takatzubo etc.)

Karen Gomes Ordovas MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand how to differentiate ischemic from non-ischemic cardiomyopathies on cardiac MRI. 2) To recognize the cardiac MR findings suggestive of the diagnosis of different types of non-ischemic cardiomyopathies. 3) To identify cardiac MR findings that have a prognostic role in patients with non-ischemic cardiomyopathies.

RC813

Pediatric: CV/Chest
**Sub-Events**

**RC813A**

**Imaging of CHD in the Neonate**

Rajesh Krishnamurthy MD (Presenter): Research support, Koninklijke Philips NV Travel support, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Understand the segmental approach to diagnosis and management of congenital heart disease in the neonate. 2) Highlight appropriateness of MRI and CT with regard to technique, pitfalls, indications and critical imaging findings that affect management for common imaging scenarios in neonatal CHD, including coarctation, aortopathy, congenital pulmonary arterial and venous anomalies, heterotaxy, and neonatal palliation of single ventricle. 3) Provide an opportunity for general radiologists, pediatric radiologists and cardiac imagers who have limited exposure to this area in their workplace an opportunity to refresh their pediatric cardiovascular imaging skills in a focused manner.

**RC813B**

**Pre-operative Imaging of Congenital Heart Disease**

Randolph K. Otto MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand common pediatric cardiovascular pathophysiology and surgical management, including such conditions as aortic coarctation, intra and extra-cardiac shunts, pulmonary arterial and venous anomalies, management of single ventricle, and anomalous coronary arteries. 2) Strengths and weaknesses of CT and MRI, highlighting specific techniques and problem-solving approaches. 3) Demonstrate various techniques for cardiovascular data acquisition, post-processing, analysis, and reporting in order to anticipate and address surgical concerns.

**RC813C**

**Monitoring of Repaired Congenital Heart Disease**

J. A. Gordon Culham MD (Presenter): Advisor, MedVoxel System Inc Stockholder, MedVoxel System Inc

**LEARNING OBJECTIVES**

1) Understand the imaging of residual structural and functional abnormalities that occur after the repair of Congenital Heart Disease. Tetralogy of Fallot and Transposition of the Great Arteries will be emphasized.

**SST02**

**ISP: Cardiac (Non-ischemic Cardiomyopathy)**

**Scientific Papers**

**MR**

**CA**

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

Fri, Dec 5 10:30 AM - 12:00 PM  Location: SS02AB

**Participants**

Moderator
Karen Gomes Ordovas MD : Nothing to Disclose
Phillip Matthew Young MD : Nothing to Disclose

Moderator
Charles S. White MD : Nothing to Disclose

**Sub-Events**

**SST02-01**

**Quantification of Diffuse Myocardial Interstitial Fibrosis in Thalassemia Major with Cardiac Magnetic Resonance Imaging**

PURPOSE
We sought to quantify left ventricular (LV) myocardial interstitial fibrosis in patients with thalassemia major using cardiac MRI based extracellular volume fraction (ECV), and to correlate ECV with the degree of myocardial iron overload.

METHOD AND MATERIALS
In this prospective case-control study, myocardial T1 mapping was performed at 1.5T pre- and 12 minutes post-contrast administration using a prototype modified Look-Locker inversion recovery (MOLLI) technique in patients with thalassemia major receiving regular transfusions (n=30; 53% male, 34.6±9.5 years) and healthy volunteers (n=10; 50% male, 31.5±4.4 years). Standard cine SSFP, late gadolinium enhancement (LGE), and T2* mapping were also performed. LGE (>5SD threshold), ECV and T2* were analyzed for each myocardial segment (AHA 16 segment model). Same day hematocrit values were used for ECV calculation. Statistical analysis included two-sample t-test, Pearson correlation, and ANOVA with Tukey's post-hoc analysis.

RESULTS
LV end-diastolic volume (89.8±15.7ml/m2 and 99.8±15.3ml/m2, p=0.12) and ejection fraction (60.5±6.3% and 60.1±3.1%, p=0.83) were not significantly different between patients and volunteers. Pre-contrast T1 values were lower in patients compared to volunteers (892.5±117.9ms vs. 1005.5±33.5ms, p=0.005), and correlated strongly with T2* values (r=0.89, p<0.001). After a significance difference between groups (p=0.002, ANOVA), post hoc analysis demonstrated higher ECV in patients with prior history of iron overload (T2*<20ms, n=19, 31.5±2.9%) compared to those without (n=11, 28.3±3.4%, p=0.030) and volunteers (27.1±0.1%, p=0.003). There was no difference in ECV between patients without iron overload and volunteers (p=0.66). ECV correlated with same-day T2* (r=-0.33, p=0.04), but had better correlation with lowest historical T2* (r=-0.49, p=0.007). Segmental LGE among patients was low (median 0.6%; range 0.3-2.1%), and did not correlate with ECV (r=-0.040, p=0.81).

CONCLUSION
In patients with thalassemia major, cardiac MRI demonstrated elevated ECV in keeping with diffuse interstitial myocardial fibrosis related to iron overload. Patients without a history of iron overload had no evidence of fibrosis despite receiving regular transfusions.

CLINICAL RELEVANCE/APPLICATION
Early aggressive chelation therapy may be warranted in patients receiving chronic transfusions to prevent diffuse interstitial myocardial fibrosis due to myocardial iron overload.

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**SST02-02**

The Cumulative Effect of Doxorubicin on the Change of Myocardial Extracellular Volume Fraction Measured by Contrast Enhanced Magnetic Resonance Imaging in Dilated Cardiomyopathy Rabbit Models; Histopathology Analysis and Electron Microscopic Findings

Yoo Jin Hong MD : Nothing to Disclose, Donghyun Hong MS : Nothing to Disclose, Chul hwan Park MD (Presenter): Nothing to Disclose, Byoung Wook Choi MD : Nothing to Disclose

PURPOSE
To examine the change of myocardial extracellular volume (ECV) fraction using contrast enhanced magnetic resonance imaging in rabbit during the dilated cardiomyopathy modeling and to investigate the correlation between ECV and the degree of fibrosis and electron microscopic findings in dilated cardiomyopathy rabbit (DCR) models.

METHOD AND MATERIALS
DCR (male adult New Zealand White rabbit, 3-4 kg) models were made by injecting doxorubicin (Doxorubicin Hydrochloride, Cayman) with doses of 1.0mg/kg twice a week for max16weeks. Every rabbit underwent cardiac MRI pre- and post- T1 mapping using modified Look-Locker inversion recovery (MOLLI) sequence, LGE, and cine MRI on a clinical 3-T cardiac magnetic resonance (CMR) system before drug administration (Control group) and at 6th , 12th , and 16th week after drug administration (DCR modeling) On MRI, ECV was calculated at the septum using the myocardial pre, post T1 value, LV blood pool T1 value, and hematocrit(Hct) as follows: ECV = [(1/T1post-contrast myocardium)-(1/T1pre-contrast myocardium)/(1/T1post-contrast blood)-(1/T1pre-contrast blood)] × (1-Hct). Fibrosis was quantitatively measured by image J (V. 1.47, NIH, Bethesda, MA) with digital images of specimens stained with picrosirius red. For electron microscopic findings, specimens were obtained at interventricular septum and lateral wall.

RESULTS
Three pre-model and fifteen post-models (five: 6-week, three; 12-week, seven; 16week models) were included. The mean ECV values significantly increased from the 6th week (pre vs. 6th week vs. 12th week vs. 16th week; 29.4±2.0 vs. 31.8±3.4 vs. 36.1±5.4 vs. 40.1±4.1, p-value<0.05). There was a good correlation between myocardial ECV measured by cardiac MRI and the degree of fibrosis (r=0.75, p-value=0.001). On electron microscopy, myocyte hypertrophy, mitochondrial swelling, pleomorphism and Z band disruption were noted. Collage bundle and strands were significantly increased in extracellular space in 12 and 16 week model specimens.

CONCLUSION
The ECV measured by contrast enhanced MRI in DCR models significantly increased from 6th week and ECV showed good correlation with histologic fibrosis.
CLINICAL RELEVANCE/APPLICATION
MR ECV is a noninvasive useful method for a quantification of diffuse myocardial fibrosis which can replace endomyocardial biopsy.

SST02-03
Assessment of Extracellular Volume Fraction in Doxorubicin Induced Dilated Cardiomyopathy Rabbit Models Using Dual Energy Computed Tomography: Comparison with Contrast Enhanced Magnetic Resonance Imaging and Histologic Findings

Yoo Jin Hong MD (Presenter): Nothing to Disclose, Donghyun Hong MS: Nothing to Disclose, Chul hwang Park MD: Nothing to Disclose, Jin Huro MD: Nothing to Disclose, Young Jin Kim MD: Nothing to Disclose, Hye-Jeong Lee MD: Nothing to Disclose, Sae Rom Hong MD: Nothing to Disclose, Young Joo Suh MD: Nothing to Disclose, Yun Jung Kim MD: Nothing to Disclose, Dong Jin Im: Nothing to Disclose, Byoung Wook Choi MD: Nothing to Disclose

PURPOSE
Purpose To validate extracellular volume (ECV) fraction using dual energy computed tomography (CT) and to compare it with contrast enhanced magnetic resonance imaging (MRI) and histologic findings.

METHOD AND MATERIALS
Dilated cardiomyopathy rabbit (DCR, male adult New Zealand White rabbit, 3-4 kg) model was made by injecting doxorubicin (Doxorubicin Hydrochloride, Cayman) at doses of 1.0mg/kg twice a week for 16 weeks. Every rabbit underwent both dual-energy CT (Siemens Somatom, Forchheim) and cardiac MRI (Siemens Magnetom, Erlangen) within two hours with pre-/post- T1 mapping using modified Look-Locker inversion recovery (MOLLI) sequence, LGE, and cine MRI on a clinical 3-T system. Rabbits underwent CT and MRI examination before drug administration (Control group) and two week interval until 16 weeks after DCR modeling. CT ECV was quantitatively assessed by measuring Hounsfield units (HUs) in the septum in a short-axis view on iodine maps with the following equation: ECV = [(1/T1post contrast myocardium)-(1/T1pre-contrast myocardium)]/(1/T1post-contrast blood)-(1/T1post-contrast blood) × (1- hematocrit (Hct)), ΔHU= HU post-contrast -HUpre-contrast. MR ECV was also calculated at the same area using the following equation: ECV = [(ΔHUmyocardium/ΔHUblood) × (1-Hematocrit)], ΔHU= HU post-contrast -HUpre-contrast. MR ECV was also calculated at the same area using the following equation: ECV = [(ΔHUmyocardium/ΔHUblood) × (1-Hematocrit)], ΔHU= HU post-contrast -HUpre-contrast. MR ECV was also calculated at the same area using the following equation: ECV = [(ΔHUmyocardium/ΔHUblood) × (1-Hematocrit)], ΔHU= HU post-contrast -HUpre-contrast.

RESULTS
Three control and seventeen DCR model were included. The mean CT ECV values were significantly elevated at the 6th week and continued to rise until the 16th week of the DCR modeling (pre vs. 6weeks vs. 16 weeks; 28.1±2.2 vs. 35.3±6.8 vs. 41.5±1.4, p-value<0.05) and there was a good correlation between CT ECV and MR ECV (r=0.803, p-value<0.001) and between CT ECV and degree of fibrosis (r=0.79, p-value<0.001).

CONCLUSION
Dual energy CT is a noninvasive feasible study to measure diffuse myocardial fibrosis quantitatively using CT ECV without misregistration error.

SST02-04
Extracellular Volume Fraction in Dilated Cardiomyopathy Patients without Obvious Late Gadolinium Enhancement: Comparison With Healthy Control Subjects

Yoo Jin Hong MD: Nothing to Disclose, Chul hwang Park MD (Presenter): Nothing to Disclose, Young Jin Kim MD: Nothing to Disclose, Jin Huro MD: Nothing to Disclose, Hye-Jeong Lee MD: Nothing to Disclose, Sae Rom Hong MD: Nothing to Disclose, Young Joo Suh MD: Nothing to Disclose, Yun Jung Kim MD: Nothing to Disclose, Dong Jin Im: Nothing to Disclose, Tae Hoon Kim MD: Nothing to Disclose, Byoung Wook Choi MD: Nothing to Disclose

PURPOSE
To evaluate whether the extra-cellular volume fraction (ECV) measured using cardiac MRI can detect myocardial tissue changes in dilated cardiomyopathy (DCM) without late gadolinium enhancement (LGE).

METHOD AND MATERIALS
Forty-one DCM patients (26 men, 15 women; mean age, 52.8 ± 16.4 years; range, 17-84 years), and 10 healthy volunteers (7 men, 3 women; mean age, 53.5 ± 4.0 years; range, 48-60 years) underwent pre- and post- T1 mapping using a modified Look-Locker inversion recovery (MOLLI) sequence, LGE, and cine MRI on a clinical 3-T cardiac magnetic resonance (CMR) system. LGE-MRI findings were used to divide DCM patients into two groups: Group A had no apparent LGE, and Group B had LGE apparent in at least one segment. The average ECV of left ventricle (LV) myocardium (16 segments) was calculated in short-axis view using the myocardial T1 value, LV blood pool T1 value, and hematocrit as follows: ECV = [(ΔR1 of myocardium/ΔR1 of LV blood pool)] × (1 - hematocrit), where ΔR1 = T1post-contrast - T1pre-contrast. The LV ejection fraction (LVEF) was obtained from cine MRI images using Simpson's method. The mean myocardial ECV in DCM patients (n = 41, 568 segments, 30.7% ± 5.9) was significantly higher (p < 0.001) than that of the control group (n = 10,
Increased Myocardial Extracellular Volume Fraction in Diabetic Patients Is Associated with LV Diastolic Dysfunction: A CMR Feasibility Study


PURPOSE

Diabetes (DM)-related myocardial changes of myocardial fibrosis and collagen deposition may lead to increased myocardial extracellular volume fraction (ECV) and myocardial stiffness. In this study, we hypothesize that increased ECV measured with quantitative CMR methods in DM patients will correlate with LV diastolic dysfunction.

METHOD AND MATERIALS

17 DM patients (6 males, age 63±10 years old) without macrovascular complications were examined on a 1.5T MR system. A short-axis SSFP stack was used to determine LV function, a pre-contrast T1 prep or a modified Look-Locker sequence was performed in a mid-LV level from which a T1 map and average LV myocardium T1 was derived. Post-contrast LGE-CMR was performed 15 minutes post injection of Gd-DTPA. A repeated T1 mapping as the pre-contrast T1 measurement was acquired around 20 min post-contrast. LV systolic function and LGE determination used software CMR42. LV diastolic function including peak filling rate (PFR) and time to peak filling rate (TPFR) was calculated using MASS software and was blinded to T1 analysis. T1 calculation used CMR42 or a customized Matlab code. Myocardial ECV = (1-haematocrit) × (ΔR1 myocardium/ΔR1blood). Increased ECV was defined as ECV > 30%.

RESULTS

The average LV function in 17 subjects were in the normal range (LVEF=61±6%, LVESV=45±17 ml, LVEDV=113±33 ml, LVSV=68±19 ml, LVM=103±25 g). No focal LGE was observed in this patient cohort. 8 of 17 subjects had ECV> 30% (38±49%) and the other 7 subjects had ECV<30% (23±5%). There is no statistically significant difference (P>0.05) in LV systolic function of LVEF, LVESV, LVEDV, LVSV and LVM between the increased ECV and normal ECV group. However, a statistically significant difference (P<0.05) was observed among diastolic functional parameters of TPFR and PFR, with significantly longer TPFR (344±148 vs.156±32 ms) and lower PFR (220±50 vs. 295±74 ml/s) observed in the increased ECV group. Also a statistically significant difference (P<0.05) was observed in pre-contrast T1 measurements.

CONCLUSION

Increased ECV was observed in diabetic patients with preserved systolic function and this was associated with altered LV diastolic function. The increased ECV may indicate the presence of diffuse interstitial fibrosis and myocardial stiffness, thus limiting the LV diastolic relaxation.

CLINICAL RELEVANCE/APPLICATION

Quantitative T1 mapping may be useful for the detection of increased ECV which is associated with LV diastolic dysfunction.

Cardiac Computed Tomography versus Cardiac Magnetic Resonance for Characterization of Left Atrium Anatomy before Radiofrequency Catheter Ablation of Atrial Fibrillation: Impact on Radiation Exposure and Outcome


PURPOSE

The aim of this study is to compare the procedural characteristics, overall radiation exposure and clinical outcomes between radiofrequency catheter ablation (RFCA) of atrial fibrillation (AF) guided by image integration.
METHOD AND MATERIALS

400 consecutive patients with drug-refractory paroxysmal or persistent AF were randomized to CT (Group 1; N: 200; mean age 61.6±10.9 yo; male:155) or MR (Group 2; N: 200; mean age 59.7±10.4 yo; male:166) for evaluation of LA before RFCA. CT was performed with 64-slices scanner (Discovery CT 750HD, GE Healthcare, Milwaukee, WI) and MR was performed with 1.5-T scanner (Discovery MR450, GE Healthcare, Milwaukee, WI) using a non-triggered contrast enhancement MR angiography sequence. All patients were treated by image integration-supported RFCA. LA diameter, LA volume, pulmonary veins anatomy and ostial dimensions, procedural characteristics, overall radiation exposure and rate of AF recurrence were measured in the two groups.

RESULTS

The two groups were homogeneous in terms of demographic characteristics, cardiovascular risk factors, prevalence of persistent AF, medical therapy and echocardiographic characteristics. The mean follow-up was similar (557±302 vs 523±265 days, respectively, p:0.24). Group 1 showed higher LA volume versus group 2 (117±46 vs 101±40 mL, p<0.001). The procedural characteristics [fluoroscopy time (32.6±16.0 vs 35.0±16.6 min, p:0.15); procedural duration (180.2±59.0 vs 182.8±53.5, p:0.65); pulmonary veins identified (4±0.1 vs. 3.9±0.2, p:0.08); pulmonary veins targeted (3.9±0.4 vs 3.9±0.4, p: 053); pulmonary veins isolated (3.9±0.4 vs 3.9±0.4, p:0.9)] and the rate of AF recurrence (29% vs 26%, p:0.5) were similar between the two groups. Group 1 showed a higher overall cumulative radiation exposure (40.4±23.7 vs 32.8±23.5, p<0.005), and LA volume measured by MR was the most robust independent predictor of AF recurrence at multivariate analysis [(HR: 1.08 (1.01-1.15), p:0.02].

CONCLUSION

MR integration-supported RFCA procedure seems to be associated with a lower overall cumulative radiation despite similar outcome in comparison with CT-guided RFCA.

CLINICAL RELEVANCE/APPLICATION

MR imaging is a good guide for atrial fibrillation ablation procedure

“Heart of Brightness” – Delayed Enhancement Detection using Motion Corrected (MOCO) Phase Sensitive Inversion Recovery (PSIR) Imaging in Non-Ischemic Cardiomyopathy

Oisin Jude Flanagan MBCh, MRCPI (Presenter): Nothing to Disclose, Shivraman Giri PhD : Employee, Siemens AG , Bruce Spottiswoode : Employee, Siemens AG , Sven Zuehlsdorff PhD : Employee, Siemens AG , Xiaoming Bi PhD : Nothing to Disclose , Maria Carr : Nothing to Disclose , Michael Markl PhD : Nothing to Disclose , Jad Marwan Bou Ayache MD : Nothing to Disclose , Marcos Paulo Ferreira Botelho MD : Nothing to Disclose , Jeremy Douglas Collins MD : Consultant, B. Braun Melsungen AG , Robert R. Edelman MD : Research support, Siemens AG Royalties, Siemens AG , James Christopher Carr MD : Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

PURPOSE

To improve image quality and diagnostic confidence in characterizing non-ischemic delayed enhancement (DE) sequences in all patients, including those with irregular cardiac rhythms and poor breath-holding ability.

METHOD AND MATERIALS

28 consecutive out-patients (11F, 17M age 25-84 years, mean 62.2) with possible non-ischemic cardiomyopathy were referred for cardiac MRI on a 1.5T system (MAGNETOM Aera, Siemens AG, Erlangen, Germany). Two standard PSIR sequences of free breathing single shot steady state free precession (FB single shot SSFP) and breath hold (BH) turboflash (TF) were performed as well as a prototype sequence FB MOCO SSFP. This latter sequence used respiratory motion compensation based on nonrigid image registration and motion corrected averaging to enhance SNR. The anonymized Images were independently graded by two blinded experienced cardiovascular radiologists for image quality (1 to 5), diagnostic confidence (1 to 3), the presence of DE (using a 16 segment model). Each segment was analysed for location of DE (subendocardial, midmyocardial or subepicardial) and finally for segmental artefact.

RESULTS

15 of 28 patients showed non-ischemic DE. Image quality for FB single shot SSFP, BH TF and FB MOCO SSFP were 3.80, 3.15 and 3.87 respectively. Diagnostic confidence was 2.63, 2.35 and 2.70 and the number of segments degraded by artefact was 41, 112 and 34. Total DE segments detected were 92, 119 and 112 in an approximate distribution of 68% subendocardial, 24% midmyocardial and 3% subepicardial across all three techniques.

CONCLUSION

FB MOCO SSFP had higher image quality and diagnostic confidence and less artifact than both FB single shot SSFP and BH TF. It detected more DE than FB single shot SSFP. BH TF detected the most DE but with the lowest image quality and diagnostic confidence and the most artefact. This suggests that in non-ischemic cardiomyopathy, FB MOCO SSFP is overall superior to FB single shot SSFP and superior to BH TF in the large number of cases where BH TF images are poor.
CLINICAL RELEVANCE/APPLICATION
As increasingly sicker patients undergo cardiac MRI, robust motion corrected images are needed to combat their poor breathholding and fast or irregular rhythms. This sequence provides this and will be increasingly important over time.

SST03-08

Cardiac Keynote Speaker: Non-ischemic Cardiomyopathy—Techniques and Applications
James Christopher Carr MD (Presenter): Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

SST03

Cardiac (Quantitative Cardiac Imaging)

Scientific Papers
CT  BQ  CA
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 10:30 AM - 12:00 PM Location: SS04AB

Participants
Moderator
Ina L. Tonkin MD : Nothing to Disclose
Moderator
Frank John Rybicki MD, PhD : Research Grant, Toshiba Corporation

Sub-Events

SST03-01

T1-, T2-Mapping and Extracellular Volume Quantification for the Diagnosis of Subclinical Acute Cellular Rejection in Patients after Heart Transplantation Using Magnetic Resonance Imaging
Lysann Hildebrand MD (Presenter): Nothing to Disclose, Clara Frank : Nothing to Disclose, Matthias Gutberlet MD, PhD : Nothing to Disclose

PURPOSE
To evaluate if cardiovascular magnetic resonance (CMR) is a suitable method for identifying subclinical acute cellular rejection (ACR) requiring treatment in patients post heart transplantation (HTX), using T1- and T2-Mapping techniques as compared to conventional CMR techniques for inflammation assessment using endomyocardial biopsy (EMB) as the standard of reference.

METHOD AND MATERIALS
Thirty-five CMRs were performed in 20 patients (mean age 53±11 years, 24 male) using a 1.5T scanner compared to EMB. The CMR protocol included a T2w STIR-sequence to calculate the myocardial edema ratio (ER), a T1w spinecho and inversion recovery sequence for global relative (gRE) and late gadolinium enhancement (LGE), as well as a modified Look-Locker inversion-recovery (MOLLI) sequence before and 15 minutes after administration of 0.1 mmol/kg body weight of Gadobutrol (Gadovist, Bayer HealthCare Pharmaceuticals, Berlin, Germany) i.v. for T1-quantification and a free-breathing, navigator-gated multi-echo sequence for T2-quantification. T1- pre- and postcontrast, T2- and ECV-maps were calculated with the software (cvi42, Calgary, Canada).

RESULTS
No or a mild ACR (ISHLT <1B) was revealed in 20/35, ACR requiring treatment in 15/35 EMBs. The area-under-the-curve (AUC) of the receiver operating characteristic (ROC) analysis were only 0.54 for the ER and 0.52 for gRE, but 0.65 for native T1-Mapping, 0.66 for ECV, 0.73 for T2-Mapping and 0.78 for postcontrast T1-Mapping. Similar to myocarditis the best cut-off values for ER were ≥2 and for gRE ≥4.5. The best sensitivity and specificity (%) could be achieved with T2-Mapping using a cut off 65ms (73/75), for T1-Mapping postcontrast using a cut off of 342ms (73/70) and for ECV with a cut off of 42 (67/70), respectively. Native T1-Mapping using a cut off of 1060 ms achieved a very high sensitivity (87%) but only low specificity (45%).

CONCLUSION
Especially T2- and T1-Mapping postcontrast as well as ECV quantification seem to be promising tools to identify subclinical ACR in patients after HTx, better than the calculation of the ER and gRE. This may help to potentially reduce, if not eliminate, the need for EMB in these patients.

CLINICAL RELEVANCE/APPLICATION
In patients post HTx, CMR using T1- and T2-Mapping techniques is a suitable method for identifying subclinical ACR requiring treatment.

SST03-02

Diagnostic Performance of the Combined CT Protocol of Coronary CT Angiography and Dynamic...
Myocardial CT Perfusion Imaging to Assess Obstructive Coronary Artery Disease

Yuki Tanabe (Presenter): Nothing to Disclose, Teruhito Kido, MD, PhD: Nothing to Disclose, Takahiro Yokoi: Nothing to Disclose, Shintaro Tsuruoka: Nothing to Disclose, Naoki Fukuyama: Nothing to Disclose, Takuya Matsuda: Nothing to Disclose, Rami Yokoyama: Nothing to Disclose, Masashi Nakamura: Nothing to Disclose, Yoshiko Nishiyama, MD: Nothing to Disclose, Masao Miyagawa, MD, PhD: Nothing to Disclose, Teruhito Mochizuki, MD: Nothing to Disclose

PURPOSE

The aim of this study was to evaluate the diagnostic performance of the combined CT protocol of coronary computed tomography angiography (CCTA) and pharmacological stress dynamic myocardial CT perfusion (CTP) to identify obstructive coronary artery disease (CAD).

METHOD AND MATERIALS

The study group comprised 32 patients (mean age 68.1±7.8 years) who underwent ATP stress dynamic CTP using 256-slice multi detector row CT and myocardial perfusion imaging (MPI) (SPECT or cardiac MRI) prior to invasive coronary angiography (ICA). Dynamic CTP (whole heart datasets over 30 consecutive heart beats in systole) was acquired with prospective ECG gating, and subsequently CCTA scan was performed. We evaluated the diagnostic performance of the combined protocol of CCTA and quantitative CTP assessment for detecting obstructive CAD. Obstructive CAD was defined as stenosis>=50% on ICA with corresponding perfusion defect on MPI. Quantitative CTP assessment was performed with myocardial blood flow (MBF) index (mL/g/min), which was calculated by Patlak plots analysis. Results of the MBF index were compared with the results of MPI by receiver operating characteristic (ROC) analysis. The uncertain vessels on CCTA because of calcium and motion artifacts were assumed as having significant stenosis >=50% on ICA. The combined protocol was classified positive if MBF was less than the cut-off point on CTP in areas corresponding to coronary stenosis >=50% on CCTA. The combined protocol was negative if no stenosis >=50% were detected on CCTA or if MBF were more than the cut-off point in areas supplied by vessels with significant stenosis or uncertain finding on CCTA.

RESULTS

In comparing quantitative CTP assessment with MPI, area under the ROC curve and the optimal cut-off point were 0.86 and 1.28 (mL/g/min) and sensitivity, specificity, positive predict value (PPV) and negative predict value (NPV) were 88.1%, 79.6%, 77.1% and 89.6% on a vessel level. The combined CT protocol had sensitivity of 87.8%, specificity of 83.6%, PPV of 80% and NPV of 90.2% for detecting obstructive CAD.

CONCLUSION

The combination of CCTA and quantitative CTP assessment allows comprehensive, obstructive and precise assessment of obstructive CAD with single modality.

CLINICAL RELEVANCE/APPLICATION

The combined protocol of CCTA and CTP may be non-invasive useful tool for assessment coronary artery disease by one time CT examination.

Coronary Calcium Scores are Underestimated at a Large Body Size: A Multivendor Phantom Study

Martin J. Willemink MD (Presenter): Nothing to Disclose, Bronislaw Abramiuc: Nothing to Disclose, Niels R. van der Werf: Nothing to Disclose, Tineke Petra Willems, MD, PhD: Nothing to Disclose, Marcel Greuter PhD: Nothing to Disclose, Tim Leiner MD, PhD: Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group

PURPOSE

Recent guidelines from the American Heart Association recommend coronary calcium scoring (CCS) with computed tomography (CT) for patients at low-to-intermediate and intermediate cardiovascular risk. Previous studies have shown that obesity is related to increased CCS. With the increasing prevalence of obesity it is essential to assess whether CCS is performed adequately in heavy patients. However, the effect of body size has not been evaluated yet on routinely used protocols of current state-of-the-art CT systems. The purpose of the current study is to evaluate the effect of body size on CCS as assessed with new-generation CT systems from the four major vendors.

METHOD AND MATERIALS

An anthropomorphic chest phantom containing 100 small calcifications (diameters 0.5-2.0 mm) was evaluated with and without an extension ring using routine protocols of state-of-the-art CT systems from four vendors. The extension ring was used to mimic a heavy patient. Image acquisition was repeated five times with small translations and/or rotations. Routine acquisition protocols for both medium and heavy patients were used. CCS was quantified as Agatston and mass scores with software from the same manufacturer as the CT systems.

RESULTS

The medium sized phantom resulted in median (interquartiles) Agatston scores of 10 (9-35), 113 (72-133), 34 (30-37) and 87 (85-89) for Philips, GE, Siemens and Toshiba, respectively. Mass scores were 4 (3-9), 18 (14-21), 8 (8-9) and 20 (20-20) mg, respectively. Adding the extension ring resulted in reduced Agatston scores for all vendors (17-86%) and mass scores for three vendors (11-86%). Median Agatston scores decreased to 9 (6-10), 16 (15-20), 27 (24-32) and 45 (29-53) units, and median mass scores increased for Philips to 4 (4-6) and decreased for the other vendors to 2 (2-8), 8 (7-8) and 10 (8-13) mg, respectively.

CONCLUSION

...
relaxation times between 1.5 and 3T significant differences were found for T2prep and GraSe (p < 0.001). No higher T2 relaxation times compared to MESE at 3T (p < 0.005) and at 1.5T (p < 0.001). Comparing T2 to MESE, the difference was significant (p < 0.05 for T2prep vs. MESE and p < 0.001 for T2prep vs. GraSe). The GraSe sequence resulted in significantly higher T2 relaxation times compared to MESE at 3T (p < 0.005) and at 1.5T (p < 0.001). Comparing T2 relaxation times between 1.5 and 3T significant differences were found for T2prep and GraSe (p < 0.001). No cofactor “heart rate” proved to have significant impact on the measured T2 relaxation times. Therefore, a correction factor should be used for CCS of heavy patients, or image acquisition protocols should be standardized across platforms of different vendors.

**CLINICAL RELEVANCE/APPLICATION**

Body size is an important determinant of the coronary calcium score and may impact perceived risk for future cardiovascular events.

**SST03-04**

The Utility of Cardiac CT in Evaluating Left Ventricular Diastolic Dysfunction

*Anto Sedlic MD : Nothing to Disclose, Elena Scali MD (Presenter): Nothing to Disclose, Savvas Nicolaou MD : Nothing to Disclose, John R. Mayo MD : Speaker, Siemens AG*

**PURPOSE**

Left ventricle (LV) diastolic dysfunction in the setting of heart failure with preserved ejection fraction is a diagnostic and therapeutic challenge with significant associated morbidity and mortality. Diastolic dysfunction is associated with abnormal LV relaxation or increased LV stiffness. Although catheterization is the gold standard in evaluation of diastolic dysfunction, the diagnosis is usually made by echocardiography. In patients undergoing retrospective cardiac computed tomography angiography (CTA), functional data can be used to quantify LV volume over time to measure the rate of LV diastolic filling in diastolic dysfunction.

**METHOD AND MATERIALS**

20 patients undergoing cardiac CTA were reviewed for CT evidence of diastolic dysfunction. All patients had diastolic dysfunction on echocardiography with preserved systolic function. Retrospective CTA was performed and LV filling curves were obtained from the functional images by application of post-processing software. LV volume was measured at 5% intervals over the cardiac cycle. LV volume versus time was plotted and the slope measured at various points in diastole to compare LV filling velocity in both groups. LV filling rates in early diastole, after mitral valve opening, was compared between patients with diastolic dysfunction and patients with normal diastolic function. LV filling due to left atrial contraction (A wave) was also measured in both groups and quantified as percent of total stroke volume.

**RESULTS**

In patients with diastolic dysfunction, early LV filling is impaired. Comparing patients with preserved LV ejection fraction, the early diastolic LV filling rate was measured at 218.4 ml/sec (95% CI: 199.7 to 237.5) compared to 308.6 ml/sec (95% CI: 278 to 338.6) for normal controls. LA contraction (A wave contribution) was also demonstrated to contribute to LV stroke volume filling to a greater extent in the diastolic dysfunction group, however, initial results did not demonstrate a statistically significant difference in volume.

**CONCLUSION**

Initial results demonstrate that functional cardiac CTA can identify patients with left ventricular diastolic dysfunction and may have a role in the assessment and quantification of diastolic dysfunction.

**CLINICAL RELEVANCE/APPLICATION**

Diastolic dysfunction is a diagnostic challenge that can be identified and quantified with functional cardiac CTA.

**SST03-05**

A Systematic Evaluation of Three Different Cardiac T2-mapping Sequences at 1.5 and 3T in Healthy Volunteers


**PURPOSE**

One of the main challenges of the T2-mapping technique is the high variability of the T2 relaxation times leading to difficulties in discriminating “still physiologic” from “already pathologic” in the case of myocardial edema. As the T2 relaxation times vary significantly depending on field strength, sequence and other influence factors, the purpose of this study was to compare three different T2-mapping sequences at 1.5T and 3T in healthy volunteers (HV) and to investigate the influence of cofactors on the T2 relaxation times.

**METHOD AND MATERIALS**

Until today, we enrolled 16 HV. Each HV was examined on a clinical 1.5T and 3T scanner in immediate succession in the morning. A third scan was performed on the 1.5T scanner in the evening of the same day. In each examination three T2-mapping sequences were performed at a basal, midventricular and apical slice in short axis view: Multi Echo Spin Echo (MESE), T2-prepared balanced Steady State Free Precession (T2prep; Giri et al., 2009) and Gradient Spin Echo (GraSe). Segmented T2-Maps were generated for each slice according to the AHA 17-segment model.

**RESULTS**

The cofactor “heart rate” proved to have significant impact on the measured T2 relaxation times. Therefore, correction for this cofactor was performed for all further statistical analyses. Significantly lower T2 relaxation times were observed between the T2prep sequence and all other sequences at 3T (p < 0.001) and at 1.5T (p < 0.05 for T2prep vs. MESE and p < 0.001 for T2prep vs. GraSe). The GraSe sequence resulted in significantly higher T2 relaxation times compared to MESE at 3T (p < 0.005) and at 1.5T (p < 0.001). Comparing T2 relaxation times between 1.5 and 3T significant differences were found for T2prep and GraSe (p < 0.001).
significant daytime variations were observed between the morning and evening scans.

CONCLUSION
The evaluation of different T2 mapping sequences at 1.5 and 3T in the heart of healthy volunteers represents a systematic approach to cardiac T2-mapping and underlines the need for dedicated reference maps for each sequence and field strength, as well as the need for a correction of the cofactor "heart rate".

CLINICAL RELEVANCE/APPLICATION
Myocardial edema is an important factor in several cardiac diseases. Cardiac T2-mapping promises to be a quantitative approach in edema imaging, overcoming some limitations of qualitative edema assessment.

SST03-06
Quantitative Coronary Plaque Burden and Contrast Density Difference from Coronary CTA Predict Ischemia by SPECT in Men and Women

Mariana Diaz-Zamudio MD : Nothing to Disclose, Tobias A. Fuchs MD : Nothing to Disclose, Damini Dey PhD (Presenter) : Research support, Siemens AG, Piotr Jan Sioniczka Ph.D : Nothing to Disclose, Reza Arsanjani : Nothing to Disclose, Heidi Gransar : Nothing to Disclose, Guido Germano : Nothing to Disclose, Daniel S. Berman MD : Research Grant, Lantheus Medical Imaging, Inc Research Grant, Astellas Group Research Grant, Siemens AG Speaker, Bristol-Myers Squibb Company Speaker, Covidien AG Speaker, Astellas Group Stockholder, Spectrum Dynamics Ltd Consultant, Bracco Group Consultant, FluroPharma, Inc, Philipp A. Kaufmann MD : Researcher, General Electric Company

PURPOSE
We aimed to investigate if quantitative plaque burden and luminal contrast density differences measured from coronary CT angiography (CTA) predict ischemia by SPECT in men and women.

METHOD AND MATERIALS
184 (62% Males) consecutive patients with suspected coronary artery disease (CAD), undergoing hybrid CTA and stress/rest myocardial perfusion SPECT scans, with calcium score ≤1000, no severe motion artifacts and no multi-vessel disease were considered. From CTA, arteries were evaluated by automated software (AUTOPLAQ) deriving non-calcified (NCP), low-density NCP (LDNCP, attenuation <30 Hounsfield Units (HU)), and total plaque (TP) burdens (% normalized to vessel volume), maximum diameter stenosis (DS), remodeling index (RI) and contrast density difference (CD, maximum difference in HU/lumen area). Regional ischemia (≥2% stress-rest perfusion deficit) was automatically derived from attenuation-corrected Cadmium-Zinc-Telluride (CZT) SPECT.

RESULTS
Plaque measures were higher in arteries corresponding to ischemic regions [DS 43.6 vs 22.9%; NCP 23.0 vs 13.6%; LDNCP 4.2 vs 1.9%; TP 25.5 vs 15.5%; RI 1.06 vs 0.7; CD 26.5 vs 10.0%; p<0.0002 for all] with higher per-vessel prevalence of LDNCP≥7% and CD≥45%. In multivariable analysis, both LDNCP≥7% and CD≥45% predicted ischemia in overall population (LDNCP: OR 4.98; CD: OR 7.6; p<0.002), and separately in men (LDNCP: OR 5.03, p<0.001; CD: OR 5.29, p=0.003) and women (LDNCP: OR 5.4, p=0.037; CD: OR 12.1, p=0.006). When adjusted for DS ≥50%, both LDNCP and CD persisted as the strongest ischemia predictors in overall population (LDNCP: OR 3.67, p=0.002; CD: OR 5.1, p=0.008; DS: OR 1.94, p=0.04), but only LDNCP in men (OR 3.66, p=0.005) and CD in women (OR 10.94, p=0.025) predicted ischemia. Further, in a sub-analysis of vessels with stenosis severity ≥50% (figure), only LDNCP predicted ischemia in men (OR 4.04, p<0.016) and CD predicted ischemia in women (OR 8.82, p=0.031).

CONCLUSION
Quantitative CTA measures of LDNCP and CD predict ischemia by SPECT independent of stenosis. There are gender-based differences in quantitative CTA features that predict ischemia: LDNCP burden is the strongest predictor for ischemia in men, while CD is the strongest predictor in women.

CLINICAL RELEVANCE/APPLICATION
From our study of patients undergoing hybrid CTA and SPECT in an unbiased population, quantitative CTA features may be important for elucidating the pathophysiology of myocardial ischemia in men and women.

SST03-07
Diagnostic Performance of Myocardial Blood Flow Index Derived from Dynamic Computed Tomography Perfusion Image; Comparison with Invasive Coronary Angiography, SPECT and Cardiac MR Myocardial Perfusion Image

Yuki Tanabe (Presenter): Nothing to Disclose, Teruhito Kido MD, PhD : Nothing to Disclose, Takahiro Yokoi : Nothing to Disclose, Shintaro Tsuruoka : Nothing to Disclose, Naoki Fukuyama : Nothing to Disclose, Takuya Matsuda : Nothing to Disclose, Rami Yokoyama : Nothing to Disclose, Masashi Nakamura : Nothing to Disclose, Yoshiko Nishiyama MD : Nothing to Disclose, Masao Miyagawa MD, PhD : Nothing to Disclose, Teruhito Mochizuki MD : Nothing to Disclose

PURPOSE
The aim of this study was to evaluate the feasibility of myocardial blood flow (MBF) index derived from whole heart dynamic myocardial perfusion imaging using 256-slice multi detector row computed tomography (256-slice MDCT) with adenosine triphosphate (ATP) stress.

METHOD AND MATERIALS
This study group comprised of 52 patients (mean age 68.7±7.5 years, males, 73.1%) who underwent ATP.
stress dynamic myocardial CT (CTP) perfusion scans without table movement by using 256-slice MDCT with an 8-cm detector. Moreover, all patients underwent invasive coronary angiography (ICA) (44 patients), single-photon emission CT myocardial perfusion imaging (SPECT-MPI) (20 patients) or cardiac magnetic resonance myocardial perfusion imaging (CMR-MPI) (24 patients). Stress dynamic CTP (whole-heart datasets over 30 consecutive heart beats in systole without spatial and temporal gaps) was acquired with prospective ECG gating (effective radiation dose: 10.6 mSv). MBF index (mL/g/min) was calculated by Patlak plots analysis. Results of the MBF index were compared with the results of ICA, SPECT-MPI or CMR-MPI by receiver operating characteristic (ROC) analysis. Significant stenosis in ICA was defined as more than 75%. SPECT-MPI and CMR-MPI were assessed visually for detecting myocardial ischemia according to the AHA 16-segment model.

RESULTS
In all cases, CTP was accomplished without severe side effects. On a vessel-based model, area under the ROC curve (AUC) and the optimal cut-off point (mL/g/min) were 0.841, 1.28 for ICA, 0.852, 1.13 for SPECT-MPI and 0.867, 1.28 for CMR-MPI. Sensitivity, specificity, positive and negative predictive values and accuracy were 82.8%, 73.5%, 74.6%, 82.0% and 78.0% for ICA (132 vessels), 75.0%, 90.9%, 75.0%, 90.9% and 86.7% for SPECT-MPI (60 vessels) and 82.9%, 86.5%, 85.3%, 84.2% and 84.7% for CMR-MPI (72 vessels).

CONCLUSION
Quantitative assessment by MBF index is useful for non-invasive evaluation of the sever coronary artery stenosis and myocardial ischemia.

CLINICAL RELEVANCE/APPLICATION
MBF index derived from dynamic myocardial CT perfusion imaging may enable non invasive, obstructive and precise assessment of coronary artery disease.

SST03-08
Regional Myocardial Strain Estimation with Hyperelastic Biomechanical Model: Application on Cardiac CT

Ken C. L. Wong PhD : Nothing to Disclose, Michael Tee BS (Presenter): Nothing to Disclose, Marcus Yen-Ta Chen MD : Institutional research agreement, Toshiba Corporation, J. Alison Noble : Nothing to Disclose, David A. Bluemke MD, PhD : Research support, Siemens AG, Ronald M. Summers MD, PhD : Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc, Jianhua Yao PhD : Royalties, iCAD, Inc

PURPOSE
Regional myocardial strains have the potential for earlier quantification and detection of cardiac dysfunction compared with global geometric measurements. Although image modalities such as tagged and CSENC MRI can provide motion information of the myocardium, they are not common practices in clinical routine. Therefore, accurate strain estimation from more available cardiac CT can be beneficial.

METHOD AND MATERIALS
As cardiac CT can only provide motion information of salient features such as heart surfaces, additional information is required. For physiologically plausible and clinically applicable strain estimation, we propose to use a hyperelastic biomechanical model. Four canine cardiac CT sequences with artificially induced myocardial infarction were used for evaluation. Each cardiac cycle (0.52-0.89s) has 20 frames with voxel size < 0.3x0.3x1 mm3. The infarcted regions were identified by experts using perfusion CT on the American Heart Association nomenclature (17 zones). Image segmentation and meshing were performed at end-diastole to provide the finite element (FE) model of the heart. Deformable image registrations based on B-spline interpolation and mutual information were performed on the whole sequence to provide the motion information on the heart surfaces. The displacements between frames were enforced as boundary conditions to the FE model, and hyperelastic biomechanics was applied to compute the quantitative myocardial strains.

RESULTS
The estimated zonal first principal strains at end-systole are consistent with the infarction manually identified by experts, with the average Cohen's kappa as 0.77+/−0.22. The average strain value of the 22 infarcted zones is 0.13+/−0.07, and that of the 46 normal zones is 0.37+/−0.17 (p<0.0001).

CONCLUSION
With the use of the hyperelastic biomechanical model, myocardial strains can be quantified from the motion of the salient cardiac features extracted from images. The consistency between the expert identification and the estimated strains shows that this framework is promising for cardiac diagnosis.

CLINICAL RELEVANCE/APPLICATION
Cardiac CT is commonly available in clinical routine and the regional myocardial strains estimated from CT have the potential for early quantification and detection of cardiac dysfunction.

SST03-09
Incorrect Dose Administration in Cardiac T1 Studies: Correction and Application to a MESA Case Study Based on BMI

Neville Gai PhD (Presenter): Nothing to Disclose, Veit Sandfort MD : Nothing to Disclose, Songtao Liu MD : Nothing to Disclose, Colin Yi BA : Nothing to Disclose, Joao A. C. Lima MD : Research Grant, Toshiba Corporation, David A. Bluemke MD, PhD : Research support, Siemens AG

PURPOSE
To show that standard gadolinium dose administration (in mmol/kg) results in biased post-contrast T1 values which can result in erroneous interpretation of results even after normalizing for dose, time and GFR. After application of the corrected dose values based on accurate estimates of blood volume, the results show a dramatic change.

**METHOD AND MATERIALS**

605 subjects who had undergone T1 mapping using the MOLLI sequence were retroactively selected from the MESA study based on availability of a complete set of physiological parameters. Precontrast blood and myocardial T1 values were corrected for heart rate bias. Post-contrast blood and myocardial T1 values obtained at time=12min and dose 0.15 mmol/kg were normalized for slight differences in dose and for GFR using an analytical model. The given dose in mmol/kg was then adjusted based on an accurate estimate for blood volume proposed by Lemmens (Obesity Surgery 2006;16:773-776). The adjusted values of dose were again used to normalize post-contrast blood and myocardial T1 values for dose and GFR. Post contrast blood T1 values were compared with subject BMI using Pearson correlation. As an example of how this bias can affect interpretation, we analyzed post-contrast myocardial T1 values before and after dose adjustment for subjects with metabolic syndrome (METS, n=177) and with no METS (n=428) using Student’s t-test.

**RESULTS**

Post-contrast blood T1 showed a strong correlation with BMI ($R = -0.257, P<0.001$) prior to adjustment for dose (based on blood volume) and no significant correlation after correction based on Lemmens estimate for blood volume ($R= -0.011, P=0.79$). Post-contrast myocardial T1 showed significant differences between METS and non-METS groups ($P<0.0001$) prior to dose adjustment and no significance ($P=0.96$) after correction.

**CONCLUSION**

Contrast based on mmol/kg overestimates dose at higher BMIs. A correction for dose based on accurate blood volume estimate is proposed. Multiple linear regression analysis models can reveal significant relationships and correct for covariates. However, there can be confusion whether both BMI (risk factor for METS) and T1 (measure of fibrosis) could be used as independent measures of METS. Our analysis helps circumvent an erroneous and confusing deduction.

**CLINICAL RELEVANCE/APPLICATION**

Standard contrast dosing (in mmol/kg) needs to be corrected for bias due to BMI which can lead to erroneous interpretation based on post contrast T1 values.