Cardiac Radiology

104th Scientific Assembly and Annual Meeting
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CA001-EC-X

3D High-Resolution Microstructure Imaging of the Heart

All Day Room: NA Custom Application Computer Demonstration

Participants
Hirohisa Oda, MENG, Nagoya, Japan (*Presenter*) Nothing to Disclose
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Tetsuya Yuasa, PhD, Yamagata, Japan (*Abstract Co-Author*) Nothing to Disclose
Toshiaki Akita, PhD,MD, Uchinada-machi, Japan (*Abstract Co-Author*) Nothing to Disclose
Kensaku Mori, PhD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Daisuke Shimao, PhD, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose
Shu Ichihara, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Masami Ando, PhD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Noriko Usami, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

1. Learn about promising applications of micro-meter-scale ex-vivo scanning for medical imaging 2. Understand the advantages/disadvantages of CT scanning modalities of microstructure using refraction X-ray (refraction CT) or absorption X-ray (μCT). 3. Learn how to prepare specimens for microstructure imaging from the example of cardiac imaging of animal hearts. 4. Study a modern visualization system for display of cardiac fibers observed in refraction CT or μCT volumes.

TABLE OF CONTENTS/OUTLINE

1. Preparation of rabbit heart specimens (Fig. 1) - Euthanasia and harvesting the heart from a rabbit - Ethanol fixation for dehydration and iodine staining for contrast enhancement 2. Scanning modalities and images - Refraction CT: High contrast for soft tissues, requirement of an electron accelerator (Fig. 2) - μCT: Low cost, easy operation (Fig. 3) 3. Fiber tracking techiniques and results on a μCT or a refraction CT volume (Fig. 4) - Comparison to anatomical studies 4. Demonstration of our visualization system on computer (Fig. 5) - Imaging results on 2D or 3D views * Difference between refraction CT and μCT - Visualization of fiber tracking results with intuitive usage for education and research of cardiac anatomies * Coloring with inclination angles of fibers * Cross-sections, trimming, changing viewpoint, zooming, etc.

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CA100-ED-X

Fat in the Heart: Defining the Spectrum of Conditions by Cardiovascular MRI

All Day Room: NA Digital Education Exhibit

Participants
Monika Arzanauskaite, MMedSc, Liverpool, United Kingdom (*Presenter*) Nothing to Disclose
Raad Mohiaddin, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Anna Marciniak, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Manuel Gutierrez, Viladecans, Spain (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

The purpose of this exhibit is: 1. To review the spectrum of appearances of conditions where macro- and microscopic fat is the predominant feature 2. To explain the value of cardiovascular magnetic resonance imaging and suggest comprehensive study protocols for each group of conditions. 3. To provide a case-based review of cardiovascular MRI appearances as well as histopathological features.

TABLE OF CONTENTS/OUTLINE

1. Review of cardiac anatomy with a focus on adipose tissue layers and their clinical implications 2. Spectrum and classification of conditions where macro- and microscopic fat is the predominant feature 3. Imaging these conditions by cardiovascular magnetic resonance 4. Case-based review of imaging and histopathological findings: tumours/pseudotumours, cardiomyopathies and remodelling: - Mediastinal Fat and its implications, - Epicardial Fat and its implications, - Lipomatous Hyperplasia of the interatrial septum, - Arrhythmogenic right / left ventricular dysplasia, - Anderson-Fabry disease, - Lipomatous metaplasia of the myocardium, - Tumours: Lipoma, Liposarcoma, Teratoma.

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CA101-ED-X

Myocardial Infarction with Normal Coronary Arteries (MINCA): Potential Etiologies and Imaging Findings

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

Participants
Joanna G. Escalon, MD, Aurora, CO (*Presenter*) Nothing to Disclose
Tami J. Bang, MD, Aurora, CO (*Abstract Co-Author*) Nothing to Disclose
Daniel Vargas, MD, Aurora, CO (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

Myocardial infarction with normal coronary arteries (MINCA) occurs when a patient presents with positive cardiac enzymes in the absence of obstructive atherosclerosis on coronary angiography. The prevalence is 1% to 12% of all myocardial infarctions and predominantly affects women. Several hypotheses for the pathogenesis of MINCA have been suggested and multiple potential underlying etiologies have been reported. By exploring the reported causes of MINCA and associated major imaging features, this educational exhibit will increase awareness of this entity. With this knowledge, radiologists can appropriately tailor imaging and play a crucial role in pinpointing the underlying diagnosis thus allowing appropriate and prompt treatment.

TABLE OF CONTENTS/OUTLINE

1. Familiarize the radiologist with the concept of MINCA. 2. Review cardiac MRI sequences necessary for assessment of MINCA. 3. Discuss the differential diagnosis of MINCA and review the clinical presentation, pathogenesis, key findings and distinguishing features on cardiac CT and/or MRI, for each of the following entities: (a) Takotsubo syndrome, (b) Myocarditis, (c) Embolic infarcts, (d) Autoimmune vasculitis, (e) Exacerbation of systemic inflammatory disease, (f) Coronary vasospasm, (g) Hypertrophic cardiomyopathy, (h) Myocardial bridging.

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CA102-ED-X

Cardiac MR Evaluation of Benign Masses and Mass-Mimicking Lesions

All Day Room: NA Digital Education Exhibit

Participants
Joanna E. Kusmirek, MD, Richmond, VA (*Presenter*) Nothing to Disclose
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TEACHING POINTS

1. Learn anatomic variants mimicking cardiac masses on CMR. 2. Be able to distniguish cardiac thrombi from other lesions. 3. Become familiar with features of bening cardiac masses with emphasis on cardiac myxoma. 4. Be able to guide further management and prevent unnecessary testing/procedures.

TABLE OF CONTENTS/OUTLINE

With increasing utilization of cardiac MR (CMR) for assessment of cardiac masses it is imperative for radiologist to be familiar with anatomic variants and be able to differentiate benign form malignant cardiac lesions to appropriately guide management. This presentation will comprise: 1. Examples of findings mimicking cardiac tumors: - normal anatomic variants (crista terminalis, Eustachian valve), - intracardiac abnormalities (dilated coronary sinus, mitral annulus calcifications) - extracardiac findings (hiatal hernia, pericardial cyst). 2. Illustrated techniques of differentiation between cardiac thrombi and other lesions with emphasis on short and long inversion recovery imaging. 3. Description of characteristic features for benign cardiac masses (tissue characteristics, location, vascularity, mobility, etc) with examples including: myxoma, vegetations, fibroelastoma, fibroma, rhabdomyoma, lipoma, hemangioma, paraganglioma.

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CA103-ED-X

1H-Magnetic Resonance Spectroscopy for Metabolic Imaging of Myocardial Triglyceride Content: How 'To Do' It

All Day Room: NA Digital Education Exhibit

Participants
Bernhard Petritsch, Wurzburg, Germany (*Presenter*) Research Cooperation, Siemens AG; Research Consultant, Siemens AG
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TEACHING POINTS

To review the indications, contraindications, and limitations of 1H-Magnetic Resonance Spectroscopy (1H-MRS) of the myocardium. To highlight the potential benefit of a metabolic investigation embedded in a comprehensive examination of cardiac morphology and function. To learn about parameter settings for spectroscopic data acquisition, including voxel placement and positioning of a navigator for double (respiratory and ECG) triggered data acquisition. To interpret cardiac 1H-MR spectra of healthy subjects, patients suffering from congenital or acquired metabolic disorders, and to learn about potential pitfalls of spectroscopic imaging of the heart.

TABLE OF CONTENTS/OUTLINE

A. How does 1H-Magnetic Resonance Spectroscopy (1H-MRS) of the myocardium work B. Technical requirements C. Spectroscopic data acquisition; positioning of respiratory motion gating navigator; voxel placement in the septum D. Spectroscopic data postprocessing E. Image analysis in healthy subjects and patients; age dependency of myocardial triglyceride content; Metabolic syndrome, Morbus Fabry F. Pitfalls of cardiac 1H-MRS G. Limitations of cardiac 1H-MRS; alternative imaging modalities

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Demystifying Coronary Bypass Grafts Using MDCT

All Day Room: NA Digital Education Exhibit

Participants
Sachin S. Pathak, MD, MBBS, Kalyan, India (*Presenter*) Nothing to Disclose
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Sumit Gupta, PhD,FRCR, Leicester, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sandeep S. Hedgire, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

1. Catheter angiography of Coronary bypass grafts is a bit more challenging than CT angiography due to variations of the graft anastomosis on aorta. 2. MDCT is now considered investigation of choice for evaluation of patency and complications of bypass grafts. CT non-invasively and accurately depicts focal, multifocal or diffuse stenosis of bypass grafts and plays an important role during follow up of post CABG patients for assessment of complications. 3. Knowledge of radiological appearances of usual and unusual coronary graft complications is essential for providing comprehensive and best patient care.

TABLE OF CONTENTS/OUTLINE

1. Discuss optimized MDCT scan protocols. 2. Review various coronary graft types (ex: SVG, LIMA, Radial artery,other uncommon types) and patterns along with their normal radiologic appearances. 3. Illustrate various early and late complications in CABG patients: graft thrombosis, Malposition or kinking, graft spasm, pericardial effusion, pleural effusion, sternal infection, pulmonary embolism, late stenosis and occlusion of graft, graft aneurysm and pseudoaneurysm. 4. Discuss role of Dual Energy CT in CABG assessment. 5. Briefly discuss treatment options for some of the graft complications. 6. Conclusion.

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Go with the Flow: Multimodality Imaging of Cardiovascular Shunts

All Day Room: NA Digital Education Exhibit

Participants
Henry Chen, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Robert C. Gilkeson, MD, Cleveland, OH (*Abstract Co-Author*) Research Consultant, Riverain Technologies, LLC; Research support, Koninklijke Philips NV; Research support, Siemens AG; Research support, General Electric Company
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TEACHING POINTS

• Understand the role of different imaging modalities for the evaluation of cardiovascular shunts • Learn how to optimize imaging protocols in the assessment of cardiovascular shunts • Illustrate the clinical applications of multimodality imaging in the evaluation of shunts

TABLE OF CONTENTS/OUTLINE

1. Overview of different imaging modalities used for assessment of cardiovascular shunts a. Echocardiogram b. ECG gated CT Angiography c. Spectral CT and iodine map d. Cardiac MRI/MRA, e. Nuclear Medicine 2. Review the imaging protocols and how to optimize for evaluation of cardiovascular shunts a. Echocardiogram (Doppler echocardiography and contrast echocardiography [bubble study]). b. ECG gated CT Angiography c. Spectral CT with emphasis on iodine mapping d. Cardiac MRI/MRA, phase contrast sequence and estimation of Qp:Qs e. Nuclear Medicine (Quantitative lung perfusion scintigraphy using 99mTc-MAA) 3. Examples of cardiovascular shunts and their imaging appearance in different imaging modalities a. Intra-cardiac shunts (ASD, VSD,...) b. Extracardiac shunts (PDA,...) c. Pulmonary vascular shunts (AVM) d. Vascular extrathoracic shunts e. Shunts before and after interventional treatments, changes in the quantitative parameters

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Coronary CT Angiography with Wide Coverage Detector: How to Optimize Contrast Injection and Scan Protocol Based on Patient Size to Reduce Contrast and Radiation Doses

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS

1)To illustrate limitations of conventional protocols with fixed tube voltage and contrast injection in coronary CT angiography (CCTA) 2)To illustrate the advantages various techniques in CCTA 3) To demonstrate strategies of optimizing keV and contrast based on patient size to reduce doses in CCTA

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CA107-ED-X

Cardiac Conduction Devices in Imaging: Simple but Easily Overlooked

All Day Room: NA Digital Education Exhibit

Awards
Identified for RadioGraphics

Participants
Moon Young Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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TEACHING POINTS

1. Differentiation of cardiac conduction devices (CCDs) in imaging including radiograph and computed tomography (CT); even in the case without the medical record about the exact device type. 2. Various complications associated with CCDs in radiographs and CTs. 3. Role of the radiologist in the imaging interpretation associated with CCDs.

TABLE OF CONTENTS/OUTLINE

1. Types of CCD - Clinical indication, component of CCD, and ideal location of each type 1) Temporary pacemaker (PM) 2) Permanent PM - Single/dual chamber PM - Cardiac resynchronization therapy (CRT) device - Epicardial PM 3) Implantable cardioverter defibrillator (ICD) 4) Implantable cardiac monitor 2. Complications associated with CCD 1) Cardiac rupture - Fig. 1. Left ventricular (LV) rupture by temporary PM lead - Fig. 2. Right ventricular (RV) rupture by permanent PM lead 2) Disruption of lead integrity: fracture, kinking, pinching 3) Superior vena cava (SVC) syndrome - Fig. 3. Lead crowding and SVC thrombosis inducing SVC syndrome 4) Lead dislodgement 5) Pneumothorax 3. Check list for interpretation 4. Diagnostic pitfalls - Fig. 4. Too large heart chamber to diagnose exact location of the lead - Fig. 5. Metal artifacts obscuring early finding of RV perforation

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Don't Strain Yourself: Strain and Multimodality Imaging in Cardiac Amyloidosis

All Day Room: NA Digital Education Exhibit

Participants
Andrea Furlani, MD, Bronx, NY (*Presenter*) Nothing to Disclose
Asmaa M. Elsayed Ahmed, MBBCh, MSc, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Waddy Gonzalez, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose
Anna Shmukler, MD, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose
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Mario J. Garcia, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose
Linda B. Haramati, MD, MS, Bronx, NY (*Abstract Co-Author*) Spouse, Board Member, Kryon Systems Ltd

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TEACHING POINTS

1) Discuss cardiac strain principles 2) Discuss amyloid cardiomyopathy pathophysiology 3) Discuss cardiac Strain particularities in cardiac amyloidosis 4) Discuss multimodality imaging findings in amyloid cardiomyopathy (MRI, SPECT and Echo)

TABLE OF CONTENTS/OUTLINE

Cardiac amyloidosis results from extracellular deposition of amyloid proteins into the myocardium, leading to loss of normal architecture and function. Advanced cardiac imaging techniques such as MR, radionuclide imaging (PET/SPECT) and Strain play a role on the diagnosis. Cardiac strain utilizes the principle of myocardial deformation for global and segmental functional analysis, detecting subclinical myocardial dysfunction. Echocardiography with strain imaging shows unique features in patients with cardiac amyloidosis but is frequently limited by image resolution. Magnetic Resonance (MR) tissue tracking is a robust tool for complementary evaluation of subclinical cardiac diseases utilizing the routine multiplanar cine images for strain analysis. There is promising evidence for the diagnostic role of MR strain imaging in amyloid-related cardiomyopathy. We present a comprehensive review of cases illustrating key multimodality imaging features that differentiate amyloid from other causes of ventricular hypertrophy.

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What Radiologists Need to Know About the Utility of Detector-Based Spectral CT Imaging for Cardiovascular Disease

All Day Room: NA Digital Education Exhibit

Participants
Noriko Oyama-Manabe, MD, PhD, Sapporo, Japan (*Presenter*) Grant, Canon Medical Systems Corporation
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Tsutomu Fujita, MD, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

1. To review basic principles of a dual-energy CT technology with a detector-based spectral CT 2. How to use each spectral image type for specific cardiovascular applications 3. To focus on quantitative evaluation of late iodine contrast enhanced CT 4. To review clinical cardiovascular cases with spectral CT

TABLE OF CONTENTS/OUTLINE

We review novel clinical applications of spectral CT for cardiovascular disease (CVD) and specifically for myocardial and plaque tissue characterizations. We present our clinical experience based on date from over 4000 patients using spectral CT. 1.What radiologists need to know about principles of spectral CT 2.Review of clinical applications of spectral CT for cardiac imaging: myocardial perfusion, late iodine enhancement, plaque imaging 3.Review image characteristics of virtual non-contrast, iodine map, Z-effective, virtual monoenergetic images with representative cases such as pulmonary embolism, acute coronary syndrome, myocardial infarction, graft endoleak and cardiac tumors 4.Review imaging tips for reduction of iodine contrast media, artifacts and radiation dose 5.Quantify the late iodine enhancement and extra cellular volume in comparison with MRI 6.How to use the spectral CT in emergency room for triple rule out 7.How to set the adequate window level and width for each reconstruction

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CA110-ED-X

Myocardial Bridging: How to Measure and Report

All Day Room: NA Digital Education Exhibit

Participants
Arash Bedayat, MD, Stanford, CA (*Presenter*) Nothing to Disclose
Signe H. Forsdahl, MD,PhD, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose
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Ian S. Rogers, MD, MPH, Palo Alto, CA (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

• Overview of Coronary myocardial bridge, classification and clinical significance based on Myocardial Bridge Mass Index (MMI) • Review CT findings of Myocardial Bridge • Review Image correlates with Intravascular Ultrasound, Echocardiography and Conventional Angiogram

TABLE OF CONTENTS/OUTLINE

• Classification of Myocardial Bridge • Describe the CT features with their conventional angiogram, Intravascular ultrasound and echocardiography correlates • Discuss diagnostic pitfalls and management options

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CA111-ED-X

The Ability of the Acute Infarct Extracellular Volume Mapping to Quantify Myocardial Area at Risk of a Non-ST Elevation Myocardial Infarction by 320-Slice CT

All Day Room: NA Digital Education Exhibit

FDA Discussions may include off-label uses.

Participants
Takayoshi Yamaguchi, Sapporo, Japan (*Presenter*) Nothing to Disclose
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Mari Morita, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose
Tetsuya Tanikoshi, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose
Keiichi Hanaoka, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

1.Review current method of evaluating myocardial extracellular volume (ECV) using cardiac magnetic resonance imaging (MRI) and summarize its advantages and disadvantages.2.Explain how to estimate myocardial ECV fraction using contrast-enhanced 320-slice CT.3.Discuss the usefulness and limitations of coronary CTA to be enforced in non-ST elevation myocardial infarction (NSTEMI).4.Discuss how evaluating coronary artery lesions and myocardial ECV simultaneously before percutaneous coronary intervention (PCI) using CT would fit into the clinical workflow in acute myocardial infarction, and identify how patients could benefit from the use of this approach.

TABLE OF CONTENTS/OUTLINE

1.Introduction2.Review of assessment in AMI follow-up by MRI-ECV3.Current status of adaptation of CT to NSTEMI patients in various guidelines4.Explanation on how to obtain ECV images using 320-slice CT5.Method of discrimination between OMI and AMI by CT-ECV6.The Significance of evaluating myocardial risk area and culprit lesions of the coronary arteries simultaneously in NSTEMI patients7.Illustrative example of clinical treatment policy by adding myocardial ECV evaluation in cardiac CT examination executed before PCI

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CA112-ED-X

Cinematic Rendering in Cardiovascular Imaging: Physics, Principles, and Applications

All Day Room: NA Digital Education Exhibit

Participants
Harold Goerne, MD, Zapopan, Mexico (*Presenter*) Nothing to Disclose
Victor Fiorentino, MD, Guadalajara, Mexico (*Abstract Co-Author*) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

1. To review the physics and principles of cinematic rendering 2. To discuss the differences between volumetric (VR) and cinematic rendering 3. To review and illustrate the applications of CR in cardiovascular imaging

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. 3d techniques in cardiovascular imaging- VR, SSD 3. Cinematic Rendering - Origin - Physics and Principles- Random sampling algorithm stimulating light transport - Comparison of CR and VR - Advantages- Accounts for complex light paths; More photorealistic - Disadvantages- High computational power demand; Longer time - Technical details - Additional tools- High-dynamic range light maps, shadowing, environment maps, Window presets (trapezoid vs ramp), Segmentations, Transfer functions, 4. Utility in cardiovascular imaging - Depiction of complex anatomy - Relationship between cardiovascular and adjacent structures - Pre-operative/interventional planning- Roadmap - Post-surgical/stent-graft evaluation - Education 5. Case Examples - Relationship of structures-CABG; congenital heart disease - Displacement of vascular structures by thrombosis/mass - Cardiac devices- LVAD, Parachute device, etc - Evaluation of stent-grafts 6. Flow chart on the use of cinematic rendering

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CA113-ED-X

Magnetic Resonance Imaging of Myocarditis

All Day Room: NA Digital Education Exhibit

Participants
Xing Chin, MD, New York, NY (*Presenter*) Nothing to Disclose
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TEACHING POINTS

Review the pathophysiology and clinical features of myocarditis. Illustrate the role of cardiac MRI as an accurate noninvasive diagnostic modality for myocarditis and its impact on treatment. Demonstrate the cardiac MRI findings in acute and chronic myocarditis

TABLE OF CONTENTS/OUTLINE

1. Introduction a. Incidence b. Classification i. Etiology ii. Chronology iii. Morphological - Dallas criteria c. Pathogenesis d. Clinical presentation 2. Diagnostic Tools a. Echocardiography b. Coronary catheterization c. Cardiac MRI d. Endomyocardial biopsy 3. Cardiac MRI a. Imaging sequences and their diagnostic targets i. SSFP - Pericardial effusion ii. SSFP - Contractile function iii. T2 weighted imaging- Myocardial edema iv. Early gadolinium enhancement - Hyperemia v. Late gadolinium enhancement - Necrosis and scar b. Lake Louise diagnostic criteria c. Differentiating acute from chronic myocarditis i. Commonly used T1 mapping techniques 1. MOLLI 2. ShMOLLI ii. Diagnostic accuracy of T1 mapping sequences 1. Native T1 map 2. Postcontrast T1 map 3. Extracellular volume calculations d. Differentiating myocarditis from similar myocardial pathologies (myocardial infarction, myocardial sarcoidosis, tako-tsubo, etc) 4. Conclusion a. Future outlook on cardiac MR in evaluation of response to treatment

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CA114-ED-X

Survivors: Cardiac MRI Guiding Ablation in Chagas Disease Patients with Sustained Ventricular Tachycardia

All Day Room: NA Digital Education Exhibit

Participants
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Maria I. Gabardo, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
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Alfredo A. Rodrigues, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

The purpose of this exhibit is:1. To verify the possibility of Cardiac MRI to locate the areas with the greatest regional arrhythmogenic potential of patients with Chagas' cardiomyopathy submitted to mapping and ablation1. To evaluate the presence and extension of myocardial fibrosis in patients with Chagas cardiomyopathy and sustained ventricular tachycardia3. To assess the value of delayed-enhanced magnetic resonance imaging (DE-MRI) to guide ablation of ventricular arrhythmias4. To show that Cardiac MRI can helps to plan an appropriate mapping and ablation strategy

TABLE OF CONTENTS/OUTLINE

Cardiomyopathy is considered to be the most frequent and severe manifestation of Chagas' disease, evolving with formation of fibrosis areas interspersed with viable tissue, leading to the onset of arrhythmogenic circuits, which may be manifested by sustained ventricular tachycardia and ventricular fibrillation, a frequent cause of sudden death in these patients.1. Epidemiology and Pathophysiology of Chagas Heart Disease2. Relationship between Fibrosis and Ventricular Arrhythmias in Chagas Heart Disease 3. Review of imaging findings - The heart in 3-D display of scar tissue that was extracted from the DE-MRI - Electroanatomical mapping (CARTO 3®) correlated with respect scar tissue in Cardiac MRI4. Future directions and summary

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CA115-ED-X

Secret War: Is the Iron Heart Invincible? Diagnosis of Cardiomyopathy Due to Iron Overload in Cardiac Magnetic Resonance

All Day Room: NA Digital Education Exhibit

Participants
Lorena S. Capeline, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose
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TEACHING POINTS

1. Juvenile hemochromatosis is a rare form of iron overload that frequently causes cardiomyopathy. 2. The cardiac function in juvenile hemochromatosis could be reversed once iron overload from treatment with iron-chelating agents. 3. The importance of the MRI using T2* evaluation showing liver iron concentration (LIC) and myocardium iron concentration (MIC) pre and post treatment with iron-chelating agents. 4. Strain as a new technology to aid in the evaluation of left ventricular function.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Definition and Causes of iron overload 3. A relationship between Iron overload and Myocardiopathy 4. Advantages of MRI - Function, tissue characterization, myocardial mechanics, hemodynamics, vascular 6. Review of imaging findings and MRI sequences - Review of several sequences and their utility in LV dilation - Black blood- Morphology - Cine SSFP- anatomy, quantification - Strain imaging- Regional function - T2* 7. Follow up management in iron overload 8. Future directions and summary

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Pericardial Diseases: Multimodality Imaging Evaluation with Pathology Correlation

All Day Room: NA Digital Education Exhibit

Awards
Identified for RadioGraphics

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TEACHING POINTS

Review normal pericardial anatomy, embryology and expected appearance on different imaging modalities.Describe and illustrate different types of pericardial abnormalities on multimodality imaging the radiologist may encounter in various subspecialty settings such as emergency radiology, trauma radiology, and oncologic radiology.Identify and establish a structured diagnostic approach for pericardial diseases based on imaging and clinical data.Include the pericardium in the systematic search pattern on multimodalities, particularly Computed Tomography.

TABLE OF CONTENTS/OUTLINE

Normal pericardium on different modalities.Different pericardial abnormalities on different imaging modalities (Echocardiography- radiograph- CT- MRI- PET/CT) and pathology correlation.Emergency radiology:- Pericarditis- Constrictive pericarditis- Pericardial fat necrosis- Pericardial tamponadeTrauma radiology- Hemoperricardium- Pneumopericardium- Pericardial rupture- Pericardial foreign bodyOncologic radiology- Pericardial effusion- Constrictive pericarditis- Pericardial masses and cystsDifferentiation of pericardial constrictive pathology versus restrictive cardiomyopathy.Practical pericardial evaluation on imaging

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MRI of Restrictive Cardiomyopathy

All Day Room: NA Digital Education Exhibit

Participants
Shaimaa A. Fadl, MD, Seattle, WA (*Presenter*) Nothing to Disclose
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Ayesha Nasrullah, MBBS, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

To discuss the different etiologies of restrictive cardiomyopathies and their characteristic imaging patterns.To identify the appropriate MRI protocols, and parameters targeting improving diagnostic accuracy.:::To establish a structured schematic approach for the restrictive cardiomyopathy diagnosis in patients presenting with heart failure and have normal ejection fraction.To differentiate constriction versus restrictive pathology.

TABLE OF CONTENTS/OUTLINE

Definition, background and epidemiology.Review of the workflow for restrictive cardiomyopathy diagnosis by different imaging modalities including echocardiography.Cardiac MRI protocols and parameters.Review of etiologies and characteristic imaging features of different types of restrictive cardiomyopathy, including sarcoidosis, amyloidosis, iron overload, charge-Strauss, scleroderma, and others.Structured schematic approach for the restrictive cardiomyopathy diagnosis in patients presenting with heart failure and have normal ejection fraction.Differentiation of restrictive and constrictive pathology on echo and MRI.

Honored Educators

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It Is Not Just a DILV (Double Inlet Left Ventricle): The Additional Value of CT in Preoperative Assessment

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS

1.CT confirms the ECHO diagnosis of DILV.2.CT may add other findings that cannot be adequately assessed by ECHO as: •Branch pulmonary artery size.•Presence and drainage of left SVC.•PDA or MAPCAs.•Aortic arch anatomy.3.CT may alter the operative decision:•In case of small LPA, augmentation was done along with Glenn.•In case of sizable pulmonary artery and arch hypoplasia, PA banding and arch repair were done.•In case of coronary sinus (CS) draining into left brachio-cephalic vein (BCV) mimicking left SVC, no left Glenn was done.

TABLE OF CONTENTS/OUTLINE

Outline:Introduction:DILV is a rare form of CHDs where both atria are seen draining into the LV with hypoplastic RV and VSD.Great vessels may be normally related, mal-posed, transposed or arise from single ventricle.Diagnosis:The initial diagnosis is usually made by ECHO; however many extra-cardiac abnormalities may not be adequately assessed and hence comes the role of MDCT in preoperative assessment.Cases Case1:DILV, double outlet RV (DORV).CT showed L-malposed great vessels, PS, LPA stenosis, PDA and small MAPCAs.Case2:DILV, L-TGA, and good sized PAs.CT showed hypoplastic aortic arch. Case3:DILV, normally related great vessels, sever PS.CT showed atresia of the CS opening,seen draining into the left BCV.Review of imaging findings in each case.How would CT change the operative decision in each case.Conclusion

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Current Trends in Diagnostic Imaging of Cardiac Amyloidosis

All Day Room: NA Digital Education Exhibit

Awards
Identified for RadioGraphics

Participants
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TEACHING POINTS

1. Cardiac amyloidosis (CA) is more common than previously thought, and it is more prevalent in patients with heart failure with preserved ejection fraction. 2. Two types account for more than 95% of all CA cases: (1) light-chain (AL) amyloidosis and (2) transthyretin amyloidosis (ATTR). ATTR is subdivided into two types as follows: (a) mutant-type ATTR; and (b) wild-type ATTR. 3. Myocardial T1 mapping by cardiac magnetic resonance imaging (CMR), a novel approach for myocardial tissue characterization, can overcome these limitations of late gadolinium enhancement (LGE) imaigng, and facilitates the detection, and assessment of severity and prognosis of CA. 4. Using advanced imaging modalities, a more precise and early diagnosis of CA can be obtained, along with the appropriate management of patients with CA.

TABLE OF CONTENTS/OUTLINE

1. Basic knowledge of CA - Classification of amyloidosis - The true prevalence of CA - Current diagnostic strategies 2. Major types of CA - AL amyloidosis - Mutant-type ATTR - Wild-type ATTR 3. Echocardiography 4. CMR - Cine CMR - LGE imaging - T1 mapping - CMR-based myocardial strain 5. Bone scintigraphy for diagnosis of cardiac ATTR 6. Recent advances in cardiac CT - Myocardial late iodine enhancement imaging - CT-based myocardial extracellular volume fraction 7. Future directions

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Athlete's Heart: The Great Pretender

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Participants
Marta Repolles Cobaleda, Madrid, Spain (*Presenter*) Nothing to Disclose
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TEACHING POINTS

The term 'athlete's heart' is used to define the pattern of morphological,functional and electrical changes that result from intensive training.These structural changes can overlap those observed in individuals with inherited cardiomyopathies and lead on important dilemas for clinician.CMR plays an increasingly important role helping to establish an accurate diagnosis in these individuals.The purpose of this review is to highlight the role of CMR in differentiating physiological athletic adaptation from pathology.

TABLE OF CONTENTS/OUTLINE

1The Athlete's heart definition -To describe the morphological, functional and electrical changes that result from intensive training.-Differencies between the impact of endurance and strength sports 2.The 'Grey zone ' definition -To describe the so called 'grey zone 'between athlete's heart and inherited cardiomyopathies as LHV, ARVC, DCM and non compacted myocardiopayhy, at the extremes of athletic cardiac remodeling.-Differentiating athlete's heart from inherited cardiomyopathies.3.The role of CMR in athlete's heart assessment.-To explain its use in differentiating athlete's heart from structural heart disease including the additional information provided by late gadolinium enhancement and other novel techniques as T1 mapping and extracellular volume fraction.

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Coronary Artery Termination Variations and Anomalies

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Participants
Hale Ersoy, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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Tiffiny Hunsaker, MD, Galveston, TX (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

1. To describe the spectrum of coronary termination variations and anomalies with emphasis on coronary CT Angiography (CCTA) illustrations. 2. To explain the utility of CCTA in diagnosis and treatment planning of coronary termination variations and anomalies.

TABLE OF CONTENTS/OUTLINE

1. Classification of coronary artery termination variations and anomalies. 2. Case Presentations and review of imaging findings. 3. Conclusion with regard to coronary CTA as the preferred imaging modality.

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CA122-ED-X

Identifying Vulnerable Coronary Plaques - What Should I Know?

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

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TEACHING POINTS

In coronary imaging, the main goal is to identify individuals at increased risk for acute coronary syndromes. The composition of atherosclerotic plaques in the coronary arteries is associated with vulnerability. Coronary Computed Tomography Angiography (CCTA) may provide information about plaque characteristics that can potentially help differentiate the most vulnerable ones. The purpose of this exhibit is:- to review which plaque characteristics on CCTA may be related to plaque vulnerability;- to illustrate these characteristics through a series of cases, with coronary angiography and optic coherence tomography (OCT) correlation, enabling radiologists to recognize imaging findings associated with vulnerable plaque;- to discuss CCTA spatial and temporal resolution limitations, as well as its impact on plaque characterization.

TABLE OF CONTENTS/OUTLINE

The cases will be presented in a quiz format. How to identify features of plaque vulnerability will be commented, with coronary angiography and OCT correlation. Also, computed tomography spatial and temporal resolution limitations will be discussed, as well as its impact on plaque characterization. The list of cases includes calcified plaques and non calcified plaques. Among the last ones there will be cases showing positive remodeling, low attenuation, the napkin-ring sign and/or spotty calcification.

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The Importance of Multi-Modality Imaging in Cardiac Amyloidosis

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Carol Whelan, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Brooke Douglas, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

The purpose of this exhibit is: 1. To review the pathophysiology of cardiac amyloidosis. 2. To highlight the importance of using multi-modality imaging to reach an accurate diagnosis. 3. To review the diagnostic and prognostic strengths and weaknesses of different imaging modalities used in cardiac amyloidosis.

TABLE OF CONTENTS/OUTLINE

Pathophysiology of cardiac amyloidosis. Review of imaging findings in amyloid light chain (AL) and transthyretin (TTR) cardiac amyloidosis (cardiac MRI, echocardiography, 99mTc-DPD scintigraphy and 18F florbetapir PET/CT). Sample cases. Future directions including the increasing role of 18F-florbetapir imaging. Summary.

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Left Ventricular Assist Devices, the Expected and Unexpected - A Multimodality Imaging Review of Left Ventricular Assist Devices in Preoperative, Perioperative, and Destination Therapy Patients

All Day Room: NA Digital Education Exhibit

Participants
Akshaar N. Brahmbhatt, MD, Rochester, NY (*Presenter*) Nothing to Disclose
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TEACHING POINTS

Despite medical advancements many patient's with heart failure eventually require functional replacement in the form of a heart transplant or Left ventricular assist device (LVAD). In recent years there have been major advances in LVAD technology. This along with the scarcity of transplants have transformed the LVAD formally considered temporary into a long term solution, bettern known as destination therapy. As LVAD use increases it is important to recognize the spectrum of complications and preemptive steps, which can prevent or reduce complications. This review is designed to help radiologists better understanding the important aspects of preoperative LVAD imaging, as well a complications in perioperative and long term LVAD patients. In addition we will briefly explore associated clinical presentation and treatments as to enable radiologists to better understand patient outcomes and provide more relevant information to the care team.

TABLE OF CONTENTS/OUTLINE

1. Basics of LVAD placement a. Clinical Significance/HM III b. Imaging and Anatomic Considerations c. Surgical Approaches 2. Perioperative Complications a. Hemorrhage b. Infection c. Thrombus d. Embolus 3. Long-term complications a. Driveline Infection b. Short to Shield c. Outflow stenosis d. Gastrointestinal bleeding e. Post removal imaging. 4. Summary

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CA125-ED-X

Demystifying Cardiac Assist Devices: Imaging Review of Pediatric Ventricular Assist Devices with Clinical Correlation

All Day Room: NA Digital Education Exhibit

Participants
Damir Ljuboja, BA,BS, Cambridge, MA (*Presenter*) Nothing to Disclose
Marc D. Succi, MD, Boston, MA (*Abstract Co-Author*) Patent agreement, Frequency Therapeutics, LLC; Patent agreement, AugMI Labs, Inc; Stockholder, 2 Minute Medicine
Sanjay P. Prabhu, FRCR,MBBS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

1. To review the history, development and functional physiology of ventricular assist devices (VADs) 2. To summarize the use of these devices in pediatric patients 3. To illustrate radiographic appearance of VADs and their cannulation tubes on radiographs and cross-sectional imaging with multiplanar and three-dimensional reconstructions 4. Highlight specific points to be kept in mind when assessing imaging studies in patients with VADs.

TABLE OF CONTENTS/OUTLINE

1) Overview of ventricular assist devices and their uses (definition, uses - mechanical assistance, bridge-to-therapy, destination therapy) 2) Standard Positioning (device locations - extracorporeal, paracorporeal, intracorporeal; cannula locations) 3) Review of Devices (first, second and third generations with specific examples of each [e.g. Abiomed BVS5000, Berlin Heart EXCOR, Thoratec HeartMate I and II, Heartware]) 4) Imaging Findings 5) Common complications

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CA126-ED-X

Clinical Applications of Spectral Cardiac CT in Ischemic Heart Disease and Various Cardiomyopathies: What the Radiologist Needs to Know

All Day Room: NA Digital Education Exhibit

Participants
Haruhiko Machida, Tokyo, Japan (*Presenter*) Nothing to Disclose
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Hiroshi Takaku, RT, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

To review cardiac CT (CCT) evaluation in ischemic heart disease (IHD) & various cardiomyopathies (CMs) To describe basic principles & various techniques in spectral CCT To illustrate clinical applications using these techniques by presenting clinical images

TABLE OF CONTENTS/OUTLINE

CCT evaluation in IHD & CMs Coronary artery calcification (CAC) score Coronary artery stenosis/plaque classification even with CAC/stent Myocardial perfusion/late iodine enhancement (LIE): myocardial ischemia/infarction/viability, diagnosis of non-ischemic CMs like cardiac MR Radiation dose/iodine load reduction Basic principles & techniques in spectral CCT Raw-data-based dual-energy CT: fast kV switching/dual-layer detector Monochromatic imaging (MI) Energy level (keV)-CT value (HU) curve Material density imaging (MDI) Effective atomic number (EAN) imaging Iterative reconstruction (IR) Clinical applications Improved contrast/delineation of coronary arteries & reduction of radiation dose/iodine load: low-keV MI/iodine MDI with IR, virtual noncontrast (VNC) CT replacing true noncontrast CT CAC subtraction: iodine/CAC MDI, MI subtracted by VNC CT Improved diagnosis of in-stent restenosis: high-keV MI, EAN imaging Coronary plaque classification: fat MDI, keV-HU curve, EAN Myocardial perfusion/LIE: iodine MDI

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Evaluation of the Accuracy of Iodine-Enhanced Subtraction Myocardial Computed Tomography in the Diagnosis of Cardiac Sarcoidosis: Comparison with Cardiac Magnetic Resonance Imaging

All Day Room: NA Digital Education Exhibit

FDA Discussions may include off-label uses.

Participants
Takayoshi Yamaguchi, Sapporo, Japan (*Presenter*) Nothing to Disclose
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Mari Morita, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose
Tetsuya Tanikoshi, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose
Keiichi Hanaoka, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

The advantage of assessing cardiac sarcoidosis in CTHow to improve the representation of late iodine enhancement (LIE) by using image subtraction techniqueComparison with cardiac magnetic resonance imaging (MRI)

TABLE OF CONTENTS/OUTLINE

The advantage for CT: Enforcement for the device implantation patients who is an absolute contraindication of MRI. Evaluated in the same space the positional relationship between the coronary artery and myocardial lesion. Advanced technique to extract LIE in 320-silice CT: Proposal of new subtraction method. Necessities for non-rigid registration processing. Noise reduction using iterative reconstruction. Comparison with cardiac magnetic resonance imaging. -OUTLINE- In patients with cardiac sarcoidosis, late gadrimiun enhancement (LGE) in MRI is essential for evaluating the expansion of myocardial lesions. Although it is possible to detect LIE in CT, improvement in image quality is sought. We developed a new CT method to subtract myocardial images for later iodine enhancement (SMILIE). By using SMILIE, it is possible to diagnose sarcoidosis only with CT by omitting invasive coronary angiography and MRI.

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Development of a New Method to Perform Calcium Scoring with High Accuracy in Pulsating Heart

All Day Room: NA Digital Education Exhibit

Participants
Katsumi Tsujioka, PhD, Toyoake, Japan (*Presenter*) Nothing to Disclose
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TEACHING POINTS

The Agatston method is one of Ca-scoring used widely in the clinical field. However, as for it, slice thickness is appointed with 3mm. In addition, according to the Agatston method, accurate measurement can not be performed by moving object. We developed the new Ca-scoring method when the patient. We developed a method to correctly perform Ca-scoring even when the patient is moving.

TABLE OF CONTENTS/OUTLINE

We developed a calcified phantom. The phantom sets it on the table that moves in the Z axis direction. CT slice thickness was changed to 1mm, 2mm and 3mm. In addition, Ca-scoring was performed from cumulative CT values using threshold values. The true volume of the calcification was 60mm3. With the object moving, the error of calcification volume was -60% to +67% in 3mm slice, -25% to +33% in 2mm slice, -5% to +5% in 1mm slice. By using 1mm slice data, the error of Agatston score was changed to 87% to 10% against in 3mm slice data. The method we developed does not deny the Agatston method. It clarifies the problems of the conventional Agatston method and improves the accuracy of moving objects. As a result, The Agatston method can be used clinically like the conventional method.

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A Radial Sampling Strategy to Overcome Artifacts in Myocardial Delayed Enhancement: Benefits and Pitfalls

All Day Room: NA Digital Education Exhibit

Participants
Norishige Hatakeyama, Nagano, Japan (*Presenter*) Nothing to Disclose
Masato Kobayashi, RT, Shinano-machi, Japan (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

In order to acquire high quality myocardial delayed enhancement MRI image, it is necessary to acquire segmented data with multiple shots. 1. To review the physical principles of Single-Shot and Multi-Shot inversion recovery sequences for assessment of myocardial LGE. 2. To review the challenges caused by patient's factors (breath, motion, and arrhythmia) during cardiac MRI. 3. To describe solutions for eliminating/reducing these artifacts by Radial-Sampling. 4. To discuss the role of Radial-Sampling in the evaluation of myocardial LGE.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Physical principles of Single-Shot and Multi-Shot 3. Artifact that became a problem with Multi-Shot 4. Comparison of different effects on Cartesian-Sampling nad Radial-Sampling 5. Solutions by Multi-Shot with Radial-Sampling; a. in-plane resolution b. shot-interval c. receiver coil sensitivity d. contrast e. artifacts due to Radial-Sampling 6. Imaging appearance of Radial-Sampling in clinical scenarios; a. breath b, motion c. arrhythmia

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CA130-ED-X

A New Star in Cardiac MRI; T2* Mapping and Intra-Myocardial Hemorrhage in the Setting of Acute Myocardial Infarction

All Day Room: NA Digital Education Exhibit

Participants
Dina F. Haroun, MBBCh, Cairo, Egypt (*Presenter*) Nothing to Disclose
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TEACHING POINTS

•Technical aspects of T2* mapping,image acquisition and interpretation. •T2* can differentiate between microvascular occlusion (MVO) and intramyocardial hemorrhage (IMH) in the setting of acute myocardial infarction.

TABLE OF CONTENTS/OUTLINE

Background: Both MVO and IMH are features of the larger concept of microvascular injury and have been linked to poorer prognosis,the presence of IMH on top of MVO carries worse prognosis than the presence of MVO only(Amier et al., 2017).Hereby we are applying T2* sequence to diffrenciate IMH from MVO after STEMI. Technical aspects and interpretation: CMR examinations were performed within 48 hours after PCI on 1.5 T machine as follow•cine SSFP images for assessment of global and regional wall motion abnormalities, ventricular function and volumes.•T2 STIR for detection of myocardial edema•T2* imaging for detection hemorrhage in the form of signal drop out•Early gadolinium enhancement,delayed gadolinium enhancement after 10 minutes for detection of intramural thrombi,MVO and myocardial necrosis. T2* acquisition parameters: •Multi-echo gradient echo with 10 equally spaced echoes,2.02 t ms apart. Review of imaging findings: Conclusion: We are proposing the use of T2* sequence for detection of IMH and infarct characterization which will help in prediction of clinical outcome and prognosis.

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CA131-ED-X

Key Stone Status of Radiology in Surgical Decision Making in TOF - Surgeons Perspective

All Day Room: NA Digital Education Exhibit

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Participants
Bharath B. Das, MD, MBBS, Bangalore, India (*Presenter*) Nothing to Disclose
Pankaj M. Kolhe, MBBS, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Prashanth Reddy, MBBS,MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Srikanth Sola, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Bhavana Nagabhushana Reddy, MBBS, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Sankar Neelakantan, MD , Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Sanjaya Viswamitra, MD, Bengaluru, India (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

1. To familiarise the reader with various check points, important for surgeon, to decide on early surgical repair Vs. palliation and interval correction Vs. medical management. 2. Reporting syntax to correctly describe the above.

TABLE OF CONTENTS/OUTLINE

Tetralogy of Fallot (TOF) is the most common cyanotic congenital heart disease. With the advances in surgical skills and sterile techniques, the current post operative mortality is <2%. Early primary repair is always the aim in the management, as it establishes a normal circulation to all the developing organ systems, reduces undue right ventricle (RV) systemic pressureand increases RV compliance in future. But, a primary repair is not always possible in every case due to presence of additional associated pathologies. In our case based exhibit we describe our experience from 480 operated TOF from 2014 - 2018 1. Approach to common and uncommon associations with the management plan based on imaging findings. 2. Complications associated with post primary repair and other lines of management. 3. Rationale for surgeon's requirement from imaging report and review algorithm to ensure that these are correctly reported.

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MSCT Imaging of Unusual Coronary to Pulmonary Circulation Fistulae

All Day Room: NA Digital Education Exhibit

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

1. Unusual coronary to pulmonary circulation fistulae 2. MSCT imaging technique and appearances of various such fistulae

TABLE OF CONTENTS/OUTLINE

Spectrum of different unusual coronary to pulmonary circulation fistulae MSCT technique & Importance of post processing techniques MSCT imaging appearances of various fistulae Summary

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Spectrum of Conotruncal Anomalies - What Surgeon Wants to Know in Pre-Operative Imaging?

All Day Room: NA Digital Education Exhibit

Participants
Yashpal Rana, MD, MBBS, Ahmedabad, India (*Abstract Co-Author*) Nothing to Disclose
Dinesh Patel, MD, Ahmedabad, India (*Abstract Co-Author*) Nothing to Disclose
S. Patel, DMRD, Ahmedabad, India (*Abstract Co-Author*) Nothing to Disclose
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Milin N. Garachh, MBBS, Ahmedabad, India (*Abstract Co-Author*) Nothing to Disclose
Zalak Patel, MD, Ahmedabad, India (*Presenter*) Nothing to Disclose

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TEACHING POINTS

1. Understanding the spectrum of conotruncal anomalies and available surgical options 2. Imaging appearances of various conotruncal anomalies with special emphasis on what information surgeon wants from radiologist

TABLE OF CONTENTS/OUTLINE

Conotruncal Anomalies- Embryology & Classification Discussion of available surgical options MSCT technique - Minimizing Radiation Dose - Importance of post processing techniques Usefulness of 3 D VR images in pre surgical evaluation Imaging appearances and must report checklists Summary

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The Pearls and Pitfalls in the Imaging of ECMO Patients

All Day Room: NA Digital Education Exhibit

Participants
Amy Agahi, MBChB,MD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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Alexander Wilson, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose
Anu Balan, MBBS, MRCP, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Emma K. Cheasty, MBChB, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

Extracorporeal membrane oxygenation (ECMO) is a form of pulmonary or cardiopulmonary support for patients with severe respiratory or cardiac failure. Using a wealth of experience from our tertiary Cardiothoracic Centre, we will demystify the complexity of these specific imaging scenarios and demonstrate the following key learning points. 1. Differentiate between clinical indications for veno-venous (VV) and veno-arterial (VA) ECMO 2. Understand the physiology and haemodynamics of the ECMO circuits and the relevant use of imaging 3. Illustrate the common radiological features of patients on ECMO including placement of ECMO catheters and assist devices 4. Unravel the quandary of contrast enhanced computed tomography in the ECMO circuit 5. Present examples of the complications frequently associated with ECMO and the role of imaging in their diagnosis and management

TABLE OF CONTENTS/OUTLINE

1. Introduction to VV and VA ECMO 2. Indications 3. Physiology and haemodynamics 4. Normal Radiological Features - Position and Types of VV and VA ECMO catheters 5. Complications of the ECMO circuit 6. Practical tips in contrast administration in computed tomography

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Pericardial Diseases: Pictorial Review of Congenital and Acquired Pathologies and Their Hemodynamic and Clinical Significance

All Day Room: NA Digital Education Exhibit

Participants
Pegah Khoshpouri, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Kianoush Ansari-Gilani, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Hamid Chalian, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

• Review anatomy of pericardium • Understanding embryogenesis of pericardium • Review the most common pathologies involving the pericardium and their causes • Review the clinical significance and management of each pathology • Review the best imaging modalities and sequences to help differentiate pericardial pathologies.

TABLE OF CONTENTS/OUTLINE

• Embryogenesis and anatomy of the pericardium • Simple pericardial effusion • Pericardial tamponade • Pericarditis • Constrictive pericarditis • Effusive constrictive pericarditis • Pericardial cyst • Pericardial lipoma • Pericardial agenesis • Pericardial tumor invasion

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Reading Between the Guidelines: Techniques and Pitfalls in the Assessment of Resting Perfusion Defects on Dual Energy CT Coronary Angiography

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Participants
Prashanth Reddy, MBBS,MD, Bangalore, India (*Presenter*) Nothing to Disclose
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Bhavana Nagabhushana Reddy, MBBS, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

The purpose of this exhibit is to: 1. Discuss techniques for reconstruction of material decomposition images and virtual monochromatic images from dual energy CT coronary scans in a time efficient manner. 2. Discuss the utility of assessment of resting perfusion defects in these images over and above routine CT coronary angiogram evaluation as per guidelines. 3. Discuss the pitfalls in the assessment of resting perfusion defects and how to avoid them.

TABLE OF CONTENTS/OUTLINE

1. Available techniques for image reconstruction of myocardial perfusion maps from dual energy CT coronary angiograms. 2. Techniques for optimising the visibility and detection of resting perfusion defects 3. How to identify artefacts and differentiate them from true perfusion defects. 4. Clinical scenarios and review of cases in which this type of analysis was of benefit.

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Normal and Abnormal Imaging Findings of Cardiovascular Devices: When ECG-Gated CT Might Help

All Day Room: NA Digital Education Exhibit

Participants
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TEACHING POINTS

Cardiovascular devices (CD) have been improving patient morbidity and mortality for decades. Radiology has played an important role in pre-procedural planning, placement and evaluation of CDs, thus the knowledge of morphologic and functional features of CDs by the radiologist is strongly recommended. Cardiac motion artifacts in non-gated CT and safety concerns of MRI have been some of the limitations in the imaging evaluation of CDs. ECG-gated CT turned out an important technique for imaging assessment of CDs, by minimizing cardiac motion artifacts and improving the method accuracy. The purposes of this exhibit are: ´ A comprehensive review of most common CDs devices and its indications; ´ Overview the imaging features of CDs, including normal findings and complications; ´ Discuss clinical situations when ECG-gated CT may be used to improve diagnostic accuracy when complications are suspected.

TABLE OF CONTENTS/OUTLINE

I. Introduction and Objectives II. Indications, imaging features and complications of CDs, including: a. Pacemakers b. Implantable cardioverter defibrillators c. Intra-aortic balloon pumps d. Ventricular assist devices e. Valve replacements and repairs f. Shuntoccluding devices III. Samples cases with ECG-gated CT elucidating complications related to CDs IV. Conclusion V. References

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Assessment of Aortic Valve Disease by Cardiac MRI: Beyond Echocardiography

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Participants
Filipe P. Carvalho, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Livia M. de Castro, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Clerio F. Azevedo, MD, PhD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

Learner shall be able to understand the role of cardiac MRI in the assessment of patients with aortic valve disease. Focus will be given on (1) imaging protocols, (2) image acquisition tips, (3) limitations, (4) most relevant diagnostic/prognostic information and (5) novel promising imaging techniques.

TABLE OF CONTENTS/OUTLINE

(1) A quick review of aortic valve disease (AVD) epidemiology.(2) Assessment of morphological and functional parameters by cardiac MRI: the gold-standard.(3) Quantification of aortic valve lesion severity by cardiac MRI: imaging protocols, image acquisition tips, limitations and post-processing.(4) Characterization of chronic myocardial injury in patients with severe AVD: quantitative assessment of myocardial fibrosis by the late gadolinium enhancement (LGE) and T1 mapping techniques.

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Assessment of Coronary Artery Fistulas by Computed Tomographic Angiography (CTA)

All Day Room: NA Digital Education Exhibit

Participants
Filipe P. Carvalho, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Livia M. de Castro, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Clerio F. Azevedo, MD, PhD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

A coronary arteriovenous fistula (CAF) is a communication between one or more of the coronary arteries and a cardiac chamber or vein. The majority of adult patients are asymptomatic and, most frequently, CAFs are incidental findings. Nevertheless, in cases with severe left-to-right shunt, patients may present with symptoms of myocardial ischemia and/or high-output heart failure.During the work-up of these patients it is important to determine no only the size of the CAF, but also its origin and its site of drainage. While small fistulas have an excellent long-term prognosis, untreated larger fistulas may predispose the individual to premature coronary artery disease in the affected vessel.In this presentation, we aim to discuss the value of coronary CTA in the detection and characterization of coronary artery fistulas.

TABLE OF CONTENTS/OUTLINE

(1) A quick review of coronary artery fistula epidemiology and clinical features. (2) Characterization of CAF morphology: most common sites of origin and of drainage. (3) Comparison between different imaging modalities: coronary CTA; MR angiography; echocardiography; invasive angiography. (4) Display of several illustrative cases. (5) A brief discussion of therapeutic options and how diagnostic imaging can help guide the process of clinical decision making.

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Comprehensive Assessment of Endomyocardial Fibrosis (EMF) by Cardiac Magnetic Resonance (CMR): Morphology, Function, and Tissue Characterization

All Day Room: NA Digital Education Exhibit

Awards
Identified for RadioGraphics

Participants
Filipe P. Carvalho, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Livia M. de Castro, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Clerio F. Azevedo, MD, PhD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

In this presentation we aim to discuss the role of CMR in the diagnostic and prognostic evaluation of patients with EMF, reviewing typical imaging findings and the correlation with macro- and microscopic appearance.

TABLE OF CONTENTS/OUTLINE

(1) A quick review of EMF epidemiology and clinical features. (2) Characterization of EMF cardiac structural changes: discuss the most common and typical CMR findings going through several illustrative cases. (3) Differential diagnosis: other causes of myocardial wall thickening, apical obliteration, myocardial fibrosis and infiltration. (4) A brief discussion of therapeutic options and how diagnostic imaging can help guide the process of clinical decision making.

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CA141-ED-X

Comprehensive Assessment of Hypertrophic Cardiomyopathy (HCM) by Cardiac Magnetic Resonance (CMR)

All Day Room: NA Digital Education Exhibit

Participants
Filipe P. Carvalho, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Livia M. de Castro, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Clerio F. Azevedo, MD, PhD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

TEACHING POINTS

The focus of this exhibit is to:(1) Present the main phenotypes of hypertrophic cardiomyopathy(2) Discuss the prognostic and diagnostic capabilities of CMR(3) Review the main differential diagnosis and potential pitfalls

TABLE OF CONTENTS/OUTLINE

(1) A quick review of HCM epidemiology.(2) Assessment of morphological and functional parameters by cardiac MRI: the gold standard. (3) Differential diagnosis of aortic valve stenosis, systemic hypertension, and some expressions of athlete's heart. (4) Characterization of chronic myocardial injury in patients with severe HCM: quantitative assessment of myocardial fibrosis by the late gadolinium enhancement (LGE) and T1 mapping techniques.

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Comprehensive Three-Dimensional Reconstruction of Adult Congenital Heart Disease

All Day Room: NA Digital Education Exhibit

Participants
Yu Izawa, Kobe, Japan (*Presenter*) Nothing to Disclose
Shumpei Mori, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Shinsuke Shimoyama, MD, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Kensuke Matsumoto, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Justin T. Tretter, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Diane Spicer, Valrico, FL (*Abstract Co-Author*) Nothing to Disclose
Ken-Ichi Hirata, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
Robert Anderson, MD, Newcastle, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

Along with improvement in standard care and diagnostics, as well as transfer from pediatric to adult cardiac centers, the chance to examine cases of adult congenital heart disease (ACHD) is currently increasing for general radiologists and cardiologists. However, the complex three-dimensional (3-D) anatomy is hard to recognize when using only conventional two-dimensional images. It is the possibility to produce 3-D reconstructions, based on the volume-rendering method, that permits more precise evaluation of complex anatomical arrangements and helps reveal even the subtlest anatomic nuances as encountered in the setting of ACHD. Radiologists, as well as cardiologists, should now be keeping abreast of all the current advance in the field of 3-D reconstruction. We demonstrate 3-D images of ACHD reconstructed using computed tomography, with comparative images obtained from dissection. The technique now permits the heart to be viewed with as much accuracy as when dissected in the autopsy room.

TABLE OF CONTENTS/OUTLINE

1. Technique for acquisition and reconstruction of images2. Comparison between two-dimensional and 3-D imaging3. Comparison between endocast and virtual dissection imaging4. Representative preoperative ACHD cases5. Representative postoperative ACHD cases6. Clinical implications

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Congenital Thoracic Aortic Anomalies

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Awards
Certificate of Merit

Participants
Luis A. Landeras, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Jonathan H. Chung, MD, Chicago, IL (*Abstract Co-Author*) Royalties, Reed Elsevier; Consultant, Boehringer Ingelheim GmbH ; Consultant, F. Hoffmann-La Roche Ltd; Consultant, Applied Clinical Intelligence LLC; Consultant, Veracyte, Inc; Speakers Bureau, Boehringer Ingelheim GmbH; Speakers Bureau, F. Hoffmann-La Roche Ltd

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TEACHING POINTS

Review the Chest CTA and MRA imaging protocols in the pediatric and adult population Provide an organized systematic approach for the assessment of thoracic aortic anomalies Recognize imaging features helpful in the evaluation of a variety of congenital thoracic aortic anomalies

TABLE OF CONTENTS/OUTLINE

TABLE OF CONTENTS 1. Title 2. Objectives 3. Embryology 4. Imaging Evaluation a. Computed tomography angiography b. Magnetic resonance imaging 5. Normal thoracic anatomy 6. Aortic congenital anomalies a. Vascular rings and arch variants i. Double aortic arch ii. Left arch variants iii. Right arch variants b. Aortic hypoplasia c. Coarctation of the aorta d. Pseudocoarctation e. Interrupted aortic arch

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CA144-ED-X

Update on Cardiovascular Devices

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Awards
Cum Laude

Participants
Jessica Telleria, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Amit Patel, MD, Chicago, IL (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV Research Grant, Astellas Group Research Grant, Myocardial Solutions, Inc Research Grant, General Electric Company Speakers Bureau, Astellas Group
Luis A. Landeras, MD, Chicago, IL (*Presenter*) Nothing to Disclose

TEACHING POINTS

Review of new cardiovascular devices and relevant radiographic anatomy. Understand their clinical indications. Evaluate correct positioning of cardiac and vascular devices. Recognize possible complications.

TABLE OF CONTENTS/OUTLINE

TABLE OF CONTENTS 1. Introduction 2. Cardiac monitoring and conductions devices • Leadless pacemaker. • Subcutaneous implantable defibrillator • Bundle of His pacemaker/ICD 3. Cardiac valves • Transcatheter Heart Valves i. CoreValve and Sapiens ii. Melody Valve • MitraClip 4. Ventricular assist devices • Impella. • HeartMate II and III • HeartWare • NuPulse intravascular assist system • Total Artificial Heart 5. Other miscellaneous devices • AtriClips. • WatchMan • LV Parachute 6. Conclusions

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The Circles of Life: Conotruncal Arterial Anastomotic Circles and Their Relevance

All Day Room: NA Digital Education Exhibit

Participants
Huasong Tang, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Andrew C. Demmert, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Amira Hussien, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Jamie L. Schroeder, MD,DPhil, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Elliot K. Fishman, MD, Baltimore, MD (*Abstract Co-Author*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics, Inc
Nagina Malguria, MBBS, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

After viewing this educational exhibit the viewer will be able to1. Understand the three conotruncal anastomotic circles2. Discuss the various coronary anomalies in light of disruption of the normal steps of development of the coronary arteries and interaction with the vessels in the conotruncal circles3. Visualize the role of these circles in providing collateral circulation in stenotic or occlusive disease of the right coronary artery and the left sided circulation

TABLE OF CONTENTS/OUTLINE

1. Preconal anastomotic pathway (Viuessens Ring) * Normal Course: * Abnormal: Prepulmonic left anterior descending artery(LAD), Type IV dual LAD; coronary to pulmonary artery fistula; Aneurysm of the Vieussens Ring; collateral pathway in stenotic/occlusive diseases of the right coronary artery and the left anterior descending artery; 2. Retroconal anastomotic pathway*Normal Course:*Abnormal: Aberrant course of the Right or left coronary artery arising from the opposite cusp and running an interarterial course. Collateral pathway3. Retroaortic anastomotic pathway (Kugel's Ring)*Normal course *Abnormal: Retroaortic Circumflex artery, Circumflex artery to Superior venacava fistula. Collateral pathway

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Cardiac Catheterization 101 for radiologists

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Awards
Magna Cum Laude

Participants
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Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Presenter*) Nothing to Disclose

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TEACHING POINTS

1. To review the basic techniques of cardiac catheterization, which is important for cardiac imagers 2. To review the standard cardiac catheterization projections 3. To review other techniques used in cardiac catheterization 4. To correlate catheterization findings with cardiac CT/MRI

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Role and advantages of cardiac catheterization in evaluation of CVD 3. Coronary angiography - Approaches - Projections (AP, AP Cranial, RAO, RAO oblique caudal, RAO cranial, LAO, LAO caudal (spider), LAO cranial) - Evaluation of stenosis - Coronary anomalies - Angioplasties, stents 4. Bypass graft angiography 5. Invasive FFR measurement- Comparison with CT-FFR 6. Intravascular Imaging- Intravascular ultrasound; Optical coherence tomography 7. Right heart catheterization 8. Hemodynamics- Making sense of numbers 9. Congenital heart disease- Right & left heart catheterization; Pulmonary angiography; Superior and inferior venography 10. Simultaneous right and left heart catheterization- For restrictive and constrictive diseases 11. Ventriculography 12. Valvular hemodynamics (Trans-valvular pressure gradient vs phase contrast MRI) 13. Endomyocardial biopsy- Imaging guidance

Honored Educators

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

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Computed Tomographic Evaluation of Myocardial Ischemia - An Update on Emerging Strategies

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Awards
Identified for RadioGraphics

Participants
Yuki Tanabe, Toon, Japan (*Presenter*) Nothing to Disclose
Akira Kurata, PhD, Toon, Japan (*Abstract Co-Author*) Nothing to Disclose
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Hamid Chalian, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

1. To review the role of imaging in evaluation of myocardial ischemia 2. To review the different CT techniques used in evaluation of myocardial ischemia 3. To compare the technique, role, advantages and disadvantages of CT techniques for myocardial ischemia.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Myocardial ischemia- Pathophysiology 3. Techniques of myocardial ischemia- Exercise ECG test, stress echo, nuclear medicine, MRI, invasive FFR 4. Coronary CTA- Limitations 5. CT techniques for myocardial ischemia A. CT myocardial perfusion - Principle - Techniques- Static/Dynamic; Single/dual Energy - Stress agents- Physiological/ Pharmacological - CT protocol including CTP and delayed enhancement - Interpretation- Qualitative; Semi-quantitative; Quantitative - Advantages, limitations - Current evidence B. CT- Fractional flow reserve (CT-FFR) - Principle - Technology- Off-site/on-site vendor-based hybrid platform - Interpretation - Advantages, limitations, pitfalls - Current evidence C. Transluminal attenuation gradient (TAG) - Principle - Technique of - Needs wide- array scanner - Interpretation- Normal, abnormal values - Advantages, limitations, pitfalls - Current evidence D. Emerging techniques 6. Comparison of the techniques 7. Appropriateness for CT myocardial ischemia

Honored Educators

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104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

CA149-ED-X

Magnetic Resonance Imaging of the Pericardium - A Comprehensive Review with Multi-Modality Correlation

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Presenter*) Nothing to Disclose
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TEACHING POINTS

1. To provide a comprehensive review of pericardial abnormalities 2. To understand the role of CT and MRI in the evaluation of pericardial abnormalities. 3. To illustrate the MRI appearances of several pericardial abnormalities 4. To correlate with other imaging modalities

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Normal anatomy, function, development 3. Role of imaging modalities- Radiograph, CT, MRI, echo, cath, nuclear 4. MRI- Advantages, Limitations 5. MRI techniques- Cine SSFP; Black-blood (DIR, TIR); Real-time cine; Flow; Late enhancement; Parametric mapping (T1, T2, T2*); Tagging 6. MRI protocol 7. Review, clinical features and illustration of the following pericardial abnormalities with case examples and multi-modality imaging correlation - Congenital- Pericardial cyst; diverticulum; Absence of pericardium - Pericardial effusion- Simple, complex - Hematoma - Cardiac tamponade - Inflammation- Pericarditis- Acute inflammatory, chronic inflammatory, Chronic calcifying - Constrictive pericarditis- Typical - Constrictive pericarditis- Variants- Transient inflammatory constriction; effusive constriction; constriction without thickening; occult constriction; radiation - Masses- Metastasis, lymphoma, sarcoma, mesothelioma, hemangioma, paraganglioma - Foreign bodies - Miscellaneous- Fat necrosis; Herniation

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CA150-ED-X

CT for Injuries of Heart and Aorta

All Day Room: NA Digital Education Exhibit

Participants
Yeo Koon Kim, Seongnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Eun Park, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose
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TEACHING POINTS

1) The readers will learn the evaluation process for thoracic injury patients in the emergency room. 2) The readers will review the various imaging findings of heart and aortic injuries.

TABLE OF CONTENTS/OUTLINE

1. Cardiac injury 1)Pathophysiology of cardiac injury 2) Cardiac injury scale 3) Evaluation of cardiac injury: cardiac enzyme, electrocardiogram, echocardiography, chest radiograph, CT angiography, coronary CT angiography 4) Review of cases: myocardial contusion, myocardial rupture, chordal rupture, myocardial infarction secondary to coronary artery thrombosis, pericardial rupture, hemopericardium and cardiac tamponade. 2. Aortic injury 1) Pathophysiology of aortic injury 2) Grade of traumatic aortic injury 3) Evaluation of aortic injury: chest radiograph and CT angiography 4) Review of cases: intimo-mediat tear, dissection, transaction, pseudoaneurysm, chronic posttraumatic pseudoaneurysm, hemopericardium and cardiac tamponade.

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CA151-ED-X

How to Quantify the Intramyocardial Hemorrhage After Reperfusion Injury: Comparison to Various Semi-Automated Methods

All Day Room: NA Digital Education Exhibit

Participants
Hideo Arai, Chikushino, Japan (*Presenter*) Nothing to Disclose
Masateru Kawakubo, PhD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose
Kenichi Sanui, Chikushino, Japan (*Abstract Co-Author*) Nothing to Disclose
Mari Eguchi, RT, Okayama, Japan (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

Intramyocardial hemorrhage (IMH) associates with prognosis of adverse remodeling and cardiac dysfunction. Three-dimensional T1-weighted magnetic resonance (MR) imaging for IMH allows not only identification of the bleeding area but also quantification bleeding volume, taking advantage of whole heart scan area. The 2 standard deviations (2SD) method is the closest one to manually delineation for quantifying IMH.

TABLE OF CONTENTS/OUTLINE

The IMH may be caused by reperfusion therapy after serious ischemic myocardial damage. The IMH associates with prognosis of adverse remodeling and cardiac dysfunction. The 3D T1-weighted MR imaging for IMH allows not only identification of the bleeding area but also quantification bleeding volume, taking advantage of whole heart scan area. Manually delineation of bleeding signals from volumetric images is time-consuming. For clinical use of IMH imaging, an appropriate semi-automatically method should be selected from various reported methods such as standard deviation (SD), Otsu, and full width at half maximum (FWHM). Comparisons between manual and various detection methods for detecting IMH in 4 patients. The 2SD volume was the closest to manual volume. The volume (mm3) of low contrast IMH signal by manual tracing and various methods were 220, 1005, 221, 95, 6464, 5421 respectively.

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CA152-ED-X

Superiority of Systolic T1 Mapping with Saturation Recovery for Errors of Image Registration and Identification of Myocardium

All Day Room: NA Digital Education Exhibit

Participants
Hideo Arai, Chikushino, Japan (*Presenter*) Nothing to Disclose
Masateru Kawakubo, PhD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose
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Toshiaki Kadokami, Chikushino, Japan (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

Diastolic T1 mapping with magnetic resonance imaging (MRI) which acquired from multiple heartbeats data causes errors for image registration. Setting a region of interest (ROI) in diastolic T1 mapping induces the misidentify the regions of lung, blood and edge as myocardium. Systolic T1 mapping with SR can solve these clinical issues and provide accurately myocardial T1 value.

TABLE OF CONTENTS/OUTLINE

Generally, the T1 mapping with MRI which acquired from multiple heartbeats data causes errors for image registration. Furthermore, the T1 mapping has acquired in diastolic phase which was the thinnest myocardium. Setting a ROI in diastolic T1 mapping is more difficult than in systolic T1 mapping. Because too much thin myocardium induces the misidentify the regions of lung, blood and edge as myocardium. Systolic T1 mapping with SR can solve these clinical issues and provide accurately myocardial T1 value. In the case of thinned myocardium with diabetes mellitus (DM), the lateral myocardial T1 value with diastolic T1 mapping is too longer than systolic T1 mapping with SR due to the misidentification of myocardium region (1969±162 ms vs 1757±199 ms). Systolic T1 mapping may be applicable to the thin myocardium of the right ventricle with the appropriate setting of ROI (systole: 1725±121 ms, diastole: 2083±91 ms).

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CA153-ED-X

The (He)art of Diagnosing Complex Cardiac Cases: Case Based Quiz for Residents

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

Participants
Vinit Baliyan, MBBS, MD, Boston, MA (*Presenter*) Nothing to Disclose
Theodore T. Pierce, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Gabriela Spilberg, MD, Brookline, MA (*Abstract Co-Author*) Nothing to Disclose
Jennifer F. Feneis, MD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
Brian B. Ghoshhajra, MD, Waban, MA (*Abstract Co-Author*) Research Grant, Siemens Healthcare USA;
Sandeep S. Hedgire, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

• Cardiac imaging often does not get the full attention of every resident due to vast and busy radiology curriculum and variable access to subspecialty rotation across the country and world. • Cardiac Imaging is not only important subject from clinical stand point but it is also among frequently tested areas on the boards. • This exhibit includes interesting cardiac cases presented in a quiz format as a primer for residents.

TABLE OF CONTENTS/OUTLINE

In this section we present 20 interesting cases in a quiz format. The quiz test following cases- 1. Congenital anomalies- ALCAPA, anomalous coronary origin and course, anatomical central venous variants 2. Coronary artery disease- CADRADS grading system and coronary territory identification. Identification of myocardial infarct on cine images and LGE. 3. MRI identification of common cardiomyopathies- Hypertrophic cardiomyopathy, Amyloidosis, Sarcoidosis, Takotsubo cardiomyopathy 4. Cardiac masses- Thrombus, caseous mitral annular calcification, benign neoplasm (myxoma, fibroelastoma), malignant neoplasm (melanoma metastasis). 5. New cardiac devices- Cardiomems, EMBLEM 6. Classic radiographs- Pneumomediastinum, Constrictive pericarditis 7. Miscellaneous- Carcinoid heart, endocardial fibroelastosis Brief literature review will be provided for each case with key references.

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CA154-ED-X

Optimization of One-beat 256 Row Detector Coronary CT Angiography Using Low Contrast Media Protocols in Patients with Free Breathing under Automatic Tube Voltage Selection

All Day Room: NA Digital Education Exhibit

Participants
Le Cao, Xian, China (*Presenter*) Nothing to Disclose
Xiang Liu, Xian, China (*Abstract Co-Author*) Nothing to Disclose
Delong Wang, Xian, China (*Abstract Co-Author*) Nothing to Disclose
Yilei Shi, Xian, China (*Abstract Co-Author*) Nothing to Disclose
Jianxin Guo, Xian, China (*Abstract Co-Author*) Nothing to Disclose
Jian Yang, Xian, China (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

1)To illustrate the limitations of Coronary CT Angiography in conventional CT imaging. 2)To illustrate novel techniques and approaches for reducing these disadvantages in CCTA. 3) To demonstrate strategies of selecting the optimal scan mode and low Contrast Media Protocols.

TABLE OF CONTENTS/OUTLINE

1) Standard CT imaging and its limitations ·Fixed tube voltage of 120kVp with mA modulation and helical scanning mode ·The scan failure when patients Breath-hold failure and Heart rate variability ·Fixed higher contrast medium (CM) dose for adequate enhancement 2) Advanced CT imaging technologies · kV Assist , smart mA and Adaptive Statistical Iterative Reconstruction-V · 160mm detector,One-beat and high time resolution · Individual contrast injection protocol to improve contrast uniformity 3) Optimal strategies using these technologies ·Patient size and clinical tasks-dependent kV Assist ,smart mA and optimal Asir-v selection ·Free breathing in patients with unlimited heart rates ·Low Contrast Media

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CA155-ED-X

Cardiac Image Analysis with Deep Learning Methods

All Day Room: NA Digital Education Exhibit

Participants
Aliasghar Mortazi, MSc, Orlando, FL (*Presenter*) Nothing to Disclose
Georgios Z. Papadakis, MD,PhD, Heraklion, Greece (*Abstract Co-Author*) Nothing to Disclose
Uygar Teomete, MD, Coral Gables, FL (*Abstract Co-Author*) Nothing to Disclose
Ulas Bagci, PhD, MSc, Orlando, FL (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

1) They will be famiiar with novel deep learning approaches 2) They learn about application of deep learning methods in cardiac image analysis 3) Challenges and problems for medical image analysis with using deep learning will be discussed

TABLE OF CONTENTS/OUTLINE

1) Deep-learning methods: -2D/3D CNN -Densely Connected CNN -Unet Densely Connected CNN -Recurrent Neural Network -Generative Adversarial Networks -Reinforcement Learning -CapsuleNet 2) Left Ventricle Analysis: -LV segmentation from myocardial infarct MRI -Automatic Localization of LV in cardiac MRI -Tracking LV endocardium in ultrasound images -LV segmentation from ultrasound -Ejection fraction measurement -ES and ED recognition 3) Myocardium Analysis: -Coronary artery stenosis detection in coronary CT angiography -Measuring wall thickness of myocardium 4) Right Ventricle Analysis: -ARVD detection Measuring -RV volume in cine-MRI 5) Left Atrium & Pulmonary Veins: -Structural analysis of LA and PPVs -Measuring LA wall thickness 6) Coronary Arteries (CA): -CA calcium segmentation -CA segmentation from CT images -Tissue classification of CA 8) Challenges in deep learning for cardiac image analysis Disease diversity, Data scarcity, annotation, motion correctness, data augmentation, optimum architecture 9) Effectiveness of deep learning in future of cardiac image analysis

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CA157-ED-X

Cardiac MR Mapping: Diagnostic Strategy in Clinical Practice

All Day Room: NA Digital Education Exhibit

Awards
Certificate of Merit

Participants
Sanghee Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Kyongmin S. Beck, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

1. To learn a basis for a novel algorithm of diagnosis in cardiomyopathy using a complementary assessment of diffuse and regional disease by CMR myocardial mapping. 2. To achieve familiarity and confidence through practicing the various clinical cases with the quiz.

TABLE OF CONTENTS/OUTLINE

The cases will be presented in a quiz format. Diagnostic strategy and key differential points will be highlighted in the discussion of each case. The list of cases includes: Dilated cardiomyopathy with LGE vs Dilated cardiomyopathy without LGE Amyloidosis Fabry's disease Iron overload Myocarditis Eosinophilic myocarditis Chronic rejection of heart transplantation lymphoma Stress-induced cardiomyopathy Uremic cardiomyopathy Hypertensive heart

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CA158-ED-X

Anatomy Halved with Complexity Doubled: Imaging Congenital Heart Disease with Univentricular Physiology

All Day Room: NA Digital Education Exhibit

Participants
Natasha Panwar, Boston, MA (*Presenter*) Nothing to Disclose
Vinit Baliyan, MBBS, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Hamed Kordbacheh, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Sachin S. Saboo, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Sandeep S. Hedgire, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

• Univentricular physiology is often encountered in adult congenital heart disease. • Given the complexity of anatomy and flow dynamics, they can be challenging both in terms of image acquisition and interpretation. • We present a simplified educational exhibit on how to approach univentricular physiology in adult congenital heart disease.

TABLE OF CONTENTS/OUTLINE

• Learning the background- 3-staged Norwood procedure in univentricular physiology (hypoplastic left/right heart). • Common complications after univentricular palliation- o Elevated central venous pressure- Veno-venous collaterals, congestive hepatopathy, protein losing enteropathy o Slow/passive non-pulsatile flow central venous and pulmonic arterial circulation- Thrombosis o Mechanical issues- Valve leaks (systemic tricuspid regurgitation), Pump failure (systemic right ventricular failure) • How to image the univentricular heart- Simplified CT and MR angiography protocols • Illustrations to show anatomy and complications.

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CA159-ED-X

Anatomic Considerations and Imaging of Mitral Valve Disease: Pertinent Imaging for Pre-Surgical Planning

All Day Room: NA Digital Education Exhibit

FDA Discussions may include off-label uses.

Participants
Rex M. Holliday, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose
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Matthew T. Grove, MD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose
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Carlos Andres Rojas, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Andrew Bowman, MD, PhD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose
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Brian Shapiro, MD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

Objectives: - Discuss the pertinent anatomic considerations of the mitral valve apparatus. - Recognize the imaging findings on CTA of Barlow's disease, flail mitral valve and ruptured chordae tendineae. - Understand the Pertinent CTA imaging findings needed for pre-surgical planning of mitral valve repair.

TABLE OF CONTENTS/OUTLINE

Discussion of Mitral valve anatomy: Understanding the anatomy of the mitral valve apparatus is essential for imaging of the mitral valve for pre-surgical planning: Mitral valve Apparatus Anatomy and Mitral Valve Leaflet Anatomy and Function. Myxomatous and Degenerative change of the Mitral Valve Mitral. Valve Regurgitation Mitral Valve Prolapse and Flail. Pre-Surgical and Surgical Considerations.

ED002-SU

Cardiac Sunday Case of the Day

Sunday, Nov. 25 7:00AM - 11:59PM Room: Case of Day, Learning Center

AMA PRA Category 1 Credit ™: .50

Participants
Suhny Abbara, MD, Dallas, TX (*Presenter*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Sachin S. Saboo, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Fernando U. Kay, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Dhiraj Baruah, MD, Milwaukee, WI (*Abstract Co-Author*) Educator, Boehringer Ingelheim GmbH;
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Carlos S. Restrepo, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Kaushik S. Shahir, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Ameya J. Baxi, MBBS,DMRD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Jinglei Li, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Harold Goerne, MD, Zapopan, Mexico (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

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

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SSA03

Science Session with Keynote: Cardiac (Coronary CTA: Flow and Fractional Flow Reserve)

Sunday, Nov. 25 10:45AM - 12:15PM Room: S404AB

CA CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants

Belinda D'Souza, MD, New York, NY (*Moderator*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (*Moderator*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; Consultant, General Electric Company; Consultant, HeartFlow, Inc; Consultant, Bayer AG; Consultant, Siemens AG; ; ;
Bernd J. Wintersperger, MD, Toronto, ON (*Moderator*) Speaker, Siemens AG; Research support, Siemens AG; Institutional research agreement, Siemens AG; Speaker, Bayer AG

Sub-Events

SSA03-01 The Relationship of Coronary Endothelial Shear Stress (ESS) at Baseline and Hyperemia, and Its Association to Invasive Fractional Flow Reserve (FFR) and Computed Tomography Angiography FFR (CT-FFR)

Sunday, Nov. 25 10:45AM - 10:55AM Room: S404AB

Awards
Trainee Research Prize - Medical Student

Participants
Anji Tang, Boston, MA (*Presenter*) Nothing to Disclose
Andreas Giannopoulos, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose
Frank J. Rybicki III, MD, PhD, Ottawa, ON (*Abstract Co-Author*) Medical Director, Imagia Cybernetics Inc
Dimitris Mitsouras, PhD, Boston, MA (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation;

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PURPOSE

Low baseline ESS promotes development of high-risk plaque features. High ESS in one CTA-based hyperemic simulation technology (Heartflow FFRCT) was also recently shown to predict invasive FFR<=0.8. We determined the relationship of resting to hyperemic ESS using non-proprietary CTA-based rest/stress simulation algorithms, and whether flow state affects the ability of ESS to predict FFR<=0.8. Neither of these relationships have been previously assessed for data derived entirely from CTA.

METHOD AND MATERIALS

Computational fluid dynamics (CFD) was performed for 63 adults from CTA prior (<90d) to invasive FFR. Rest-state CFD used only CTA data (myocardial mass, Murray's law). Stress CFD coupled the epicardial arteries to a microvascular resistance model using 1/4 the resistance values obtained by the rest CFD. Only commercial CTA segmentation and CFD software was used. Rest and stress ESS at relevant locations (eg, coronary segments, across lesion, min lumen diameter, every 3 mm, min/max ESS) were compared (t-test) between FFR<=0.8 vs >0.8 vessels. Receiver operating characteristic area-under-the-curve (AUC) to predict FFR<=0.8 in all vessels was compared for diameter stenosis (%DS) and plaque volume (%PV) by CTA, CT-FFR, and rest and stress ESS.

RESULTS

In vessels where CT-FFR differed <0.05 from FFR (ie, stress CFD matched the patient's true hyperemic conditions), most ESS metrics differed significantly for FFR<=0.8 vs >0.8 vessels, eg lesion rest ESS=4.2 vs 1.9 Pa (p=0.012) and stress ESS=17.0 vs 9.6 (p=0.001), or, maximum ESS (rest: 9.5 vs 4.1, p=0.001; stress: 37.0 vs 19.6, p<0.001). Notably, the minimum ESS did not differ for FFR<=0.8 vs >0.8 vessels (rest p=0.184, stress p=0.454), but the location of minimum ESS differed in 31 of 40 vessels between rest and stress. AUC to detect FFR<=0.8 was 0.57 for CTA %DS, 0.74 for %PV, 0.9 for CT-FFR, and 0.86 for rest and 0.85 for stress ESS across the lesion. The AUC of rest and stress ESS was not inferior to that of CT-FFR (p=0.446); CT-FFR statistically significantly improved only upon the AUC of %PV.

CONCLUSION

High ESS across a lesion at either baseline or hyperemia is associated with lesion-specific ischemia, and both have similar diagnostic accuracy as CT-FFR to detect FFR<=0.8. Low ESS regions differ between rest and stress.

CLINICAL RELEVANCE/APPLICATION

ESS from CTA can detect lesion-specific ischemia similarly to CT-FFR, with or without the need to simulate hyperemia.

Honored Educators

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SSA03-02 Comparison Between Stress Cardiac Computed Tomography Perfusion versus Fractional Flow Reserve CT Derived in the Evaluation of Suspected Coronary Artery Disease: PERFECTION Prospective Study

Sunday, Nov. 25 10:55AM - 11:05AM Room: S404AB

Participants
Andrea Baggiano, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Margherita Soldi, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Giuseppe Muscogiuri, MD, Charleston, SC (*Presenter*) Nothing to Disclose
Andrea Guaricci, MD, Foggia, Italy (*Abstract Co-Author*) Nothing to Disclose
Marco Guglielmo, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Daniele Andreini, MD, Milan, Italy (*Abstract Co-Author*) Consultant, General Electric Company
Saima Mushtaq, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Edoardo Conte, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Andrea D. Annoni, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Maria E. Mancini, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Alberto Formenti, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Mauro Pepi, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Gianluca Pontone, MD, Milan, Italy (*Abstract Co-Author*) Speakers Bureau, General Electric Company Consultant, General Electric Company Research Consultant, HeartFlow, Inc Speakers Bureau, HeartFlow, Inc Speakers Bureau, Medtronic plc Speakers Bureau, Bayer AG

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PURPOSE

The PERFECTION study is a longitudinal, prospective and consecutive cohort study to compare the feasibility and accuracy of FFRCT versus stress-CTP for the diagnosis of functionally significant CAD.

METHOD AND MATERIALS

One-hundred-forty-seven consecutive symptomatic patients (Mean age: 65.8±9.2; Male: 105) for chest pain who were referred for non-emergent, clinically indicated ICA plus invasive FFR were enrolled. The primary endpoint was to compare the diagnostic accuracy of cCTA versus cCTA+FFRCT versus cCTA+stress-CTP for the detection of significant CAD in a vessel and patients-based analysis defined by ICA with an invasive FFR <= 0.80 or coronary artery stenoses >= 80% or totally occluded vessels.

RESULTS

Rest cCTA was successfully performed in all patients, FFRCT was performed in 143 out of 147 patients and stress-CTP was performed in 144 out of 147 patients. cCTA demonstrated a vessel and patient-based sensitivity (SE), specificity (SP), negative predictive value (NPV), positive predictive value (PPV) and diagnostic accuracy (ACC) of 99%, 76%, 100%, 61%, 82% and 95%, 54%, 94%, 63%, 74%, respectively. The diagnostic performance of integrated protocol of rest cCTA+FFRCT showed a vessel and patient-based SE, SP, NPV, PPV and ACC of 88%, 94%, 95%, 84%, 92% and 90%, 85%, 92%, 83%, 87%, respectively. Finally, the diagnostic performance of integrated protocol of rest cCTA+stress-CTP showed a vessel and patient based SE, SP, NPV, PPV and ACC of 92%, 95%, 97%, 87%, 94% and 98%, 87%, 99%, 86%, 92%, respectively. Both FFRCT and stress-CTP significantly improved SP, PPV and overall ACC in both per-vessel and per-patient based model when added to cCTA, while no differences were found between cCTA+FFRCT versus cCTA+stress CTP.

CONCLUSION

Both FFRCT and stress-CTP are valid tool in addition to cCTA to evaluate the functional relevance of CAD. Based on these results, in patients with suspected CAD, cCTA alone or with integrated FFRCT might be sufficient to exclude relevant stenosis with the advantage to require a single acquisition with a low radiation exposure and low amount of contrast agent. Nevertheless, it might be reasonable to combine stress-CTP data in some patients with positive integrated cCTA+FFRCT exam thanks to the better specificity.

CLINICAL RELEVANCE/APPLICATION

FFRCT and CTP in addition to cCTA can be helpful to evaluate the functional relevance of CAD

SSA03-03 CT Myocardial Perfusion Imaging and CT Angiography-Derived Coronary Fractional Flow Reserve for the Prediction of Major Adverse Cardiac Events in Patients with Coronary Artery Disease

Sunday, Nov. 25 11:05AM - 11:15AM Room: S404AB

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PURPOSE

To determine the prognostic value of dynamic CT perfusion imaging (CTMPI) and CT coronary angiography (CCTA)-derived fractional flow reserve (CT-FFR) for the prediction of major adverse cardiac events (MACE).

METHOD AND MATERIALS

Data was included from four institutions using patients who underwent CCTA and stress dynamic CTMPI on a 3rd generation dual-source CT system with a follow up period of 18 months or until MACE occurred. On-site CT-FFR was computed for each coronary artery. Using CTMPI data, a myocardial blood flow (MBF) index was calculated, for which each vessel territory was normalized to global MBF. The lowest CT-FFR and MBF index was recorded for each patient. The prognostic value of CTA, CT-FFR, MBF index, as well as the combination of the three was evaluated for the prediction of MACE using binary logistic regression and measures of diagnostic accuracy.

RESULTS

Of the 81 total patients included, 25 (31%) experienced MACE during the follow up period. CCTA alone had an area under the curve (AUC) of 0.655 for predicting MACE, with a corresponding sensitivity and specificity of 56% and 75%, respectively. The CT-FFR AUC for the prediction of MACE was 0.703 with a sensitivity and specificity of 64% and 80%, respectively. The optimal threshold computed with the Youden index was 0.75. Dynamic CTMPI had an AUC of 0.812 using the index MBF with a sensitivity and specificity of 88% and 75%, respectively. Using the Youden index, the optimal threshold for index MBF was 0.88. In cases with a negative CTMPI and positive CT-FFR, index MBF was most predictive of outcome (83% of patients). The combination of CCTA, CT-FFR, and CTMPI resulted in an improved AUC of 0.857 compared to CT-FFR and CTMPI alone.

CONCLUSION

Combined CT-FFR and dynamic CTMPI analysis based on cardiac CT imaging is a promising approach for the prediction of MACE in patients with coronary artery disease. While both techniques individually demonstrate good diagnostic accuracy, an integrated approach using both modalities improved the diagnostic accuracy for predicting MACE.

CLINICAL RELEVANCE/APPLICATION

This study shows the benefit of a combined CT-FFR/CTMPI approach to predict MACE. The correct identification of patients at risk of MACE can improve the efficiency and cost-effectiveness of treatment.

SSA03-04 Machine Learning Based CT-FFR Integrating With Quantitative Myocardial Mass Subtended By Coronary Stenosis Outperforms Plaque Features for Predicting Hemodynamical Significance of Lesions

Sunday, Nov. 25 11:15AM - 11:25AM Room: S404AB

Participants
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PURPOSE

To study the diagnostic performance of the ratio of subtended myocardial mass to the minimal lumen diameter (MLD) at coronary computed tomographic angiography (CCTA) and machine learning based CT-FFR for differentiating functionally significant from insignificant lesions, with reference to fractional flow reserve (FFR).

METHOD AND MATERIALS

Patients who underwent both coronary CTA and FFR measurement at invasive coronary angiography (ICA) within 2 weeks were retrospectively included in our study. CT-FFR, subtended myocardial mass (V sub), percentage of V sub, V ratio/MLD, along with other parameters, including minimal luminal area (MLA), MLD, lesion length (LL), diameter stenosis, area stenosis, plaque burden, and remodeling index, low attenuation plaque, napkin-ring sign, spotty calcification of lesions were recorded. Lesions with FFR <= 0.8 were considered to be functionally significant.

RESULTS

One hundred and seventy-two patients with 196 lesions were ultimately included for analysis. The LL, diameter stenosis, area stenosis, plaque burden, V sub , V ratio and V ratio/MLD were all significantly longer or larger in the group of FFR <= 0.8 ($p < 0.001$ for all), while smaller MLA, MLD and CT-FFR value were also noted ($p < 0.001$ for all). There were no significant differences between the hemodynamic significant subgroup and insignificant subgroup with respect to the risky plaque features The area under the curve (AUC) of V ratio/MLD was comparable to that of CT-FFR (AUC=0.84 vs 0.88; p=0.28) and was significantly better than other parameters and for diagnosing functionally significant stenosis. For vessels with CT-FFR values below 0.70, 0.70 to 0.79, 0.80 to 0.89, and above 0.89, diagnostic accuracy of CT-FFR was 92.6%(25/27), 61.8%(34/55), 83.9%(47/56), 94.8%(55/58), respectively. For lesions with CT-FFR values ranging from 0.70 to 0.79, the accuracy could be improved to 80.0% (44/55) if these lesions were evaluated with Vratio/ MLD instead of CT-FFR.

CONCLUSION

The "grey-zone" lesions, which have CT-FFR values ranging from 0.7 to 0.8, showed lower diagnostic performance. A stepwise

approach, reserving Vratio/ MLD for "grey-zone" lesions instead of CT-FFR, can improve diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

integrating ML based CT-FFR and V ratio/MLD allowed the most accurate discrimination between flow-limiting and non flow-limiting coronary lesions.

SSA03-05 Coronary Computed Tomography Angiography-Derived Fractional Flow Reserve in Anomalous Origin of the Right Coronary Artery from the Left Coronary Sinus

Sunday, Nov. 25 11:25AM - 11:35AM Room: S404AB

Participants
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PURPOSE

To examine fractional flow reserve derived from computed tomographic angiography (FFRCT) in patients with anomalous origin of the right coronary artery from the left coronary sinus with interarterial courses (AORLIC), its relationship with patient demographics, anatomical features of AORLIC on coronary computed tomographic angiography (CCTA) images, and its clinical relevance.

METHOD AND MATERIALS

Ninety-four patients with AORLIC who underwent CCTA were retrospectively included. Anatomic features (including RCA ostium location relationship with the pulmonary valve [high or low interarterial courses], takeoff angle, degree of stenosis, etc.) associated with abnormal FFRCT values (<0.8) on CCTA were analyzed. Patient demographics and anatomical data were analyzed using binary logistic regression analysis. Receiver operating characteristic analyses were performed to describe the diagnostic performance in detecting AORLIC with normal or abnormal FFRCT values.

RESULTS

Compared to patients with normal FFRCT values, more patients with high interarterial courses and greater proximal RCA stenosis were found to have abnormal FFRCT values (all P < 0.05). AORLIC with high interarterial courses was found to be the main contributor to abnormal FFRCT values (odds ratios =4.61, 95% confidence interval [CI], 1.51-14.08; P=0.007). The corresponding sensitivity and specificity for predicting abnormal FFRCT were 57.4% and 76.6%, respectively (area under the curve=0.670, 95% CI: 0.560-0.781). AORLIC patients with abnormal FFRCT values showed a higher prevalence of typical angina (19.1% vs 4.3%, P=0.025) and atypical angina (23.4% vs 6.4%, P=0.026) compared to patients with normal FFRCT values.

CONCLUSION

AORLIC patients with abnormal FFRCT values have a higher prevalence of high interarterial courses, typical angina, and atypical angina than patients with normal FFRCT values.

CLINICAL RELEVANCE/APPLICATION

Patients with AORLHIC were more likely to have abnormal FFRCT, showing a higher prevalence of typical angina and atypical angina compared to patients with normal FFRCT values. Thus, this noninvasive FFRCT method may have potential to identify patients at risk for sudden cardiac death.

SSA03-06 Building-Block-Based 3D Deep Learning: Fully Automated Estimation of Fractional Flow Reserve from Coronary CT Angiography

Sunday, Nov. 25 11:35AM - 11:45AM Room: S404AB

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PURPOSE

To evaluate the accuracy of a building-block-based fully automated 3D deep-learning model for estimating fractional flow reserve

(FFR) from whole coronary CT angiography (CCTA) data, with catheter FFR as the reference standard.

METHOD AND MATERIALS

This HIPAA-compliant, IRB-approved retrospective study of 1052 consecutive patients (mean age, 63 ± 17 years) included 131 patients whose CCTA studies showed 30%-90% stenosis in at least one segment and underwent catheter FFR, and 921 patients who underwent clinically indicated CCTA without catheter FFR. We designed a fully automated building-block-based 3D deep-learning model that inputs whole CCTA data and outputs FFR without requiring any manual segmentations. The model was trained with all 1052 CCTAs. The model comprised lumen extraction, residual extraction, and prediction blocks. In the first and second blocks, a conditional generative adversarial network and a 3D convolutional ladder network, respectively, were used to extract specific features from the CCTA by eliminating image inputs less related to FFR estimation. The prediction block estimated FFR via two independent neural networks with integrated virtual adversarial training and a self-consistency check to reduce overfitting. We used Monte Carlo cross-validation to evaluate the accuracy of the deep-learning model for estimating FFR, with catheter FFR as the reference standard.

RESULTS

Abnormal catheter FFR values (<=0.8) were observed in 55% of the labeled data (72/131). The deep-learning FFR achieved area under the curve (AUC) of the receiver-operating curve of 0.72 for detection of abnormal FFR, which is significantly higher than for CTA > 50% stenosis (AUC = 0.56). The deep-learning FFR model achieved 76% accuracy for detecting abnormal FFR, with sensitivity of 86.2% (95%CI: 80.5%-90.7%) and specificity of 61.2% (52.4%-69.5%).

CONCLUSION

The building-block-based 3D deep-learning model, performing fully automatic estimation of FFR from whole cardiac CT data, achieved accuracy of 76% for the detection of abnormal FFR.

CLINICAL RELEVANCE/APPLICATION

Our deep-learning model estimates FFR without time-consuming vessel segmentation and may greatly improve the clinical workflow when selecting patients suitable for revascularization procedures.

SSA03-07 Prediction of Lesion-Specific Ischemia from Machine Learning-Derived Fractional Flow Reserve

Sunday, Nov. 25 11:45AM - 11:55AM Room: S404AB

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PURPOSE

This study evaluate the diagnostic performances of machine learning-based model for predicting fractional flow reserve (ML-FFR) and computed tomography (CT) derived-FFR (CT-FFR) in patients with coronary artery diseases with reference standard of invasive FFR.

METHOD AND MATERIALS

In 472 patients with coronary artery diseases, CT angiography (CTA) and invasive coronary angiography were performed with FFR in 555 lesions. CTA data were visually analyzed to evaluate the location, stenosis degrees and plaque types, and analyzed by semi-automated software to quantify computational fluid dynamics (CFD)-based CT-derived FFR. The trained ML-FFR at each point along the centerline of the coronary tree, was obtained by automated feature selection and model building from quantitative CTA. Correlation between CT-FFR and ML-FFR was obtained. The diagnostic performance of CFD-based CT-FFR and ML-FFR were compared using invasive FFR as reference standard.

RESULTS

A total of 270 lesions showed ischemia by invasive FFR (FFR <= 0.80). The correlation between CFD-based CT-FFR and ML-FFR was high (r= 0.60 - 0.99, P<0.001). CT-FFR showed moderate to high sensitivity and specificity for all lesions including left main, left anterior descending, left circumflex and right coronary arteries (Sensitivity: 55.4 - 83.3; specificity 65.1 - 73.9). For intermediate (visual stenosis grading 30-80%) lesions and tandem lesions, moderate sensitivity and specificity were observed (sensitivity: 65.1 and 62.5; specificity: 70.7 and 58.0, respectively). ML-FFR showed comparable results to CT-FFR for all lesions (Sensitivity: 57.1 - 83.3; specificity 66.5 - 77.3), and also in intermediate or tandem lesions (sensitivity: 65.1 and 62.5; specificity: 71.3 and 59.1, respectively). Compared with the CFD-based CT-FFR, the time to perform ML-FFR was shortened to a few seconds.

CONCLUSION

ML-FFR showed comparable results to CFD-based CT-FFR for the prediction of lesion-specific ischemia confirmed by invasive FFR.

CLINICAL RELEVANCE/APPLICATION

ML-FFR can be used as additional information after obtaining CTA for evaluation of coronary artery stenosis with equivalent diagnostic performance of CFD-based CT-FFR.

SSA03-08 Cardiac Keynote Speaker: Value of CTA for Fractional Flow Reserve

Sunday, Nov. 25 11:55AM - 12:15PM Room: S404AB

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SSA04

Science Session with Keynote: Cardiac (Nonischemic Cardiomyopathies)

Sunday, Nov. 25 10:45AM - 12:15PM Room: S404CD

CA MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

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Sub-Events

SSA04-01 Cardiac Keynote Speaker: Prognostic Role of MR Imaging in Nonischemic Myocardial Disease

Sunday, Nov. 25 10:45AM - 11:05AM Room: S404CD

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SSA04-03 Prevalence, CMR Characteristics, and Outcomes of Hypertrophic Cardiomyopathy with Restrictive Phenotype

Sunday, Nov. 25 11:05AM - 11:15AM Room: S404CD

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PURPOSE

Previous reports indicated that there was a subgroup of HCM with restrictive phenotype, which was defined by restrictive filling and reduced diastolic volumes. However, the CMR characteristics and prognosis of the restrictive phenotype has not been systematically investigated. The aim of this project was to investigate the prevalence, clinical significance, CMR characteristics and outcomes of hypertrophic cardiomyopathy (HCM) with restrictive phenotype .

METHOD AND MATERIALS

A total of 2892 consecutive patients with HCM were evaluated to identify individuals who fulfilled diagnostic criteria for restrictive phenotype. 32 patients of HCM with restrictive phenotype and 32 age and gender matched patients with typical non obstructive HCM were retrospectively enrolled.

RESULTS

The left and right atrium diameter were 55.4±4.8 mm and 61.4±8.7 mm, which were significantly larger than those of the controls ($p<0.001$); The left ventricular end-diastolic volume index, the cardiac index, and the left heart ejection fraction of patients with restrictive phenotype were all significantly less than those of the controls. The segments with late gadolinium enhancement(LGE) were 7.8±2.4 in restrictive phenotype group, which were significantly greater than controls (4.6±2.3, $p=0.004$). The 62-month survival rate was 54.1% in HCM with restrictive phenotype, compared with 91.7% in control group.

CONCLUSION

Restrictive phenotype is a special subtype of HCM. The MR features of this phenotype include mild-to-moderate left ventricular hypertrophy, severely enlarged atria, normal or small ventricles, pericardial effusion and a wide range of LGE. These patients have severe clinical symptoms and poor prognosis. MRI shows high diagnostic value in the identification of this phenotype.

CLINICAL RELEVANCE/APPLICATION

MRI shows high diagnostic value in the identification of hypertrophic cardiomyopathy with restrictive phenotype and will help indicate patients' prognosis.

SSA04-04 The Prognostic Significance of Subclinical Myocardial Deformation for Heart Failure in End-Stage

Renal Disease

Sunday, Nov. 25 11:15AM - 11:25AM Room: S404CD

Participants
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PURPOSE

This study aimed to investigate the subclinical myocardial deformation of left ventricle (LV) in end stage renal disease (ESRD) patients by cardiac magnetic resonance (CMR) tissue tracking and explore its prediction of HF.

METHOD AND MATERIALS

Sixty-two consecutive ESRD patients with preserved LV ejection fraction (LVEF>50%) and 21 age- and sex- matched healthy volunteers were prospectively recruited and underwent 3.0T CMR examination. A series of SSFP cine sequence, including short axis, horizontal 4-chamber and vertical 2-chamber long axis were scanned. LV function variables were measured. LV myocardial strain parameters such as global peak strain (PS), peak strain rate, peak velocity indices were automatically computed. After examination, patients were followed up for a duration of 11-30 months to assess HF outcome by phone contact.

RESULTS

ESRD patients with preserved LVEF had decreased radial, circumferential and longitudinal PS compared with normal controls (42.11±12.53% vs. 48.01±11.22%, -17.89±2.73% vs. -19.67±2.23%, -15.25±2.49% vs. -17.18±2.52%; respectively, all P<0.05). After a 11-30-month follow-up, 30 of 62 patients had HF. By analyzing myocardial strain data, it showed that ESRD patients suffered from HF was already found to have lower values of PS in three directions than both normal controls and patients free from HF (all P<0.05). The global circumferential and longitudinal PS were proven to be significant risk factors of HF (OR 1.294, 1.228; 95% confidence interval 1.100-1.522, 1.035-1.457; respectively, all P<0.05). A significantly lower survival rate and higher risk of HF were displayed in patients with circumferential and longitudinal PS lower than the median value. Cut-off values of PS -18.78% for circumferential and -14.54% for longitudinal to discriminate HF outcome was identified with relatively high sensitivity and specificity (AUC of 0.840, 0.821, respectively).

CONCLUSION

CMR tissue tracking provided subclinical and prognostic information to predict HF in ESRD patients before notably decreased LVEF. LV global circumferential and longitudinal PS were demonstrated to be independent risk factors of HF in ESRD patients.

CLINICAL RELEVANCE/APPLICATION

Our study proved the ability of CMR tissue tracking parameters to provide subclinical and prognostic information to predict heart failure in ESRD patients before notably decreased LVEF which may give a guidance of appropriate and early cardiovascular treatment.

SSA04-05 Value of Fractal Analysis in Identification and Further Discrimination of Isolated Left Ventricular Non-Compaction and Dilated Cardiomyopathy by Cardiac Magnetic Resonance

Sunday, Nov. 25 11:25AM - 11:35AM Room: S404CD

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PURPOSE

The aim of this study was to compare cardiac magnetic resonance imaging (MRI) features between isolated left ventricular non-compaction (IVNC) and dilated cardiomyopathy(DCM).

METHOD AND MATERIALS

A consecutive series of 35 patients with IVNC (males,n=23) and 30 patients with DCM (males,n=21) from a tertiary university hospital were reviewed. 20 healthy volunteers (males,n=13) were selected as control group.All groups were matched for age, gender, and body surface area. The degree of LV trabeculation was evaluated by a semi-automatic tool based on fractal analysis (FA).The resulting FD is a unitless measure value of how completely the object fills space. Myocardial deformation and Left ventricular (LV) function was assessed by feature tracking.

RESULTS

IVNC group had higher max apical FD and mean global FD than DCM group (max apical FD:1.433±0.074 vs. 1.341±0.062,P < 0.001; mean global FD:1.323±0.036 vs.1.267± 0.041, p<0.001, respectively). FDs show positively correlation with the ratio of NC/C . Compared with controls, both patient groups showed significantly reduced strain and strain rate values of all LV segments. Of note,The global longitudinal strain value of the left ventricle (GPSL) was different in the IVNC group -6.49(-11.41, -4.90) and the

DCM group -4.61(-5.87, -3.61) (P < 0.01). and Left ventricular (LV) function . The diagnostic accuracy is equivalent in univariable, but the accuracy is higher when using FDs in coordination with myocardial deformation(AUC=0.93,CI 95% [0.86; 0.98], P<0.001).

CONCLUSION

Fractal analysis can measure quantitatively the extent of non-compacted myocardium of the left ventricle, and have a definite value in the identification of pathological non-compacted myocardium and normal trabeculation. Fractal dimension combined with myocardial strain is a superior predictor of distinguishing IVNC from DCM.

CLINICAL RELEVANCE/APPLICATION

(dealing with isolated ventricular non-compaction) 'Fractal analysis based on Cine MR studies has a definite value in the identification of pathological non-compacted myocardium and normal trabeculation .'

SSA04-06 Native T1 Mapping Distinguishes Patients with Arrhythmogenic Right Ventricular Cardiomyopathy from Control Subjects

Sunday, Nov. 25 11:35AM - 11:45AM Room: S404CD

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PURPOSE

Arrhythmogenic right ventricular cardiomyopathy (ARVC) is an inherited heart disease characterized by fibrofatty replacement of the myocardium. Native T1 mapping is a promising technique to quantify changes in cardiac microstructure on cardiac magnetic resonance imaging (CMR). We aimed to analyze the diagnostic value of native T1 mapping in ARVC.

METHOD AND MATERIALS

We analyzed short-axis cine 1.5 Tesla CMR images obtained using a MOLLI sequence in 51 subjects (15 ARVC patients fulfilling the 2010 diagnostic Task Force Criteria, 23 phenotype negative ARVC relatives, and 13 control subjects with right ventricular outflow tract ventricular tachycardia [RVOT VT]). Global and regional fibrosis of the left ventricle (LV) were measured as native T1 times using cvi42 (version 5.6.6, Calgary, Canada). LV segmentation was according to the 16-segment American Heart Association recommendation. We also assessed dispersion of regional T1 times, defined as the standard deviation of regional T1 times within the same patient over all analyzed segments. Diagnostic performance was assessed using ROC curve analysis.

RESULTS

Mean age was 39±17 years and 49%(25/51) were male. Mean global native T1 times were not significantly different among ARVC patients (1061±40ms p=0.085) and relatives (1053±23ms p=0.181) compared to controls (1038±27ms). However, in comparison to controls (67±12), the dispersion of regional T1 times was significantly higher in ARVC patients (91±32ms p=0.014) and relatives (77±15ms p=0.044). This was reflected in longer regional T1 times in the basal (p=0.037) and mid (p=0.013) segments in ARVC patients; and only in the basal (p=0.042) segment in relatives. More specifically, ARVC patients had longer posterolateral, inferior and anterior T1 times (p<=0.027) while relatives had longer posterolateral and inferior T1 times (p<=0.009) compared to controls. ROC analyses revealed the highest AUC for the diagnosis of ARVC using posterolateral native T1 time in both ARVC patients (AUC=0.794) and relatives (AUC=0.790).

CONCLUSION

Native T1 mapping distinguishes ARVC patients and at-risk relatives from RVOT VT controls using regional (posterolateral and inferior) T1 times.

CLINICAL RELEVANCE/APPLICATION

Early detection of ARVC is pertinent as life-threatening ventricular arrhythmias can occur. Native T1 mapping has a possible role in differentiating ARVC patient and at-risk relatives from controls.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Ihab R. Kamel, MD, PhD - 2015 Honored EducatorStefan L. Zimmerman, MD - 2012 Honored EducatorStefan L. Zimmerman, MD - 2015 Honored Educator

SSA04-07 The Study of T1-Mapping and Extracellular Volume (ECV) Quantification of Myocardial Fibrosis Caused by Iron Deposited in a Pig Model

Sunday, Nov. 25 11:45AM - 11:55AM Room: S404CD

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PURPOSE

To explore the relationship between myocardial extracellular volume(ECV) and myocardial fibrosis index--collagen volume fraction(CVF) using an iron overloaded pig model by 3T MRI.

METHOD AND MATERIALS

27 pigs underwent iron dextran loading from 1 to 15 weeks. 4 controls were studied as well. T1 values were measured using a ShMOLLI sequence at 3T. Gd-DTPA was used to enhance. Measured the T1 values of the ventricular septum and left ventricular blood pool at the short axial slices of the papillary muscle respectively at plain scan and enhanced scan at the time of 20 minutes after injecting Gd-DTPA contrast medium, then calculated the ECV. Ex vivo cardiac pathology was obtained for all pigs studied. Pathological fibrosis index-collagen volume fraction(CVF) was acquired. Postmortem assessments of cardiac iron concentration(CIC) was conducted in an atomic absorption spectrophotometer. MRI measures were fitted against CVF using linear regression for the first 22 pigs. The remaining 5 were used to test the accuracy of the derived model.

RESULTS

In the experimental pigs, as dextran iron injection increased over time, the cardiac iron content increased, and myocardial collagen fibrils increased accordingly. ECV was linearly correlated to CVF (r= 0.990) in this study at 3T. By regression, the linear equations were determined as Y=-0.010+0.467X (F=1139.33,P<0.001) (Y:CVF, X:ECV). In the 5 test pigs, the predicted CVFs using the derived equations agreed well with the results quantified by pathology.

CONCLUSION

ECV are highly correlated with CVF in a novel iron overloaded pigs model. MRI quantification of myocardial fibrosis caused by iron deposited is feasible at 3T.

CLINICAL RELEVANCE/APPLICATION

Used MRI method to assess the degree of myocardial fibrosis caused by iron deposited in iron overloaded patients and developed a reliable and noninvasive techniques to measure myocardial fibrosis.

SSA04-08 Texture Analysis of Magnetic Resonance T1 Mapping with Dilated Cardiomyopathy: A Machine Learning Approach

Sunday, Nov. 25 11:55AM - 12:05PM Room: S404CD

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PURPOSE

Diagnosis of dilated cardiomyopathy is a challenge in clinical radiology. We want to find out whether texture analysis parameters on magnetic resonance T1 mapping can be helpful for the diagnosis of dilated cardiomyopathy (DCM).

METHOD AND MATERIALS

We screened 50 dilated cardiomyopathy cases retrospectively and recruited 24 healthy controls prospectively between March 2015 and July 2017. T1 maps were acquired using Modified Look-Locker Inversion Recovery (MOLLI) sequence at 3.0 T MR scanner. Endocardium and epicardium were drawn on short-axis slices of T1 maps by an experienced radiologist. Twelve histogram parameters and five gray-level co-occurrence matrix (GLCM) features were extracted during texture analysis. Differences in texture features between DCM patients and healthy controls were evaluated by T-tests. Support vector machine (SVM) was used to calculate the diagnosis accuracy of those texture parameters.Schematic diagram of this study is shown on figure one.

RESULTS

Most histogram features were higher in DCM group as compared to healthy control, and nine of them had significant differences between DCM group and healthy control. As for GLCM features, energy, correlation, and homogeneity were higher in DCM group than that of the healthy control. Also, Entropy and contrast were lower in DCM group. Entropy, contrast, and homogeneity had significant differences between two groups. The diagnosis accuracy using SVM classifier with all those histogram features and GLCM features was 0.85±0.07.

CONCLUSION

A computer-based texture analysis and machine learning approach of T1 mapping could provide an objective tool for the diagnosis of dilated cardiomyopathy.

CLINICAL RELEVANCE/APPLICATION

Texture analysis of T1 mapping could provide an objective tool for the diagnosis of dilated cardiomyopathy.

SSA04-09 Fully Automated Diagnosis of Cardiomyopathy from Cardiac MR Imaging Using Convolutional Neural Networks

Sunday, Nov. 25 12:05PM - 12:15PM Room: S404CD

Participants
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PURPOSE

Primary cardiomyopathies are diseases of the myocardium that are characterized by remodeling of the left ventricle and impaired cardiac function. Dilated cardiomyopathy (DCM) is a leading cause of heart failure while hypertrophic cardiomyopathy (HCM) is a common cause of sudden death. Diagnosis is made on imaging criteria but relies on manual volumetric analysis of the data and requires expertise to differentiate from other conditions which mimic cardiomyopathy. Deep learning approaches have shown promise in image classification tasks, and here we designed and evaluated a convolutional neural network (CNN) for fully-automated diagnosis of cardiomyopathy in a large sample of cardiac magnetic resonance (CMR) datasets.

METHOD AND MATERIALS

The study cohort consisted of 1,069 adult participants: 311 patients with DCM, 396 patients with HCM and 362 healthy volunteers (HV) matched by gender, age and body surface area. All subjects had a conventional CMR including retrospectively-gated cine imaging. The 4-chamber cine sequence was used for analysis and passed to a 6-layer convolutional neural network implemented in TensorFlow. Five convolutional layers, with between 64 and 128 nodes, were followed by a fully-connected 128-node layer. A predicted classification was obtained from an output later with a SoftMax activation function. The model was trained over 100 epochs using a Titan X GPU. Four-fold cross validation was performed with results reported as mean accuracy.

RESULTS

All subjects were included in the analysis. Processing time per subject was approximately 2 seconds. In total 80/82 DCM, 84/97 HCM and 87/87 HV participants were correctly classified in the held-out data. Overall, 251/266 participants were correctly classified (94.3%).

CONCLUSION

Cardiomyopathy can be diagnosed with a high degree of accuracy through direct analysis of time-resolved CMR imaging using a CNN. This includes correctly excluding disease in every healthy adult. Future work will include simultaneous analysis of cine sequences in different cardiac planes and external validation of the model on an independent cohort.

CLINICAL RELEVANCE/APPLICATION

These findings demonstrate the potential of an automated method to efficiently and objectively diagnose cardiomyopathy on cardiac MRI.

SSA16

Nuclear Medicine (Chest and Cardiovascular Nuclear Imaging)

Sunday, Nov. 25 10:45AM - 12:15PM Room: S505AB

CA CH CT NM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
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Phillip J. Koo, MD, Phoenix, AZ (*Moderator*) Advisory Board, Bayer AG; Advisory Board, Johnson & Johnson; ; ; ;

Sub-Events

SSA16-01 Association Between Asynchrony and Stenoses in Apparently Normal Coronary Arteries

Sunday, Nov. 25 10:45AM - 10:55AM Room: S505AB

Participants
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PURPOSE

Left ventricular (LV) arteries are considered abnormal if stenosis > 70%, but lesser stenoses may be concerning. Our study was undertaken to determine the % of cases in which stenoses are < 70% & perfusion images suggest apparently normal (ApNl) arteries, yet myocardial flow reserve (MFR) is abnormally low, & whether PET parameters predict magnitude of stenosis.

METHOD AND MATERIALS

Data were analyzed of 105 pts evaluated by Rb-82 rest/regadenoson-stress PET/CT & arteriography, which measured % stenoses. Global ejection fractions (EFs) & regional summed stress score (SSS) & summed rest score (SRS) of relative myocardial perfusion were assessed. Rest & stress systolic & diastolic asynchrony (Asynch) was assessed by a medical imaging physicist who visually scored phase histograms & phase polar maps within a coronary territory using a 5-point scale (0 = normal to 4 = markedly asynchronous extensive territory), based on phase polar maps being out of phase from expected contraction patterns of normal pts. Absolute myocardial blood flow (MBF) was quantified from rebinned first pass dynamic transit images of the Rb-82 bolus injection through the heart chambers, with myocardial flow reserve (MFR) computed as stress-MBF/rest-MBF. ApNl arteries were defined as those with SRS < 4 & SSS < 4 & stenosis < 70%. Following convention, abnormal regional MFR was defined as < 2.0.

RESULTS

Among 315 arteries, 174 had undetectable stenosis, 72 ranged from 25-69% & 69 ranged from 70-100%. Among all arteries, 162 were ApNl with higher MFR than the other 153 arteries (2.65±1.34 versus 1.96±1.26, $p < 0.0001$). Nonetheless, 35% (56/162) of ApNl arteries had abnormally low MFR < 2.0 (mean = 1.50±0.31). For all arteries, magnitude of % stenosis was most strongly associated with magnitude of Asynch ($r = 0.50$, $p < 0.0001$), & significantly associated with stress MBF ($r = -0.25$, $p < 0.0001$), SSS ($r = 0.24$, $p < 0.0001$), SRS ($r = 0.17$, $p = 0.002$), & MFR ($r = -0.18$, $p = 0.002$). For ApNl arteries, % stenosis was associated with magnitude of Asynch ($r = 0.34$, $p < 0.0001$).

CONCLUSION

In arteries that are apparently normal by relative perfusion assessment & by conventional arteriographic criteria, MFR can nonetheless by abnormally low, with stenoses < 70% associated with regional asynchrony.

CLINICAL RELEVANCE/APPLICATION

It is advisable to measure regional MFR & regional asynchrony for pts with suspected CAD.

SSA16-02 Evaluation of Role of F-18 FDG Cardiac PET and Tc-99m Sestamibi Myocardial Perfusion Imaging in Assessing the Therapeutic Benefit in Patients with Coronary Artery Disease and Left Ventricular Systolic Dysfunction

Sunday, Nov. 25 10:55AM - 11:05AM Room: S505AB

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PURPOSE

To evaluate the therapeutic benefit with revascularization and optimal medical treatment (OMT) in patients diagnosed with hibernating myocardium on myocardial perfusion imaging (MPI) using F-18 FDG cardiac PET

METHOD AND MATERIALS

59 consecutive patients (43 males, 16 females, Mean Age 60.7 ± 9.4 years) with CAD and LV systolic dysfunction who underwent myocardial viability imaging for revascularization work-up and were diagnosed with hibernating myocardium were enrolled in this study. Patients were later treated with either revascularization or OMT and were followed for a median duration of 7.7 months for assessing the therapeutic benefit. Therapeutic benefit was assessed under 3 categories (a) Improvement in functional class (b) Adverse cardiac-events and (c) Improvement in LV function and myocardial perfusion on follow-up resting 99mTc-sestamibi myocardial perfusion imaging.

RESULTS

29 patients underwent revascularization (49%) and 25 patients received OMT (42%). Five patients were lost to follow-up. Patients were matched for baseline characteristics in both treatment arms. On follow-up, significant improvement was noted in NYHA functional class and CCS angina class post-revascularization. No such improvement was noted in the OMT group. The cardiac-event rate of patients in OMT group was significantly higher than that of patients in revascularization group (36% vs. 10.3 %; p = 0.046). At 1 year of follow-up, event-free survival in revascularization group was significantly superior compared to OMT group (83.8% vs. 50.8%; p= 0.039). On follow-up resting MPI scan, mean improvement in LVEF in revascularization group was significantly higher than in OMT group (6.0% vs. 1.4%; p=0.04).

CONCLUSION

Myocardial viability imaging is a sensitive modality to identify hibernating myocardium in patients with CAD and LV dysfunction and predicting its recovery following revascularization, thereby guiding the optimal treatment strategy for these patients.

CLINICAL RELEVANCE/APPLICATION

Myocardial viability imaging should be performed prior to revascularization in patients with coronary artery disease with left-ventricular dysfunction to help predict recovery post-treatment.

SSA16-03 A Comparative Analysis of Myocardial Perfusion on Gated SPECT versus Coronary Atherosclerosis and Calcium Score on 64-Slice CT

Sunday, Nov. 25 11:05AM - 11:15AM Room: S505AB

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PURPOSE

The aim of the current study was to compare the results of 64-slice CT and gated SPECT on a regional basis (per vessel distribution territory) in patients with known or suspected CAD.

METHOD AND MATERIALS

Three hundred and seventy five patients underwent both gated SPECT for myocardial perfusion imaging and 64-slice CT for coronary calcium scoring and coronary angiography. The coronary calcium score was determined for each coronary artery. Coronary arteries on multislice CT angiography were classified as having no CAD, insignificant stenosis (<50% luminal narrowing),significant stenosis, or total or subtotal occlusion (>90% luminal narrowing).Gated SPECT findings were classified as normal or abnormal (reversible or fixed defects) and were allocated to the territory of one of the various coronary arteries.

RESULTS

In coronary arteries with a calcium score of 10 or less, the corresponding myocardial perfusion was normal in 96 %. In coronary arteries with extensive calcifications (score > 400), the percentage of vascular territories with normal myocardial perfusion was lower, 48%. Similarly, in most of the normal coronary arteries on 64-slice CT angiography, the corresponding myocardial perfusion was normal on SPECT in >94%. In contrast, the percentage of normal SPECT findings was significantly lower in coronary arteries with obstructive lesions (<57%) or with total or subtotal occlusions (<10%) (P < 0.01). Nonetheless, only 42% of vascular territories with normal perfusion corresponded to normal coronary arteries on multislice CTangiography, whereas insignificant and significant stenosis were present in, respectively, 40% and 18% of corresponding coronary arteries.

CONCLUSION

Although a relationship exists between the severity of CAD on multislice CT and myocardial perfusion abnormalities on SPECT, analysis on a regional basis showed only moderate agreement between observed atherosclerosis and abnormal perfusion. Accordingly, 64-slice CT and gated SPECT provide complementary rather than competitive information, and further studies should address how these two modalities can be integrated to optimize patient management.

CLINICAL RELEVANCE/APPLICATION

Accordingly, 64-slice CT and gated SPECT provide complementary rather than competitive information.

SSA16-04 The Association of Carotid Plaque 18F-FDG and 18F-Naf Uptake on PET Scan with Symptomatic Carotid Artery Disease: A Systematic Review and Meta-Analysis

Sunday, Nov. 25 11:15AM - 11:25AM Room: S505AB

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PURPOSE

We sought to investigate the ability of 18F-FDG and 18F-NaF PET imaging to identify vulnerable carotid plaques and predict stroke recurrence in the setting of recent cerebrovascular accidents by performing a systematic review.

METHOD AND MATERIALS

We performed this study according to the Meta-Analysis of Observational Studies in Epidemiology (MOOSE) group and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines. We performed a systematic review of Ovid MEDLINE, Ovid EMBASE, and the Cochrane Library Databases yielding a total of 4,144 unique articles for screening after de-duplication. These were screened for peer-reviewed journal articles that examined the association between carotid plaque tracer uptake and recent or future ischemic events such as strokes, transient ischemic attacks and retinal artery embolisms. Screened articles were then adjudicated as meeting inclusion criteria by two independent readers.

RESULTS

Fourteen articles were included for subsequent analysis. Of those, 11 articles analyzed 18F-FDG uptake in recently symptomatic carotid arteries as compared to asymptomatic carotid arteries. Two of these studies analyzed 18F-NaF uptake as well. The remaining 3 articles investigated the risk of stroke recurrence associated with 18F-FDG uptake. The existing literature demonstrates significant heterogeneity in the PET protocols, reported tracer uptake metrics, and thresholds for positive uptake.

CONCLUSION

Our systematic review revealed a growing body of literature supporting 18F-FDG's utility in predicting future stroke recurrence and its modest ability in discerning symptomatic from asymptomatic carotid plaques. Additional studies are needed to elucidate the role of 18F-NaF as compared to 18F-FDG imaging. Further work is needed to define more standardized approaches for PET image acquisition and imaging analysis in order to improve the generalizability of this technique to detect high-risk carotid plaques.

CLINICAL RELEVANCE/APPLICATION

Carotid atherosclerosis is responsible for 15% of ischemic strokes. Further work is needed to investigate the utility of 18F-FDG and 18F-NaF PET imaging in detecting high-risk carotid plaques.

SSA16-05 Provider Utilization Trends for Elective Myocardial Perfusion Imaging

Sunday, Nov. 25 11:25AM - 11:35AM Room: S505AB

Participants
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PURPOSE

To analyze trends in performance of elective stress nuclear myocardial perfusion imaging (MPI) modalities in the Medicare population.

METHOD AND MATERIALS

The nationwide Medicare Part B fee-for-service databases for 2004-2016 were reviewed. CPT codes relevant to stress MPI were selected: planar and single photon emission computed tomography (SPECT), and positron emission computed tomography (PET). The databases indicate procedure volume for each code, and these were used to calculate utilization rates per 1,000 Medicare beneficiaries. Elective MPI exams were identified by using place-of-service codes for private offices and hospital outpatient departments (HOPDs). The specialty of the performing physician was determined using Medicare physician specialty codes. Because the Medicare Part B databases are complete population counts, sample statistics are not required.

RESULTS

Elective standard (STD) MPI (both planar imaging and SPECT) utilization peaked in 2006 at 74 studies per 1,000 beneficiaries and then progressively decreased to 45 by 2016 (-36%). In 2004, cardiologists' share of elective STD MPI had been 79%, and this steadily increased in subsequent years to 87% in 2016. Cardiologists perform elective STD MPI mostly in private offices where

utilization peaked in 2008 at 50 studies per 1,000 and then declined to 22 in 2016 (-56%). In HOPDs, utilization by cardiologists has increased over the period of the study from 7 studies to 15 (+120%). Utilization in private offices and HOPDs by radiologists has declined from 13 in 2004 to 6 in 2016 (-58%). Elective PET MPI, less frequently used at 3 studies per 1,000 in 2016, maintained an overall net upward trend since 2005, and most of this growth reflected increasing use by cardiologists (90% share in 2016).

CONCLUSION

In the Medicare population, the overall use of elective STD MPI is declining, however cardiologists are performing an increasing market share in the outpatient setting. A shift in place-of-service has been noted with fewer studies performed in private offices and increasing numbers performed in HOPDs. PET MPI utilization, while still not widespread, has grown over the period of the study, reflecting an increasing use by cardiologists.

CLINICAL RELEVANCE/APPLICATION

Cardiologists maintain an increasing share in utilization of elective standard and PET MPI.

SSA16-06 Medium and Large Vessel Vasculitis: Recognizing Patterns on FDG PET-CT

Sunday, Nov. 25 11:35AM - 11:45AM Room: S505AB

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PURPOSE

The diagnosis of medium to large-vessel vasculitis and the assessment of its activity and extent remain challenging. We assess the clinical utility of FDG PET CT in patients with suspected medium and large vessel vasculitis to evaluate the pattern and extent of vessel involvement.

METHOD AND MATERIALS

100 consecutive patients (64 males and 36 females) with suspected medium and large-vessel vasculitis were evaluated with FDG PET/CT. FDG uptake in the major vessels was visually graded using a four-point scale and quantified with standardised uptake values (SUV max). Patients were further sub-divided into three groups: (a) steroid-naive medium to large-vessel vasculitis (N=34, 69% of total positive patients), (b) vasculitis on steroid treatment (N=15, 30.6% of total positive patients) and (c) no evidence of vasculitis (N=51). Analysis of variance and linear regression were used to investigate the association of FDG uptake with clinical parameters.

RESULTS

FDG-PET revealed pathological findings in 49 of 100 patients. FDG PET/CT was positive (visual uptake >2; equal to or greater than liver) in all patients with steroid-naive medium to large-vessel vasculitis. The thoracic aorta, the carotid and the subclavian arteries were most frequently involved. In these patients, SUVmax values were significantly higher than in the other groups.

CONCLUSION

FDG PET is a sensitive and specific imaging tool for medium and large vessel vasculitis, especially when performed in steroid naive patients. It increases the overall diagnostic accuracy and has an impact on the clinical management in a significant proportion of patients.

CLINICAL RELEVANCE/APPLICATION

FDG-PET should be used in diagnosis and characterisation of medium and large vessel vasculitis to determine optimal treatment methodologies.

SSA16-07 Assessing the Feasibility of 18F-Naf PET/CT to Detect the Atherosclerotic Calcification of Aortic Wall in Rheumatoid Arthritis Patients

Sunday, Nov. 25 11:45AM - 11:55AM Room: S505AB

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PURPOSE

Rheumatoid arthritis (RA) has long been associated with increased risk for atherosclerosis. 18F-sodium fluoride (NaF) is a PET tracer that detects calcium deposition in the early stages of atherosclerotic plaque formation. We aimed to assess whether NaF-PET/CT can sensitively discriminate aorta calcification between RA patients and normal subjects.

METHOD AND MATERIALS

Fifteen RA patients (11 men, 4 women; mean age 53.8±10.8 y, range 25-64) and fifteen healthy controls (11 men, 4 women; mean age 53.5±11.2 y, range 25-64) were included in this study. Controls were matched to patients by sex and age (±5 years). All subjects in this study underwent NaF-PET/CT scanning 90 minutes after NaF tracer administration. Using OsiriX software, regions of interest were manually drawn around the abdominal aorta wall starting superiorly with the first axial slice containing the left kidney, ending with the last slice before the aortic bifurcation. The global mean standardized uptake value (global SUVmean) was obtained and compared between RA patients and healthy subjects. An unpaired t-test assessed the difference in means of RA group and controls, and a ROC analysis assessed discrimination.

RESULTS

The global SUVmean of RA patients ranged from 0.88 to 2.35, and from 0.79 to 1.47 in healthy controls. Furthermore, average global SUVmean scores among RA patients was significantly greater than that of healthy controls. (1.62±0.49 and 1.04±0.16, respectively, $P<0.01$). ROC analysis revealed fair discrimination between the two groups (AUC = 0.77).

CONCLUSION

Our findings indicate that global assessment with NaF-PET/CT is a feasible technique to detect active vascular calcification in the abdominal aorta. Discriminant validity was observed by assessing a known co-morbidity of RA and comparing RA to non-RA. Further studies are needed to validate this technique to diagnose and monitor patients at high risk for atherosclerosis.

CLINICAL RELEVANCE/APPLICATION

Global assessment with NaF-PET/CT can determine the degree of active vascular calcification, which can help diagnose, monitor, and assess treatment response in atherosclerosis.

SSA16-08 F-18 FLT PET/CT for Therapeutic Monitoring in Patients with Cardiac Sarcoidosis: Comparison with F-18 FDG PET/CT

Sunday, Nov. 25 11:55AM - 12:05PM Room: S505AB

Participants
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PURPOSE

F-18 fluorodeoxyglucose (FDG) PET has been used in sarcoidosis including cardiac involvement for therapeutic monitoring. However, it can be challenging because it accumulates physiologically in normal myocardium. The purpose of this study was to evaluate the ability of F-18 fluorothymidine (FLT) PET for therapeutic monitoring in patients with cardiac sarcoidosis, in comparison with FDG.

METHOD AND MATERIALS

FLT and FDG PET/CT studies were performed before and after immunosuppressive therapy in 6 patients with newly diagnosed cardiac sarcoidosis. The patients had fasted for at least 18 h before FDG PET/CT, but were given no special dietary instructions before FLT PET/CT. Uptake of FLT and FDG was examined visually and semiquantitatively using maximal standardized uptake value (SUV).

RESULTS

Before therapy, all patients had both cardiac and extra-cardiac thoracic sarcoidosis. Fifteen lesions in cardiac region and 22 lesions in extra-cardiac region were visually detected on both FLT and FDG PET/CT. After therapy, 10 and 8 lesions in cardiac region and 15 and 11 lesions in extra-cardiac region showed no increased uptake on FLT and FDG PET/CT, respectively. On after therapy FLT scan, all SUV for each lesion were lower than those on before therapy FLT scan, and the mean SUVs in cardiac and extra-cardiac lesions decreased significantly ($p<0.001$ and $p<0.001$, respectively). On after therapy FDG scan, all SUV for each lesion were also lower than those on before therapy FDG scan, and the mean SUVs in cardiac and extra-cardiac lesions also decreased significantly ($p<0.001$ and $p<0.001$, respectively). The mean SUV reductions in cardiac and extra-cardiac lesions on FLT scan were 53% and 57%, respectively. The mean SUV reductions in cardiac and extra-cardiac lesions on FDG scan were 57% and 55%, respectively. No significant difference in SUV reduction was found between FLT and FDG scans.

CONCLUSION

This preliminary study indicates that FLT PET/CT, even without the usually necessary fasting, may have the potential to identify the therapeutic response in patients with cardiac sarcoidosis as well as FDG PET/CT.

CLINICAL RELEVANCE/APPLICATION

FLT PET/CT, even without the usually necessary fasting, may have the potential to identify the therapeutic response in patients with cardiac sarcoidosis.

SSA16-09 Feasibility of Using Global Lung FDG Uptake in COPD Patients on PET/CT to Assess the Correlation Between Pulmonary Parenchymal Inflammation and Pulmonary Function Test Indices as well as Emphysema Severity

Sunday, Nov. 25 12:05PM - 12:15PM Room: S505AB

Participants
Pegah Jahangiri, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

Kamyar Pournazari, MD,MSc, Philadelphia, PA (*Presenter*) Nothing to Disclose
Esha S. Kothekar, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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Thomas J. Werner, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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Drew A. Torigian, MD, MA, Philadelphia, PA (*Abstract Co-Author*) Co-founder, Quantitative Radiology Solutions LLC

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PURPOSE

The purpose of this study was to determine the relationship between the degree of pulmonary parenchymal inflammation measured from FDG-PET/CT with the degree of emphysema and also with PFT indices in chronic obstructive pulmonary disease (COPD) patients based on image segmentation and partial volume correction.

METHOD AND MATERIALS

56 COPD patients (51 men; median age 64) who underwent 18F-fluorodeoxyglucose-positron emission tomography/computed tomography (FDG-PET/CT) were studied. Lung parenchymal volume (L), macroscopic emphysema volume (E) and non-emphysematous lung parenchyma mean attenuation (A) were measured from CT images. Uncorrected maximum standardized uptake value of lung (USUVmax) was measured from PET/CT images. A first level of partial volume correction was then applied to account for varying amounts of macroscopic emphysema (CSUVmax) followed by a second level of correction to account for the mixture of air and lung parenchyma at the microscopic level (CCSUVmax). Correlation of fraction of emphysema(F=E/L) with USUVmax, CSUVmax, CCSUVmax were tested using Pearson correlation and linear regression statistical tests. Pearson correlation and linear regression statistical tests were applied to test the correlations of USUVmax, CSUVmax, and CCSUVmax with FEV1/FVC ratio.

RESULTS

Lung USUVmax and CSUVmax were not significantly correlated with fraction of emphysema ($r=0.03$, $p=0.831$ and $r=0.18$, $p=0.292$, respectively). However, CCSUVmax was significantly positively correlated with fraction of emphysema ($r=0.47$, $p=0.013$). Lung CSUVmax and CCSUVmax were significantly negatively correlated with FEV1/FVC ratio ($r=-0.49$, $p=0.026$ and $r=-0.71$, $p<0.001$, respectively), whereas there was no significant correlation between lung USUVmax and FEV1/FVC ratio ($r=-0.25$, $p=0.073$).

CONCLUSION

These data demonstrate that the degree of pulmonary inflammation increases with the degree of emphysema severity and that patients with lower FEV1/FVC ratios have greater degrees of pulmonary parenchymal inflammation based on FDG-PET/CT quantitative assessment. These correlations are more statistically significant when pulmonary FDG uptake is corrected for the partial volume effect, which shows the importance of partial volume correction for accurate quantification of lung disease severity.

CLINICAL RELEVANCE/APPLICATION

Measurement of pulmonary FDG uptake on PET/CT may therefore be useful in the diagnostic and response assessment of patients with COPD.

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

RCB11

Teaching Congenital Heart Morphology with 3D Print Models II: Understanding Surgical Procedures in Congenital Heart Diseases with Illustrations and 3D Print Models (Hands-on)

Sunday, Nov. 25 11:00AM - 12:30PM Room: S401CD

CA ED IN

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Shi-Joon Yoo, MD, Toronto, ON (*Presenter*) Owner, 3D HOPE Medical; CEO, IMIB-CHD; Spouse, CEO, 3D PrintHeart;
Cynthia K. Rigsby, MD, Chicago, IL (*Presenter*) Nothing to Disclose
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Whal Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Andreas Giannopoulos, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
Hyun Woo Goo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Lorna Browne, MD, FRCR, Aurora, CO (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Understand the terms used in describing the pathology of criss-cross heart and related conditions. 2) Understand the pathologic and surgical anatomy of various forms of criss-cross heart and related conditions. 3) Develop ideas how to image the patients with criss-cross heart and related conditions for surgical management.

ABSTRACT

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

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Rajesh Krishnamurthy, MD - 2017 Honored Educator

CAS-SUA

Cardiac Sunday Poster Discussions

Sunday, Nov. 25 12:30PM - 1:00PM Room: CA Community, Learning Center

CA CH CT MR VA AI

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Sub-Events

CA200-SD-SUA1 Clinical and CT Angiographic Characteristics of Coronary Lesions that Later Progressed to Chronic Total Occlusion

Station #1

Participants
Hee Jeong Park, MD, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Jeehoon Kang, Seongnam-si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jeong A Kim, MD, Goyangsi, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Since percutaneous coronary intervention (PCI) for chronic total occlusions (CTOs) is still challenging, estimating lesions that later progressed to CTOs are helpful. Thus, we aimed to investigate the clinical and coronary CT angiography (CCTA) characteristics that later progressed to CTO.

METHOD AND MATERIALS

From 2006 to 2015 invasive coronary angiography (ICA) database, we retrospectively enrolled patients with at least 1 vessel disease with a severe stenosis (> 70% in luminal stenosis) confirmed by ICA who underwent prior CCTA more than 12 months before ICA. We reviewed medical chart for patient-level risk factors and analyzed CCTA findings (stenosis degree, lesion length, density, remodeling index and napkin-ring sign) for lesion-level risk factors. Adverse plaque characteristics (APCs) were defined as positive remodeling with >1.1 remodeling index, low attenuation with < 30 HU and napkin ring sign.

RESULTS

In a total of 216 patients (159 males, 65.8±10.2 years), 32 patients had a CTO lesion in ICA (CTO group) and 184 patients had stenosis with >70% without CTO (non-CTO group). There was no statistical difference of patient-level risk factor including age, sex and traditional clinical risk factors between CTO and non-CTO group. Comparing the lesion-level risk factors, CTO group had the higher ratio of severe stenosis (CTO vs. non-CTO group, 43.8% vs. 24.5%) and length with >2cm (31.2% vs. 12.5%), and more APCs (40.6% vs. 3.8%) (all $p<0.05$). In CTO groups, we compared lesion that later CTO (n=32) and the most-stenotic non-CTO lesion (n=32). Compared to the most-stenotic non-CTO lesion, later CTO lesion had longer plaque (15.4±10.8mm vs. 8.9±7.7mm), more stenotic diameter (1.02±0.74mm vs. 2.32±0.92mm), less calcified plaques (3.1% vs. 34.4%) and more APCs (83.3% vs. 43.8%) (all $p<0.05$).

CONCLUSION

Although no differences of patient-level risk factors between CTO and non-CTO groups, the lesion that later CTO had distinctive CCTA findings compared to lesions which did not progress to CTO.

CLINICAL RELEVANCE/APPLICATION

From this retrospective analysis, CCTA might be helpful to predict CTOs in the case of the lesion with severe stenosis, long length with > 2 cm, and adverse plaque characteristics.

CA201-SD-SUA2 Prognostic Value of Normal Coronary Diagnosed Using Coronary CT on Long Time Follow up of 10 Years

Station #2

Participants
Satoru Shindo, RT, Kasugai, Japan (*Presenter*) Nothing to Disclose
Masashi Hayakawa, Kasugai, Japan (*Abstract Co-Author*) Nothing to Disclose
Ryosuke Kametani, MD,PhD, Kasugai, Japan (*Abstract Co-Author*) Nothing to Disclose
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Miyuki Ando, Kasugai-City, Japan (*Abstract Co-Author*) Nothing to Disclose
Hidekazu Aoyama, Nagoya, AP (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Long-term follow-up of coronary angiography (CCTA) is important. Cardiac events of normal coronary artery patients are expected

Long-term follow-up of coronary angiography (CCTA) is important. Cardiac events of normal coronary artery patients are expected to be rare. In CCTA, it is possible to identify a small amount of plaque even if it is positive remodeling. So we conducted a prognostic survey of patients diagnosed with normal coronary artery at CCTA 10 years ago.

METHOD AND MATERIALS

The subjects were 1474 consecutive patients who underwent CCTA from May 2007 to April 2008. Among them, 218 patients with normal coronary artery who can evaluate the coronary artery and do not recognize a small amount of plaque were followed. The CT device is Aquilion 64, coronary artery analysis was performed using Ziostation 2 with Slab MIP method.

RESULTS

The average age of 218 people is 60.51±12.25 years old, and 107 (49.1%) men. The survival rate of the patients who was able to follow up for 10 years was 88.07% (192 people), there was no coronary artery disease as a cause of the patient who died.

CONCLUSION

Patients diagnosed with 'truly' normal coronary arteries by CCTA may have zero coronary events for 10 years.

CLINICAL RELEVANCE/APPLICATION

Patients diagnosed with 'truly' normal coronary artery by CCTA at our hospital had zero coronary events for 10 years.

CA202-SD-SUA3 Development and Validation of Generalized Linear Regression Models to Predict Vessel Enhancement on Coronary CT Angiography Scans

Station #3

Participants
Takanori Masuda, Hiroshima, Japan (*Presenter*) Nothing to Disclose
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Yoshinori Funama, PhD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

If contrast medium (CM) dose is adjusted based on the body size, or using contrast enhancement elicited by a test bolus, in some patients we observed poor or extremely high contrast enhancement. We investigated whether the generalized linear regression models (GLMs) using various patient characteristics and time density curve (TDC) factors of the test bolus facilitates the accurate prediction of contrast enhancement on coronary computed tomography angiography (c-CTA) images.

METHOD AND MATERIALS

This prospective study received institutional review board approval; prior written informed consent to participate was obtained from all patients. We enrolled 222 patients who had undergone c-CTA under a total body weight (TBW)-tailored-, iodinated contrast medium (CM) protocol. We performed univariate and multivariate regression analysis to evaluate the effect of the patient age, sex, TBW, cardiac output (CO), and the peak time, and to compare contrast enhancement of the ascending aorta per gram of iodine (HU/gI) on test- and c-CTA scans (ΔHU/gI). We developed GLMs to predict ΔHU/gI at c-CTA. The GLMs using independent variables were validated with leave-one-out cross-validation using the correlation coefficient and Bland-Altman analysis.

RESULTS

Univariate linear regression analysis showed that all factors except the peak time on the test scan had a significant effect on ΔHU/gI on c-CTA scans. However, by multivariate analysis, only TBW and ΔHU/gI on the test scan maintained their independent predictive value ($p < 0.01$). By validation analysis, the GLM showed the highest correlation coefficient with the predictive values ($r = 0.75$), followed by ΔHU/gI on the test scan ($r = 0.69$) and TBW ($r = 0.63$). It also revealed the lowest Bland-Altman limit of agreement with GLM (mean difference -0.0 HU/gI ± 5.0, 95% limit of agreement, -10.1 to 10.1 HU/gI), followed by ΔHU/gI at c-CTA (-0.0 HU/gI ± 5.9, -11.9 to 11.9 HU/gI) and TBW (1.1 HU/gI ± 6.1, -11.1 to 13.3 HU/gI).

CONCLUSION

The patient TBW and ΔHU/gI on the test scan significantly affected contrast enhancement of the ascending aorta on c-CTA images.

CLINICAL RELEVANCE/APPLICATION

The combined use of clinical information and test scan results is a useful methods of predicting aortic enhancement.

CA203-SD-SUA4 Prevalence and Clinical Sequalae of Non-Ischemic Myocardial Enhancement Detected on Delayed Enhancement Cardiac CT

Station #4

Participants
Ahmed H. Heussein, MD,MSc, Tsu, Japan (*Presenter*) Nothing to Disclose
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Masafumi Takafuji, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
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Group; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Siemens AG; Research Grant, Nihon Medi-Physics Co, Ltd; Speakers Bureau, Bayer AG

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PURPOSE

Myocardial fibrosis can be evaluated by using delayed enhancement CT (DE-CT) obtained following coronary CT angiography (CCTA). The purpose of this study is to investigate the prevalence of non-ischemic pattern of DE detected by DE-CT in patients referred for CCTA and the clinical sequelae following detection of non-ischemic DE.

METHOD AND MATERIALS

Between January 2015 and January 2018, cardiac CT including acquisition of both CCTA and DE-CT was performed in 955 patients at our institution. DE-CT was evaluated by consensus of cardiovascular radiologists, and when detected, presence of non-ischemic DE (not confined to vascular distribution and/or not involving subendocardium) was notified to the referring physician through a radiology report. Clinical sequelae following detection and reporting of non-ischemic DE was gathered through a review of hospital records.

RESULTS

Myocardial DE was detected in 286 of 955 subjects (29.9%) with non-ischemic DE in 53 subjects (5.5%). Of patients with non-ischemic DE, 68% (36 of 53) were referred to cardiac CT for investigation of suspected coronary artery disease and the remaining 32% were referred for structural evaluation such as pre-radiofrequency ablation assessment in atrial fibrillation (n=6) and adult congenital heart disease (n=4). The most common etiology for the non-ischemic DE was HCM (n=17) followed by hypertensive heart disease (n=12), pulmonary hypertension (n=6) and dilated cardiomyopathy (n=5). Reporting of non-ischemic DE triggered further investigation using cardiac MRI (n=8), myocardial biopsy (n=4), and other tests. Late gadolinium enhancement MRI confirmed the presence of DE in all the patients referred for cardiac MRI after DE-CT and excellent agreement was found for presence or absence of non-ischemic fibrosis in segment-based analysis (kappa=0.829, p<0.001).

CONCLUSION

Non-ischemic myocardial enhancement is frequently encountered on delayed enhancement cardiac CT and might necessitate further clinical workup in a significant fraction of the newly discovered cases.

CLINICAL RELEVANCE/APPLICATION

Acquisition of delayed enhancement images on cardiac CT might be recommended as it might unveil unsuspected non-ischemic cardiomyopathy/fibrosis.

CA204-SD-SUA5 Machine Learning Based CT-FFR Integrating With Quantitative Myocardial Mass Subtended By Coronary Stenosis Outperforms Plaque Features for Predicting Hemodynamical Significance of Lesions

Station #5

Participants
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Jiayin Zhang, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To study the diagnostic performance of the ratio of subtended myocardial mass to the minimal lumen diameter (MLD) at coronary computed tomographic angiography (CCTA) and machine learning based CT-FFR for differentiating functionally significant from insignificant lesions, with reference to fractional flow reserve (FFR).

METHOD AND MATERIALS

Patients who underwent both coronary CTA and FFR measurement at invasive coronary angiography (ICA) within 2 weeks were retrospectively included in our study. CT-FFR, subtended myocardial mass (V sub), percentage of V sub, V ratio/MLD, along with other parameters, including minimal luminal area (MLA), MLD, lesion length (LL), diameter stenosis, area stenosis, plaque burden, and remodeling index, low attenuation plaque, napkin-ring sign, spotty calcification of lesions were recorded. Lesions with FFR <= 0.8 were considered to be functionally significant.

RESULTS

One hundred and seventy-two patients with 196 lesions were ultimately included for analysis. The LL, diameter stenosis, area stenosis, plaque burden, V sub , V ratio and V ratio/MLD were all significantly longer or larger in the group of FFR <= 0.8 ($p < 0.001$ for all), while smaller MLA, MLD and CT-FFR value were also noted ($p < 0.001$ for all). There were no significant differences between the hemodynamic significant subgroup and insignificant subgroup with respect to the risky plaque features The area under the curve (AUC) of V ratio/MLD was comparable to that of CT-FFR (AUC=0.84 vs 0.88; p=0.28) and was significantly better than other parameters and for diagnosing functionally significant stenosis. For vessels with CT-FFR values below 0.70, 0.70 to 0.79, 0.80 to 0.89, and above 0.89, diagnostic accuracy of CT-FFR was 92.6%(25/27), 61.8%(34/55), 83.9%(47/56), 94.8%(55/58), respectively. For lesions with CT-FFR values ranging from 0.70 to 0.79, the accuracy could be improved to 80.0% (44/55) if these lesions were evaluated with Vratio/ MLD instead of CT-FFR.

CONCLUSION

The "grey-zone" lesions, which have CT-FFR values ranging from 0.7 to 0.8, showed lower diagnostic performance. A stepwise approach, reserving Vratio/ MLD for "grey-zone" lesions instead of CT-FFR, can improve diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION

integrating ML based CT-FFR and V ratio/MLD allowed the most accurate discrimination between flow-limiting and non flow-limiting coronary lesions.

CA162-ED-SUA6 A Primer on Echocardiography and Cardiac Angiography for the Cardiothoracic Radiologist

Station #6

Participants
Kevin R. Kalisz, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Robert C. Gilkeson, MD, Cleveland, OH (*Abstract Co-Author*) Research Consultant, Riverain Technologies, LLC; Research support, Koninklijke Philips NV; Research support, Siemens AG; Research support, General Electric Company
Kianoush Ansari-Gilani, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

The purpose of this exhibit is to: - Review the basic acquisition techniques, relevant anatomy, and views obtained at routine echocardiography and coronary angiography examinations - Illustrate different pathologies at echocardiography and angiography with cross-sectional cardiac imaging correlation - Evaluate the advantages and limitations of traditional cardiac imaging modalities compared to more advanced cross-sectional techniques

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Overview of echocardiography (transthoracic and transesophageal) and coronary angiography Acquisition principles and techniques Standard views with illustration of relevant anatomy (with CTA and MRI correlation) 3. Examples of pathologies evaluated at traditional cardiac imaging modalities, each with cardiac CT and/or MRI correlation Echocardiography: Cardiomyopathies Valvular heart disease Cardiac masses and mass-like entities Pericardial disease Cardiac shunts Coronary angiography: Acquired coronary disease Aberrant coronary anatomy 4. Strengths and weaknesses of traditional and advanced imaging modalities in the assessment of the above pathologies

CA163-ED-SUA7 Cut the Mustard: A Pictorial Review of Post-Surgical Anatomy in the Repair of Conotruncal Abnormalities

Station #7

Participants
Mary F. Hall, DO, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
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Alexander Croake, MD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Trinh T. Nguyen, DO, Rochester, NY (*Presenter*) Nothing to Disclose

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TEACHING POINTS

1. The surgical repair of common conotruncal abnormalities is complex from both physiologic and imaging perspectives, requiring intimate knowledge of the goals of procedures. 2. Over the years, surgical techniques have been retooled, so as to improve upon common complications with classic surgical approaches. Many of these are radiologically evident. 3. As technique improves, so do patient outcomes, and a new population of patients who survived once-fatal congential abnormalities is emerging. 4. The radiologist must adapt to these changes, and find novel, safe, and effective ways to screen for and monitor such patients. The arsenal of cardiac MRI and CT are invaluable tools for such a task.

TABLE OF CONTENTS/OUTLINE

1. Review historic and current surgical techniques in the treatment of common congenital conotruncal abnormalities. 2. Provide an image-rich spectrum of the expected postsurgical anatomy, as seen via cardiac MRI. 3. Review the appearance of common complications encountered with these procedures. 4. Demonstrate interpretive pitfalls. 5. Discuss future applications of cardiac MRI in pre and post surgical patients in this population.

CA165-ED-SUA8 CAD-RADS™: Pushing the Limits

Station #8

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
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Suhny Abbara, MD, Dallas, TX (*Abstract Co-Author*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Luis A. Landeras, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

1. To review the CAD-RADS system 2. To illustrate the CT findings of different categories and modifiers of CAD-RADS 3. To illustrate common clinical situations with ambiguities in classification and management of findings

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Background 3. Overview of CAD-RADS with illustrations - Categories- 0, 1, 2,3,4A, 4B, 5, N - Modifiers- S (Stent); G (Graft); V(Vulnerability); N (non-diagnostic) 4. Challenging situations with case illustrations a) Minimal/mild stenosis with non-diagnostic segments -Category N, not modifier N b) High grade stenosis in small vessels- CAD-RADs only for vessels > 1.5 mm c) High-risk anatomy considered into grading (2 vessels/left main with severe stenosis- 4B not 4A) d) LAD & LCX stenosis- 3-vessel equivalent in cath, but 2-vessel in CAD-RADS e) 2 high-risk plaque features in different coronary arteries - Not V f) Coronary artery bypass grafts- Grade/G g) Coronary artery bypass grafts- Stenosis in bypassed vessels is not classified h) Coronary artery stents- If non-evaluable N/S i) Coronary artery stents- If severe in-stent stenosis/occlusion- Grade 5/S j) Coronary artery anomalies k) Non-coronary cardiac or extra-cardiac findings l) Functional information- CT-FFR, CT-perfusion

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Prabhakar Rajiah, MD, FRCR - 2014 Honored EducatorSuhny Abbara, MD - 2014 Honored EducatorSuhny Abbara, MD - 2017 Honored Educator

CAS-SUB

Cardiac Sunday Poster Discussions

Sunday, Nov. 25 1:00PM - 1:30PM Room: CA Community, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Sub-Events

CA205-SD-SUB1 Native True T1 Mapping for Non-Contrast Assessment of Myocardial Fibrosis in Patients with Cardiomyopathy: Correlation with Late Gadolinium Enhancement MRI

Station #1

Participants
Amarino C. Oliveira JR, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
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Juliana Serafim, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of this study was to reinvestigate native T1 mapping with SmarT1 in the non-contrast assessment of diffuse myocardial fibrosis in patients with cardiomyopathy by comparing it to Late Gadolinium Enhanced cardiac MRI. SmarT1 directly measures true T1, increasing accuracy when compared to other methods, crucial to become an objective quantitative biomarker in different clinical settings.

METHOD AND MATERIALS

90 patients underwent routine CMR at 3T to investigate CMP including SmarT1 (saturation method using adaptive recovery times for cardiac T1 mapping) sequence. Left ventricular ejection fraction (LVEF), left ventricular diastolic volume (LVDVol), left atrium volume (LAVol) and late gadolinium enhancement (LGE) indicators a) diffuse evident (CE) and b) not evident (nCE) were obtained. Native T1 relaxation times were extracted by placing ROIs on the T1 maps within the myocardium (T1nat,myo) and blood by an experienced Radiologist (20y). Statistical Analysis (Normality Kolmogorov Smirnov, Pearson Correlation coefficient; Mann Whitney median dif in native T1 CE and nCE groups) was done using Minitab, considering $p<0.05$ as statistical significant.

RESULTS

Native T1 of myocardium in patients without LGE (T1nat,median, nCE = 1477ms) are lower than native T1 in patients with CE in any other segment of the heart (T1nat, median, CE=1500ms), (male group: p=0.0496, T1nat,median, nCE=1468ms, T1nat,median, CE=1500). Increase in native T1 reflects the higher content of fibrosis due to expansion of the extracellular/interstitial volume in patients with cardiomyopathy. T1nat,myo showed a positive correlation with LVDVol (r=0.291,p=0.005), increasing in its strength with exclusion of hypertrophic cardiomyopathy (low cavity volume) patients (r=0.366, p=0.002).

CONCLUSION

Native true T1 mapping of the myocardium using SmartT1 can detect tissue alterations and functional abnormalities without measuring contrast dynamics. Higher native T1 reflects higher content of fibrosis and/or expansion of the extracelular volume.

CLINICAL RELEVANCE/APPLICATION

Patients with severe renal impairment precluding gadolinium contrast injection may benefit of native T1 mapping. Accurate T1 estimation is crucial to establish itself as an objective biomarker for different clinical settings.

CA206-SD-SUB2 The Effect on Left Ventricular Diastolic Function 12 Month After Renal Denervation: An Evaluation Based on Cardiac Magnetic Resonance Imaging

Station #2

Participants
Malte L. Warncke, MD, Hamburg, Germany (*Presenter*) Nothing to Disclose
Andreas Koops, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gunnar K. Lund, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Fabian Brunner, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Richard A. Coulden, MD, Edmonton, AB (*Abstract Co-Author*) Nothing to Disclose
Lennart Well, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Karsten Sydow, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Jitka Starekova, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

Johannes Neumann, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Roland Fischer Sr, DiplPhys, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Enver G. Tahir, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

m.warncke@uke.de

PURPOSE

Catheter-based renal denervation (RDN) has been investigated as a potential treatment for patients suffering from resistant arterial hypertension. It has been demonstrated that RND decreases ventricular hypertrophy (LVH) and improves diastolic left ventricular (LV) function on a short-term follow-up. We investigated the prolonged long-term effect (12 months) of RDN on diastolic function by cardiac magnetic resonance (CMR).

METHOD AND MATERIALS

Fifteen patients with resistant arterial hypertension were examined by CMR before and twelve months after RDN. Clinical visits at the same time points included 24-hour ambulant blood pressure monitoring (ABPM). Functional and structural LV parameters were analyzed. Based on volume-time-curve analyses diastolic LV function was analyzed by calculation of early diastolic (EPFR), atrial peak filling rates (APFR) and EPFR/APFR ratio, which is the equivalent of the echocardiographic E/A ratio. CMR data were analyzed by two independent observers using Cardiovascular Imaging Solutions Ltd. (CVIS) CMRtools. Data are given as the mean of both observers. Statistical analysis was performed using GraphPad Prism 5 and Microsoft Excel.

RESULTS

Twelve months after RDN systolic ABPM showed a moderate decrease (152.0 mmHg vs. 148.0 mmHg, p=0.076), but did not reach significance. Indexed left ventricular mass (LVMM) decreased from 80.7 ±21.2 g/m2 to 74.6 ±20.7 g/m2 ($p<0.05$). This effect was associated with an increase in EPFR ($r=-0.528$; $p<0.05$) and with a tendency of APFR reduction ($r=0.468$; $p=0.079$). The EPFR/APFR ratio increased significantly over one year (0.89 ± 0.37 vs. 1.05 ± 0.49; $p<0.05$), indicating improvement of LV diastolic function.

CONCLUSION

We investigated the sustained effect of RDN on the diastolic function of the left ventricle 12 months after the procedure by CMR. Diastolic LV function was improved 12 months post-RDN and was associated with the significant decrease of LV mass.

CLINICAL RELEVANCE/APPLICATION

Our study indicates that patients may benefit from RDN due to a potential improvement of diastolic function facilitated by LV mass reduction.

CA207-SD-SUB3 Relationship between Texture Features of Myocardial Late Gadolinium Enhancement and Ventricular Tachyarrhythmias in Hypertrophic Cardiomyopathy

Station #3

Participants
Yasuo Amano, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose
Fumi Yanagisawa, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Yasuyuki Suzuki, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Naoya Matsumoto, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose

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yas-amano@nifty.com

PURPOSE

Hypertrophic cardiomyopathy (HCM) often shows myocardial late gadolinium enhancement (LGE) on magnetic resonance imaging (MRI). Thus, only the presence of LGE does not stratify the risks for serious arrhythmias associated with HCM. Texture analysis may provide new quantitative information about LGE which can induce ventricular tachyarrhythmias, including ventricular fibrillation and ventricular tachycardia. The aim of this study was to evaluate the relationship between texture features of myocardial LGE and ventricular tachyarrhythmias in HCM.

METHOD AND MATERIALS

Twenty-three patients with HCM were enrolled. LGE MRI was performed using a 3-dimensional inversion-recovery T1-weighted segmented gradient echo sequence 10 minutes after 0.1 mmol/kg gadolinium injection. Texture analysis was performed for 43 myocardial LGE areas using an open-access software (MaZda, Technical University of Lodz, Institute of Electronics, Poland). The relationship between the texture features of LGE (i.e., variance, skewness, kurtosis, and entropy of LGE signal intensity) and ventricular tachyarrhythmias were evaluated in the 23 patients with HCM.

RESULTS

Sixteen (69.6%) of the 23 HCM patients had myocardial LGE. Six patients (26.1%) had history of ventricular tachyarrhythmias, all of whom showed LGE. Among 4 texture features of the LGE, entropy was significantly lower in HCM patients with ventricular tachyarrhythmias (14969.9 ± 9107.6) than those without (25565.2 ± 1408.5; $p = 0.0058$). A receiver-operating characteristic analysis gave the threshold of 19624 with the area under the curve of 0.72 for identification of HCM patients with ventricular tachyarrhythmias.

CONCLUSION

Patients with HCM and history of ventricular tachyaarrhythmias had myocardial LGE of lower entropy, indicating microscopically less random fibrosis of the myocardium. The texture analysis provides the quantitative information about LGE related to ventricular tachyarrhythmias associated with HCM.

CLINICAL RELEVANCE/APPLICATION

Texture analysis is a quantitative method to identify myocardial late gadolinium enhancement which is related to ventricular tachyarrhythmias in patients with hypertrophic cardiomyopathy.

CA209-SD-SUB5 Progression of Coronary Artery Calcification in Primary Chronic Glomerulo-Nephritis After Renal Transplantation

Sunday, Nov. 25 1:00PM - 1:15PM Room: CA Community, Learning Center Station #5

Participants
Changqing Yin, Zhenjiang, China (*Presenter*) Nothing to Disclose
Dongqing Wang, Zhenjiang, China (*Abstract Co-Author*) Nothing to Disclose
Haitao Zhu, Zhenjiang, China (*Abstract Co-Author*) Nothing to Disclose
Lirong Zhang, MD, zhenjiang, China (*Abstract Co-Author*) Nothing to Disclose
Shao Xun, Zhenjiang, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The aim was to determine the effect of renal transplantation on the progression of CAC in common primary chronic glomerulonephritis.

METHOD AND MATERIALS

Renal transplantation (RT) and dialysis patients with primary chronic glomerulonephritis(IgA, MembranousNephropathy(MN),MesangialProliferativeNephritis(MPN),MembranoproliferativeGlomerulonephritis(MPGN), Focal Segmental Glomerulosclerosis(FGSG), Podocyte Disease(PD)) were enrolled in this study. CAC and serum parameters at baseline and 1 year follow-up were measured. These associations were analyzed by multiple logistic regression.

RESULTS

The study included 108 RT patients (n=20,18,15,19,18,18,respectively) and 125 dialysis patients (n=22,19,20,21,23,20,respectively) as control groups. The baseline evaluations showed a very high prevalence of CAC in all groups, which was positively correlated with LDL(p=0.001) and CRP (p=0.03). The follow-up evaluations showed a significantly slower progression of calcification after RT, expect MPN, MPGN and PD In MN the decrease was the most pronounced. In all groups, baseline score, calcium and phosphorus had a strong correlation with the progression of CAC (P=0.001, 0.004, 0.03, respectively).

CONCLUSION

In this study, CAC is high prevalent in all group, and was correlated with LDL and CRP. There was a significantly slower progression of CAC after RT, expect in MPN, MPGN and PD, however in MN was the most pronounced. Baseline score, calcium and phosphorus were correlated with the progression.

CLINICAL RELEVANCE/APPLICATION

Through pathology, there is different attention to CAC in patients with different degrees of renal transplantation and we can reduce the number of follow-up visits of patients with slow calcification progression.

CA161-ED-SUB7 Cardiac MR in Pulmonary Hypertension: From Magnet to Bedside

Station #7

Awards
Certificate of Merit
Identified for RadioGraphics

Participants
Jordi Broncano, MD, Cordoba, Spain (*Presenter*) Nothing to Disclose
Antonio Luna, MD,PhD, Jaen, Spain (*Abstract Co-Author*) Consultant, Bracco Group; Speaker, General Electric Company; Speaker, Canon Medical Systems Corporation; Royalties, Springer Nature
Fernando R. Gutierrez, MD, Saint Louis, MO (*Abstract Co-Author*) Spouse, Stockholder, UnitedHealth Group
Eric E. Williamson, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Daniel Vargas, MD, Aurora, CO (*Abstract Co-Author*) Nothing to Disclose
Majesh Makan, MD, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Sanjeev Bhalla, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

j.broncano.c@htime.org

TEACHING POINTS

1. To analyze the value of cardiac imaging in patients with pulmonary hypertension with emphasis on physiopathology and prognosis. 2. To discuss the importance of different cardiac MR based parameters in PH attending on its acquisition, dedicated analysis and potential pitfalls. Correlation with echocardiography will also be applied.

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Pulmonary hypertension (PH): definition and classification 3. Cardiac remodeling in PH 4. Biomarkers in cardiac imaging: definition and clinical implications 5. Rationale of CMR protocol in PH 6. Cardiac findings in PH 6.1. Black blood sequences in PH 6.2. Cine SSFP in PH: more than just volumes and function 6.3. Phase contrast imaging and 4D flow: More than velocity 6.4. First pass perfusion imaging in PH: value in prognosis 7. Impact of multiparametric CMR in PH 8. Conclusion

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CA167-ED-SUB8 Cardiovascular Imaging in Pregnancy - An Update on Current Practice

Station #8

Participants
Kamlesh J. Jobanputra, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Verghese George, MBBS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Kevin R. Kalisz, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Asha Kandathil, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Abhishek Chaturvedi, MD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

radpr73@gmail.com

TEACHING POINTS

1. To review the physiological changes that occur during pregnancy 2. To review the cardiovascular complications that occur during pregnancy/peripartum period 3. To discuss the role of imaging in evaluation of cardiovascular complications during pregnancy 4. To develop an approach on imaging pregnant patients safely

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Physiological cardiovascular changes in pregnancy - Increased blood volume - Increased cardiac output - Decreased BP - Pro-inflammatory 3. Role of Imaging in pregnancy 4. Imaging modalities- X-ray, CT, MRI, nuclear, echo, ultrasound, angio 5. Complications related to pregnancy (Discussion, illustration of imaging findings with case examples) - Pulmonary embolism - Amniotic fluid embolism - Post-partum cardiomyopathy - Spontaneous coronary artery dissection - Pulmonary hypertension - Hypertension 6. Exacerbation of pre-existing diseases during pregnancy (Illustration with case examples) - Inherited aortic diseases - Adult congenital heart disease - Hereditary hemorrhagic telangiectasia - Acquired valvular disorders 7. Cardiovascular changes due to abdominal disease 8. Issues related to imaging in pregnancy - CT- Radiation, contrast agents - MRI- Gadolinium 9. Appropriateness criteria for imaging in pregnancy

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RC103

Rapid Fire: 80 Cardiac Cases in 80 Minutes

Sunday, Nov. 25 2:00PM - 3:30PM Room: S406B

CA CH

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Suhny Abbara, MD, Dallas, TX (*Moderator*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

Sub-Events

RC103A Thoracic Vascular: 20 Cases

Participants
Sachin S. Saboo, MD, FRCR, Dallas, TX (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

saboo_100@yahoo.com

LEARNING OBJECTIVES

1) Describe key imaging features of twenty interesting thoracic vascular cases. 2) Assess significance of these imaging findings with respect to management.

Honored Educators

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RC103B Cardiothoracic Oncology: 20 Cases

Participants
Eric E. Williamson, MD, Rochester, MN (*Presenter*) Nothing to Disclose

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williamson.eric@mayo.edu

LEARNING OBJECTIVES

1) Describe the imaging features seen in the most common benign and malignant cardiac masses.

RC103C Pericardium: 20 Cases

Participants
Seth J. Kligerman, MD, Denver, CO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

skligerman@ucsd.edu

LEARNING OBJECTIVES

1) Review various acute and chronic inflammatory conditions that involve the pericardium on CT and MRI. 2) Show various benign and malignant masses that involve the pericardial on CT and MRI. 3) Discuss differential diagnosis and methods of differentiation.

RC103D Coronary Arteries and Myocardium: 20 Cases

Participants
Jacobo Kirsch, MD, Weston, FL (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

kirschj@ccf.org

LEARNING OBJECTIVES

1) To review the imaging manifestations of common and uncommon ischemic and non-ischemic cardiac pathologies.

Honored Educators

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RC112

CTA for TAVR and Other Aortic Valve Replacements

Sunday, Nov. 25 2:00PM - 3:30PM Room: N230B

CA CT VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Jonathon A. Leipsic, MD, Vancouver, BC (*Moderator*) Speakers Bureau, General Electric Company; Speakers Bureau, Edwards Lifesciences Corporation; Consultant, Heartflow, Inc; Consultant, Circle Cardiovascular Imaging Inc; Consultant, Edwards Lifesciences Corporation; Consultant, Neovasc Inc; Consultant, Samsung Electronics Co, Ltd; Consultant, Koninklijke Philips NV; Consultant, Arineta Ltd; Consultant, Pi-Cardia Ltd;
Jean Jeudy JR, MD, Baltimore, MD (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

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jjeudy@som.umaryland.edu

Sub-Events

RC112A Pre-TAVR CT Imaging Protocols

Participants
Stefan L. Zimmerman, MD, Ellicott City, MD (*Presenter*) Project consultant, Siemens Healthcare; Research grant, American Heart Association;

LEARNING OBJECTIVES

1) To review CT imaging requirements for TAVR planning. 2) To provide an overview of default acquisition protocols to ensure robust CT image quality with various CT systems. 3) To provide tips and tricks of how to image challenging patients with renal failure or atrial fibrillation.

Honored Educators

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RC112B CTA for Sizing Transcatheter Heart Valves

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

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jleipsic@providencehealth.bc.ca

LEARNING OBJECTIVES

1) Discuss the importance of reproducible and accurate annular anatomical definition. 2) Define the meaning of oversizing in device selection and the role that capture and sealing have to optimize clinical outcomes. 3) Discuss the importance of appropriate sizing to optimize clinical outcomes.

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RC112C Aortic Valve Assessment in the Post-TAVR Patient

Participants
Jean Jeudy JR, MD, Baltimore, MD (*Presenter*) Nothing to Disclose

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RC112D CT for the Evaluation of Surgical Bioprostheses

Participants
Dominika Sucha, MD,PhD, Utrecht, Netherlands (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To understand differences in surgical bioprostheses and learn to appreciate normal CT findings after surgical implantation. 2) To review the underlying pathology in biovalve dysfunction and the role of CT. 3) To learn what the surgeon and cardiologist want to know for clinical decision-making. 4) To discuss latest literature and developments.

RC124

The Best of RADIOLOGY in 2018: The Editors of RADIOLOGY Keep You Up to Date

Sunday, Nov. 25 2:00PM - 3:30PM Room: E353A

BR CA CH NR RS

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Sub-Events

RC124A Review of 2018: New Research That Should Impact Your Practice

Participants
David A. Bluemke, MD,PhD, Bethesda, MD (*Presenter*) Nothing to Disclose

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dbluemke@rsna.org

LEARNING OBJECTIVES

1) Identify key publications over the past year that may affect your clinical practice. 2) Evaluate new research developments in the field of radiological imaging. 3) Describe new developments in radiology that may affect the management of your patients.

ABSTRACT

RADIOLOGY is the leading journal for publications leading to new, important and translatable discoveries in imaging research. In the past year, there continue to be basic developments in radiology, as well as new guidelines and clinical trials in imaging that affect your practice. Overall trends for new scientific studies reflect an increasing number of clinical trials being submitted from around the world in addition to those of North America. Publications from Europe have been prominent in recent years, but new research programs from countries such as Japan, South Korea and China are developing quickly. Large numbers of study subjects in clinical trials are now common, and tends to result in more robust demonstration of the efficacy of imaging interventions. Artificial intelligence applications are becoming commonplace in our publications, as are radiomics studies with increasing large numbers of study subjects. This seminar will highlight the results of key publications in the past year that are most likely to affect your practice in the near future, as well as presenting novel topics that are likely to be important to the field over the next 5 years.

RC124B Innovations in Cardiothoracic Imaging in 2018

Participants
Albert De Roos, MD, Leiden, Netherlands (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

a.de_roos@lumc.nl

LEARNING OBJECTIVES

1) Key publications in cardiothoracic imaging 2018 will be highlighted.

ABSTRACT

Cardiothoracic manuscripts are frequently introducing new technology, acquisition techniques and clinical evaluation. Major advances in cardiothoracic imaging over the last year published in Radiology will be discussed for their innovation and potential impact.

RC124C Research and Innovations in Breast Imaging in 2018

Participants
Linda Moy, MD, New York, NY (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

linda.moy@nyumc.org

LEARNING OBJECTIVES

1) To highlight key publications on breast imaging over the past year. 2) To discuss the implications of these publications for patient care

RC124D New Developments in Neuroimaging in 2018

Participants
Birgit B. Ertl-Wagner, MD, Toronto, ON (*Presenter*) Spouse, Stockholder, Siemens AG; ;

For information about this presentation, contact:

BirgitBetina.Ertl-Wagner@sickkids.ca

LEARNING OBJECTIVES

1) Identify key publications over the past year that may affect your clinical practice. 2) Evaluate new research developments in the field of radiological imaging. 3) Describe new developments in radiology that may affect the management of your patients.

RC131

CTA from Head to Toe

Sunday, Nov. 25 2:00PM - 3:30PM Room: S503AB

CA CT HN VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Christopher Lee, MD, Los Angeles, CA (*Moderator*) Nothing to Disclose

For information about this presentation, contact:

christopher.lee.1@med.usc.edu

LEARNING OBJECTIVES

1) Describe techniques for CTA of the neck, upper and lower extremities. 2) Distinguish common artifacts on CTA of these anatomic regions. 3) Evaluate protocol/scanner modifications for optimal CTA imaging. 4) Formulate a CTA protocol to optimally image acute aortic syndrome. 5) Distinguish the imaging appearances and pitfalls of acute aortic syndrome. 6) Summarize the important measurements that help guide therapy. 7) Describe pre-procedural patient preparation including appropriate patient selection, contraindications, and beta-blockade. 8) Evaluate peri-procedural issues including vasodilation, continued heart rate control, and breathholding. 9) Evaluate Image acquisition including radiation dose reduction techniques and technique choice. 10) Describe postprocedural complications including contrast reactions and their management.

Sub-Events

RC131A Head and Neck CTA

Participants
Alexander Lerner, MD, Los Angeles, CA (*Presenter*) Research Grant, Koninklijke Philips NV; Research Grant, Bracco Group

LEARNING OBJECTIVES

1) Describe techniques for CTA of the neck, upper and lower extremities. 2) Distinguish common artifacts on CTA of these anatomic regions. 3) Evaluate protocol/scanner modifications for optimal CTA imaging.

RC131B Aortic CTA

Participants
Christopher Lee, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

christopher.lee.1@med.usc.edu

LEARNING OBJECTIVES

1) Formulate a CTA protocol to optimally image acute aortic syndrome. 2) Distinguish the imaging appearances and pitfalls of acute aortic syndrome. 3) Summarize the important measurements that help guide therapy.

ABSTRACT

Acute aortic syndrome (AAS) represents the triad of aortic dissection, intramural hematoma, and penetrating atherosclerotic ulcer. Imaging with CTA is essential for the accurate diagnosis of AAS. CTA protocols should optimally image the aorta while minimizing radiation exposure and intravenous contrast administration. Newer CT technology can reduce radiation dose and contrast delivery while preserving image quality. Minimally invasive treatment of acute aortic syndrome with thoracic endovascular aortic repair (TEVAR) has become increasingly popular.

RC131C Cardiac CTA

Participants
Cameron Hassani, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

ch602nyc@gmail.com

LEARNING OBJECTIVES

1) Describe pre-procedural patient preparation including appropriate patient selection, contraindications, and beta-blockade. 2) Evaluate peri-procedural issues including vasodilation, continued heart rate control, and breathholding. 3) Evaluate Image acquisition including radiation dose reduction techniques and technique choice. 4) Describe postprocedural complications including contrast reactions and their management.

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PS12

Sunday Afternoon Plenary Session

Sunday, Nov. 25 4:00PM - 5:45PM Room: Arie Crown Theater

BR CA CH GI GU MK NR PD VA

AMA PRA Category 1 Credits ™: 1.75
ARRT Category A+ Credit: 1.75

Participants
Vijay M. Rao, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

Sub-Events

PS12A Report of the RSNA Research and Education Foundation

Participants
N. Reed Dunnick, MD, Ann Arbor, MI (*Presenter*) Royalties, Wolters Kluwer nv; Editor, Reed Elsevier

PS12B Image Interpretation Session

Participants
Donald P. Frush, MD, Durham, NC (*Moderator*) Nothing to Disclose
John Eng, MD, Cockeysville, MD (*Introduction*) Nothing to Disclose
Laura W. Bancroft, MD, Orlando, FL (*Presenter*) Author with royalties, Wolters Kluwer nv; Speaker, World Class CME; Editor, Thieme Medical Publishers, Inc; Travel support, Thieme Medical Publishers, Inc ; ;
Matthew S. Davenport, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Tomas C. Franquet, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose
R. Paul Guillerman, MD, Houston, TX (*Presenter*) Consultant, Guerbet SA
Christopher P. Hess, MD, PhD, Mill Valley, CA (*Presenter*) Nothing to Disclose
Andrea Laghi, MD, Rome, Italy (*Presenter*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Presenter*) Nothing to Disclose
Pamela K. Woodard, MD, Saint Louis, MO (*Presenter*) Research agreement, Siemens AG; Research, Eli Lilly and Company; Research, F. Hoffmann-La Roche Ltd; ; ; ; ; ;

For information about this presentation, contact:

woodardp@wustl.edu

ED002-MO

Cardiac Monday Case of the Day

Monday, Nov. 26 7:00AM - 11:59PM Room: Case of Day, Learning Center

AMA PRA Category 1 Credit ™: .50

Participants

Suhny Abbara, MD, Dallas, TX (*Presenter*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Sachin S. Saboo, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Fernando U. Kay, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Dhiraj Baruah, MD, Milwaukee, WI (*Abstract Co-Author*) Educator, Boehringer Ingelheim GmbH;
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Carlos S. Restrepo, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Kaushik S. Shahir, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Ameya J. Baxi, MBBS,DMRD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Jinglei Li, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Harold Goerne, MD, Zapopan, Mexico (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

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

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RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

SPDL20

You Take the Red Pill-You Stay in Wonderland and I Show You How Deep the Rabbit Hole Goes (Case-based Competition)

Monday, Nov. 26 7:15AM - 8:15AM Room: E451B

CA GI HN MK NR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Adam E. Flanders, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Sandeep P. Deshmukh, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Vishal Desai, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Christopher G. Roth, MD,MS, Philadelphia, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Be introduced to a series of radiology case studies via an interactive team game approach designed to encourage 'active' consumption of educational content. 2) 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) 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.*

MSMC21

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

Monday, Nov. 26 8:30AM - 10:00AM Room: S406A

CA CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Jill E. Jacobs, MD, New York, NY (*Moderator*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To be able to identify and understand normal cardiac anatomy. 2) To be able to identify and understand some of the common coronary anomalies.

Sub-Events

MSMC21A Normal Coronary Anatomy

Participants
Brian B. Ghoshhajra, MD, Waban, MA (*Presenter*) Research Grant, Siemens Healthcare USA;

MSMC21B Anomalous Coronary Arteries

Participants
Prachi P. Agarwal, MD, Canton, MI (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) List the various coronary artery anomalies. 2) Identify the CT imaging features and hemodynamics of clinically significant coronary artery anomalies. 3) Apply the knowledge of treatment options to understand normal postoperative appearance and postoperative complications.

RC203

Coronary CTA and Calcium Scoring

Monday, Nov. 26 8:30AM - 10:00AM Room: E263

CA CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Gregory Kicska, MD, PhD, Seattle, WA (*Moderator*) Nothing to Disclose

Sub-Events

RC203A CT Derived Fractional Flow Reserve (FFR CT): A Sine Qua Non?

Participants
Eric E. Williamson, MD, Rochester, MN (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Discuss the current evidence for using CT-based fractional flow reserve. 2) Describe a potential role for FFRct in the clinical practice of cardiac CT.

RC203B Interpreting and Reporting Cardiac CT - CAD-RADS

Participants
Geoffrey D. Rubin, MD, Durham, NC (*Presenter*) Consultant, Fovia, Inc; Consultant, HeartFlow, Inc; Consultant, General Electric Company;

LEARNING OBJECTIVES

1) To review the CAD-RADS lexicon, including assessment categories and modifiers, for coronary CT angiography in the evaluation of acute and stable chest pain. 2) To understand how CAD-RADS can improve patient care through standardized reporting and linking management recommendations to actionable information in the radiology report. 3) To apply appropriate CAD-RADS coding for difficult coronary CT angiography cases.

RC203C Added Value of Myocardial Perfusion Imaging in Cardiac CT

Participants
Ricardo C. Cury, MD, Miami, FL (*Presenter*) Research Grant, General Electric Company; Research Consultant, General Electric Company

LEARNING OBJECTIVES

1) To review the literature and available evidence of Myocardial CT perfusion. 2) To evaluate the emerging role of Myocardial CTP in the work-up of patients with suspected or known CAD. 3) To describe the incremental value of Myocardial CTP over CT angiography.

RC203D Cardiac CT in Acute Chest Pain: Critical Review of the Evidence

Participants
Marc Dewey, MD, Berlin, Germany (*Presenter*) Research Grant, General Electric Company; Research Grant, Bracco Group; Research Grant, Guerbet SA; Research Grant, Canon Medical Systems Corporation; Research Grant, European Commission; Research Grant, BIH Digital Health Accelerator; Speakers Bureau, Canon Medical Systems Corporation; Speakers Bureau, Guerbet SA; Speakers Bureau, Bayer AG; Consultant, Guerbet SA; Author, Springer Nature; Editor, Springer Nature; Institutional research agreement, Siemens AG; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Canon Medical Systems Corporation; ; ; ; ; ; ; ; ;

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LEARNING OBJECTIVES

1) Get to know the evidence for using CT in patients with acute chest pain. 2) Learn about important details from these studies that will show in which patients CT might have greatest clinical value.

ABSTRACT

Several clinical trials and smaller studies looked at the advantages and disadvantages of using CT in patients with acute chest pain. This practical talk about the pivotal facts from these clinical studies will provide the information required for informed decision making with referring physicians.

Active Handout:Marc Dewey

http://abstract.rsna.org/uploads/2018/17001208/dewey 2018 handout RC203D.pdf

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RC213

Pediatric Series: Pediatric Chest/Cardiovascular Imaging

Monday, Nov. 26 8:30AM - 12:00PM Room: E353B

CA CH PD

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants
Edward Y. Lee, MD, Boston, MA (*Moderator*) Nothing to Disclose
Ladonna J. Malone, MD, Aurora, CO (*Moderator*) Nothing to Disclose
David M. Biko, MD, Philadelphia, PA (*Moderator*) Nothing to Disclose
Randolph K. Otto, MD, Seattle, WA (*Moderator*) Nothing to Disclose
Demetrios A. Raptis, MD, Saint Louis, MO (*Moderator*) Nothing to Disclose

Sub-Events

RC213-01 Cardiac CT in Neonates

Monday, Nov. 26 8:30AM - 8:50AM Room: E353B

Participants
Ladonna J. Malone, MD, Aurora, CO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe different cardiac CT techniques used in infants with congenital heart disease. 2) Discuss the common scenarios that cardiac CT can be useful in infants including evaluation of a. systemic arteries, b. pulmonary arteries and veins, c. evaluation of common shunts performed for palliation (BT, Sano, central), d. coronary arteries, and e. Heterotaxy.

RC213-02 Image Quality and Incidental Findings of Chest MRI in a Large Pediatric Population-Based Study

Monday, Nov. 26 8:50AM - 9:00AM Room: E353B

Participants
Alice Pittaro, Rotterdam, Netherlands (*Presenter*) Nothing to Disclose
Liesbeth Duijts, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Piotr A. Wielopolski, PhD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Harm A. Tiddens, MD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Meike W. Vernooij, MD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Mariette Kemner - Corput van de M.P.C., Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Vincent Jaddoe, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Pierluigi Ciet, MD, Rotterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To describe image quality (IQ) and incidental findings (IF) of chest MRI in a large pediatric cohort from a population-based prospective multi ethnic study.

METHOD AND MATERIALS

Two end-inspiratory (INSP) and end-expiratory (EXP) breath-old chest MRI scans were performed in 2498 healthy children using a spirometry-gated 3D spoiled gradient echo sequence (TR/TE/FA/voxel-resolution=1.6ms/0.7ms/2°/2mm isotropic) in a 3 Tesla scanner. IQ was assessed using 5-point scale from poor (score 1) to excellent (score 5). IFs were classified in clinically relevant or non clinically relevant. Imaging artifacts included four main categories (motion, wrap, ghosting, low signal-to-noise ratio). Analysis was conducted by two indipendent observers. Descriptive statistic was used to assess IQ, IFs and artifacts. Inter-observer agreement of IQ was assessed with Intra-class Correlation Coefficient (ICC) and Bland-Altman plots. Significant differences between IQ-INSP and IQ-EXP were assessed with Wilcoxon test.

RESULTS

47 children were excluded for missing data (i.e. no inspiratory or expiratory scans). Final analysis included 2451 children (median age 9.9 years, range 9.5-11.9). Median IQ was good to excellent 4.5 (Interquartile Range, IQR=4-5). Median IQ-INSP and IQ-EXP was 4.5 (IQR=4-5) for both. Despite deemed excellent, IQ-EXP was significantly lower than IQ-INSP ($Z=-8.487$, $p<0.0001$). 1,7% of the cohort subjects had clinically relevant IFs, 45% had non-clinically relevant IFs. Clinically relevant IFs included pulmonary nodules (diameter >10 mm), severe tracheomalacia (collapse>70%), severe trapped-air (>25% lung lobe volume) and congenital abnormalities (i.e. sequester). Non-clinically relevant IFs were: mild trapped-air (23,8%), atelectasis (15,4%) and mild tracheomalacia (4,5%). IQ was mostly affected by motion artifact (31,9%), fat ghosting (7,9%) or both (6,3%). Inter-observer agreement for IQ was good (ICC=0.7, 95% C.I 0.48-0.83).

CONCLUSION

Chest MRI is a robust technique for large cohort studies in children. Clinically relevant IFs are rare in children, but a large percentage of the cohort had non-clinically relevant IFs.

CLINICAL RELEVANCE/APPLICATION

Trapped-air, atelectasis and mild tracheomalacia are common non-clinically relevant incidental findings on chest MRI in healthy children.

RC213-03 Pediatric Heart Transplant Patients Demonstrate Altered Regional Left and Right Ventricular Velocities

Monday, Nov. 26 9:00AM - 9:10AM Room: E353B

Participants
Haben Berhane, Chicago, IL (*Presenter*) Nothing to Disclose
Alexander Ruh, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Joshua D. Robinson, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Cynthia K. Rigsby, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Michael Markl, PhD, Chicago, IL (*Abstract Co-Author*) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;
Nazia Husain, MBBS,MPH, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Endomyocardial biopsy is the gold standard for rejection monitoring after heart transplantation (Tx) at the expenses of invasiveness, cost and possible sampling errors. Alternatively, MRI has emerged as a potential noninvasive tool for assessing changes in left ventricular (LV) adult Tx graft structure (e.g. T2-mapping) and function (e.g. strain). However, few have studied these findings in children or explored post-Tx right ventricular (RV) function. Our goal was to apply MRI tissue phase mapping (TPM), which quantifies 3-directional biventricular myocardial velocities, to investigate LV and RV mechanics and interventricular dyssynchrony in pediatric Tx patients compared to healthy controls.

METHOD AND MATERIALS

Cardiac MRI, including TPM, was performed on 1.5T system Siemens Aera for 17 pediatric Tx patients (age: 16.1 ± 2.9 yrs, 9 males, time after Tx: 5±5 yrs) and 10 healthy controls (age: 15.3 ± 2.5 yrs, 4 males). TPM was acquired during breath-holding in short axis orientation at base, mid, and apex (TR=20.8-24.8 ms, in-plane voxel size=1.5-2.5 mm2, slice thickness=5-8 mm, venc = 25 cm/s). TPM data analysis involved endo- and epicardium contouring and the transformation of the acquired velocities into radial, circumferential, and long-axis motion components (vr, vφ, vz). Peak systolic and diastolic vr and vz were calculated from time-velocity curves and mapped onto an extended 16+10 AHA segment LV-RV model. Peak velocity twist was quantified from the difference in vφ between base and apex. Cross-correlations between slice-averaged LV and RV velocity time courses were used to assess interventricular dyssynchrony.

RESULTS

Global (averaged over segments) peak systolic and diastolic vz in the LV and RV were significantly lower in Tx patients compared to controls ($p<0.01$). RV peak twist showed significant reduction in systole ($p<0.01$) and diastole ($p<0.05$). Tx patients also showed increased interventricular circumferential ($p<0.01$) and long-axis ($p<0.05$) dyssynchrony compared to controls. Moreover, diastolic LV peak vr was inversely correlated to time after Tx ($r=-0.52$, $p=0.03$).

CONCLUSION

The findings of this feasibility study indicate the potential of TPM for noninvasive monitoring of graft function.

CLINICAL RELEVANCE/APPLICATION

Tissue phase mapping can detect alterations in LV and RV myocardial velocities in pediatric Tx patients and may add to noninvasive monitoring of graft function.

RC213-04 First Experience of Application in Pediatric Cardiac CT: 640-Slice Volume Computed Tomography Angiography in Children with Congenital Heart Disease

Monday, Nov. 26 9:10AM - 9:20AM Room: E353B

Participants
Djuraeva Nigora, PhD,DSc, Tashkent, Uzbekistan (*Presenter*) Nothing to Disclose
Vaxidova Nargiza, Tashkent, Uzbekistan (*Abstract Co-Author*) Nothing to Disclose
Amirxamzaev Aybek, MD, Tashkent, Uzbekistan (*Abstract Co-Author*) Nothing to Disclose
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Ikramov Adham, Tashkent, Uzbekistan (*Abstract Co-Author*) Nothing to Disclose
Abralov Xakimjon, Tashkent, Uzbekistan (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

to evaluate the quality of the images and radiation dose (RD) in children with congenital heart disease (CHD) with a heart rate of up to 180 beats/min.

METHOD AND MATERIALS

48 patients from 1 month to 18 years, weighting 4,5 to 52 kg, heart rate 81-172 (117.3±27.26) were examined. The amount of contrast agent (CA) was 1-1.5 ml/kg, kV80/100, mA200/350, the effective radiation dose (ERD) was 0.9-3.2mSv. ERD was calculated using DLP (mGy*cm) multiplied to e (e is the dose coefficient for the corresponding anatomical region (0.017mSv/mGy*cm)) and multiplied by the age coefficient. Patients were divided: A - HR of up to 120beats/min(one volume scanning) (27patients 56,25%), B-HR over 120 beats/minute (two volumes) (21patients 43,75%). 5 patients underwent postoperative control CTA of the heart.

RESULTS

RD in group A-1,57±0,62mSv; B-1,84±0,58, mean dispersion within the group was 0,36, intergroup dispersion 0.018, total dispersion 0.387, and the empirical correlation ratio was 0.22, which clearly demonstrates the weak effect of heart rate on the choice of the scan mode. The CTA results coincided with the intraoperative in 100% of cases.

CONCLUSION

Volume CTA of the heart in children can adapt heart rate even 180 beats/min and provides high image quality with low RD up to 0.92mSv.

CLINICAL RELEVANCE/APPLICATION

Cardiac CT in pediatric: Row-640 MSCT recomending in diagnosting and planning of surgical treatment.

RC213-05 Automatic Computation of Iso-Perimetric Ratio as Quantitative Index for Degree of Left Ventricular Trabeculation in Adolescents and Young Adults: Potential Indicator for Left Ventricular Non-Compaction

Monday, Nov. 26 9:20AM - 9:30AM Room: E353B

Participants
Amol Pednekar, PhD, Houston, TX (*Presenter*) Nothing to Disclose
Siddharth P. Jadhav, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The purpose of this study is to assess the discriminating power of fractal analysis and perimetric ratio to distinguish between pathologic left ventricular noncompaction (LVNC) and physiologic variant of hyper-trabeculation in bright blood cine balanced steady-state free precession (bSSFP) MR images at end-diastole using an automated analysis tool in a pediatric population.

METHOD AND MATERIALS

Short-axis stack of end-diastolic balanced SSFP images from 26 (age 15±4.9, range 8-31yrs, 21m) LVNC positive (non-compacted(NC)/compacted(C) length ratio (LR)>2.3 and mass ratio(MR)>35%), 20 (age 16±6.6, range 6-35yrs, 12m) hyper trabeculated (NC/C LR<2.3 and MR>35%), and 18 (age 16±5.5, range 6-28yrs, 12m) LVNC negative (NC/C LR<2.3 and MR<35%, anomalous coronary origins or Kawasaki) patients with normal anatomy, preload and afterload, were analyzed with an automated tool. Manually drawn epicardial contours were used to automatically segment the blood pool and extract endocardial boundaries. Using blood pool edges and endocardial contour fractal dimension (FD) and iso-perimetric ratio (PR) i.e. ratio of blood pool to endocardial contour perimeter, are computed for each slice. Mean of top half - 50 percentile FD (mthFD) and cumulative PR (cPR) were used as geometric markers to quantify degree of hyper-trabeculation. Rays normal to and from epicardial contour are generated to compute Endo-blood/Epi-Endo length ratios. The 95 percentile of length ratios in apical third is used as LR.

RESULTS

Both NC/C LR and MR increase with degree of trabeculation as a continuous spectrum. Values for both mthFD and cPR were statistically significantly higher ($p<0.0001$) for LVNC +ve compared to LVNC -ve subjects. However, mthFD values have overlap between LVNC +ve and -ve subjects.Values for mthFD and cPR for patients with MR>35 and LR<2.3 overlap with both LVNC +ve and LVNC -ve subjects.

CONCLUSION

This study indicates that automatic computation of cPR can be used for quick assessment of degree of trabeculation. This quantification can serve as potential indication for LVNC which can be assessed further by manual drawings of epi- and endocardial contours to check against established diagnostic criteria

CLINICAL RELEVANCE/APPLICATION

Automatic computation of cumulative iso-perimetric ratio as quantitative index for degree of trabeculation is feasible and can serve as a potential indicator for further evaluation of LVNC.

RC213-06 Splenic Switch-Off and Hemodynamic Changes in Pediatric Adenosine Stress Perfusion Cardiac Magnetic Resonance Imaging

Monday, Nov. 26 9:30AM - 9:40AM Room: E353B

Participants
Kenneth K. Cheung, MBBS,FRCR, Toronto, ON (*Presenter*) Nothing to Disclose
Lars Grosse-Wortmann, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Mike Seed, MBBS, FRCR, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Shi-Joon Yoo, MD, Toronto, ON (*Abstract Co-Author*) Owner, 3D HOPE Medical; CEO, IMIB-CHD; Spouse, CEO, 3D PrintHeart;

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PURPOSE

Adenosine stress perfusion cardiac magnetic resonance imaging (CMR) is well established to be useful in detecting adult coronary artery disease. A positive drug response to adenosine is signified by an increase in heart rate and change in blood pressure (haemodynamic response). 'Splenic switch-off' (SSO) has recently been proposed as a new marker for drug response in adults. Due to the different disease spectrum and physiology, the use of adenosine as a stressor agent in children is not well established. By observing the prevalence of haemodynamic response and SSO, we aim to investigate the utility of adenosine as a stressor agent in the paediatric population.

METHOD AND MATERIALS

Retrospective analysis of 52 studies in 48 patients of stress perfusion CMR from July 2014 to March 2018 using adenosine was performed. Visual and semi-quantitative analysis of SSO was performed. Haemodynamic changes (blood pressure and heart rate changes of more than 20% of baseline rates) and imaging findings in the stress perfusion CMR examination were correlated with presence of SSO.

RESULTS

Splenic switch-off was visualised in 46.2% (24/52) cases, and was present in 66.7% (16/24) of patients with positive haemodynamic response. Both rates were lower than the reported rates in adults. Splenic switch-off was not associated with haemodynamic response (p=0.22). Presence of inducible stress perfusion defects was associated with positive SSO (p=0.01), but not with positive haemodynamic response (p=0.47). The optimal threshold for SIR as an indicator of SSO was 0.44 (sensitivity = 91.7%, specificity=89.3%, AUC=0.94). Use of general anaesthesia (GA) was associated with less overall haemodynamic response (p=0.001), a drop in systolic blood pressure (p=0.01) and reduced increase in heart rate (p<0.001) on adenosine infusion, but was not associated with absence of splenic switch-off (p=0.25).

CONCLUSION

Presence of inducible stress perfusion defects was associated with positive splenic switch-off, which may signify adequate stress response. There was a lower rate of splenic switch-off and absent association with haemodynamic response in children. Children under GA displayed less overall haemodynamic response to adenosine.

CLINICAL RELEVANCE/APPLICATION

Adenosine may not be a reliable stressor agent in children. A lower incidence of splenic-switch off may infer a higher incidence of understress even with a standard pharmacological protocol.

RC213-07 Imaging of Tetralogy of Fallot

Monday, Nov. 26 9:40AM - 10:00AM Room: E353B

Participants
Randolph K. Otto, MD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the classic imaging findings in tetralogy of Fallot. 2) Recognize, differentiate, and describe common variants and anomalies with this syndrome. 3) Understand requisite imaging data used for pre-surgical or pre-interventional planning both initially and in the post-operative patient undergoing surveillance imaging. 4) List the appropriate modality and salient imaging features for reporting. 5) Review current management recommendations.

RC213-08 Lymphatic System in Congenital Heart Disease

Monday, Nov. 26 10:20AM - 10:40AM Room: E353B

Participants
David M. Biko, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Improve knowledge of MR techniques to image the lymphatic system in pediatric congenital heart disease. 2) Understand the relationship between the complications of surgical palliation of congenital heart disease and the lymphatic system. 3) Expand knowledge of lymphatic disorders and how they relate to congenital heart disease.

RC213-09 PedsCheXNet: Deep Learning-Based Automated Detection of Pediatric Thoracic Diseases

Monday, Nov. 26 10:40AM - 10:50AM Room: E353B

Participants
Tae Kyung Kim, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Paul H. Yi, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Ji Won Shin, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Jinchi Wei, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
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Ferdinand K. Hui, MD, Richmond, VA (*Abstract Co-Author*) Speakers Bureau, Terumo Corporation Speakers Bureau, Penumbra, Inc Stockholder, Blockade Medical Inc
Cheng Ting Lin, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of this study was to develop and test the performance of a deep convolutional neural network (DCNN) called PedsCheXNet for the automated detection of pediatric thoracic diseases.

METHOD AND MATERIALS

We obtained a subset of 5941 (5.2%) pediatric chest radiographs (CXRs) from the NIH ChestX-ray14 database, the largest publicly-available CXR database containing 112,120 CXRs labeled with 14 thoracic diseases. For each thoracic disease of interest, the 5941 pediatric CXRs were randomly split into training (70%), validation (10%), and test (20%) datasets. In total, we evaluated 11 diseases (Table 1), while excluding fibrosis, hernia, and pneumonia due to low number of positive cases (<30). The CXRs were used to train, validate, and test the ResNet-18 DCNN pretrained on ImageNet for each disease of interest. During each training epoch, each image was augmented by random rotations, cropping, and horizontal flipping. Receiver operating characteristic (ROC) curves with area under the curve (AUC) and standard diagnostic measures were used to evaluate the DCNNs' performance on the test datasets.

RESULTS

Our DCNNs trained on only pediatric patients from the NIH ChestX-ray14 database for detection of thoracic pathology achieved AUCs ranging from 0.66 for atelectasis to 0.94 for pneumothorax, which are comparable to prior state-of-the-art work using the entire NIH ChestX-ray14 database (Figure 1). In some cases, such as pneumothorax, our AUC outperformed that achieved by prior work utilizing the entire database. Accuracy of each DCNN ranged from a low of 81% for infiltrate to a high of 98% for edema; in fact, infiltrate was the only DCNN to have accuracy <90%.

CONCLUSION

PedsCheXNet is our in-house DCNN specifically trained to detect thoracic pathology utilizing a pediatric subset of the NIH ChestX-ray14 database. PedsCheXNet achieved similar overall performance and improved accuracy for certain diagnoses compared to prior DCNNs utilizing the entire database, demonstrating that DCNNs can optimize diagnostic accuracy when stratifying by age.

CLINICAL RELEVANCE/APPLICATION

We have developed a deep convolutional neural network specifically trained to detect pediatric thoracic pathology utilizing a subset of the NIH ChestX-ray14 database with AUC as high as 0.94 for pneumothorax.

RC213-10 Quantifying Dynamic Tracheal Collapse in Neonates with Bronchopulmonary Dysplasia Using Respiratory-gated MRI

Monday, Nov. 26 10:50AM - 11:00AM Room: E353B

Participants
Nara S. Higano, PhD, Cincinnati, OH (*Presenter*) Nothing to Disclose
Alister Bates, PhD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Robert J. Fleck JR, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Andrew Hahn, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Sean B. Fain, PhD, Madison, WI (*Abstract Co-Author*) Research Grant, General Electric Company Research Consultant, Marvel Medtech, LLC
Paul Kingma, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
Erik Hysinger, MD, Cincinnati, OH (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Extremely preterm infants face serious chronic lung disease (bronchopulmonary dysplasia, BPD), often complicated by comorbid dynamic tracheal collapse (tracheomalacia, TM). Tracheostomy can be used to bypass segments of the collapsing airway or to provide long-term positive pressure to improve respiratory mechanics in patients with TM or who otherwise struggle to wean from intubated support. Bronchoscopy is the gold standard for diagnosis of airway collapse but requires sedation and increased risk to patients. We present an innovative MRI technique for quantitative evaluation of dynamic tracheal collapse in non-sedated neonates.

METHOD AND MATERIALS

High-resolution (0.7mm isotropic) 3D radial ultrashort echo-time (UTE) MRI was obtained in 23 neonates (11 severe BPD, 1 moderate, 5 mild, 6 non-BPD control [4 preterm control]; gestational age 28±5 wks) on a NICU-sited 1.5T neonatal-sized scanner. Images were retrospectively gated to end-inspiration (EI) and end-expiration (EE) using the respiratory-modulated time-course of the MRI k-space center. Tracheas were segmented from gated images, and airway surfaces were geometrically analyzed to calculate minimum minor:major ratios of tracheal diameter (Rmin) at EI and EE along the trachea. MRI values of Rmin were compared to preterm subjects' clinical need for tracheostomy (required by 7 severe patients 15±13 days after MRI).

RESULTS

EI and EE images demonstrated clear changes in tracheal lumen size during respiration. Severe BPD subjects had significantly smaller values of Rmin at EE (0.69±0.18) than combined control, mild, and moderate subjects (0.80±0.04; P=0.042) and also exhibited a larger Rmin range. Values of Rmin at EE significantly correlated with preterm subjects' need for tracheostomy (0.62±0.20 and 0.80±0.04 for patients who did and did not receive tracheostomy, respectively; P=0.002).

CONCLUSION

This work demonstrates an innovative, quantitative MRI assessment of dynamic tracheal collapse in neonates with BPD, without

requiring invasive procedures, sedation, or ionizing radiation. Excessive tracheal collapse on MRI was predictive of later tracheostomy requirement and thus has potential to be used in a comprehensive clinical evaluation of neonatal BPD.

CLINICAL RELEVANCE/APPLICATION

MRI of neonates with BPD can quantify dynamic tracheal collapse, is predictive of eventual tracheostomy, and advantageously is non-invasive, non-ionizing, and does not require sedation.

RC213-11 Kids Don't Follow the Rules: Underperformance of E-FAST in the Pediatric Population for Detection of Pneumothorax

Monday, Nov. 26 11:00AM - 11:10AM Room: E353B

Participants
Serge G. Srour, DO , Wichita, KS (*Presenter*) Nothing to Disclose
Donald Vasquez, MD, Wichita, KS (*Abstract Co-Author*) Nothing to Disclose
Gina Berg, PhD, Wichita, KS (*Abstract Co-Author*) Nothing to Disclose
Kamran Ali, MD, Wichita, KS (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Chest trauma is a common cause of pneumothorax in the pediatric population and is often seen associated with rib fractures and pulmonary contusions. Multiple modalities are currently used to evaluate the chest offering variable sensitivities for pneumothorax detection including CT, ultrasound, and chest x-ray. CT is currently the gold-standard for pneumothorax detection, however this modality delivers a higher radiation dose. Therefore radiation-related increased risk of cancer must be outweighed with the potential benefits. Chest ultrasound has been gaining popularity due to reports of superior sensitivity compared to the chest radiograph and it offers a desirable safety profile. The current literature describes sensitivities ranging from 58.9%-98.2%. Despite the growing body of evidence supporting its use in the adult patient, there is a paucity of supporting data in the pediatric population. Therefore we performed a single institution retrospective analysis of chest ultrasound in the trauma patient.

METHOD AND MATERIALS

This was an Institutional Review Board approved retrospective medical record review of pediatric trauma patients that received extended focused assessment with sonography (EFAST) between May 1, 2016 and September 21, 2017. Mean comparison was evaluated using an independent samples t-test with .05 defined as statistically significant. Statistical analysis was performed including the sensitivity, specificity, and accuracy.

RESULTS

403 of the 750 pediatric trauma patients identified underwent EFAST exam as part of the initial work up in the trauma bay. There were 226 patients (56%) whose EFAST findings were confirmed with either a chest x-ray or a CT scan. The remaining 177 (44%) were confirmed by observation and clinical outcome. A total of 11 pneumothoraces were observed of which 6 were were falsely negative on the chest ultrasound compatible with 45.5 % sensitivity and 99.2 % sensitivity.

CONCLUSION

Although there were only a total of 11 confirmed pneumothorax cases (2.7%), chest ultrasound demonstrated a low sensitivity in the pediatric population (45.5%). Further research in the pediatric population is needed to reproduce the findings described in the adult population. Additionally there is a need for a standardized protocol which optimizes the sensitivity while maintaining a time sensitive exam in the trauma setting.

CLINICAL RELEVANCE/APPLICATION

Pediatric E-fast underperforms in excluding pneumothorax.

RC213-12 Evaluation of Respiratory Gated Stationary Digital Chest Tomosynthesis in Pediatric Cystic Fibrosis Patients

Monday, Nov. 26 11:10AM - 11:20AM Room: E353B

Participants
Elias T. Gunnell, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose
Christy Inscoe, MS, BS, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
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Otto Zhou, PhD, Chapel Hill, NC (*Abstract Co-Author*) Board of Directors, XinRay Systems Inc
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PURPOSE

Cystic fibrosis is a common disease in the pediatric population reliant on imaging for accurate disease assessment. During imaging extended breath holds can be challenging for younger patients. The primary goal of this study was to perform the first clinical evaluation of our prospective respiratory gated stationary digital chest tomosynthesis (RG s-DCT) system using a carbon nanotube (CNT) x-ray source array.

METHOD AND MATERIALS

Pediatric CF patients undergoing indicated CXR were recruited for this study. Following CXR, patients underwent RG s-DCT using our CNT x-ray source array. Prior to imaging, the respiratory signal was obtained (DTU300 BIOPAC system) and a gating window was

selected at the inspiratory peak. Accuracy of gating was determined by comparing the relative respiratory trace height with the breath with the maximum peak height of the 29 projections. Retrospective analysis was used to remove projections with significant motion. Custom Matlab code measured diaphragm sharpness to evaluate between original s-DCT sets and motion corrected sets. A reader study was performed with three pediatric radiologists to compare CXR and s-DCT. Image quality, motion blur, and CF pathology was assessed. A Wilcoxon sign-rank test was used for statistical analysis.

RESULTS

A total of thirteen pediatric patients were successfully imaged using our system. The average age of the patients was 9.6 +/- 3.4 years. The mean peak breath ratio was 0.89 +/- 0.06. Pixel widths of the diaphragm border were 27.08 +/- 6.20 for the original s-DCT set and 21.31 +/- 6.94 for the corrected set. Comparison yielded a t-value of -3.18, p-value of 0.0079. Summed quality and pathology assessment scores were significantly improved on motion corrected images, z-value-2.76 and p-value 0.006. Blur was also significantly decreased in corrected images, z-value -3.12 and p-value 0.002. CXR scores were significantly higher than s-DCT.

CONCLUSION

Prospective respiratory gated tomosynthesis imaging is possible using our CNT RG s-DCT system. Precision gating and analysis of gating allows for significantly reduced respiratory motion blur. Quality and CF pathology scores determined by reader study are improved in motion corrected sets, however more work is required to reach the quality found on conventional imaging.

CLINICAL RELEVANCE/APPLICATION

Respiratory gated s-DCT has the potential to be an effective method of performing CF imaging without the need for a breath hold.

RC213-13 Magnetic Resonance T1 Mapping And Ultrashort Echo Time (UTE) Magnetic Resonance Imaging (MRI) of the Lung in the Evaluation of Early Regional Pulmonary Disease in Pediatric Cystic Fibrosis (CF) Patients: A Cross-Sectional Pilot Study

Monday, Nov. 26 11:20AM - 11:30AM Room: E353B

Participants
Maryam Ghadimi Mahani, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Fatima Neemuchwala, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Ramon Sanchez, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Eunjee Lee, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Yuxi Pang, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Samya Z. Nasr, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Craig J. Galban, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
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Chris A. Flask, PhD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To compare the normalized T1 (nT1) relaxation metric and UTE MRI of the lungs in early pediatric pulmonary CF disease with healthy subjects

METHOD AND MATERIALS

In this institutional review board- approved prospective study 5 CF patients (mean 11 ± 3 years) with normal spirometry tests and 5 age and sex -matched healthy subjects (mean 11 ± 4 years) were recruited. Signed informed assents/consents were obtained. Subjects completed a non-contrast chest MRI, using UTE and T1 mapping (modified look-locker inversion recovery) of the lung. Spirometry and CF Respiratory Symptom Diary (CFRSD) questionnaire were obtained on a same day. CF MRI scoring (Eichinger) was performed by two experienced pediatric radiologists blinded to the patients' clinical information. T1 mapping was used as a surrogate for perfusion images for functional scoring. A region of interest analysis on T1 mapping images was used to calculate the mean nT1 values for all lobes. The primary outcome was to assess the differences in mean nT1 and MRI scores between two groups. Correlation between the mean nT1 and MRI scoring with spirometry and CFRSD were evaluated. Reproducibility of T1 mapping images was evaluated by repeating right lung MRI. Statistical analysis was performed by t-test to compare means. A normality assumption was validated by a Shapiro-Wilk normality test. Pearson, Spearman's, and Kendall's correlation tests were conducted to evaluate relationship between two variables. $P < 0.05$ were considered significant.

RESULTS

Mean nT1 values were lower in CF patients compared to healthy subjects ($p<0.05$). Repeat T1 mapping results of the lung were similar to the first results ($p> 0.1$). Negative correlation between mean nT1 and CFRSD was found (r -0.94, p 0.05). No correlation between mean nT1 and spirometry results was found. Morphologic MRI scoring in CF and healthy group was similar (p 0.11), yet the T1 scoring was different (p 0.03)

CONCLUSION

MR T1 mapping of lung was different between our CF patients with normal spirometry and healthy subjects. Combining T1 mapping with a morphologic MRI assessment of the lung can detect early pulmonary disease in pediatric CF patients without risk of radiation or contrast agent.

CLINICAL RELEVANCE/APPLICATION

MR T1 mapping of the lung detects early regional pulmonary CF disease on MRI, before morphologic changes. This can be used to individualize treatment and introduce therapies before irreversible lung damage occurs.

RC213-15 Pediatric Cardiac Masses

Monday, Nov. 26 11:40AM - 12:00PM Room: E353B

Participants
Demetrios A. Raptis, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1. Review the more commonly encountered pediatric cardiac masses2. Distinguish rare tumors and mimickers from the common pediatric cardiac tumors3. Develop an age and location based approach for evaluation of cardiac tumors

LEARNING OBJECTIVES

1) Review the commonly encountered cardiac masses in the pediatric patient and their CT and MRI imaging findings. 2) Develop a differential diagnosis for pediatric cardiac masses based on age, location, and imaging findings. 3) Discuss tips for applying CT and MRI to evaluate pediatric cardiac masses.

MSMC22

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

Monday, Nov. 26 10:30AM - 12:15PM Room: S406A

CA CT

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

Participants
Jill E. Jacobs, MD, New York, NY (*Director*) Nothing to Disclose
Charles S. White, MD, Baltimore, MD (*Moderator*) Consultant, Koninklijke Philips NV

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LEARNING OBJECTIVES

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

Sub-Events

MSMC22A Coronary Atherosclerosis I

Participants
Geoffrey D. Rubin, MD, Durham, NC (*Presenter*) Consultant, Fovia, Inc; Consultant, HeartFlow, Inc; Consultant, General Electric Company;

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMC22B Coronary Atherosclerosis II

Participants
Karin E. Dill, MD, Worcester, MA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMC22C Valves and Cardiac Function

Participants
Suhny Abbara, MD, Dallas, TX (*Presenter*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

LEARNING OBJECTIVES

View learning objectives under main course title.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Suhny Abbara, MD - 2014 Honored EducatorSuhny Abbara, MD - 2017 Honored Educator

SSC01

Science Session with Keynote: Cardiac (Coronary Artery Disease: Practice and Prognosis)

Monday, Nov. 26 10:30AM - 12:00PM Room: S504CD

CA CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Yeon Hyeon Choe, MD, PhD, Seoul, Korea, Republic Of (*Moderator*) Nothing to Disclose
Gregory Kicska, MD, PhD, Seattle, WA (*Moderator*) Nothing to Disclose

Sub-Events

SSC01-01 Cardiac Keynote Speaker: Prognostic Role of Coronary CT Angiography

Monday, Nov. 26 10:30AM - 10:50AM Room: S504CD

Participants
Gregory Kicska, MD, PhD, Seattle, WA (*Presenter*) Nothing to Disclose

SSC01-03 The Intermediate-Term Impact of Coronary CT Compared to Stress Echocardiography During Risk Assessment in Patients Undergoing Liver Transplantation: A Prospective Follow-Up Study in a Consecutive Patient Population

Monday, Nov. 26 10:50AM - 11:00AM Room: S504CD

Participants
Patricia Tischendorf, Frankfurt, Germany (*Presenter*) Nothing to Disclose
Claudia Frellesen, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Christophe Arendt, MD, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Ralf W. Bauer, MD, Frankfurt, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG; Speakers Bureau, General Electric Company

PURPOSE

Aim of this study was to evaluate the intermediate-term impact of coronary Computed Tomography (cCT) versus Stress Echocardiography (STE) as a cardiac risk stratification prior to liver transplantation in a consecutive patient population with unknown coronary artery disease (CAD).

METHOD AND MATERIALS

From 2014 to 2017, 139 consecutive patients, who underwent cCT or STE as a part of the institutional liver transplantation evaluation procedure, were enrolled unless they met the predefined exclusion criteria. 67 patients underwent non-enhanced CaSc followed by prospectively ECG-triggered sequential coronary CTA, in addition to the Agatston-Score, we used the CAD-RADS classification for risk assessment. 72 patients were examined by STE. Follow-up information concerning the primary endpoint, consist of cardiac or non-cardiac death and the combined endpoint of cardiac death, myocardial infarction, revascularisation and stroke was obtained from general practitioners, or treating hospitals, respectively.

RESULTS

The mean follow-up period was 569±442 days. During this time, 40 primary endpoints and 7 combined endpoints occurred. There was no significant difference in the incidence of primary endpoints in patients with pos. cCT or STE compared to patients without a pathological finding. In patients with pos. cCT, significantly more combined endpoint were observed than in the control group (p=0.0004). Moreover, the absence of a pathological finding in cCT or STE was shown to exhibit high negative predictive value. On multivariate analysis, Child-Pugh C liver status was the strongest independent predictor for an primary endpoint, with a 5-fold increased risk. While pos. cCT was the strongest independent predictor for an combined entpoint.

CONCLUSION

cCT and STE both provide excellent risk stratification and intermediate-term prognostic value in patients with unknown CAD. cCTA shows promising results in the initial work-up of unselected liver transplantation candicates with perviously unknown CAD. Patients with positive findings in cCT were successfully routed towards revascularization leading to a non-significant difference concerning the primary endpoint combared to patients with neg. cCT (p=0.47).

CLINICAL RELEVANCE/APPLICATION

Different cardiac imaging methods need to be investigated to avoid cardiac complications in patients undergoing liver transplantation, because the prevalence of asymptomatic CAD is relatively high in this population.

SSC01-04 Utilization of Coronary CT Angiography in Private Offices and Hospitals: Reversal of Earlier Trends and Implications for Radiologists

Monday, Nov. 26 11:00AM - 11:10AM Room: S504CD

Participants
David C. Levin, MD, Philadelphia, PA (*Presenter*) Consultant, HealthHelp, LLC; Board Member, Outpatient Imaging Affiliates, LLC
Laurence Parker, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Ethan J. Halpern, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Vijay M. Rao, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess recent trends in utilization of coronary CT angiography (CCTA), based upon place-of-service and provider specialty.

METHOD AND MATERIALS

The nationwide Medicare Part B Physician/Supplier Procedure Procedure Summary Master Files for 2006-2016 were the data source. CPT-4 codes for CCTA were selected. The files provided procedure volume for each code. Utilization rates per 100,000 Medicare fee-for-service enrollees were then calculated. Medicare's place-of-service codes were used to identify CCTAs performed in private offices, hospital outpatient departments (HOPDs), emergency departments (EDs), and inpatient settings. Physician specialty codes were used to identify CCTAs interpreted by radiologists, cardiologists, and all other physicians as a group. Because these files represent an entire population count, sample statistics are not required.

RESULTS

The overall CCTA utilization rate per 100,000 Medicare enrollees rose abruptly from 99.1 in 2006 to 210.3 in 2007, but then progressively dropped to 107.1 by 2013. However, thereafter it rose each year, reaching 131.0 in 2016. The private office CCTA utilization rate increased abruptly from 70.3 in 2006 to a peak of 150.1 in 2007, but thereafter dropped rapidly to 39.5 in 2016. The HOPD rate rose from 22.9 in 2006 to 46.1 in 2007, then declined to 36.1 by 2010. However, it thereafter increased progressively to 69.8 in 2016. The ED rate increased continually from 0.4 in 2006 to 5.3 in 2016. Among inpatients, the rate was 11.0 in 2007 and remained relatively unchanged through 2013. But in the 3 subsequent years, it increased to 16.4 by 2016. Radiologists' CCTA market share in the 4 venues in 2016 were: offices 44%, HOPDs 62%, EDs 85%, inpatients 66%. Radiologists' overall share had been 32% in 2007 (the peak year), compared with 60% for cardiologists. However, by 2016, radiologists' overall share was 58%, compared with 38% for cardiologists.

CONCLUSION

After years of declining CCTA utilization, the rate is now increasing, primarily in hospital settings. The private office rate has declined sharply. In a noteworthy reversal of another earlier trend, radiologists currently predominate in this procedure.

CLINICAL RELEVANCE/APPLICATION

After years of decline, the frequency of use of CCTA appears to be increasing, especially in hospital settings and among radiologists.

SSC01-05 Radiomics-Based Machine Learning Differentiates Early from Advanced Coronary Lesions: A Proof of Concept

Monday, Nov. 26 11:10AM - 11:20AM Room: S504CD

Awards
Trainee Research Prize - Fellow

Participants
Marton Kolossvary, MD, Budapest, Hungary (*Presenter*) Creator and Developer - Radiomics Image Analysis
Julia Karady, MD, Budapest, Hungary (*Abstract Co-Author*) Nothing to Disclose
Yasuka Kikuchi, MD, Sapporo, Japan (*Abstract Co-Author*) Nothing to Disclose
Alexander Ivanov, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose
Christopher L. Schlett, MD, MPH, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael T. Lu, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Borek Foldyna, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Hugo Aerts, PhD, Boston, MA (*Abstract Co-Author*) Stockholder, Sphera Inc
Pal Maurovich-Horvat, MD, PhD, Pecs, Hungary (*Abstract Co-Author*) Nothing to Disclose
Udo Hoffmann, MD, Boston, MA (*Abstract Co-Author*) Institutional Research Grant, Kowa Company, Ltd; Institutional Research Grant, Abbott Laboratories; Institutional Research Grant, HeartFlow, Inc; Institutional Research Grant, AstraZeneca PLC

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PURPOSE

Coronary plaques can be classified into the following histological categories: adaptive and pathological intimal thickening (AIT, PIT), fibrous plaque (Fib), early and late fibroatheroma (EFA, LFA) and thin-cap fibroatheroma (TCFA). Advanced atherosclerotic lesions (EFA, LFA, TCFA) carry higher risk versus early plaques (AIT, PIT, Fib). We sought to assess if radiomic analysis of coronary CTA is superior to conventional CTA plaque assessment performed by experts to identify early vs. advanced lesions and to classify plaques into the six histological categories.

METHOD AND MATERIALS

Coronary cross-sections of 95 plaques in 7 ex-vivo hearts were analyzed. Overall, 607 histology slides and coronary CTA cross-sections were co-registered and analyzed in random order. We derived 1015 radiomic features from each CTA plaque cross-section. Principal components accounting for 90% of the variation were derived. A multivariate k-nearest neighbors machine learning (ML) model was built based-on these parameters. We calculated the diagnostic accuracy of the radiomics-ML model and plaque attenuation pattern classification by experts to differentiate early from advanced atherosclerotic plaques and to classify CTA

cross-sections into the six histological categories. We compared the diagnostic accuracies between the models using the McNemar-test.

RESULTS

After excluding sections with heavy calcium (n=32) and no visible atherosclerotic plaque on CTA (n=134), we analyzed 411 cross-sections of which 30.4% (134/441) were advanced atherosclerotic lesions. The radiomics-ML model which included 13 parameters correctly differentiated early from advanced plaques with a diagnostic accuracy of 82.3%, whereas the expert classification had a diagnostic accuracy of 76.0% (p=0.001). Our ML model was able to classify 63.0% of the CTA cross-sections into the six histological categories correctly.

CONCLUSION

Radiomics-based ML outperforms experts to identify advanced atherosclerotic lesions on coronary CTA. However, ML-based classification of coronary plaques into the corresponding six histological categories has moderate accuracy. Further analysis with larger samples size and validation is needed.

CLINICAL RELEVANCE/APPLICATION

Radiomics-based machine learning could increase the diagnostic accuracy of coronary CT angiography to identify gold-standard histological entities.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Udo Hoffmann, MD - 2015 Honored Educator

SSC01-06 Diagnostic Accuracy of Low Dose Dynamic Stress Computed Tomography Myocardial Perfusion (CTP) in Intermediate-to-High-Risk Patients for Suspected Coronary Artery Disease (CAD)

Monday, Nov. 26 11:20AM - 11:30AM Room: S504CD

Participants
Andrea Baggiano, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
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Giuseppe Muscogiuri, MD, Charleston, SC (*Presenter*) Nothing to Disclose
Marco Guglielmo, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

The aim of this study is to evaluate the incremental diagnostic value of stress CTPdyn over CCTA in intermediate to high risk patients scheduled for invasive coronary angiography (ICA) plus clinically indicated invasive fractional flow reserve (FFR) for suspected CAD by using a low dose acquisition protocol with last generation of whole-heart single beat CT scanner.

METHOD AND MATERIALS

Consecutive symptomatic patients with intermediate-to-high pre-test probability of CAD and scheduled for clinically indicated ICA+FFR, were prospectively enrolled. All patients underwent rest-CCTA followed by stress-CTP protocol with adenosine and with injection of 0.7 ml/kg of iodixanol 320 as additional test. CCTA and CTP were defined positive for the presence of >= 50% stenosis and for the presence of subendocardial hypoenhancement encompassing >= 25% of transmural myocardial thickness within a specific coronary territory, respectively. At ICA, obstructive CAD was defined by the presence of >= 50% stenosis and hemodynamically significant CAD was defined by the presence of > 50% stenosis on left main coronary artery, severe (> 80%) or occlusive stenosis or FFR < 0.80. The additive value of CTP versus CCTA alone to rule out the presence of hemodynamically relevant stenosis was assessed on a per-vessel basis.

RESULTS

Forty-eight patients [mean age: 65 ± 8 years, male: 35 (73%)] were included in our study. Obstructive CAD was found in 38% (54/144) of vessels and in 73% (35/48) of patients. Hemodynamically significant CAD was present in 23% (36/144) of vessel and in 54% (26/48) of patients. In a vessel-based model, CCTA alone and CCTA+CTPdyn showed a sensitivity, specificity, negative predictive value, positive predictive value and diagnostic accuracy of 92%, 64%, 96%, 46%, 71% and 89%, 89%, 96%, 76%, 89%, respectively. CCTA+CTPdyn showed a significant improvement in specificity (p: <0.001), positive predictive value (p: 0.002) and diagnostic accuracy (p: <0.001) to rule out haemodynamically significant CAD as compared to CCTA alone. The mean radiation exposure due to CTPdyn alone is 5.13 ± 1.51 mSv.

CONCLUSION

In patients with intermediate-to-high pre-test likelihood of CAD, low dose dynamic CTP had incremental value over CCTA alone to diagnose the presence of hemodynamically significant CAD.

CLINICAL RELEVANCE/APPLICATION

Combination of CTP an CCTA can improve diagnosis of hemodynamically significant CAD.

SSC01-07 Triple-Rule-Out CT Angiography in Low-intermediate and High Risk Patients with Acute Chest Pain: Impact on Patient Management

Monday, Nov. 26 11:30AM - 11:40AM Room: S504CD

Participants
Christian Tesche, MD , Munich, Germany (*Presenter*) Nothing to Disclose
Katharina Otani, PhD, Tokyo, Japan (*Abstract Co-Author*) Employee, Siemens AG
Julian L. Wichmann, MD, Frankfurt, Germany (*Abstract Co-Author*) Speaker, General Electric Company; Speaker, Siemens AG
Carlo N. De Cecco, MD, PhD, Atlanta, GA (*Abstract Co-Author*) Research Grant, Siemens AG
Taylor M. Duguay, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; Consultant, General Electric Company; Consultant, HeartFlow, Inc; Consultant, Bayer AG; Consultant, Siemens AG; ; ;
Moritz H. Albrecht, MD, Frankfurt am Main, Germany (*Abstract Co-Author*) Speaker, Siemens AG
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Sheldon Litwin, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG
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PURPOSE

To investigate the impact of triple-rule-out cardiac CT angiography (TRO-CTA) on patient management in patients presenting with chest pain to the emergency department (ED) compared to standard of care (SOC) work-up.

METHOD AND MATERIALS

In this IRB-approved, HIPAA-compliant study we analyzed data of 2156 patients who presented to the ED with chest pain. Patients were divided into two groups according to their cardiovascular risk: low-intermediate risk (<=1 risk factor regardless of body-mass-index [BMI]) and high risk (>=2 risk factors and BMI >=30kg/m2 or >=4 risk factors regardless of BMI). Patients received either TRO-CTA as an initial test or SOC without initial CTA. ED length of stay, downstream utilization of additional tests, and hospital costs were compared between both groups.

RESULTS

515 patients were assigned to the high-risk group (TRO-CTA, n=274; SOC, n=241) and 1610 to the low-intermediate risk group (TRO-CTA, n=837; SOC, n=773). No significant differences between groups and corresponding treatment arms were observed for age, gender, or race. The rate of diagnosis of coronary artery disease (CAD), pulmonary embolism (PE), or aortic dissection (AD) was significantly higher in the TRO-CTA vs. the SOC arm for the low-intermediate risk group (all $p<0.05$). Median ED wait time (5.0 vs. 7.0hrs, $p<0.001$), median total length of hospital stay (48.0 vs. 72.0hrs, $p<0.001$), additional downstream testing, rate of invasive coronary angiography (11.6% vs. 38.7%, $p<0.001$), and total costs (9.184$ vs. 17.253$, $p<0.001$) were significantly lower in the TRO-CTA vs. the SOC arm. No significant difference in the diagnosis of CAD, PE, or AD was found between TRO-CTA vs. SOC in the high-risk group with significant lower median ED waiting time (4.0 vs. 8.0hrs, $p<0.001$), median total length of hospital stay (48.0 vs. 72.0hrs, $p<0.001$), additional downstream testing, invasive coronary angiography (16.4% vs. 34.0%, $p<0.001$), and total costs ($10,532 vs. $21,518, $p<0.001$) in the TRO-CTA vs. the SOC arm.

CONCLUSION

TRO-CTA as an initial imaging test in ED patients presenting with acute chest pain was associated with shorter ED and hospital length of stay, lower utilization of downstream testing, and lower total cost both for the episode of care and overall.

CLINICAL RELEVANCE/APPLICATION

TRO-CTA is a robust imaging modality with lower resource use and lower cost in the work-up of patients presenting to the ED with chest pain regardless of their a-priori risk.

SSC01-08 Prognostic Role of Adenosine Stress Cardiac Magnetic Resonance Compared to CCTA in the Long-Term Outcome of Heart Disease Patient

Monday, Nov. 26 11:40AM - 11:50AM Room: S504CD

Participants
Pierpaolo Palumbo, MD, L'Aquila, Italy (*Presenter*) Nothing to Disclose
Ester Cannizzaro, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Camilla De Cataldo, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Silvia Torlone, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Antonella Corridore, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandra di Sibio, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
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Ernesto E. Di Cesare, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo Masciocchi, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Coronary heart disease is still the leading cause of death and the need for a prognostic assessment of CAD patients is continuously increasing. With this regard, the anatomic and morphological approach is not completely satisfying in the CAD definition. The purpose of our study was assessing the prognostic role of Adenosine Stress Cardiac Magnetic Resonance compared to Computed Tomography Angiography (CTA) in the outcome of the heart patient

METHOD AND MATERIALS

55 patients with previous PTCA-stenting who underwent CTA examination and CMR with adenosine were included in our study. A 5-year follow-up was carried out to evaluate the clinical evolution of these patients

RESULTS

Nine patients showed negative CTA and CMR under stress, with reported well-being in the 5-year follow-up. 78% of the remaining patients showed stent filling defects in the CTA examination; among these, 86% showed also perfusion defect in the CMR, associated to major cardiovascular symptoms referred in the follow-up, while the remaining 14% were negative for perfusion CMR and for symptoms.22% of patients who showed perfusion alterations in CMR, although in absence of stent apparent filling defects in CTA examination, reported acute myocardial infarction treated with re-stenting. 5 patients out of 18 with positive LGE images developed MACE (arrhythmias, cardiac death).

CONCLUSION

Our experience shows how, despite a CTA examination positive for the presence of moderate stenosis, a negative Adenosine Stress CMR represents a positive prognostic factor for the patient outcome. On the other hand, also with a negative CTA, the positivity of Adenosine Stress CMR is strongly associated with a high probability of developing a cardiovascular accident and constitutes a negative prognostic factor

CLINICAL RELEVANCE/APPLICATION

Our study demonstrates the prevalent role of Stress CMR in comparison to Computed Tomography as a predictive prognostic factor in the outcome of heart patient

SSC01-09 Additional Diagnostic Value of CT Perfusion Over Coronary CT Angiography in Stented Patients with Suspected In-Stent Restenosis or Coronary Artery Disease Progression: ADVANTAGE Study - Preliminary Results

Monday, Nov. 26 11:50AM - 12:00PM Room: S504CD

Participants
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PURPOSE

Aim of the study is to assess the diagnostic performance of CCTA alone, CTP alone and CCTA plus CTP performed with the latest scanner generation that combine a whole-heart coverage with high spatial and temporal resolution, by using invasive coronary angiography (ICA) as standard of reference.

METHOD AND MATERIALS

A cohort of consecutive patients referred for a clinically ICA for suspicion of ISR or progression of native CAD were enrolled. The feasibility of CCTA, CTP and the combined evaluation CCTA plus CTP were calculated in a stent-based, territory-based and patient-based analysis. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CCTA, CTP, combined evaluation CCTA-CTP vs. ICA in a stent-based, territory-based and patient-based analysis. Radiation exposure of CCTA, CTP and ICA was recorded.

RESULTS

Ninety-eight patients were enrolled (83 male, mean age 64 ± 9 years-old). CTP feasibility was significantly higher than CCTA feasibility in a stent-based, territory-based and patient based analysis (97% vs. 87%, p=0.001; 98% vs. 92%, p=0.001; 97% vs. 70%, p<0.0001, respectively). The feasibility of the combined evaluation CCTA-CTP was significantly higher than CCTA feasibility in a stent-based, territory-based and patient based analysis (96% vs. 87%, p=0.001; 99% vs. 92%, p<0.001; 100% vs. 70%, p<0.0001, respectively). The diagnostic accuracy of CCTA was 81%, 85% and 79%, in a stent-based, territory-based and patient based analysis, respectively; the diagnostic accuracy of CTP was 90%, 93% and 84%, respectively; the diagnostic accuracy of combined CCTA-CTP was 85%, 90% and 83%, respectively; the diagnostic accuracy of concordant CCTA-CTP was 95% and 92% in a territory and patient-based analysis, respectively. The diagnostic accuracy of CTP was higher than that of CCTA in a stent-based (p=0.001) and territory-based (p<0.0001) analysis. The mean effective dose of the entire CT assessment (CCTA-CTP) was 2.76 ± 2.32 mSv.

CONCLUSION

The CTP assessment appears as more feasible and more accurate than the anatomical evaluation alone by CCTA in patients with coronary stents. When results of CCTA and CTP are concordant, the diagnostic accuracy of the combined evaluation is very high and associated with very low radiation exposure.

CLINICAL RELEVANCE/APPLICATION

Evaluation with cardiac CT of both anatomy and perfusion

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

SSC02

Cardiac (Myocardial Ischemia and Viability (MRI): I)

Monday, Nov. 26 10:30AM - 12:00PM Room: S502AB

CA MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
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Sub-Events

SSC02-01 Comparison Between Radio-Water PET and Model-Based Quantitative Analysis of 3.0T Myocardial Perfusion Magnetic Resonance Imaging

Monday, Nov. 26 10:30AM - 10:40AM Room: S502AB

Participants
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PURPOSE

Radio-water PET is the most accurate method in quantifying myocardial blood flow (MBF). Model-based analysis of perfusion MRI with corrections of blood saturation and flow-dependent alteration in extraction fraction of gadolinium contrast medium may permit quantification of absolute MBF. The purpose of this study was to determine the accuracy of MR measurements of rest and stress MBF at 3.0T by using radio-water PET as a reference.

METHOD AND MATERIALS

Twenty-nine patients with suspected coronary artery disease underwent MRI including stress and rest perfusion MRI and LGE MRI at 3.0T and radio-water PET. ATP stress and rest perfusion MRI were performed with injections of 0.03mmol/kg of Gd-DOTA. Dual bolus method was used to correct blood saturation. Patlak plot method was employed in quantifying MBF. Myocardial unidirectional influx constant (K1) was determined from blood input and myocardial output functions in 16 myocardial segments. The extraction fraction of Gd-DOTA (E) was determined using K1 and PET-derived MBF (MBFPET) for the first 15 patients. For validation, MRI-derived absolute MBF (MBFMRI) was calculated using the relation between E and MBF for the remaining 14 patients and compared with MBFPET. The segments including myocardial infarction were excluded from the analysis.

RESULTS

In the first 15 patients, K1 by perfusion MRI was 0.60±0.21 ml/min/g at rest and 1.07±0.37 ml/min/g during stress, while MBFPET was 1.15±0.35 ml/min/g at rest and 3.08±0.81 ml/min/g during stress. The relationship between E and MBF was E=1-exp(-(0.24xMBF+0.63)/MBF). In the remaining 14 patients, MBFMRI at rest and during stress were 1.24±1.16 ml/min/g and 2.63±1.48 ml/min/g, while MBFPET at rest and during stress were 1.17±0.61 ml/min/g and 2.69±0.70 ml/min/g, respectively. MBFMRI showed a good linear correlation with MBFPET ($r=0.71$, $p<0.001$). The measurement bias in measuring MBF between MRI and PET was 0.01±1.06ml/min/g.

CONCLUSION

Model-based analysis of perfusion MRI at 3.0T with corrections of blood saturation and flow-dependent alteration of extraction of gadolinium contrast medium allows for accurate quantification of MBF both at rest and during ATP stress.

CLINICAL RELEVANCE/APPLICATION

Accurate quantification of myocardial blood flow by using perfusion MRI may permit objective assessment of myocardial ischemia and early detection of high risk patients in the routine cardiac MRI.

SSC02-02 Oxygenation-Sensitive Cardiovascular Magnetic Resonance for Differentiation of Reversible and Irreversible Myocardial Damage by Evaluation of the Balance between Supply/Demand in Myocardial Oxygenation after ST-Segment-Elevation Myocardial Infarct

Monday, Nov. 26 10:40AM - 10:50AM Room: S502AB

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PURPOSE

T2* BOLD imaging is a quantitative magnetic resonance imaging(MRI) technique allowing for evaluation of the balance between supply/demand in myocardial oxygenation and myocardial hemorrhage. We sought to investigate the ability of T2* BOLD imaging to differentiate reversible and irreversible myocardial injury as well as the time course of myocardial oxygenation after reperfusion in patients with ST-segment elevation myocardial infarction (STEMI).

METHOD AND MATERIALS

Twenty two patients(age, 60±11 years;77.27% male)with STEMI underwent cardiac MRI on four occasions: at 1 day, 3 days, 7 days, and 30 days after (percutaneous coronary intervention)PCI. T2* BOLD MRI was performed on a 3T scanner to assess myocardial oxygenation in myocardial infarcted regions with or without intramyocardial hemorrhage (IMH), salvaged myocardium, remote myocardium and normal myocardium.

RESULTS

T2* BOLD value in myocardial infarction(MI) with IMH was lowest(9.77±3.29ms), while that of the salvaged zone was the highest(33.97±3.42ms). Hyperemia induced by inflammation may increase blood flow in the salvaged area. T2* BOLD value in salvaged myocardium demonstrated a unimodal temporal pattern from 1 day(37.91±2.23ms) to 30 days(30.68±1.59ms).

CONCLUSION

T2* BOLD MRI performed in post-STEMI patients allows for accurate evaluation of myocardial damage severity, and can discriminate between reversible and irreversible myocardial injury. The increased T2* BOLD values may imply the pathophysiological mechanism of salvaged myocardium. T2* BOLD could represent a more accurate alternative without contrast to late gadolinium enhancement (LGE) imaging in acute STEMI patients.

CLINICAL RELEVANCE/APPLICATION

BOLD MRI could evaluate the balance between supply/demand in myocardial oxygenation and myocardial damage severity, and discriminate between reversible and irreversible myocardial injury and is recommended in the initial evaluation of STEMI patients.

SSC02-03 Intra-Myocardial Hemorrhage and Microvascular Obstruction After Acute Re-Perfused Myocardial Infarction: Are They Really Two Different Complications?

Monday, Nov. 26 10:50AM - 11:00AM Room: S502AB

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PURPOSE

To evaluate the performance of T2* mapping for intra-myocardial hemorrhage (IMH) detection in acute re-perfused myocardial infarction and to demonstrate in vivo the pathophysiological coincidence of microvascular obstruction (MVO) and intra-myocardial hemorrhage (IMH) at the level of the infarcted zone.

METHOD AND MATERIALS

74 consecutive Patients (Pts) after primary percutaneous intervention for first acute myocardial infarction (AMI) underwent cardiovascular MR (CMR) within 1 week after treatment, using a standard protocol (T2 3IR-FSE, cine-SSFP, rest FGRET and 2D IR-FGRE). Before gadolinium administration, we performed T2* mapping at the level of the infarct zone. T2* images were analyzed with a dedicated software (Reportcard 4.0, GE Medical Systems), considering a T2* value <=20 ms as positive for IHM. First-pass perfusion images were acquired during administration of different Gadolinium chelates at a standard dose of 0.1 mmol/kg; early and late gadolinium enhancement (EGE and LGE) were obtained at 2-3 and 12-15 minutes after contrast injection, respectively.

RESULTS

On the basis of post-Gadolinium sequences, MVO in the infarct area was demonstrated in 34 Pts at the first pass perfusion images, in 29 Pts at EGE and in 26 Pts in LGE images.A focal IMH was identified in 13/74 Pts at T2 3IR-FSE images, while on the basis of T2* mapping IMH was detected in 28/74 Pts.We found that IMH coincided with the area of MVO: all 13 Pts with IMH at T2 3IR-FSE images showed MVO at first pass perfusion and/or at EGE and LGE; all 28 Pts positive for IMH at T2* mapping showed MVO at EGE, while only 2 Pts did not show MVO at LGE.

CONCLUSION

T2* imaging should be the preferred CMR method for assessment of IMH because its higher sensitivity than conventional T2 images. Reperfusion IMH is closely associated with the presence of MVO and they represent patho-physiologically the same complication of the ischemia-reperfusion injury.

CLINICAL RELEVANCE/APPLICATION

We demonstrated that MVO and IMH represent the same complication in re-perfused AMI. T2* mapping (better than T2) can be used to assess MVO also in Pts not suitable for gadolinium administration.

SSC02-04 Intramyocardial Hemorrhage May Not Change from 48 Hours to 7days While Myocardial Ischemia and Myocardial Edema Decrease After Reperfusion: A Rat Study at 7T

Monday, Nov. 26 11:00AM - 11:10AM Room: S502AB

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PURPOSE

To study the change of intramyocardial hemorrhage(IMH), myocardial edema(ME) and myocardial ischemia(MI) in reperfused myocardial ischemic rat from 48h to 7d in a 7.0T MR scanner.

METHOD AND MATERIALS

Nine rats (SD, 250-300g, male) with 60min myocardial ischemia followed by 48h and 7d were investigated. The myocardial ischemia was induced by occluding the proximal left anterior descending coronary artery, which was then released for reperfusion. The T2*-mapping and T2-mapping pulse sequences (T2-mapping: TR/TE=1500ms/10,20,30 ms, MTX=192×192, FOV=50×50mm, slice thickness=1.5mm. T2*-mapping: TR/TE=1000ms/3.5,7,10.5,14,17.5,21,24.5,28,31.5 ms, FA (Flip angle)=30°, MTX=192×192, FOV=50×50mm, slice thickness=1.5mm) were implemented and optimized on a 7.0T MR system (BRUKER BIOSPEC 70/30, Germany). Images were acquired on the short axis slices during mid-diastolic phase in each end-inspiratory period using both ECG and respiratory gating systems. After the acquisition of T2*-mapping and T2-mapping images, Late gadolinium enhancement (LGE) imaging was performed by FISP(TR/TE=5.2ms/1.8ms, FA=25°, MTX=256×256, FOV=50×50mm, slice thickness=1.5mm) to evaluate the extent of myocardial ischemia after an injection of gadolinium diethylenetriamine pentaacetic acid (Gd-DTPA, Magnevist, Bayer Health Care Pharmaceuticals) at a dose of 0.15 mmol/kg. The T2*-maps and T2-maps were calculated using a custom-made software. The areas of edema regions were defined by high T2 values (> mean ± 2SD in remote areas) on T2 maps. The areas of hemorrhage were identified as a hypointense core within a hyperintense territory on T2* maps. All areas were expressed as a percentage of the whole myocardial tissue of left ventricle.

RESULTS

The area of ME and MI decreased from 48h (31.2±7.9%; 21.9±10.2%) to 7d (23.6±3.8%, $p<0.01$; 10.8±6.6%, $p<0.01$). However, they were not significant different between the area of IMH at 48h (4.8±3.3%) and 7d (5.1±3.4%, $p>0.05$).

CONCLUSION

The area of ME and MI decreased, which may indicate the self-healing of myocardial edema and myocardial ischemia after reperfusion. However, intramyocardial hemorrhage, caused by reperfusion injury, would not recover in this duration.

CLINICAL RELEVANCE/APPLICATION

Reperfusion will decrease myocardial ischemia and myocardial edema, but also cause sustained intramyocardial hemorrhage, which should be recommended as an important risk point for percutaneous coronary intervention of myocardial ischemic patients.

SSC02-05 Larger Myocardial Ischemia May Cause Larger Intramyocardial Hemorrhage and Smaller Area at Risk in Acute Reperfused Myocardial Ischemic Rats

Monday, Nov. 26 11:10AM - 11:20AM Room: S502AB

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PURPOSE

To study the correlations between myocardial infarction and intramyocardial hemorrhage, area at risk in reperfused myocardial ischemic rats with a comprehensive method on 7.0T MR.

METHOD AND MATERIALS

Eleven rats (SD, 250-300g, male) with 60min myocardial ischemia followed by 48hours reperfusion were investigated. The different degrees of myocardial ischemia were induced by occluding the different section of proximal left anterior descending coronary artery. The T2*-mapping and T2-mapping pulse sequences (T2-mapping: TR/TE=1500ms/10,20,30 ms. T2*-mapping: TR/TE=1000ms/3.5,7,10.5,14,17.5,21,24.5,28,31.5 ms, FA (Flip angle)=30°) were implemented and optimized on a 7.0T MR system (BRUKER BIOSPEC 70/30, Germany). Images were acquired on the short axis slices during mid-diastolic phase in each end-inspiratory period using both ECG and respiratory gating systems. After the acquisition of T2*-mapping and T2-mapping images, Late gadolinium enhancement (LGE) imaging was performed by FISP(TR/TE=5.2ms/1.8ms, FA=25°) to evaluate the extent of myocardial ischemia after an injection of gadolinium diethylenetriamine pentaacetic acid (Gd-DTPA) at a dose of 0.15 mmol/kg. The T2*-maps and T2-maps were calculated using a custom-made software. Area at risk were defined as the difference between edema areas with high T2 values(> mean ± 2SD in remote normal tissue areas) in T2 maps and positive enhanced area in LGE images. The areas of hemorrhage were identified as a hypointense core within a hyperintense territory on T2* maps. All areas were expressed as a percentage of the whole myocardial tissue of left ventricle.

RESULTS

Myocardial ischemia ranged from 9.5% to 47% (22.7±10.4%), intramyocardial hemorrhage ranged from 1.25% to 17% (5.3±4.5%), area at risk ranged from 2.8% to 15.2% (8.4±3.9%). There was a significant positive correlation between myocardial ischemia and intramyocardial hemorrhage ($r=0.85$, $P<0.01$), while a negtive correlation was found between myocardial ischemia and area at risk ($r=0.77$, $P<0.01$).

CONCLUSION

Larger myocardial ischemia may cause larger intramyocardial hemorrhage and smaller area at risk in 48h reperfused myocardial ischemic rats.

CLINICAL RELEVANCE/APPLICATION

The prognosis of intramyocardial hemorrhage and area at risk could be made by the area of reperfused myocardial ischemia, which should be recommended as a critical index before percutaneous coronary intervention of myocardial ischemic patients.

SSC02-06 Fully Automated Analysis of LGE MRI in Post-Infarct Patients Using Convolutional Neural Networks: Simultaneous Segmentation of Ventricular Myocardium and Myocardial Infarction

Monday, Nov. 26 11:20AM - 11:30AM Room: S502AB

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PURPOSE

To investigate the feasibility of deep-learning convolutional neural network (CNN) image segmentation for fully automated analysis of late gadolinium enhanced (LGE) MRI in post-infarct patients.

METHOD AND MATERIALS

In 180 consecutive post-infarct patients LGE MRI was acquired prior to ICD implantation. An inversion-recovery 3D turbo-field echo sequence was used with parallel imaging, in one or two breath-holds and reconstructed into 20-24 levels in the short-axis view with a typical image resolution of 1.56×1.56×5 mm. For reference, an experienced observer manually traced the endocardial and epicardial contours and assessed the region of myocardial scar using the Full Width Half Maximum (FWHM) method, followed by visual correction, if needed. The cohort was randomly divided into a training set of 150 (3,606 images) and a testing set of 30 subjects (726 images). The training images were augmented into a total of 144,240 images by applying moderate rotation (-15 to 15 degree) and scaling (0.8 to 1.25). The U-Net CNN architecture was adopted to learn the manual segmentation from the training set, using cross entropy as the metric, with a learning rate of 10-4, in 50 epochs, initialized from a previously trained network for cine MR segmentation. The trained network was evaluated on the 30 independent testing subjects. We evaluated: (1) the accuracy of endocardial and epicardial contour in terms of average perpendicular distance (APD) in pixels, and (2) the accuracy of identified myocardial scar size per subject.

RESULTS

On the independent training set, the APD was 1.10±0.39 and 1.09±0.29 pixels for the endocardial and epicardial contours, respectively. The identified scar size per subject was not significantly different between the CNN and the human observer: 29.1±21.3 g vs. 31.7±20.8 g ($p=0.2$). The processing time for CNN based segmentation was less than 0.2 seconds per subject.

CONCLUSION

Deep-learning CNN shows great promise in the challenging segmentation problem of automated LGE MRI quantification in post-infarct patients, by simultaneously identifying the left ventricle and myocardial scar in a fully automated manner.

CLINICAL RELEVANCE/APPLICATION

With further validation, the developed deep-learning CNN can be used to rapidly identify and quantify the myocardial scar from LGE MRI, avoiding time-consuming and user-dependent scar assessment and contour tracing.

SSC02-07 Myocardial Edema and Necrosis after ST-Segment Elevation Myocardial Infarction by T2-Weighted and Late Gadolinium Enhancement MR Imaging: A Meta-Analysis

Monday, Nov. 26 11:30AM - 11:40AM Room: S502AB

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PURPOSE

To analyze existing data on the extent of myocardial edema and necrosis measured by T2-weighted and late gadolinium enhancement (LGE) magnetic resonance (MR) imaging after ST-segment elevation myocardial infarction (STEMI).

METHOD AND MATERIALS

We searched MEDLINE, EMBASE, and ISI Web of Science for patient studies reporting the extent of myocardial edema and necrosis measured by T2-weighted and LGE MR imaging after STEMI. All information on patient demographics, treatment features, and imaging techniques reported by included studies were extracted. Multiple imputation was used for missing data and mixed-effects models to identify significant predictors of edema and necrosis. Follow-up data were used to evaluate the further temporal evolution of edema and necrosis.

RESULTS

Forty-four studies with 5028 patients were included. Overall, edema area measured using T2-weighted MR imaging during the first week after STEMI was 33.8% of left ventricular (LV) myocardium (confidence interval [CI]: 31.9, 36.5), necrosis area measured using LGE MR imaging was 18.1% of LV myocardium (CI: 14.7, 21.4), and the proportion of edematous myocardium without necrosis was 42.0% (CI: 34.6, 49.4). Each hour of delay in revascularization increased necrosis by 3.6% of LV myocardium (95% CI: 1.1, 6.0; P = .013) and decreased the proportion of edematous myocardium without necrosis by 12.5% (95% CI: 6.9, 18.1; P = .002), while edema was not significantly affected. Other significant predictors were the degree of obstruction of the culprit artery before revascularization and the applied method for interpreting MR images. Within 6 months after STEMI, edema disappeared, while necrosis decreased only slightly but significantly.

CONCLUSION

This meta-analysis indicates that myocardial edema on T2-weighted MR imaging delineates the area at risk after STEMI and can be used to quantify the proportion of reversibly injured myocardium, commonly defined as myocardial salvage index, when combined with LGE MR imaging of necrotic myocardium.

CLINICAL RELEVANCE/APPLICATION

Quantification of the proportion of reversibly injured, salvaged myocardium after STEMI by T2-weighted and LGE MR imaging allows evaluation of therapeutic efficiency.

SSC02-08 Detection of Occult Myocardial Scars with Cardiovascular Magnetic Resonance Imaging in Patients with Asymptomatic Type 2 Diabetes Mellitus: The ACCREDIT Study

Monday, Nov. 26 11:40AM - 11:50AM Room: S502AB

Participants
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PURPOSE

To determine the prevalence of occult myocardial scars (OMS) on contrast-enhanced cardiovascular magnetic resonance imaging (CMR) in asymptomatic patients with type 2 diabetes mellitus (DM) and to assess the relationship between the occurrence of OMS detected with CMR and coronary atherosclerosis observed with contrast-enhanced coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS

This multi-center, prospective, open-label study included asymptomatic patients with type 2 DM and at least two identified cardiac risk factors, scheduled to undergo CMR and CCTA procedures. CMR and CCTA were performed with gadoterate meglumine (Dotarem®, Guerbet) and iobitridol (Xenetix®, Guerbet), respectively. The prevalence of OMS was calculated on CMR. For each main coronary artery, stenosis degree and plaque characteristics were assessed on CCTA. For each myocardial segment with OMS, the corresponding infarct-related artery (IRA) was identified according to the American Heart Association recommendations. The

characteristics of the plaques located in IRA were compared to those located in non-IRA.

RESULTS

Among the 348 patients included (mean (±SD) age: 60.2±6.5 years; male: 60.9%; mean BMI: 25.4±3.1 kg/m2), 322 patients completed both CMR and CCTA procedures. At least one OMS was detected by CMR in 23 patients (7.1%). CCTA showed a significant stenosis (>50% diameter reduction) or occlusion for 13 (56.5%) of the 23 patients with OMS and for 67 (22.4%) of the 299 patients without OMS. Sixty-two IRA plaques and 52 non-IRA plaques were identified with CCTA in patients with OMS. In IRA, 16.1% plaques were non-calcified, 22.6% mixed and 61.3% calcified while in the non-IRA, 30.8% were non-calcified, 17.3% mixed and 51.9% calcified. No differences in calcification status were demonstrated between IRA and non-IRA plaques (p=0.175, Chi²).

CONCLUSION

OMS were identified with CMR in 7.1% of asymptomatic patients with type 2 DM. No significant difference was demonstrated in plaque characteristics between IRA and non-IRA in patients with OMS. Further investigations are still required to determine whether the occurrence of OMS is related to atherosclerosis detected with CCTA.

CLINICAL RELEVANCE/APPLICATION

CT and MRI screening in diabetes patients without chest pain can provide the information of occult myocardial infarction and its relationship to coronary arterial disease.

SSC02-09 Multi-Parametric Rest and Dobutamine Stress Cardiovascular Magnetic Resonance in Assessment of Myocardial Viability: Could Feature Tracking Strain Analysis Add Value?

Monday, Nov. 26 11:50AM - 12:00PM Room: S502AB

Awards
Student Travel Stipend Award

Participants
Mahmoud N. Shaaban, MSc,MBChB, Aswan, Egypt (*Presenter*) Nothing to Disclose
Sara W. Tantawy, MBBCh, Aswan, Egypt (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the diagnostic accuracy of multi-parametric CMR in assessment of myocardial viability in chronic ischemic patients using 4 different techniques; delayed gadolinium enhancement(DGE) as gold standard for detection of scar burden, CMR feature tracking(CMR-FT) at rest and with low dose dobutamine(LDD), visual assessment of myocardial contractility with LDD and LV end-diastolic wall thickness(EDWT)

METHOD AND MATERIALS

15 patients(53±12years) &10 controls(38±11years) were prospectively enrolled. All subjects had CMR exams on 1.5T scanner. A LDD IV infusion was administrated in 2 stages, 3 minutes each, with a dose of 5 µg/kg/min that is increased to 10 µg/kg/min in 2nd stage. LV was divided into 16 segments and FT parameters were derived from SSFP Cine images using dedicated software. Viable myocardium was defined as a dobutamine induced increase in resting FT values of >20 % & systolic wall thickening of >=2 mm by visual assessment. A segment with no or <=50 % fibrosis on DGE & EDWT of >5 mm was defined as viable

RESULTS

240 segments were analyzed for patients at rest & with LDD &160 segments for controls at rest. 44 segments were non-viable based on DGE &196 were viable. Both peak global circumferential(Ecc) & radial(Err) strains were significantly impaired in ischemic patients compared to healthy(-12.84±7.72 vs -19.63±7.08,P<0.0001 & 22.07±15.19 vs 30.90±18.59,P=0.0039)respectively. With segmental Ecc, 50 segments were identified as non-viable & 190 as viable(sensitivity 72%,specificity 91% &diagnostic accuracy 87%).With segmental Err, 49 segments were identified as non-viable & 191 as viable(sensitivity 54%,specificity 87% & diagnostic accuracy 81%).By visual assessment of myocardial contractility with LDD, 43 segments were identified as non-viable & 197 as viable(sensitivity 70%,specificity 86% & diagnostic accuracy 88%).Based on EDWT assessment, 41 segments were identified as non-viable & 199 as viable(sensitivity 50%,specificity 90%& diagnostic accuracy 83%)

CONCLUSION

Quantitative assessment of Ecc & Err with FT, along with EDWT & qualitative visual assessment of myocardial contractility at rest & with LDD may improve diagnostic accuracy of non-viable segments with moderate sensitivity & high specificity

CLINICAL RELEVANCE/APPLICATION

FT and EDWT are non-contrast parameters that could be of particular importance in determining viability in patients with impaired glomerular filtration rate or patients with known hypersensitivity to contrast agents

SSC04

Emergency Radiology (Thoracic, Cardiac and Vascular)

Monday, Nov. 26 10:30AM - 12:00PM Room: S504AB

CA CH CT ER VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Felipe Munera, MD, Key Biscayne, FL (*Moderator*) Nothing to Disclose
Ferco H. Berger, MD, Toronto, ON (*Moderator*) Nothing to Disclose

Sub-Events

SSC04-01 Model-Based Iterative Reconstruction on 80kV CT Pulmonary Angiography: Image Quality and Radiation Dose Saving Compared with Hybrid Iterative Reconstruction on 100Kv CT Study

Monday, Nov. 26 10:30AM - 10:40AM Room: S504AB

Participants
Andrea De Vito, MD, Milano, Italy (*Presenter*) Nothing to Disclose
Davide Ippolito, MD, Monza, Italy (*Abstract Co-Author*) Nothing to Disclose
Cammillo R. Talei Franzesi, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate dose reduction and image quality of 80 kV CT pulmonary angiography (CTPA) reconstructed with model-based iterative reconstruction (IMR), and compared with 100 kV CTPA with hybrid iterative reconstruction (iDose4).

METHOD AND MATERIALS

One hundred and fifty-one patients were prospectively investigated for pulmonary embolism; a study group of 76 patients underwent low-kV setting (80kV,automated mAs) CTPA study, while a control group of 75 patients underwent standard CTPA protocol (100kV; automated mAs); all patients were examined on 256 MDCT scanner (Philips iCTelite). Study Group images were reconstructed using IMR while the Control Group ones with iDose4. CTDIvol, DLP and ED were evaluated. Region of interests placed in the main pulmonary vessels evaluated vascular enhancement (HU); signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated.

RESULTS

Compared to iDose4-CTPA, low kV IMR-CTPA presented lower CTDIvol (6.41 ± 0.84 vs 9.68 ± 3.5 mGy) and DLP (248.24 ± 3.2 vs 352.4 ± 3.59 mGy x cm), with ED of 3.48 ± 1.2 vs 4.93 ± 1.8 mSv. Moreover IMR-CTPA showed higher attenuation values (670.91 ± 9.09 HU vs 292.61 ± 15.5 HU) and a significantly higher SNR (p<0,0001) and CNR (p<0,0001). The subjective image quality of low kV IMR-CTPA was also higher compared with iDose4-CTPA (p<0,0001).

CONCLUSION

Low dose CT with IMR represents a feasible protocol for the diagnosis of pulmonary embolism in the emergency setting and permits to achieve excellent diagnostic images (in terms of subjective quality) with extremely low noise, and a significant reduction of the dose led to the patient (in terms of mSv) within reasonable reconstruction times (less than 120 seconds).

CLINICAL RELEVANCE/APPLICATION

Low kV IMR approach allows a significant dose reduction of CTPA studies improving attenuation values, SNR and CNR in the pulmonary vessels, as compared with standard kV iDose4-CTPA.

SSC04-02 A Proposal of a New System Score to Evaluate With Lung Ultrasound the Necessity of a Drainage Tube in Pneumothorax in Emergency Room

Monday, Nov. 26 10:40AM - 10:50AM Room: S504AB

Participants
Maria Luisa De Cicco, MD, Roma, Italy (*Presenter*) Nothing to Disclose
Vittorio Miele, MD, Florence, Italy (*Abstract Co-Author*) Nothing to Disclose
Vincenza Di Giacomo, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
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Stefania Ianniello, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Aim of this study was to evaluate the validity of a new system score and its utility in the Emergency Room to estabilish the necessity to drainage pneumothorax diagnosed by ultrasound in unstable adults major trauma.

METHOD AND MATERIALS

Retrospective observational study that involved, from January 2015 to January 2018, 274 adults patients with pneumothorax, evaluated by lung ultrasound in Emergency Room during Primary Survey. All ultrasound were performed with portable ultrasound machine in Emergency Room, with patients lying on the spinal board stretcher. It was applied a system score which included the evaluation of the lung point site (parasternal =1, emiclavear =2 or axillary line=3), the presence of pleural effusion (><300 ml=1 o 0) and the position of the heart (with o without dislocation=1 o 0). Cut off estabilished to indicate the necessity of the thorax drainage was 4. All patients underwent to MDCT (gold standard) and the results compared.

RESULTS

Among the enrolled patients with pneumothorax 184/274 had a score > 4 and the necessity of a drainage was indicated on the report. Of these in 164 the necessity was confirmed by CT, while in 20 the patients were just observed. Among the 20 'false positive to need drainage' of our retrospective review, someone had a high BMI (8), someone had subcutaneous emphysema (5), while in the other or there was an overvaluation by the US evaluation or the patients conditions improved (7).

CONCLUSION

Our data regarding the validity of a new system score should be useful in deciding the necessity of a draining tube in major trauma unstable patients. This score would allow an early diagnosis and a promptly therapeutic decision, avoiding wasting time, essential in patients with many traumatic lesions and above all with serious pneumothorax.

CLINICAL RELEVANCE/APPLICATION

Identify an useful new scoring system, helpful to estabilish the necessity to drainage pneumothorax diagnosed by ultrasound, in unstable adults major trauma

SSC04-03 Identifying Patients with Low Cardiac Output Using Vessel Density at CTPA

Monday, Nov. 26 10:50AM - 11:00AM Room: S504AB

Awards
Student Travel Stipend Award

Participants
Andrew D. Chang, MSc, Providence, RI (*Presenter*) Nothing to Disclose
Scott Collins, RT, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Derek Merck, PhD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Grayson L. Baird, PhD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Cardiac output (CO) is an important metric that has diagnostic and prognostic value in emergency and inpatient settings. However, determining CO currently requires invasive or costly procedures such as Swan-Ganz catheterization (SGC) or cardiac MR (CMR). CT for pulmonary angiography (CTPA) is a commonly performed examination that provides a snapshot of exogenously administered contrast as it distributes through the thoracic vasculature in a manner chiefly determined by CO. We hypothesized that by measuring attenuation in different vessels we could (1) identify patients with reduced CO and, potentially, (2) quantify CO.

METHOD AND MATERIALS

We retrospectively identified patients who underwent SGC or CMR within 14 days of CTPA between 1/1/2006 to 12/30/2016. Using CO values from SGC or CMR as the gold standard, patients were stratified into three groups: CO < 4 L/min (low), 4-8 L/min (normal), and over 8 L/min (high). All CT studies were performed using a standardized protocol with a fixed delay of 22 sec and an injection rate of 4 cc/s. For each patient, density (HU) was measured in the superior vena cava [SVC], main pulmonary trunk [PT], and ascending aorta [AO] on a single mid-thoracic transaxial slice. Densities and density differences were then compared with measured vales of CO.

RESULTS

We identified 119 patients with concurrent CO measurements and CTPA studies within the study period. Compared to patients with normal CO (n=76, 63.9%), patients with low CO (n=35, 29.4%) exhibited higher attenuation in the SVC (1305±846 vs 944.4±556.8 HU, p=0.026) and PT (518.4±149.6 vs 385.3±122.4 HU, p<0.001). Adjusting for body surface area, PT-AO difference predicts low CO (OR per unit increase 1.007, 95% CI 1.004-1.010, p<0.001). ROC analysis yielded a PT-AO difference threshold of 130 HU for differentiating low from normal CO, with sensitivity and specificity of 74.3% and 87.7% (AUC 0.776, p<0.001).

CONCLUSION

This study provides a simple approach to estimate low CO status by measuring vessel density on a single transaxial CTPA image at the level of the mid-ascending aorta. We found that the greater the attenuation difference between the PT and AO, the greater the odds of low CO, with a difference of 130 HU serving as a useful threshold distinguishing low from normal CO.

CLINICAL RELEVANCE/APPLICATION

Using a standardized CTPA protocol it may be possible to confidently identify patients with reduced cardiac output.

SSC04-04 Multi Factorial Comparative Study of Dual Source CT Scanners in Acute Pulmonary Embolism

Monday, Nov. 26 11:00AM - 11:10AM Room: S504AB

Participants
Waleed Abdellatif, MD, Vancouver, BC (*Presenter*) Nothing to Disclose
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PURPOSE

To compare mean acquisition time, image quality and diagnostic accuracy of two dual-energy CT scanners for the evaluation of acute pulmonary embolism (PE).

METHOD AND MATERIALS

Total of 50 scans on the 2nd generation dual source SOMATOM Definition Flash CT scanner (the Flash) and 49 scans on the 3rd generation dual source SOMATOM Force (the Force) were included. Scans with inadequate opacification of pulmonary artery or known chronic PE were excluded. Imaging acquisition parameters were adjusted to be the same on both the Force and the Flash. In a randomized blinded design, two radiologists independently reviewed both sets of scans in two settings (3-week interval) for image quality using a 5-point scale. The interobserver reliability and diagnostic accuracy were calculated for each reviewer. Diagnosis of acute PE was made using clinical data (acute chest pain), laboratory data (D-Dimer > 500 ug/L) and CTPA.

RESULTS

Mean acquisition time for the Force (x= 2.81 sec, SD= 0.1) and the Flash (x= 9.7 sec, SD = 0.15) was found to be very statistically significant (P= 0.0001; 95% CI = 6.8 - 6.9) with the Force 3.4 times faster than the Flash. The mean image quality was found to be 4.47/5 and 4/5 for the Force and the Flash respectively with statistical significance (P= 0.0064 on the unpaired t-test; 95% CI= 0.80-0.13). Interobserver reliability for image quality indicates strong agreement on both, the Force (K= 0.83, p <0.005) and the Flash-generated scans (k= 0.85, p < 0.005).Acute PE was diagnosed in 17 cases on the Force and in 21 cases on the Flash. Diagnostic accuracy was 94.1% and 98.2% on the Force and 90.2% and 94.8% on the Flash for reviewers one and two respectively. Although diagnostic accuracy was higher on the Force, the difference wasn't statistically significant. Study limitations includes retrospective design and Berkson's selection bias as the Force was routinely used for emergency patients while the Flash was used for inpatients.

CONCLUSION

Image quality is significantly higher on the Force CT scanner with significantly lower mean acquisition time and less motion artifact in comparison to the Flash.

CLINICAL RELEVANCE/APPLICATION

The improved image quality and speed of the Force CT scanner with resultant less motion artifact and repeated studies could be particularly useful in emergency radiology setting with large patient volume.

SSC04-05 Axial or Helical? CT Imaging of the Chest for Uncooperative Emergency Patients with 16-cm Wide Detector CT

Monday, Nov. 26 11:10AM - 11:20AM Room: S504AB

Participants
Yanan Li, Xian, China (*Presenter*) Nothing to Disclose
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PURPOSE

To compare image quality and radiation dose between the fast-helical mode (FHM) and two-axial mode (TAM) in chest CT imaging for uncooperative emergency patients with 16-cm wide detector CT scanner.

METHOD AND MATERIALS

Thirty emergency patients who were unconscious or uncooperative with the breathing instructions underwent chest CT were prospectively divided randomly into two groups: FHM Group (n=15, helical scan mode with 80mm detector coverage and pitch 0.992:1), TAM Group (n=15, axial scan mode with 160mm detector coverage, two scans). Both groups used the 0.28s rotation speed and automatic tube current modulation. All scans were performed in free-breathing. CT value, image noise and signal-to-noise ratio (SNR) were measured at each of the following locations: descending thoracic aorta, lung parenchyma and paraspinal muscle at the level of the carina. Two radiologists assessed the images for subjective image quality, motion artefacts and diagnostic confidence. The volume CT dose index (CTDIvol) and dose-length product (DLP) were evaluated from the dose reports, and effective dose was calculated. All measurements between the two groups were statistically compared.

RESULTS

The mean total exposure time was significantly shorter for TAM group than FHM group (0.56s vs.1.12s, P<0.001). Image quality was generally better with TAM than with FHM (diagnostic confidence score, 3.87 vs. 3.47, P<0.05); However, there was no

significant difference in CT value, image noise and SNR between two groups. The DLP value was higher in FHM than TAM (123.92±38.54mGy·cm vs. 94.22±33.63mGy·cm, P=0.041), while CTDIvol was not significantly different. TAM group reduced the total effective radiation dose by 24% compared to FHM (1.32±0.50 mSv vs. 1.73±0.54mSv).

CONCLUSION

The use of the two-axial mode further reduces the scan time in chest CT for emergency patients and ensures good image quality with 24% radiation dose reduction, compared with chest CT that uses the fast-helical scan with 80mm collimation.

CLINICAL RELEVANCE/APPLICATION

The two-axial scan mode can be used for lung evaluation in uncooperative emergency patients in free breathing to obtain satisfactory image quality while reducing radiation dose.

SSC04-06 Utility of 3D Post-Processing Cinematic Rendering Reconstruction Images in Acute Trauma Setting: Initial Observations

Monday, Nov. 26 11:20AM - 11:30AM Room: S504AB

Participants
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PURPOSE

Multiple post-processing reconstruction techniques based on volumetric CT datasets are used to generate three-dimensional (3D) images to better depict complex anatomical details. Volume rendering (VR) is frequently used as a standard 3D technique, however recently an FDA-approved alternative called Cinematic Rendering (CR) is emerging with vast clinical potentials (1,2). Contrary to traditional VR reconstruction, CR utilizes a global illumination model to create high definition photo-realistic images. We describe our initial experience with CR images in the setting of acute trauma.

METHOD AND MATERIALS

A set of polytrauma patients with ISS score >16 with simple to complex injuries presenting to Vancouver General Hospital, level 1 trauma center were evaluated. Source DICOM images using a 2nd generation 128-slice dual-source CT (Somatom Definition Flash, Siemens Healthineers, Forchheim, Germany) were used to create CR images. Cinematic Rendering software (Siemens Syngo.via Frontier) was used applying default and customized presets. CR images were assessed for image quality, depth and shape perception, delineation of osseous, vascular, soft tissue and solid organ anatomy in comparison to VR images. The images were also evaluated for their role in clinical decision making and education. Multiple trauma surgeons assessed the images using Likert scale analysis with 1 being much lower, 3 equivocal, and 5 much higher. Frequencies, percentages, mean and standard deviation were calculated.

RESULTS

CR images were rated higher than VR images with a mean+/- SD of 4.0+/-0.8. 67 % of trauma surgeons categorized CR images as much higher for use as an education tool and 61% graded them as higher in helping with clinical decision compared to VR images.

CONCLUSION

Our observations are one of the very few initial studies to evaluate the clinical utility of CR images. Understanding complex and challenging anatomical and pathological details are imperative for better patient management from a trauma surgeon assessment. CR provides remarkable details relative to VR reconstructions in context of complex acute trauma

CLINICAL RELEVANCE/APPLICATION

Cinematic Rendering is a promising novel technique to display visually receptive 3D photorealistic high definition images with exquisite anatomical details. Formal evaluations and research is needed to assess the CR images in order to understand their clinical application in patient management.

SSC04-07 Improving Pulmonary Embolism Detectability for Computer-Aided Detection Software Using Optimal Kev Monochromatic Images in Dual-Energy Spectral CT

Monday, Nov. 26 11:30AM - 11:40AM Room: S504AB

Participants
Ma Guangming, MMed, Xianyang City, China (*Presenter*) Nothing to Disclose
Nan Yu, MD, Xian Yang, China (*Abstract Co-Author*) Nothing to Disclose
Shan Dang, Xian, China (*Abstract Co-Author*) Nothing to Disclose
Jing Chen, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose
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Chenwang Jin, Xi'an, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compare pulmonary embolism detectability using computer-aided detection (CAD) software with optimal keV monochromatic images and conventional images.

METHOD AND MATERIALS

Retrospectively analyzed CT images of 20 patients with clinically proven pulmonary embolism (PE). These patients underwent CT pulmonary angiography (CTPA) with spectral imaging mode. The conventional images (140kVp polychromatic, group A) were reconstructed. Using the standard Gemstone Spectral Imaging (GSI) viewer on an advanced workstation (AW4.6), an optimal energy level (group B) could be automatically obtained. The images in two group were independently analyzed for detecting PE using a commercially available CAD software. Two experienced radiologists reviewed all images and recorded the number of emboli, and the results were used as the gold standard. The attenuation in the main pulmonary artery (MPA) and the embolus (in the most substantial part of the embolus) were measured. The difference in attenuation (MPA-embolus), as well as the detectability for pulmonary embolism in each case (sensitivity, false positive rate) were calculated. Data were statistically compared between the two groups.

RESULTS

The optimal energy levels were 62.4keV. The attenuation in the MPA, difference in attenuation (MPA-embolus) for group A and B were (314.46±81.41HU vs. 446.30±151.88HU) and (281.89±73.82HU vs. 404.75±138.74HU), respectively (all $p<0.001$). The mean sensitivity for pulmonary embolism detection in group A was 74.63±6.16%, which was lower than the 82.17±4.51% in group B ($t=-4.26$, $p<0.001$). The mean false positive rate in group A was 32.71±4.89%, which was higher than the 13.41±3.02% in group B ($t=13.41$, $p=0.00$).

CONCLUSION

Compared with conventional images, the combination of optimal keV monochromatic images and CAD improves the diagnostic accuracy of CAD.

CLINICAL RELEVANCE/APPLICATION

The combination of optimal keV monochromatic images and CAD could improve the detection rate for emboli.

SSC04-08 Implementation of Fully Automated Computer-Aided Detection of Nodules in The Lung Bases on Emergent Abdominal CT Scans: Accuracy and Effect on Workflow

Monday, Nov. 26 11:40AM - 11:50AM Room: S504AB

Participants
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Vahid Yaghmai, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To assess the value of fully automated computer-aided diagnosis (CAD) for detection of lung nodules on emergent abdominal CT studies in.

METHOD AND MATERIALS

Abdominal CT scans of 50 patients in the emergency department were reviewed. A radiologist with 5 years' experience (RAD) reviewed the scans to detect pulmonary nodules in the lung bases. In order to simulate the emergency setting, time limit of 30 seconds was set in each case for RAD to review image datasets. The CAD detection performance was also evaluated in the same session by RAD. CAD nodule detection was fully automated and required no additional processing time by RAD. Fisher`s exact test and T-test were used to determine the differences between the rate of detection between RAD and CAD.

RESULTS

A total number of 54 nodules were detected by RAD in 50 patients (28 male, mean±SD age, 51.2±17.6 years). Adding the CAD increased the rate of detection by 30% (1.47 vs. 1.13 nodule/scan, $P<0.05$). Moreover, there was no significant difference in the rate of missed nodules per scan between CAD and RAD (0.33 nodule /scan vs. 0.25 nodule/scan), respectively. 25 out of 74 nodules detected by CAD were false positives .

CONCLUSION

Using fully automated CAD may significantly improve the performance of the radiologist in detecting nodules located in the lung bases on abdominal CT scans obtained in the emergency department.

CLINICAL RELEVANCE/APPLICATION

The role of CAD as a second reader may improve detection of lung base nodules on emergency department abdominal CT scans.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Vahid Yaghmai, MD - 2012 Honored EducatorVahid Yaghmai, MD - 2015 Honored EducatorVahid Yaghmai, MD - 2017 Honored Educator

SSC04-09 Spectrum of Radiological Manifestations of Melioidosis, Association with Risk Factors, and Its Role in Prognostication of Clinical Outcome

Monday, Nov. 26 11:50AM - 12:00PM Room: S504AB

Participants
Leena Robinson Vimala, MD, Vellore, India (*Presenter*) Nothing to Disclose

PURPOSE

Melioidosis being a mimicker of its more common clinical counterpart tuberculosis, is often mismanaged.The primary objective is to describe the spectrum of radiological manifestations of melioidosis. Secondary objectives are to evaluate the association between the organ involvement, known risk factors, predisposing conditions and also to predict effect on clinical outcome.

METHOD AND MATERIALS

Retrospective image analysis of all culture proven cases of Burkholderia pseudomallei,between January 2011 & October 2017 was done. Demographic data, clinical characteristics, risk factors and clinical outcome were anlaysed. Unfavourable clinical outcome considered were those patients with severe disease condition requiring ICU admission for administration of ionotropes, requirement of ventilation or death.

RESULTS

194 patients (162 males) with median age of 45 years,were included.Among the risk factors, diabetes mellitus was most common (63%), followed by alcohol abuse (28%).Table 1 demonstrates the radiological manifestation of organ/ system involvement of melioidosis.Patients with diabetes were found to have increased incidence of liver, spleen, bone and soft tissue involvement ($p<0.05$).Significant association of diabetes with liver, spleen and bone and soft tissue involvement seen, having odds ratios 3.213 (95% CI:1.048 - 9.855;p=0.04),3.478 (95% CI:1.728-7;p=<0.001)&2.668 (95% CI:1.232 - 5.778;p=<0.001) respectively. Statistical significant difference was identified in the melioidosis involvement of genitourinary tract between the positive and negative TB group. 25% of patients suffered unfavourable outcome. Mortality was 11%. Using univariate binary logistic regression analysis,lung involvement was found to have 4.3 times risk for unfavourable outcome (95% CI 1.971 - 9.496; $p< 0.001$),whereas spleen and lymph node involvement, protected from unfavourable outcome (odds ratio being 0.202 & 0.457 respectively).

CONCLUSION

The constellation of imaging findings could mimic disseminated tuberculosis or other pyogenic infection. Combination of organ involvement, associated superficial soft tissue involvement are imaging diagnostic clues.Knowledge about the radiological manifestations of melioidosis is essential for accurate diagnosis and management.

CLINICAL RELEVANCE/APPLICATION

Present study is the largest study that has illustrated the radiological manifestations of melioidosis and its association with clinical outcome and risk factors.

CAS-MOA

Cardiac Monday Poster Discussions

Monday, Nov. 26 12:15PM - 12:45PM Room: CA Community, Learning Center

BR CA

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Abhishek Chaturvedi, MD, Rochester, NY (*Moderator*) Nothing to Disclose

Sub-Events

CA211-SD-MOA2 Cardiac Magnetic Resonance Reveals Signs of Subclinical Myocardial Disease in Patients with Myotonic Muscular Dystrophy

Station #2

Participants
Julian A. Luetkens, MD, Bonn, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

Myotonic muscular dystrophy (DM) is a genetic multisystem disorder characterized by skeletal muscle weakness and myotonia. Cardiac involvement seems to be rare, but patients with DM are at an increased risk for ventricular dysfunction and sudden cardiac death. We aimed to determine the extent of cardiovascular involvement in DM patients by a comprehensive cardiac magnetic resonance (CMR) approach.

METHOD AND MATERIALS

DM patients (n=12; 6 with type 1 and 6 with type 2) without cardiac symptoms and preserved ejection fraction and age- and gender-matched control subjects (n=24,) underwent CMR. Multiparametric CMR protocol allowed for the determination of late gadolinium enhancement (LGE), visible myocardial edema, T1 relaxation times, T2 relaxation times, extracellular volume (ECV), longitudinal strain and cardiac function.

RESULTS

When compared with healthy controls, DM patients showed alterations in myocardial tissue composition (native T1 relaxation times: 1018±32 ms vs. 953±35 ms; P<0.001; T2 relaxation times: 56±7ms vs. 53±2ms; P=0.023; ECV: 31±8% vs, 27±5%, P=0.049). No differences in left ventricular ejection fraction were observed (59±6% vs. 62±4%; P=0.110), but DM patients demonstrated lower average systolic longitudinal values (-19±4% vs. -22±4%; P=0.036). No alterations in LGE were observed.

CONCLUSION

Comprehensive CMR revealed a high burden of cardiovascular disease in DM patients without cardiac symptoms. We could demonstrate that DM patients have subtle evidence of impaired myocardial function and also elevated markers of diffuse myocardial fibrosis and injury. Subclinical myocardial disease might be a precursor of cardiac involvement in DM patients.

CLINICAL RELEVANCE/APPLICATION

Comprehensive CMR revealed a high burden of cardiovascular disease in DM patients and might serve as a potential screening parameter for beginning cardiovascular disease in these patients.

CA212-SD-MOA3 2D/3D CMR-Tissue Tracking in the Assessment of Spontaneous T2DM Rhesus Monkeys with Isolated Diastolic Dysfunction

Station #3

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PURPOSE

To investigate the left ventricle dysfunction and myocardial deformation in spontaneous type 2 diabetes mellitus (T2DM) rhesus monkeys with isolated diastolic dysfunction (DD) by 2D/3D CMR-tissue tracking (CMR-TT).

METHOD AND MATERIALS

Spontaneous T2DM rhesus monkeys with isolated DD (T2DM-DD, n=10) and corresponding non-diabetic healthy animals (ND, n=9) were scanned prospectively for the CMR study. Parameters of myocardial deformation obtained from 2D/3D CMR-TT were compared between the two groups. In addition, all CMR imaging protocols were performed twice (i.e., test and retest scans) in 9 ND animals to assess test-retest reproducibility.

RESULTS

Compared with ND, T2DM-DD monkeys demonstrated significantly reduced peak systolic circumferential strain (Ecc), peak diastolic circumferential strain rate (CSR), with 2D CMR-TT, and only Ecc with 3D CMR-TT ($p<0.05$). Test-retest repeatability analysis showed that the ICC of 2D CMR-TT derived Ecc (0.77, $p<0.05$), CSR (0.86, $p<0.05$), peak systolic longitudinal strain (Ell) (0.90, $p<0.01$) and peak diastolic longitudinal strain rate (LSR) (0.87, $p<0.01$) showed good reproducibility, but only 3D TT-derived Ell (0.77, $p<0.05$) showed good reproducibility.

CONCLUSION

Left ventricular systolic and diastolic deformation functions were both impaired in spontaneous T2DM rhesus monkeys with isolated diastolic dysfunction, which were similar to the findings in human T2DM. The 2D CMR-TT derived Ecc and CSR were effective in the evaluation of the myocardial systolic and diastolic functions of early diabetic cardiomyopathy with relatively higher test-retest reproducibility compared with the 3D CMR TT method.

CLINICAL RELEVANCE/APPLICATION

Spontaneous T2DM rhesus monkeys can be used as an effective model, particularly in the investigation and preclinical testing of novel T2DM therapeutic agents, with a high potential for translatability to humans. 2D CMR-TT can be used as an integral part in the one-stop shop of CMR and to evaluate the cardiac function of DCM accessibly.

CA213-SD-MOA4 Accuracy of RECHARGE Score Derived From Coronary CT Angiography versus Conventional Angiography for the Prediction of Successful Percutaneous Coronary Intervention in Patient with Chronic Total Occlusion

Station #4

Participants
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PURPOSE

To investigate the feasibility and accuracy of coroanry CT angiography (cCTA) versus conventional angiography to predict procedural success and 30-minutes wire crossing in percutaneous coroanry intervention (PCI) for chronic total occlusion (CTO) lesions

METHOD AND MATERIALS

In this IRB-approved, HIPAA-compliant investigation data of 89 consecutive patients (median 58 years, 79% male) with 99 lesions who underwent cCTA prior conventional angiography (CA) with CTO-PCI were retrospectively analyzed. The RECHARGE score (the sum of the following 6 binary parameters: 1. proximal cap blunt; 2 severe calcification;3.bending;4. CTO length > 20mm;5. diseased distal landing zone;6. previous bypass graft on CTO vessel) was calculated and compared between cCTA (RECHARGEcCTA) and CA (RECHARGECA).

RESULTS

The procedual success rate of the CTO-PCI procedures was 70.7%, and 60.6% of cases achieved 30-minutes wire crossing. No significant difference was observed between median RECHARGEcCTA score (2[IQR1-3]) and median RECHARGECA score (2[IQR1-3]) for procedural success ($p=0.084$). However, the median RECHARGEcCTA score (2[IQR1-3]) was higher than that of the RECHARGECA score (1.5[IQR1-3]) for 30-min wire crossing, $p=0.001$).The area under the curve (AUC) of the RECHARGEcCTA and RECHARGECA score for predicting procedural success showed no statistical significance (0.751 vs. 0.757, $p=0.922$). The sensitivity, specificity, positive predictive value, negative predictive value of RECHARGEcCTA score<=2 for predictive procedual success was 64.25, 79.3%, 88% and 48%, respectively.

CONCLUSION

Non-invasive cCTA-dervied RECHARGE score performs equally to invasive determination and may help to predict procedural success and within 30-minutes guide wire crossing of CTO-PCI.

CLINICAL RELEVANCE/APPLICATION

CCTA has been demonstrated as an alternative pre-procedural imaging method for CTO-PCI and provided prognostic information beyond angiography alone.

CA214-SD-MOA5 Compressed SENSE Single-Breath-Hold and Free-Breathing Cine Imaging for Accelerated Clinical Evaluation of Left Ventricle

Station #5

Participants

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Quanmei Ma, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To compared the accuracy of CS-SENSE cine CMR with and without breath-hold (BH) and BH standard cine CMR for left ventricular (LV) function assessment.

METHOD AND MATERIALS

Thirty-three healthy volunteers underwent balanced turbo field-echo cine CMR with breath-hold (BTFE-BH; reference standard), single BH CS-SENSE (csBTFE-BH) cine CMR, and free-breathing (FB) CS-SENSE (csBTFE-FB) cine CMR on 3.0T scanner. All images were acquired in stacks of 8 short-axis slices. Image quality was assessed and compared by Wilcoxon matched-pair signed-rank test. Comparison of sequences was made in end-diastolic volumes, end- systolic volumes, stroke volume, ejection fraction, LV end-diastolic (LVED) mass, regional myocardial wall motion, and scan times using paired t-test, linear regression and Bland-Altman analyses.

RESULTS

All techniques provided acceptable image quality (score >=3) for LV volumetric analysis in all subjects (BTFE-BH [reference]: 5.00±0.00; csBTFE-BH: 4.03±0.17 [p<0.001]; csBTFE-FB: 3.76±0.44 [p<0.001]), and all had good agreement on assessment of LV function. However, there was a small but significant underestimation of LVED mass with csBTFE-FB (csBTFE-FB: 73.63±17.31 g vs. BTFE-BH [reference]: 75.12±18.18 g, p=0.037). There was strong correlation among all methods for quantitative regional myocardial wall motion. The acquisition times for both csBTFE-BH and csBTFE-FB were significantly shorter than BTFE-BH (BTFE-BH [reference]: 89.3±5.70 s; csBTFE-BH: 24.42±2.18 s [p<0.001]; csBTFE-FB: 22.48±1.85 s [p<0.001]).

CONCLUSION

Assessment of LV function with the novel CS-SENSE cine CMR is noninferior to the standard cine CMR irrespective of BH. However, LVED mass is underestimated with csBTFE-FB.

CLINICAL RELEVANCE/APPLICATION

csBTFE cine CMR irrespective of BH commands might be a suitable alternative to standard BH cine CMR for assessment of LV function for CHD patients who cannot tolerate BH. The CS-SENSE technique is time efficient and can potentially improve the clinical utility of CMR.

CA215-SD-MOA6 Unmodified, Autologous Adipose Tissue Derived Regenerative Cells Improve Cardiac Function, Structure and Revascularization in a Porcine Model of Chronic Myocardial Infarction

Station #6

Awards
Trainee Research Prize - Resident

Participants
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PURPOSE

Numerous studies have investigated cell-based therapies for acute myocardial infarction (MI), with mixed results. In chronic MI less is known about stem cells and the best delivery route. This study evaluated the effects of unmodified, autologous adipose tissue-derived regenerative cells (UA-ARDCs) in a porcine reperfusion model of chronic MI.

METHOD AND MATERIALS

The left anterior descending (LAD) artery of pigs was occluded for 180 min. Four weeks later, the mean left ventricular ejection fraction (LVEF) was shown to have been reduced to approximately 35%. At that time, 18×106 unmodified, autologous adipose-derived regenerative cells (UA-ADRCs) were delivered into the LAD vein (control: delivery of saline). Myocardial parameters were assessed by cardiac magnetic resonance imaging (CMR) in a blinded manner immediately prior to cell delivery at four weeks after MI induction. Follow-up scans were performed after six weeks (at ten weeks after MI induction).

RESULTS

Six weeks following UA-ADRCs/saline delivery, the mean LVEF had increased by 18% (p<0.01) after delivery of UA-ADRCs, but was unchanged after delivery of saline. Delivery of UA-ADRCs reduced myocardial fibrosis by 20%, controls exhibited a 22% increase (p<0.002). This is among the best outcome ever reported in studies on porcine animal models of cell-based therapies for MI in which functional and structural outcome was assessed with cardiac magnetic resonance imaging.

CONCLUSION

In this chronic MI model, the retrograde venous injection of UA-ADRCs is feasible and safe. Treatment significantly improved

hemodynamics, myocardial muscle mass and reduced scar as measured by CMR.

CLINICAL RELEVANCE/APPLICATION

The unique combination of the procedure used for isolating UA-ADRCs, the late cell delivery time and the uncommon cell delivery route applied in the present study may open new horizons for cell-based therapies for MI.

CA216-SD-MOA7 The Correlation Between Coronary Artery Calcification and Biochemical Risk Factors in Non-Dialysis Patients with Chronic Kidney Disease Using 16cm Wide-Detector Computed Tomography

Station #7

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PURPOSE

The aim of this study was to investigate the correlation between the CAC and biochemical risk factors in Chinese non-dialysis patients with CKD.

METHOD AND MATERIALS

4189 non-dialysis patients with CKD underwent blood biochemical examinations and risk factors including calcium, phosphate, vitamin D3, parathyroid hormone, triglyceride, high- and low-density lipoprotein, total cholesterol, C-reactive protein, creatinine, cystatin C, urate and glomerular filtration rate (eGFR) were collected. Subsequently, CAC severity was determined using a 16-cm detector CT (Revolution, GE Healthcare). The correlation between CAC and these risk factors were analyzed by logistic regression model.

CONCLUSION

The reduction of the glomerular filtration rate was not associated with CAC score; low-density lipoprotein and total cholesterol were associated with CAC incidence while and other biochemical risk factors had no correlation with CAC.

CLINICAL RELEVANCE/APPLICATION

Biomarkers derived from blood examinations could potentially assist the prediction of CAC in non-dialysis patients with CKD.

CA164-ED-MOA8 Fontan Circulation in Adults: What a Radiologist Needs To Know

Station #8

Awards
Certificate of Merit

Participants
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TEACHING POINTS

Teaching Points1. To understand the indications for Fontan procedure and types of surgeries2. To review the haemodynamics of Fontan circulation and relevant imaging protocols3. To familiarise with complications on MRI and CT using a case-based approach.

TABLE OF CONTENTS/OUTLINE

Table of contents1. Pre-existing conditions2. Fontan procedure3. Fontan haemodynamics4. Imaging protocols5. Case-based review of imaging findings with a focus on:• satisfactory haemodynamical result• spectrum of complications: ventricular failure, cavity dilatation, Fontan pathway stenosis, shunt formation, specific sites and appearances of thrombus formation, pulmonary arteriovenous malformations, failure of thoracic lymphatic drainage and Fontan hepatopathy.

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

CAS-MOB

Cardiac Monday Poster Discussions

Monday, Nov. 26 12:45PM - 1:15PM Room: CA Community, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
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Sub-Events

CA217-SD-MOB1 A Comprehensive Comparison of Two Accelerated 4D-Flow Sequences in Healthy Volunteers Regarding Acquisition Time, Diagnostic Accuracy, Image Quality, and Importance of Eddy Currents Using the Software "Bloodline"

Station #1

Participants
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PURPOSE

To prove the non-inferiority of a kt-GRAPPA 4D flow sequence compared to a standard GRAPPA sequence in healthy volunteers. In addition to the quantification of flow-parameters, image quality, susceptibility to artifacts, and the importance of eddy current correction (ECC) were assessed.

METHOD AND MATERIALS

Fourty healthy volunteers (22 females, mean age 41.8±11.8 years) were examined at a 3T scanner. Anatomic and flow datasets of the thoracic aorta were acquired using a 3D-T2w-SPACE- and two accelerated 4D-flow sequences, one with k-t undersampling and one with a standard GRAPPA parallel imaging protocol. Additional 2D-flow measurements were used as the standard reference in the ascending and descending aorta. A new comprehensive, custom-made software tool ("Bloodline") allowed measurements of the flow volume and peak velocity at the exact same location using a standardized segmentation of the anatomical images for all measurements. Quantitative flow analyses were performed with and without ECC. Furthermore, overall image quality (oIQ) and the occurrence of motion artifacts (mIQ) were assessed using a qualitative scale from 0-2 with 2 indicating the best IQ

RESULTS

The use of the kt-GRAPPA sequence allowed a mean scan time reduction of 60% and provided significantly less motion artefacts than the standard GRAPPA sequence (mIQ 1.6±0.6 vs. 0.84±0.8; $p<0.001$). Both 4D-flow sequences demonstrated neither significant differences of the mean flow volume in the ascending aorta with 83.54±25.0 ml/min (GRAPPA), 88.14±26.2 (kt-GRAPPA) and 87.86±23.1(2D-flow) nor of the mean peak velocity with 1.2±0.4m/s or with and without ECC. Nevertheless, the correlation between both 4D-sequences and 2D-flow was better with ECC; the best correlation showed the kt-GRAPPA sequence (R=0.96 vs. 0.90) with good limits of agreement (LOA).

CONCLUSION

The significantly faster kt-GRAPPA sequence provided no significant different flow volumes or peak velocities as the standard GRAPPA sequence with less motion artifacts and better correlation to the standard reference; is therefore non-inferior and can be used for future research.

CLINICAL RELEVANCE/APPLICATION

In clinical and scientific settings acceptable acquisition times are crucial, therefore we showed that 4D-flow with kt-GRAPPA is non-inferior to standard GRAPPA and can be used for future research and for clinical studies.

CA218-SD-MOB2 Pulsatile Lung Deformation Derived from Feature Tracking of Cardiac Cine Magnetic Resonance Imaging: Assessment of Systemic Sclerosis Related Pulmonary Fibrosis

Station #2

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PURPOSE

Systematic sclerosis (SSc) is characterized by the progression of fibrosis in the all organs. Pulmonary fibrosis and cardiac involvement are important prognostic factors. The present study proposes a new imaging technique to analyze pulsatile lung deformation using feature tracking of cardiac cine MRI (FT-CMR), and investigates the relation to pulmonary fibrosis and cardiac deterioration in SSc.

METHOD AND MATERIALS

Data of cardiac MRI for 25 SSc patients with (mean age, 60.6 years, Female 96%) who were suspected cardiac involvement and age-matched 10 healthy controls with a left ventricle ejection fraction (LVEF) > 50% was analyzed. Cardiac cine MR imaging of short-axis left ventricle was performed using a SSFP sequence with 3.0 Tesla. Cine images in which posterior wall of the left ventricle is closest to the left lung and the mostly movement by heart beat were selected. Peripheral zone of the lower lung with a depth of 1 cm from the pleura were set as a region of interest, and the strain in the radial direction to the center of the left lung was calculated using FT-CMR. The maximum absolute value of the strain during a cardiac cycle was defined as lung strain, and was used as an estimate of pulsatile lung deformation. The presence of pulmonary fibrosis was identified by chest high-resolution CT. Comparison of lung strain was analyzed by Mann-Whitney test.

RESULTS

CT showed pulmonary fibrosis in 14 SSc patients (56%). Lung strain was significantly lower for SSc patients with pulmonary fibrosis (7.2±5.5%) than those without it and controls. (11.3±11.1%; 10.5±7.4%; p50% (6.8±3.6% vs.9.8±9.9%).

CONCLUSION

Development of pulmonary fibrosis in SSc associates with decreasing pulsatile lung deformation regardless of cardiac deterioration. FT-CMR derived lung strain is a new functional technique for assessment of pulmonary fibrosis.

CLINICAL RELEVANCE/APPLICATION

Cardiac cine MRI adding lung strain enables non-invasively both evaluations of cardiac function and pulmonary fibrosis.

CA219-SD-MOB3 Effect of Long Term CPAP Usage on Cardiac Parameters Assessed with Cardiac MRI

Station #3

Participants
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PURPOSE

The obstructive sleep apnoea syndrome (OSAS) is a disorder with a high prevalence and is associated with an elevated cardiovascular risk and increased morbidity and mortality. Common OSAS associated cardiovascular disorders include coronary artery disease, heart failure, hypertension, cardiac arrhythmias and stroke. Continuous positive airway pressure (CPAP) has been demonstrated to improve daytime performance and to reduce cardiovascular effects associated with OSAS. For longitudinal studies and functional analysis cardiac MRI is regarded as the gold standard. Aim of this study was to evaluate the long term effect of CPAP therapy on cardiac functional parameters with cardiac Magnetic Resonance Imaging (cMRI).

METHOD AND MATERIALS

54 patients with OSAS (mean AHI: 31) were prospectively enrolled in this study and cMRI was performed before and after 7 months of CPAP therapy. Data were acquired on a 1.5T MRI and right and left ventricular cardiac morphology and function were analysed. CPAP treatment was considered compliant when used >= 4 h per night. 24-hour blood pressure was measured at baseline and follow up.

RESULTS

33 patients could be assigned to the compliance group. Left ventricular stroke volume (LV SV) and right ventricular ejection fraction (RV EF) improved significantly with CPAP therapy (LV SV from 93±19ml to 99±20ml, p=0.02; RV EF from 50±6% to 52±6 %, p=0.04). All other cardiac parameters did not change significantly while mean systolic and diastolic blood pressure improved significantly (p<0.01). 21 patients were assigned to the non-compliance group and were considered as a control group; there were no relevant differences in cardiac parameters between baseline and follow up examination in these patients.

CONCLUSION

CPAP therapy significantly improved LV SV, RV EF, systolic and diastolic blood pressure in OSAS patients.

CLINICAL RELEVANCE/APPLICATION

CPAP therapy has a postive long term effect on the right ventricle.

CA220-SD-MOB4 Non-Ischemic Myocardial Fibrosis: Diagnostic Performance of Delayed Enhancement Cardiac CT in Comparison with Late Gadolinium Enhancement Cardiac MRI

Monday, Nov. 26 1:00PM - 1:15PM Room: CA Community, Learning Center Station #4

Participants

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PURPOSE

Delayed enhancement CT (DE-CT) obtained following coronary CT angiography (CCTA) can be used to evaluate myocardial fibrosis either visually or through estimation of the extracellular volume fraction (ECV). The purpose of this study is to assess diagnostic performance of DE-CT and CT-derived ECV in comparison to late gadolinium enhancement (LGE)-MRI and MRI-ECV in non-ischemic myocardial fibrosis.

METHOD AND MATERIALS

Between January 2015 and January 2018, 28 patients with proven non-ischemic cardiomyopathies/myocardial fibrosis who underwent both cardiac MRI with LGE and comprehensive cardiac CT protocol including acquisition of CCTA and DE-CT comprised the final study population. DE-CT was acquired 5 minutes after CCTA using dual-source CT. Diagnostic performance of DE-CT and agreement with LGE-MRI on patient and segment levels (28 patients with 476 segments) were investigated. Similarly, agreement and correlation between CT-ECV and MRI-ECV were studied in a subset of patients with pre- and post-contrast T1 mapping on MRI (17 patients).

RESULTS

Delayed enhancement CT had a sensitivity and specificity of 100% on patient-based analysis and 85% sensitivity, 98% specificity, 90% PPV, 96% NPV and 95% diagnostic accuracy on segment-based analysis when compared to LGE-MRI for detection of non-ischemic myocardial scarring. ROC analysis showed an AUC of 0.908. Agreement with LGE-MRI for detection and localization of myocardial scars was good (kappa=0.836, p<0.001). In the subset of patients with pre- and post-contrast T1 mapping, CT-ECV correlated well with MRI-ECV (r=0.71, p=0.001). Bland-Altman analysis showed a mean difference of 1% with 95% limits of agreement between -4.4 and 6.3%. The average radiation dose of the delayed scans was 2.1 mSv.

CONCLUSION

Delayed enhancement cardiac CT is a reliable and accurate method for detection of focal or diffuse non-ischemic myocardial fibrosis.

CLINICAL RELEVANCE/APPLICATION

Cardiac CT, which is an easier and faster imaging technique than cardiac MRI, can be used confidently to assess focal or diffuse non-ischemic myocardial fibrosis when cardiac MRI is not available or contraindicated, e.g. in patients with implanted cardiac electronic devices.

CA221-SD-MOB5 Effect of Collateral Circulation on Left Ventricular Myocardial Strain in Patients with Coronary Artery Chronic Total Occlusion by Cardiovascular Magnetic Resonance Feature Tracking

Station #5

Participants
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Shuangchun Ma, Dalian, China (*Presenter*) Nothing to Disclose

PURPOSE

To study the relation between different levels of collateral circulation to the strain of left ventricular myocardium in the segment of the CTO territory by means of the cardiovascular magnetic resonance feature tracking(CMR-FT)in the patients with coronary artery chronic total occlusion.

METHOD AND MATERIALS

In the patients who underwent CMR during the period of 2015 - 2017 in our hospital, and diagnosed by coronary angiography with chronic total occlusion (CTO), 12 patients (age 44-77 years old, mean age 64.64±9.90 years old , 4 male, 8 female,3LAD,5LCX , 4RCA) were randomly selected as the research objects. Coronary angiography was performed using the standard Judkins technique. The collateral circulation was graded with the Cohen and Rentrop classification with scores of 0 (no collateral flow), 1 (collateral circulation fills only the side branches), 2 (partial filling of the main epicardial coronary vessel) and 3 (complete filling of the epicardial coronary vessel) applied. According to 17 segments to quantitatively evaluate the myocardial strain of two groups by Circle Cardiovascular Imaging 42 software, outline the endocardium and epicardium in the left ventricular short axis, two chamber long axis and four chambe cine image,respectively, then calculate the strain of 17 myocardial segments and got the corresponding bovine eye diagram. Analyze the relation among radial strain(RS), circumferential strain(CS) and longitudinal strain(LS) to the different levels of collateral circulation by SPSS 22.0 software.

RESULTS

There was significant difference in RS, CS of left ventricular myocardium in the segment of the CTO territory among Rentrop grade 0 and Rentrop grade 1, Rentrop grade 2,Rentrop grade 3 in CTO patients (P = 0.000, 0.000, 0.000, 0.002, 0.000 , 0.011, respectively), and there was no difference in the strain among Rentrop grade 1, Rentrop grade 2 and Rentrop grade 3.

CONCLUSION

The RS and CS of CTO patients without collateral circulation were significantly decreased. CMR-FT can quantitatively evaluate the RS, CS and LS of left ventricular myocardial in the patients with CTO , and provide a new method of noninvasive, accurate and convenient for the objective assessment of left ventricular function in patients with CTO.

CLINICAL RELEVANCE/APPLICATION

CMR-FT can provide a non-invasive, accurate and easy method for objective evaluation of left ventricular function in patients with myocardial ischemia.

CA222-SD-MOB6 Usefulness of Strain Imaging During Stress-CMR with Adenosine Infusion for a Combined Perfusion-Contractility Evaluation in Detection of Myocardial Ischaemia and Viability

Station #6

Participants
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PURPOSE

Cardiac Magnetic Resonance Stress Imaging with adenosine is an accurate tool for the detection of perfusion abnormalities. Neverthless, it shows low sensibility in the evaluation of cardiac contractility defects, allowing an exclusively visual assessment of wall movement abnormalities in case of inducible perfusion defects. The aim of our study is the identification of global and segmental deformation abnormalities during perfusional examination with adenosine, through feature tracking analysis

METHOD AND MATERIALS

CINE-sequences of 30 patients with known CAD performed during and after adenosine infusion were evaluated: 10 patients showed focal reversible defects ("ischemic"group), 10 patients focal irreversible perfusion defects and LGE ("infarcted"group), 10 patients did not show any perfusion abnormalities or LGE (control group). 3D values analysis of global, per planes and segmental (according to AHA classification) LS and CS were performed.The increase of Strain values between rest and stress during adenosine infusion was calculated

RESULTS

Statistical analysis showed regular growth of all Longitudinal and Circumferential Strain values during stress in the control group (>10%). In the "ischemic"group with focal defect and in the "infarcted" group with subendocardic defect, there was a significant rise of global and per planes values of LS and CS during stress; however, per segments analysis showed focal alterations of longitudinal deformability (increase <10%)($p<0,05$) at the level of segments with perfusion defects identified through dedicated sequences. In addition, a significant modification of CS values was observed in all patients except in case of LGE>50%

CONCLUSION

In conclusion, Strain analysis showed high capability of identifying myocardial global and segmental deformability alterations in patients with focal subendocardic defects and good residual function of the remaining myocardial portions.

CLINICAL RELEVANCE/APPLICATION

Strain analysis is a reliable analysis applicable in a clinical routine setting thanks to its capability to provide information necessary for clinical decision making, particularly about myocardial contractility, avoiding more stressed evaluation as the dobutamine stress.

CA223-SD-MOB7 The Correlation Between Kidney Pathological Type and Coronary Artery Calcification in End-Stage Dialysis Patients Using 16cm Wide-Detector CT

Station #7

Participants
Changqing Yin, Zhenjiang, China (*Presenter*) Nothing to Disclose
Dongqing Wang, Zhenjiang, China (*Abstract Co-Author*) Nothing to Disclose
Lirong Zhang, MD, zhenjiang, China (*Abstract Co-Author*) Nothing to Disclose
Haitao Zhu, Zhenjiang, China (*Abstract Co-Author*) Nothing to Disclose
Shao Xun, Zhenjiang, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The aim of this study was to investigate the associations between kidney pathological type and CAC in end-stage dialysis patients.

METHOD AND MATERIALS

1125 dialysis patients were enrolled in this study, baseline as well as follow-up CAC were measured (average interval of 2.5 years) by 16cm wide-detector CT (Revolution, GE Healthcare). Biomarkers from blood examinations (Serum calcium, phosphorus, HDL/LDL, PTH) and nephropathy were also measured. These individuals then conducted pathology and pathological categories include IgA, Membranous Nephropathy(MN), Mesangial Proliferative Nephritis(MPN), Membranoproliferative Glomerulonephritis(MPGN), Focal Segmental Glomerulosclerosis(FGSG), Podocyte Disease(PD), Diabetic Nephropathy(DN), Hypertensive Nephropathy(HN), Nephritis of

Schonlein-Henoch purpura and Lupus Nephritis(LN). Among 1125 patients, number of patients with various pathological conditions are as follows: IgA(n=183), MN(n=105), MPN(n=93), MPGN(n=88), FSGS(n=95), PD(n=102), DN(n=126), HN(n=92), HPN(n=89), LN(n=83).The associations of nephropathy with CAC was analyzed using multiple logistic regression.

RESULTS

At baseline, CAC was present in 69% (87 of 126) DN patients, the percentage was higher than that in other types. At follow-ups, the most new-onset CAC developed in 33% (31 of 95) in IgA; MN patients' severity increased from a median CAC score of 38 to 82 in those with baseline CAC was higher than others. In multiple logistic regression, phosphate level(B=4.6; 95% confidence interval [95% CI],1.42 to 9.11; P=0.002) and baseline scores(B=7.0;95%CI,1.8 to 7.5;P=0.003) were associated with CAC progression in all nephropathy;high total PTH (>540pg/ml;B=7.1;95%CI,2.8to11.3;P=0.001)and elevated whole PTH(>450pg/ml;B=6.9;95%CI,2.4to11.4;P=0.003) were the predictors for CAC progression except in MPN, MPGN, PD, HPN, LN.

CONCLUSION

In this study, CAC is more prevalent in DN; whereas CAC has a higher incidence in IgA and a faster progression in MN. Phosphate level and baseline scores are associated with CAC progression in all nephropathy. However, high total PTH and elevated whole PTH are the predictors for CAC progression except in MPN, MPGN, PD, HPN, and LN.

CLINICAL RELEVANCE/APPLICATION

Through pathology, different degrees of CAC need different attention.

CA166-ED-MOB8 Pap in a Snap: All You Need to Know About Papillary Muscles

Station #8

Participants
Prachi P. Agarwal, MD, Canton, MI (*Presenter*) Nothing to Disclose
Sara Saberi, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Sharlene M. Day, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Elizabeth Lee, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Nicholas S. Burris, MD, San Francisco, CA (*Abstract Co-Author*) Entitled to royalties from liscensure of intellectual property to Imbio LLC
Brent Little, MD, Boston, MA (*Abstract Co-Author*) Author, Reed Elsevier; Editor, Reed Elsevier
Kristopher W. Cummings, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose

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TEACHING POINTS

1. Understand the anatomy of mitral subvalvular apparatus with emphasis on left ventricular papillary muscles (PM). 2. Recognize the radiologic findings of a wide spectrum of PM abnormalities 3. Develop an understanding of the relation between morphologic abnormalities and hemodynamic consequences

TABLE OF CONTENTS/OUTLINE

1. Anatomy of mitral sub valvular apparatus 2. Spectrum of anatomic abnormalities and variants: a. Congenital: These include a wide spectrum ranging from variant anatomy to complex lesions such as parachute (single papillary muscle) and parachute like mitral valve. Variant anatomy becomes particularly important in the context of hypertrophic cardiomyopathy. Examples include accessory PM, displaced PM, anomalous direct insertion of PM to the mitral valve leaflet with absent or short chordae tendineae b. Ischemic heart disease/ trauma leading to scarring or rupture of PM c. Mitral valve prolapse and delayed enhancement of PM d. Tumors: Fibroelastoma, metastases e. Pitfalls: PM (especially accessory) can be misinterpreted for intraventricular mass/thrombus, apical insertion can be confused for hypertrophy 3. Functional consequences of papillary muscle abnormalities: a. Mitral valve dysfunction: Carpentier classification of mitral valve dysfunction b. Sub aortic obstruction 4. Comprehensive imaging protocols for assessment

Honored Educators

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MSMC23

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

Monday, Nov. 26 1:30PM - 3:00PM Room: S406A

CA CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Jill E. Jacobs, MD, New York, NY (*Director*) Nothing to Disclose
Karen G. Ordovas, MD, San Francisco, CA (*Moderator*) Advisor, Arterys Inc

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LEARNING OBJECTIVES

1) Identify cardiac and coronary artery anatomy. 2) Recognize cardiac disease processes, including coronary atherosclerosis, as diagnosed on CT. 3) Understand methods of cardiac CT and coronary CT angiography post-processing. 4) Understand the role of coronary artery calcium scoring. 5) Understand the role of Cardiac CTA in coronary artery pathologies including aneurysms, fistulae and other anomalies.

Sub-Events

MSMC23A Pulmonary Veins and Pericardial Disease

Participants
Harold I. Litt, MD, PhD, Philadelphia, PA (*Presenter*) Research Grant, Siemens AG ; ; ;

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 Atherosclerosis III

Participants
Elliot K. Fishman, MD, Baltimore, MD (*Presenter*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics, Inc

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LEARNING OBJECTIVES

1) To provide a more complete understanding of cardiac CTA through a series of illustrative cases. 2) Discuss calcium scoring and its current role in a range of clinical scenarios, coronary artery anomalies, coronary artery fistulae, coronary artery aneurysms, and coronary artery challenging cases.

Honored Educators

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SSE03

Cardiac (CTA: General Topics)

Monday, Nov. 26 3:00PM - 4:00PM Room: N229

CA CT

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Smita Patel, FRCR,MBBS, Ann Arbor, MI (*Moderator*) Nothing to Disclose
Daniel Vargas, MD, Aurora, CO (*Moderator*) Nothing to Disclose

Sub-Events

SSE03-01 Association of Plasma Uric Acid and Creatinine with Coronary Artery Calcium Score

Monday, Nov. 26 3:00PM - 3:10PM Room: N229

Participants
Lei Zhang, MD, PhD, Songjiang, China (*Abstract Co-Author*) Nothing to Disclose
Chen Qiao, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Han Wang, MD, PhD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose
Shu Hong Fan, Shanghai, China (*Presenter*) Nothing to Disclose

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PURPOSE

The aim of this study was to conduct a statistical analysis of low-radiation-dose coronary computed tomography screening for coronary artery calcium score (CACS) to determine the correlation of the CACS with age, sex, systolic blood pressure, diastolic blood pressure, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), total cholesterol (TC), triglycerides (TG), uric acid (UA) and creatinine (Cr), as well as to investigate the predictive value of these traditional risk factors for coronary artery disease.

METHOD AND MATERIALS

There were 646 patients with chest pain or suspected coronary atherosclerosis, a clinical history, smoking habit, symptoms, high blood pressure, and high blood sugar. The following biochemical parameters were assessed: LDL-C, HDL-C, TC, TG, UA, and creatinine. All patients underwent a CT scan for coronary artery calcium score analysis. The scan was then analyzed in relationship to CACS levels and the above items for all patients.

RESULTS

In total, 326 patients were male (59.8%), and 219 patients were female (40.2%). The average age was 69.1 ± 10.2 years, and the mean CACS was 485 ± 814. Significant correlations of CACS with UA ($r = 0.1518$, $P < 0.05$) and creatinine ($r = 0.2752$, $P < 0.05$) were found. According to the multivariate Cox regression analysis, after adjusting for demographic characteristics and other serum parameters, serum UA levels (odds ratio [OR], 1.003, 95% confidence interval [CI], 1.001-1.005, $p = 0.003$) and creatinine levels (OR, 1.002, 95% CI, 0.999-1.005, $p = 0.002$) qualified as independent discriminators of the severity of coronary artery calcification.

CONCLUSION

We propose the need for identifying and managing UA and creatinine abnormalities to reduce excess coronary artery disease (CAD) risk. This proposal remains to be formally tested in a prospective study.

CLINICAL RELEVANCE/APPLICATION

The severity of coronary artery calcification score may indicated the UA and creatinine abnormalities in the blood.

SSE03-03 Feasibility Study of Coronary Computed Tomography Angiography in Patients with Free-Breathing Using 256-Detector CT

Monday, Nov. 26 3:20PM - 3:30PM Room: N229

Participants
Zhuo Liu, Beijing, China (*Presenter*) Nothing to Disclose
Nan Hong, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To evaluate the feasibility of coronary computed tomography angiography (CCTA) in patients with free-breathing using 256-detector CT.

METHOD AND MATERIALS

616 patients underwent CCTA without heart rate control. 325 examinations were performed during free-breathing (group A), and the remaining 291 were performed during breath-holding(group B). The image quality scores were defined as 1 (excellent), 2 (good), 3 (adequate), and 4 (poor). 22 patients in group A and 24 in group B also underwent invasive coronary angiography (ICA) after CCTA within two weeks. The image quality score, diagnostic performance using ICA as reference, signal-to-noise ratio (SNR), and effective dose (ED) were compared between the two groups.

RESULTS

Mean heart rate during scanning was 70.8±13.8 bpm in group A and 70.7±13.2 bpm in group B (P=0.950). No significant differences were observed in the quality score between breath-holding and free-breathing groups (1.10±0.31 vs. 1.12±0.33; P=0.647). The SNR, effective dose were not significantly different between the two groups. In a segment-based analysis, the sensitivity and specificity in the detection of coronary stenosis of more than 50% were 82.1% and 96.8%, respectively in the breath-holding group and 82.2% and 96.6%, respectively in the free-breathing group with no significant differences for these parameters between the two groups.

CONCLUSION

CCTA for patients without heart rate control and with free-breathing using 256-detector CT showed no significant difference in image quality and diagnostic accuracy compared with patients with breath-holding.

CLINICAL RELEVANCE/APPLICATION

In patients without heart rate control, CCTA can be acquired during free breathing without substantial loss of image quality when using a 256-detector CT.

SSE03-04 Prognostic Value of Delayed Enhancement Imaging by Cardiac Computed Tomography in Predicting Major Adverse Cardiac Events in Patients with Suspected Coronary Artery Disease

Monday, Nov. 26 3:30PM - 3:40PM Room: N229

Participants
Yoshitaka Goto, MD, Tsu, Japan (*Presenter*) Nothing to Disclose
Kakuya Kitagawa, MD, PhD, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Satoshi Nakamura, MD, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Naoki Nagasawa, RT, PhD, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Ahmed H. Heussein, MD,MSc, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Masafumi Takafuji, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Hajime Sakuma, MD, Tsu, Japan (*Abstract Co-Author*) Research Grant, Fuji Pharma Co, Ltd; Research Grant, DAIICHI SANKYO Group; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Siemens AG; Research Grant, Nihon Medi-Physics Co, Ltd; Speakers Bureau, Bayer AG

PURPOSE

Myocardial CT delayed enhancement (CTDE) shares the same pathophysiological principle with late gadolinium enhancement MRI, and allows for infarct detection and viability assessment. However, the prognostic value of CTDE is unknown. The purpose of this study was to investigate whether the presence of delayed enhancement (DE) detected by CT is an independent predictor of major adverse cardiac events (MACEs) in patients with suspected coronary artery disease (CAD).

METHOD AND MATERIALS

We studied 429 consecutive patients with suspected CAD who underwent coronary CT angiography (CTA) and CTDE. Patients with known previous myocardial infarction (MI), percutaneous coronary intervention, coronary artery bypass surgery were excluded. MACEs were defined as severe cardiac events (cardiac death, nonfatal MI, unstable angina, heart failure necessitating hospitalization) and late revascularization (>180 days after CT examination). CTA results were divided into obstructive (>=50% luminal narrowing), mild (<50%), or no CAD groups. The Cox proportional hazards model was used to investigate the relationship between conventional clinical risk factors, coronary calcium sore and coronary CTA result and MACEs.

RESULTS

Follow-up information was obtained in 389 of the 429 patients (91%). DE was observed in 72 of the 389 patients (19%). During a median follow-up of 26 months, 24 cardiac events (2 cardiac death, 2 MI, 2 unstable angina, 6 heart failure and 12 late revascularization) were observed. When adjusted for obstructive CAD, the presence of DE maintained a significant association with risk of all cardiac events (adjusted hazard ratio, 5.9; $p< 0.0001$) and severe cardiac events (adjusted hazard ratio, 14.2; $p= 0.0002$). Kaplan-Meier curves demonstrated a significant difference in event-free survival between patients with DE and those without for severe cardiac events (log-rank test, $p< 0.0001$), as well as for all cardiac events (log-rank test, $p< 0.0001$).

CONCLUSION

The presence of CTDE was an independent predictor of MACEs and severe cardiac events in patients with suspected CAD among common clinical risk factors and coronary CTA findings.

CLINICAL RELEVANCE/APPLICATION

Acquisition of CTDE following coronary CTA seems to be useful since CTDE provides additional prognostic information in patients with suspected CAD.

SSE03-05 Factors Affecting FFRCT Analysis in Routine Clinical Practice

Monday, Nov. 26 3:40PM - 3:50PM Room: N229

Awards

Student Travel Stipend Award

Participants
Jonathan Weir-McCall, MBBCh, FRCR, Vancouver, BC (*Presenter*) Speaker, Guerbet SA; Travel suppor, Guerbet SA
Gianluca Pontone, MD, Milan, Italy (*Abstract Co-Author*) Speakers Bureau, General Electric Company Consultant, General Electric Company Research Consultant, HeartFlow, Inc Speakers Bureau, HeartFlow, Inc Speakers Bureau, Medtronic plc Speakers Bureau, Bayer AG
Jonathon A. Leipsic, MD, Vancouver, BC (*Abstract Co-Author*) Speakers Bureau, General Electric Company; Speakers Bureau, Edwards Lifesciences Corporation; Consultant, Heartflow, Inc; Consultant, Circle Cardiovascular Imaging Inc; Consultant, Edwards Lifesciences Corporation; Consultant, Neovasc Inc; Consultant, Samsung Electronics Co, Ltd; Consultant, Koninklijke Philips NV; Consultant, Arineta Ltd; Consultant, Pi-Cardia Ltd;
Francesca Pugliese, MD, PhD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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Jang W. Son, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose
Han Y. Jin, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Reports exist of the acceptance rates of CCTA for FFRCT analysis from trials performed in academic centres, however real world data is lacking. The aim of the current study was to examine the acceptance rate, and the factors associated with rejection for FFRCT analysis.

METHOD AND MATERIALS

All clinical CCTAs referred between July 2016 and March 2018 for HeartFlow FFRCT analysis were included. Metadata from the submitted CCTAs was used to extract information on patient factors, scanner type, acquisition parameters and dose while HeartFlow FFRCT analysis data was used for quantification of aortic enhancement.

RESULTS

Of 10,621 CCTAs submitted, 9,524(89.7%) were accepted for FFRCT analysis. Of the 1,097 rejected: 205(18.7%) were for technical limitations of the submitted data (slice thickness/spacing >=1mm, pixel size >=0.5mm); 181(16.4%) due to the presence of stents, bypass grafts, other cardiac hardware; and 711(64.8%) for image quality. Patient factors associated with rejection were: higher heart rate (64.0(IQR 12.3) vs. 59.0(IQR 10.0) bpm, p<0.001) and heart rate variability (9.0(IQR 21.0) vs. 8.0(IQR 10.0) bpm, p<0.001). Technical factors associated with rejection were: retrospective acquisition (54% vs 31% retrospective, p<0.001), systolic phase acquisition (25% vs. 12% systolic, p<0.001), higher slice thickness (0.63(IQR 0.15) vs. 0.63(IQR 0.07) mm, p<0.001), higher pixel size (0.43(IQR 0.09) vs 0.40(IQR 0.06) mm, p<0.001), lower aortic attenuation (368(IQR 147) vs. 431(IQR 167), p<0.001) and higher kVp (120(IQR 0) vs. 120(IQR 20) kVp, p<0.001). BMI (p=0.9), and image noise (p=0.07) were no different in those with accepted or rejected CCTAs. On logistic regression, heart rate, systolic image acquisition, aorta contrast, pixel spacing, and slice thickness all remained significant predictors of rejection for image analysis (p<0.001 for all).

CONCLUSION

Almost 20% of FFRCT rejection could be avoided by stringent post processing protocols, and a further 20% by appropriate case selection. For the remainder, utilization of CTFFR requires similar strict heart rate and contrast timing image optimization strategies required of CCTA.

CLINICAL RELEVANCE/APPLICATION

Stringent patient preparation, case selection and post processing strategies hold potential to improve the opportunity for successful utilization of FFRCT analysis.

Honored Educators

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SSE03-06 Interaction of Endurance Sport, Coronary Atherosclerosis and Flow by Coronary Computed Tomography Angiography (CTA): Insights from 3D CFD Modelling

Monday, Nov. 26 3:50PM - 4:00PM Room: N229

Participants
Gudrun Feuchtner, MD, Innsbruck, Austria (*Presenter*) Researcher, HeartFlow, Inc
Christian Langer, Innsbruck, Austria (*Abstract Co-Author*) Nothing to Disclose
Christoph Beyer, Innsbruck, Austria (*Abstract Co-Author*) Nothing to Disclose
Stefan Rauch, Innsbruck, Austria (*Abstract Co-Author*) Nothing to Disclose
Fabian Plank, MD, Innsbruck, Austria (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

to investigate coronary atherosclerosis and flow physiology by coronary computed tomography angiography (CTA) including 3D computational fluid dynamics (CFD) (noninvasive CT-FFR) in endurance athletes compared to inactive controls (CR)

METHOD AND MATERIALS

90 subjects (age 56.2y, 26 females) were examined with 128-dual source coronary CTA. Coronary arteries were evaluated per

90 subjects (age 56±2), 20 females) were examined with 128 dual source coronary CTA. Coronary arteries were evaluated per segment (AHA-16-s-classification) for CAD:1) Stenosis severity (CADRADS 0-5) 2) Total plaque burden (segment involvement score, SIS) and G-score: a new indicator for non-calcified plaque burden3) High risk plaque features (LAP-HU, spotty calcification, NRS, RI) were quantified4) Coronary Fractional Flow reserve (FFR) was remodelled by CFD Study design was retrospective (matched case controlled, 45 endurance-athletes vs 45 CR)The endurance group was defined as "regular" training (cycling, running or others) for least 1h per unit and >=3 times per week. Years of training were recorded.

RESULTS

Coronary stenosis severity (CAD RADS) score was lower in the endurance group vs CR (1.44 vs 2.1, p=0.007). Total and non-calcified plaque burden (SIS and G-score) were also sign. lower (1.8 vs 3.3 ; p=0.003 and 3.5 vs 6.6, p=0.002) while calcium score was trended lower only (38.9 AU vs 137.2 AU, p=0.06)HRP prev. was eminenty lower in athletes (5 vs 14 (2.2% vs 31.1%) p=0.02), and NRS (4 vs 7), resp.Non-calcified and total plaque burden (G-score and SIS) were strongest and significantly correlated with declining distal FFR (RCA S4:r=-0.32 and r=-0.3; p=0.03 and p=0.02, LAD S8 r=-0.2,p=0.09 for G-score), while calcium score was not (S4:p=0.07 and S8:p=0.861, Spearman), in the entire cohort. There was no difference in distal FFR between athletes vs CR (p= 0.532, 0.203, 0.358, 0.343 ANOVA)

CONCLUSION

Regular endurance training (min. 1 h and >=3x/week) reduces CAD burden (coronary stenosis severity, total and non-calcified plaque burden and most eminenty, high-risk plaques). Total and non-calcified plaque burden (G-score) rather than coronary calcium predicts distal coronary flow limitations in both athletes and inactives

CLINICAL RELEVANCE/APPLICATION

Regular endurance training reduces CAD burden and risk, with a dominant effect on high-risk plaque. We describe a novel non-calcifying plaque burden score (G-score),which is easy- to-implement into clinical structural reporting and potentially predicts myocardial ischemia

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

SSE04

Cardiac (MRI: General Topics)

Monday, Nov. 26 3:00PM - 4:00PM Room: N226

CA MR AI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Pamela K. Woodard, MD, Saint Louis, MO (*Moderator*) Research agreement, Siemens AG; Research, Eli Lilly and Company; Research, F. Hoffmann-La Roche Ltd; ; ; ; ; ;
Harold I. Litt, MD, PhD, Philadelphia, PA (*Moderator*) Research Grant, Siemens AG ; ; ;

Sub-Events

SSE04-01 Convolutional Neural Network Based Guidance System for Multiplanar Cardiac MRI

Monday, Nov. 26 3:00PM - 3:10PM Room: N226

Awards
Student Travel Stipend Award

Participants
Kevin Blansit, MS,BS, La Jolla, CA (*Presenter*) Nothing to Disclose
Tara A. Retson, MD, PhD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
Evan Masutani, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose
Naeim Bahrami, PhD, MSc, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
Kang Wang, MD,PhD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
Albert Hsiao, MD,PhD, La Jolla, CA (*Abstract Co-Author*) Founder, Arterys, Inc; Consultant, Arterys, Inc; Consultant, Bayer AG; Research Grant, General Electric Company;

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PURPOSE

Cardiac MRI (cMRI) is the gold standard for quantitative cardiac evaluation. However, it requires specialized training and expertise to perform. To advance the accessibility and quality of cMRI, we developed a convolutional neural network (CNN) to localize key cardiac landmarks to guide plane prescription. We hypothesize that CNN-based landmark localization may generate similar imaging planes to those acquired by a dedicated cardiac technologist.

METHOD AND MATERIALS

With HIPAA-compliance and IRB waiver of informed consent, we retrospectively collected clinical cMRIs performed at our institution from February 2012 to June 2017, including 472 short axis (SAX) and 892 long axis (LAX) cine series. Anatomic landmarks were annotated by expert radiologists. U-Net CNNs were implemented to predict the location of these structures using heatmap localization. Data was split into 80% of cases for training and 20% for testing. SAX, 4, 3, and 2 chamber planes were computed from predicted anatomic localizations. We analyzed performance of localization by calculating distances between predictions and ground truth annotation, and report mean error and standard deviations. We assessed plane prescription by calculating the angle difference between CNN-predicted planes and those acquired by the technologist. Angle bias, mean error, and standard deviations are reported for each plane orientation.

RESULTS

From LAX images, the mean distance between annotation and predicted location was 7.70±5.90 mm for apex and 5.70±4.02 mm for the mitral valve. For SAX images, the mean distance was 11.99±7.80 mm for aortic valve, 10.20±5.65 mm for mitral valve, 12.56±5.10 mm for pulmonic valve, and 11.99±6.43 mm for tricuspid valve. For SAX stack prescription, average angle bias, mean error, and standard deviations were -7.80°, 7.80°±5.44°. For LAX prescriptions, average angle bias, mean error, and standard deviations were 5.64°, 6.65°±5.22° for 4-chamber, 10.86°, 11.95°±8.02° for 3-chamber, and 4.21°, 7.46°±7.36° for 2-chamber.

CONCLUSION

CNN-based anatomic localization is a feasible strategy for planning cMRI imaging planes. In this study, we show that this approach can produce imaging planes similar to those chosen by dedicated cardiac technologists.

CLINICAL RELEVANCE/APPLICATION

CNNs have the potential to improve the quality and accessibility of MRI, and may even benefit complex examinations like cardiac MRI, which require multiple double oblique image planes.

SSE04-02 Deep Learning for Accelerated CMR Image Reconstruction

Monday, Nov. 26 3:10PM - 3:20PM Room: N226

Participants
Jo Schlemper, London, United Kingdom (*Presenter*) Nothing to Disclose
Chen Qin, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

CMR acquisition is inherently time consuming and requires multiple breath-holds, which is not only challenging for many patients, but it also makes the modality susceptible to motion artefacts. The aim of this study is to accelerate the CMR data acquisition by reducing the amount of k-space data needed for reconstructing images from undersampled data.

METHOD AND MATERIALS

Fully sampled, short-axis cardiac cine MR scans from 10 volunteers were acquired. Each scan contains a single slice SSFP acquisition with 30 temporal frames, resolution of 256x256 pixels, FOV of 320x320 mm with slice thickness 10mm. The recombined single-coil images were retrospectively undersampled respecting a linear frequency/phase encode structure, while the central 8 lines in k-space were always included. Deep learning-based iterative denoising algorithms are proposed: 3D-convolutional neural network (CNN) and 2D-convolutional recurrent neural network (CRNN). The networks were trained to directly output clean image from the aliased image. The proposed methods were compared to state-of-the-art compressed sensing approaches: kt-FOCUSS and kt-SLR. The methods were evaluated using peak signal-to-noise ratio (PSNR) and reconstruction speed. We considered acceleration factors 6 and 9 and performed 3-fold cross validation.

RESULTS

The networks were trained within three days on GPU GeForce GTX 1080. Even from small number of training subjects one could train a network that works well on test data. For acceleration factor 6, PSNR was 32.5, 34.6, 37.2 and 37.37 dB for kt-FOCUSS, kt-SLR, CRNN and CNN respectively. For acceleration factor 9, the numbers were 29.7, 31.4, 33.3 and 34.95 dB respectively. The reconstruction speeds were 15, 450, 6 and 10 seconds respectively.

CONCLUSION

We have proposed deep learning-based approaches for CMR image reconstruction, which both outperform current state-of-the-art both in terms of speed and reconstruction quality for single-coil, retrospective undersampling study.

CLINICAL RELEVANCE/APPLICATION

The method will be able to accelerate the CMR acquisition, which reduces burden on patients and improves image quality. In future, parallel imaging extension and implementation on scanner is expected.

SSE04-03 Multiparametric Cardiovascular Magnetic Resonance Imaging Assessment in End Stage Renal Disease Patients with Preserved Left Ventricular Ejection Fraction

Monday, Nov. 26 3:20PM - 3:30PM Room: N226

Participants
Xuhui Zhou, MD, PhD, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose
Ling Lin, MD, Leiden, Netherlands (*Presenter*) Nothing to Disclose
Qiuxia Xie, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Yang Peng, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Hildo J. Lamb, MD, PhD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Early detection of cardiac dysfunction in end stage renal disease (ESRD) patients is beneficial but challenging. Our study aimed to evaluate myocardial strain and tissue characteristic changes by cardiovascular magnetic resonance (CMR) imaging in ESRD patients with preserved left ventricular ejection fraction (LVEF), especially focused on those with no echocardiographic evidence of diastolic dysfunction.

METHOD AND MATERIALS

29 ESRD patients (17 males; mean age 44±11 years) with LVEF >50% in ultrasonagraphy and 43 healthy volunteers (24 males; mean age 43±10 years) underwent CMR imaging including cine, native T1 and T2 mapping. LV function, global LV strains as well as LV myocardial native T1 and T2 of the mid-cavity slice were measured and compared between the two groups. Correlations between LVMASS and CMR parameters were analyzed. According to ASE/EACVI recommendations for the evaluation of LV diastolic function by echocardiography, ESRD group were divided into normal diastolic function subgroup (n=11) and diastolic dysfunction subgroup (n=18). CMR parameters were compared among the two subgroups and the healthy group.

RESULTS

Native T1 and T2 were statistically higher in ESRD group (1296.2±38.4ms, 44.0±2.8ms) than healthy group (1260.1±51.9ms, 41.0±1.7ms; p=0.002, p<0.001). LV Global longitudinal strain (GLS) and global circumferential strain (GCS) were statistically

impaired in ESRD group (-14.5±2.9%, -16.4±3.0%) compared with the healthy group (-16.5±2.2%, -18.2±2.5%; p=0.002, 0.008). Increased LVMASS was strongly associated with impaired LV GLS and GCS (r= 0.72, 0.73; p<0.001) in ESRD group. In subgroup with normal diastolic function, T2 (43.2±1.5ms) and LV GLS (-14.3±3.0%) were statistically different from those in the healthy group (p=0.002, 0.008), while native T1 and LV GCS were similar with those in the healthy group.

CONCLUSION

ESRD patients with preserved LVEF demonstrated higher myocardial native T1, T2, and impaired LV GLS and GCS compared with healthy people. Myocardial edema and decreased myocardial compliance might exist in ESRD patients with preserved LVEF and normal diastolic function, as indicated by higher T2 and impaired LV GLS.

CLINICAL RELEVANCE/APPLICATION

Early stage of myocardial fibrosis, edema and decreased myocardial compliance might exist in ESRD patients with preserved LVEF, even when their diastolic function is normal on echocardiography.

SSE04-04 Subharmonic Aided Pressure Estimation (SHAPE) for Obtaining Intra-Cardiac Pressures Noninvasively in Real-Time: Preliminary Results

Monday, Nov. 26 3:30PM - 3:40PM Room: N226

Participants
Cara Esposito, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Jaydev K. Dave, PHD, Philadelphia, PA (*Presenter*) Research Grant, Koninklijke Philips NV; Equipment support, Lantheus Medical Imaging, Inc; Equipment support, General Electric Company
Flemming Forsberg, PhD, Philadelphia, PA (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation; Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Lantheus Medical Imaging, Inc
Maureen McDonald, MBA, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Priscilla Machado, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Kris Dickie, Burnaby, BC (*Abstract Co-Author*) Employee, Clarius Mobile Health Corp
Ira S. Cohen, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Praveen Mehrotra, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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David Fischman, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Subharmonic aided pressure estimation (SHAPE) utilizes subharmonic signals from ultrasound contrast agents for pressure estimation. The purpose of this work was to evaluate the efficacy of intra-cardiac SHAPE using Definity (Lantheus Medical Imaging) and Sonazoid (GE Healthcare) microbubbles in patients scheduled for cardiac catheterization procedures.

METHOD AND MATERIALS

Patients scheduled for left and/or right heart catheterization procedures were recruited into this IRB-approved study. During the catheterization procedure, 15 patients received an infusion of Definity (2 activated vials mixed in 50 mL saline; 4-10 mL per minute) and 3 patients received a co-infusion of Sonazoid (infusion rate (mL/hour) = 0.18 x body weight in kg) and saline (120 mL/hour). During contrast infusion, the patients were scanned using a customized interface developed on a SonixTablet scanner (BK Ultrasound; interface developed using C/C++ and cross-platform Qt libraries (The Qt Company)) to determine optimum incident acoustic output (IAO; from a set of 16 pre-configured acoustic outputs coded from 0 or minimum to 15 or maximum) eliciting ambient pressure sensitive growth phase subharmonics for SHAPE, on a per-patient basis. Previously determined optimal parameters for Definity (ftransmit: 3.0 MHz; a chirp down pulse) and Sonazoid (ftransmit: 2.5 MHz; square wave pulse) were used for data acquisition. Correlation coefficient between the SHAPE and pressure catheter data was computed using MATLAB (2016A, The MathWorks, Inc.).

RESULTS

The IAO's at which the best correlation coefficient obtained between the SHAPE and pressure catheter data varied on a per-patient basis from coded values of 3 to 15 (patient BMI range: 22.7-64.6). Data with Definity infusion showed that the correlation coefficient between SHAPE and pressure catheter for the left ventricle (LV) was -0.8 ± 0.03 (mean ± standard deviation; n = 10) and for the right ventricle (RV) was -0.8 ± 0.08 (n = 12). Data with Sonazoid infusion showed the correlation coefficient between SHAPE and pressure catheter for the LV was -0.8 ± 0.04 (n = 2) and the RV was -0.8 (n = 1).

CONCLUSION

Preliminary results indicate a good correlation (correlation coefficient range: -0.7 to -0.9) between SHAPE and pressure-catheter based intra-cardiac pressures.

CLINICAL RELEVANCE/APPLICATION

Intra-cardiac SHAPE may become an effective noninvasive alternative to cardiac catheterization procedures.

SSE04-05 Transient Ischemic Dilation and Coronary Artery Disease Burden in Cardiac MRI

Monday, Nov. 26 3:40PM - 3:50PM Room: N226

Participants
Jerry Yan, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose

Jason Rubenstein, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose
Andrew E. Kott, MD, Nashville, TN (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Transient Ischemic Dilation (TID) is a well-established finding in nuclear myocardial perfusion imaging (MPI) and is a marker for coronary artery disease (CAD) severity. Stress perfusion cardiac MRI (CMR) offers significantly improved spatial and temporal resolution relative to MPI and allow for direct measurement of the LV wall cavity dimensions. Despite these advantages, CMR-derived TID ratios are not well established and thus not utilized in the clinical setting for CAD severity. The aim of this study was to confirm whether TID occurs during stress perfusion CMR and define a TID ratio that predict the presence and severity of CAD.

METHOD AND MATERIALS

Patients who underwent a complete stress CMR from 2012-2016 were included in the study. Imaging studies were analyzed and stress and rest left ventricular (LV) area at three myocardial cross-sections, basal, mid, and apex, was recorded. Coronary angiographic data for all patients with this information available was reviewed. TID ratio was calculated as the LV cavity area minus papillary muscles at stress versus rest. Global TID ratio was calculated by taking the mean of the segments (basal, mid, and apex) for each patient. Patients were classified into High Risk group if angiography results show >= 70% stenosis in the proximal LAD, >= 70% stenosis in the Left Main, >=90% lesion in more than 2 major vessels, or prior CABG with >=70% graft lesion. Unpaired t-test was used to compare mean values of High Risk and Low Risk groups and a ROC analysis was performed to determine the global TID ratio that differentiated patients with High Risk CAD versus Low Risk CAD.

RESULTS

One hundred forty three patients underwent stress CMR. Fourteen patients met criteria for High Risk CAD on coronary angiography, while the remainder had either negative stress or positive stress with low risk CAD. Mean Global TID ratio for high risk group was 1.18 vs 0.98 in the low risk group (p = 0.004). AUC in the ROC analysis was 0.734 (p=0.004). Associated criterion maximizing specificity revealed global TID ratio > 1.16 with a sensitivity of 57% and specificity of 85%.

CONCLUSION

Significant dilation in the LV area at stress occurs when severe CAD is present compared to rest.

CLINICAL RELEVANCE/APPLICATION

A global stress to rest ratio of 1.16 in cardiac stress MRI may provide an additional marker for identifying high-risk multi-vessel CAD.

SSE04-06 Is Cardiac MR Indispensable for Assessing the Cardiac Mass?: Based on the Review of 10-Years of Hospital Records

Monday, Nov. 26 3:50PM - 4:00PM Room: N226

Participants
Ji Eun Park, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose
Eun Ju Chun, MD, PhD, Seongnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jeong A Kim, MD, Goyangsi, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jin Young Yoo, MD, Cheongju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yeonyee E Yoon, Sengnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Although cardiac magnetic resonance (MR) is useful for assessing cardiac mass, it has limited to use as the first modality because of high cost and long scan times. Therefore, we aimed to evaluate how MR is effective in assessing the cardiac mass based on the review of 10-years of hospital records.

METHOD AND MATERIALS

We hypothesized that cardiac mass is firstly detected with echocardiography, and further evaluated with CT and MR. On the basis of echocardiography from 2008 to 2017 in single tertiary hospital, we searched patients with cardiac mass using ICD code and keywords. Cardiac mass was classified by the location (intracardiac, valve and extracardiac) and evaluated the transferred ratio to next modality (CT or MR) from echocardiography according to mass location. Finally, we evaluated why the clinician performed MR and how successful that goal was achieved.

RESULTS

In a total of 718 adults (390 males, 62.6±18.7 years) with cardiac mass (282 intracardiac mass, 262 valve mass, 174 extracardiac mass) which detected on echocardiography, 406 patients (56.5%) were performed CT. Among them, CT performed ratio is highest for extracardiac mass (92.0%) followed by intracardiac mass (66.0%) and valve mass (22.9%), sequentially. MR was performed in 64 patients (8.9%); 16 patients with directly performed MR, 48 patients were performed MR after CT. Role of MR in assessing the cardiac mass was as follows; tissue characterization (n=36), differentiation of thrombus from tumor (n=15) and detection of invasiveness (n=25). After MR, the successful rate which met the goals of MR was highest for detection of invasiveness (92.0%), followed by differentiation of thrombus (80.0%) and tissue characterization (61.1%).

CONCLUSION

Valve mass may be sufficient with echocardiography, and extracardiac mass requires CT to assess the extent. CMR is useful for determine invasiveness and differentiate thrombus from tumor than tissue characteristics

CLINICAL RELEVANCE/APPLICATION

From this review of our data, the efficacy of CMR for assessing cardiac mass might be higher to determine the invasiveness and differentiate the thrombus from tumor than to detect tissue characteristics.

MSMC24

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

Monday, Nov. 26 3:30PM - 5:30PM Room: S406A

CA CT

AMA PRA Category 1 Credits ™: 2.00
ARRT Category A+ Credits: 2.25

Participants
Jill E. Jacobs, MD, New York, NY (*Director*) Nothing to Disclose
Stefan L. Zimmerman, MD, Ellicott City, MD (*Moderator*) Project consultant, Siemens Healthcare; Research grant, American Heart Association;

LEARNING OBJECTIVES

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

Sub-Events

MSMC24A Coronary Atherosclerosis and Bypass Grafts

Participants
Gregory Kicska, MD, PhD, Seattle, WA (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognizing anatomic subsets coronary artery bypass. 2) Technical considerations when imaging a bypass graft.3) Stenosis and aneurysms in vein grafts.4) Patterns of stenosis in internal mammary grafts.5) Evaluating a bypass patient before reoperation.

ABSTRACT

Cardiac CT is often used to evaluate coronary bypass graft function. To accurately interpret these images, the Imager needs to be familiar with the patterns of stenosis, aneurysms or other complications associated with different bypass types. In addition to assessing function and need for intervention, CT can identify patients with unique risks associated with reoperation.

MSMC24B Congenital Heart Disease

Participants
Carlo N. De Cecco, MD, PhD, Atlanta, GA (*Presenter*) Research Grant, Siemens AG

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LEARNING OBJECTIVES

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

ABSTRACT

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

MSMC24C Coronary Artery Disease and Incidental Non-cardiac Findings

Participants
Diana Litmanovich, MD, Haifa, Israel (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Recognizing non-cardiac and non-coronary anatomic structures that can be seen on cardiac CT. 2) Become familiar with possible non-cardiac and non-coronary pathological findings that could be seen on cardiac CT. 3) Review the suggested work-up for patients with incidentally found non-cardiac and non-coronary pathologies on cardiac CTA.

ABSTRACT

ABSTRACT Cardiac CT often includes information about surrounding structures such as lungs, meidastinum, airways, pleura, liver and bones. To accurately interpret the scan and not to overlook the possible non-cardiac pathologies, familiarity with potential incidental findings is required. Clinical importance and severity of incidental findings varies, thus currently existing algorithms for incidental findings on cardiac CT are helpful for further work-up.

ED002-TU

Cardiac Tuesday Case of the Day

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

AMA PRA Category 1 Credit ™: .50

Participants

Suhny Abbara, MD, Dallas, TX (*Presenter*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Sachin S. Saboo, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Fernando U. Kay, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Dhiraj Baruah, MD, Milwaukee, WI (*Abstract Co-Author*) Educator, Boehringer Ingelheim GmbH;
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Carlos S. Restrepo, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Kaushik S. Shahir, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Ameya J. Baxi, MBBS,DMRD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Jinglei Li, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Harold Goerne, MD, Zapopan, Mexico (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

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

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Suhny Abbara, MD - 2014 Honored EducatorSuhny Abbara, MD - 2017 Honored EducatorSachin S. Saboo, MD, FRCR - 2017 Honored EducatorPrabhakar Rajiah, MD, FRCR - 2014 Honored EducatorCarlos S. Restrepo, MD - 2012 Honored EducatorCarlos S. Restrepo, MD - 2014 Honored EducatorCarlos S. Restrepo, MD - 2017 Honored EducatorCarlos S. Restrepo, MD - 2018 Honored Educator

RC303

Cardiac Series: Emerging Cardiovascular MR and CT Imaging Techniques

Tuesday, Nov. 27 8:30AM - 12:00PM Room: E350

CA BQ CT MR

AMA PRA Category 1 Credits ™: 3.00
ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

Participants
Hildo J. Lamb, MD, PhD, Leiden, Netherlands (*Moderator*) Nothing to Disclose
Gautham P. Reddy, MD, Seattle, WA (*Moderator*) Researcher, Koninklijke Philips NV;
Karen G. Ordovas, MD, San Francisco, CA (*Moderator*) Advisor, Arterys Inc
Albert Hsiao, MD,PhD, La Jolla, CA (*Moderator*) Founder, Arterys, Inc; Consultant, Arterys, Inc; Consultant, Bayer AG; Research Grant, General Electric Company;
Karin E. Dill, MD, Worcester, MA (*Moderator*) Nothing to Disclose

Sub-Events

RC303-01 Spectral Detector CT

Tuesday, Nov. 27 8:30AM - 8:55AM Room: E350

Participants
Suhny Abbara, MD, Dallas, TX (*Presenter*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Suhny Abbara, MD - 2014 Honored EducatorSuhny Abbara, MD - 2017 Honored Educator

RC303-02 Spectral Detector Computed Tomography Enabled Contrast Media Reduction for TAVR Planning CT: Evaluation in 60 Patients

Tuesday, Nov. 27 8:55AM - 9:05AM Room: E350

Participants
Nils Grosse Hokamp, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Rahul B. Thomas, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Amit Gupta, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Omer Alabar, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Leslie Ciancibello, RT, Cleveland , OH (*Abstract Co-Author*) Consultant, Cassling Group Consultant, Siemens AG
Armando Cavallo, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Sanjay Rajagopalan, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Robert C. Gilkeson, MD, Cleveland, OH (*Abstract Co-Author*) Research Consultant, Riverain Technologies, LLC; Research support, Koninklijke Philips NV; Research support, Siemens AG; Research support, General Electric Company

PURPOSE

Computed tomography is imaging method of choice for procedural planning in patients prior to transcatheter aortic valve replacement (TAVR). The patients eligible for TAVR constitute an elderly population which frequently have an impaired kidney function. We aimed to evaluate if TAVR imaging with reduced contrast media is enabled by spectral detector computed tomography (SDCT).

METHOD AND MATERIALS

60 patients (31 female, mean age 81.6±10.3) were included in this retrospective, IRB-approved and HIPPA-compliant study. The imaging protocol comprised a prospective-ECG gated study of the entire chest (Th) immediately followed by a retrospective, ECG-gated covering the heart (Car) and a non-gated study of the abdomen and pelvis (Abd). For both, Th/Car and Abd, 25 ml of iodinated contrast media (c=350 mg/ml ioversol) was administered through an antecubital vein followed by a 40 ml saline flush. 25 ml constitutes a reduction by 50% as compared to the institutional standard. Th/Car/Abd images were reconstructed in axial plane with a slice thicknesses of 2/0.9/2 mm as conventional images (CI) and virtual monoenergetic images of 40-200 keV (VMI). Objective image evaluation was performed based on regions of interest placed in the aortic bulb, the descending aorta and the external iliac arteries. Further, one cardiologist and one radiologist evaluated the studies with respect to their utility for TAVR planning. Pre- and post-proecedural serum creatinine was collected. Data was assessed statistically using ANOVA with Dunnet's post-hoc or Wilcoxon test.

RESULTS

VMI 40keV resulted in a significant improvement in image contrast as compared to CI, this accounts for all, e.g. in the aortic bulb

VMI_40keV resulted in a significant improvement in image contrast as compared to CI, this accounts for all, e.g. in the aortic bulb and the external iliac arteries 215.9±81.3 HU/604.9±274.4 HU and 205.3±74.6 HU/583.3±241.5 HU (p<=0.05). Out of all studies, 2 studies were not diagnostic due to missed contrast bolus. All other studies provided sufficient image quality for TAVR evaluation. No patient showed adverse renal effects.

CONCLUSION

Pre-TAVR examinations can be carried out using SDCT using the described protocol. Moreover, SDCT enables a reduction of contrast media by 50% possibly limiting adverse renal effects.

CLINICAL RELEVANCE/APPLICATION

In patients with impaired kidney function, examination on SDCT should be considered for TAVR planning as it enables contrast dose reduction by 50%.

RC303-03 Myocardial Rest Perfusion CTA Improves Stenosis Quantification in Regions of Artefact from Calcified Plaque and Motion: Dual Energy CTA Compared With Catheter Coronary Angiography

Tuesday, Nov. 27 9:05AM - 9:15AM Room: E350

Awards
Student Travel Stipend Award

Participants
Prashanth Reddy, MBBS,MD, Bangalore, India (*Presenter*) Nothing to Disclose
Bharath B. Das, MD, MBBS, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Srikanth Sola, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Bhavana Nagabhushana Reddy, MBBS, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Sankar Neelakantan, MD , Bangalore, India (*Abstract Co-Author*) Nothing to Disclose
Sanjaya Viswamitra, MD, Bengaluru, India (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To assess the utility of resting CT dual energy myocardial perfusion in improving the diagnostic performance of CT coronary angiography in assessment of coronary artery stenosis in areas of artefact due to calcified plaque and motion: direct comparison with catheter coronary angiography.

METHOD AND MATERIALS

1347 CT coronary angiograms were performed in our institute from January 2104 to December 2017, out of with 32 cases with dual energy CT angiography(DE-CTA) and catheter coronary angiography performed within a span on 2 weeks from each other were included in this study. DE-CTA was performed using a 64 detector row CT scanner with fast KvP switching and ECG gating in the prospective mode. High calcium score in these patients prompted the use of DE-CTA. Iodine-water material decomposition images in the short axis plane using minimum intensity projections of 5 mm thickness, were reviewed for the presence of resting perfusion defects. Diagnostic accuracy was assessed by comparison with CAG. Coronary segments with indeterminate stenosis due to blooming artefact from heavily calcified plaque or motion artefact were reclassified as significant stenosis if there was a perfusion defect in the corresponding myocardial segment. Significant coronary stenosis was defined as a > 50% stenosis on CAG. Sensitivity, specificity, positive predictive value and negative predictive value of DE-CTA alone and DE-CTA combine with perfusion assessment for the detection of significant stenosis were calculated.

RESULTS

DE-CTA combined with perfusion assessment for the detection of significant stenosis showed improvement over DE-CTA alone. mean age of 58 ± 7. The calcium scores ranged from 40 to 344 AU.The sensitivity, specificity, positive predictive value and negative predictive value increased from 81% to 85%, 87% to 94%, 63% to 79% and 95% to 96%, respectively. The area under the receiver operating characteristic curve for detecting CAD also increased from 0.84 to 0.89 (p=0.02).

CONCLUSION

Dual energy CT with rapid KvP switching showed a high sensitivity and negative predictive value of the detection of significant coronary stenoses. There was improvement in diagnostic performance when both CTCA and perfusion assessment were used for stenosis evaluation.

CLINICAL RELEVANCE/APPLICATION

Myocardial rest perfusion CT has additional value is assessment of coronary stenoses in vessels with heavily calcified plaque and motion artefacts.

RC303-04 Quantifying Regional Myocardial Function-Strain, Torsion and Twist

Tuesday, Nov. 27 9:15AM - 9:40AM Room: E350

Participants
Bernd J. Wintersperger, MD, Toronto, ON (*Presenter*) Speaker, Siemens AG; Research support, Siemens AG; Institutional research agreement, Siemens AG; Speaker, Bayer AG

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LEARNING OBJECTIVES

1) Describe the principle architecture of the LV related to cardiac function. 2) Describe the principles of regional myocardial function assessment. 3) Compare different imaging approaches for quantification of regional myocardial function. 4) Identify

possible applications of regional function analysis in clinical cardiac imaging.

ABSTRACT

A complex joint effort of the entire heart muscle facilitates normal ventricular output. While the evaluation of cardiac volumes and global function aims at assessment of the gross ventricular status, measures of regional myocardial function provide a more detailed analysis of myocardial function at tissue level.Parameters of regional myocardial function generally describe the relationship between force and resulting deformation of finite elements. Furthermore, such regional parameters are used to describe these relationships along various directions of the cardiac axis and coordinate system. The complex composition of myocardial layers including the change of fiber orientation with location may also allow more insight into the effect of pathologies on function.Different modalities (Echo, MRI, CT) have been proposed for the assessment of such parameters. While in MRI regional parameters have predominately been used for research purposes, the development of speckle-tracking echocardiography (STE) and its evaluation has pushed towards clinical applications of regional myocardial functional parameters. In MRI, the recent push towards analysis of strain based on standard cine SSFP techniques enables further analysis without impact on scanning workflow; and with the use of modern post-processing semi-automated/automated approaches appear feasible. At this stage, normal ranges and the test-retest variability of the different algorithms are under evaluation.The clinical use of such techniques may allow for earlier identification of subclinical pathology and as such may trigger therapy decisions at earlier time points.Standardization of approaches and definition of normal ranges may be required for different techniques; preferably black box approaches should be avoided.

Active Handout:Bernd J. Wintersperger

http://abstract.rsna.org/uploads/2018/16001381/WinterspergerRSNA2018 RC303-04.pdf

RC303-05 Standardization for FT-CMR Strain Analysis: The Long Road to an Imaging Biomarker

Tuesday, Nov. 27 9:40AM - 9:50AM Room: E350

Participants
Moritz Halfmann, Mainz, Germany (*Presenter*) Nothing to Disclose
Sebastian Benz, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Andre Lollert, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Christoph Dueber, MD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Karl F. Kreitner, MD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose
Tilman S. Emrich, MD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

While post-processing feature tracking cardiac magnetic resonance (FT-CMR) imaging is rapidly evolving, the literature available still remains scarce. This is especially striking for the right ventricle (RV), where only 9 out of the 17 publications recently compiled in a meta-analysis by Vo et al. included the RV. In order to establish imaging biomarkers however, it is essential to have a broad dataset to analyze and then standardize for various influencing factors.

METHOD AND MATERIALS

CMR was performed on 62 carefully selected healthy volunteers at 3T (Magnetom Skyra®, Siemens Healthineers). Eligible for inclusion were adults without any cardiac disease history from 20 to 80 years old who were then stratified in 3 age groups with uniform distribution of men and woman. A semi-automatic tissue tracking software (CVI42 Circle®) then subsequently tracked the myocardial movement enabling us to calculate strain parameters, standardize for age and sex using ANOVA and establish reference values for the right ventricle.

RESULTS

The following mean normal values for the RV were found: global radial strain 13.47% (+- 6.46), global circumferential strain -7.61% (+- 3.92) and median global longitudinal strain -24.35% (+- 5.22). RV strains values were significantly different between old and young individuals ($p<0.05$), while sex had a smaller impact. Interestingly, all global left ventricular strains showed statistically significant differences with regard to sex (all $p<0.05$) but not with regard to age.

CONCLUSION

Parts of our results contrast those of recently published studies. These differences might be explained by the use of different software, number of slices used for tracking and measured strain parameters. This stresses the urgent need of further standardization before we can effectively employ FT-CMR in clinical routine.

CLINICAL RELEVANCE/APPLICATION

FT-CMR derived imaging biomarkers hold a great potential to increase the diagnostic accuracy for myocardial pathologies while simultaneously reducing the need for more invasive diagnostic measures.

RC303-06 Strain Analysis Using Feature Tracking Cardiac Magnetic Resonance (FT-CMR) In Assessment of Myocardial Viability in Chronic Ischemic Patients

Tuesday, Nov. 27 9:50AM - 10:00AM Room: E350

Awards
Student Travel Stipend Award

Participants
Sara W. Tantawy, MBBCh, Aswan, Egypt (*Presenter*) Nothing to Disclose
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PURPOSE

To determine the strength of peak circumferential and radial strain analysis by FT-CMR using routinely acquired cine images in differentiating between viable and non-viable myocardium in chronic ischemic patients.

METHOD AND MATERIALS

CMR exams were performed on a 1.5T machine to assess viability in 30 patients with chronic ischemia, 26 males and 4 females, with a mean age of 55 (range=33-85 years). Mean ejection fraction was 40±12%. Short axis standard steady-state in free-precession(SSFP) cine images were used in peak circumferential and radial strain quantification, and results were compared with regional wall motion and visually evaluated late gadolinium enhancement (LGE) scar transmurality. A total of 480 segments for ischemic patients were analyzed. 135 segments were hypokinetic, 78 were akinetic and only 1 segment was dyskinetic. 76 segments were non-viable and 404 segments were viable based on LGE. CMR exams of a control group of 10 healthy volunteers with a mean age of 38±11 were used. 160 normal myocardial segments were analyzed.

RESULTS

Peak global circumferential strain was statistically significantly impaired in ischemic patients compared to controls(-13.29 ±8.98 vs. -19.63 ±7.08),P< 0.0001. Similarly, peak global radial strain was statistically significantly impaired in ischemic patients compared to controls(21.88 ±17.96 vs. 30.90 ±18.59),P<0.0001. Segmental circumferential strain was statistically significantly impaired in non-viable segments compared to viable segments(-8.21 ±9.32 vs. -14.26 ±8.64),P<0.0001. Segmental radial strain was statistically significantly impaired in non-viable segments compared to viable segments(14.68 ±13.59 vs. 23.24 ±18.49),P<0.0001. A cut-off point of circumferential strain of -8 was attained (below which the segment is considered as non-viable) with sensitivity 58 %, specificity 84%, NPV 90%, PPV 44% and diagnostic accuracy 79%. A cut-off point of radial strain of 14 was attained (below which the segment is considered as non-viable) with sensitivity 55%, specificity 73%, NPV 90%, PPV 28% and diagnostic accuracy 70%.

CONCLUSION

FT-CMR is a time-efficient post processing tool than can reliably aid in differentiating viable and non-viable myocardium with no need for additional sequence acquisition or contrast administration.

CLINICAL RELEVANCE/APPLICATION

FT-CMR can robustly predict prognosis by viability assessment and is recommended in routine CMR exams before percutaneous intervention.

RC303-07 Valvular Flow Quantification with Phase Contrast Imaging (2D, 4D)

Tuesday, Nov. 27 10:20AM - 10:45AM Room: E350

Participants
Michael Markl, PhD, Chicago, IL (*Presenter*) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;

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LEARNING OBJECTIVES

1) Understand principles and techniques for cardiovascular flow quantification using 2D phase contrast MRI and 4D flow MRI. 2) Describe advantages of 4D flow MRI for the comprehensive assessment of valvular flow characteristics. 3) Identify possible applications of 2D and 4D flow MRI in clinical cardiovascular imaging.

RC303-08 4D Flow in vitro Evaluation of Aortic Valve Replacements Reveals Physiologic Hemodynamics Distal to Mechanical Valves in Contrast to Biological Valves

Tuesday, Nov. 27 10:45AM - 10:55AM Room: E350

Participants
Thekla Helene Oechtering, MD, Luebeck, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

To evaluate hemodynamics distal to mechanical and biological aortic valves in vitro by 4d flow MRI.

METHOD AND MATERIALS

Five aortic valve prostheses of identical diameter [mechanical valves, MV; trileaflet valve (prototype), On-X (CryoLife); biological

valves, BV: Perimount Magna Ease (Carpentier-Edwards), Trifecta valve (Abbott), Tribio (protoype); all 21mm] were placed in a flexible silicone aortic phantom (Elastrat, Switzerland). Scans were conducted at 3T with and without valves under pulsatile flow conditions (60 bpm with home-built piston pump) in a pressure-controlled model using Gadolinium-doped blood mimicking fluid (36.6% glycerin solution). Three levels of cardiac output (CO) were tested to simulate ascending flow conditions (CO-1, CO-2, CO-3). Time-resolved velocity information of every voxel was measured and analyzed using GTFlow (GyroTools, CH). Hemodynamic parameters and presence of secondary flow patterns were evaluated.

RESULTS

There was a pronounced central ejection jet in the aortic bulb distal to biological valves at all COs with higher peak velocities compared to mechanical ones (e.g. CO-2 Bulb: MV 138±12cm/s; Tribio+Perimount: 198±15cm/s; Trifecta: 159cm/s), indicating a relative stenosis of BV compared to MV with the same diameter. All valves were regurgitant with an average retrograde volume of 10±3ml. While mechanical valves resulted in near-physiological aortic flow patterns with pronounced sinus vortices, there was marked formation of secondary helices and vortices in the ascending aorta distal to biological valves at all CO-levels altering commonly observed primary flow patterns.

CONCLUSION

Biological valves result in increased flow velocities in the aortic bulb and ascending aorta as compared to mechanical valves. The valve leaflets of the Trifecta valve are attached at the outside of the commissures in contrast to other BV. Apparently, this results in a lesser degree of relative stenosis with peak velocities between those of MV and BV. In addition, biological valves also caused secondary flow patterns in contrast to mechanical valves that revealed near-to-normal hemodymamics. These results are in line with previous turbulent kinetic energy measurements and CFD simulations.

CLINICAL RELEVANCE/APPLICATION

Aortic flow patterns distal to mechanical valves more closely mirror physiology which may translate in alterations in kinetic energy or wall shear forces and thus influence patients' long-term health.

RC303-09 4D Flow MRI Evaluation of a New Technique of Valve-Sparing Aortic Root Replacement (VSARR)

Tuesday, Nov. 27 10:55AM - 11:05AM Room: E350

Participants
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PURPOSE

The aim of this study was to evaluate hemodynamics and blood flow patterns by 4D flow MRI after a modified VSARR in comparison with the standard David procedure. The new technique is conceived to ease the operative procedure, avoid prosthesis and annular deformation and facilitate coronary reimplantation.

METHOD AND MATERIALS

27 patient (23 males; mean age= 59.5 ±13.14) including 13 patients after David procedure (group 1) and 14 patients after the modified one (group 2) underwent 4D flow evaluation with a 1.5 T MRI system (Siemens MAGNETOM Aera, Siemens Healthineers, Erlangen, Germany). Four-dimensional flow CMR data were acquired using a sagittal oblique volume covering the thoracic aorta. Data were transferred to an onsite computer equipped with a commercially available software CAAS (Pie Medical Imaging, Maastricht, The Netherlands). Average interval from surgery was 8.7 ±1.7 years. Analysis included (a) wall shear stress (WSS) measurements performed at different levels of the thoracic aorta (neo-sinuses, sinotubular junction, ascending aorta and proximal arch), (b) qualitative assessment of flow pattern (laminar, helical or turbulent) and (c) flow eccentricity using a 3-point scale.

RESULTS

No significant differences were found between the two groups in terms of: (a) WSS (neo-sinuses: 1183 mPa ±610 vs 1418 ±664, p=0.35; sinotubular jonction: 1577 ±519 vs 1864 ±673, p=0.23; ascending aorta: 1464 ±598 vs 1697 ±430, p=0.25; arch: 835 ±401 vs 898 ±214, p=0.62) and (b) flow pattern mainly rated as turbulent in both groups (p=0.12). A higher overall degree of flow eccentricity was observed in group2 mainly rated as moderate (6/14, 43%) without significant difference with group1 (6/13, 46% rated as central; p=0.34).

CONCLUSION

4D flow MRI demonstrates similar haemodynamics and blood flow patterns with the simplified David procedure compared with the classical one.

CLINICAL RELEVANCE/APPLICATION

MRI 4D flow allows a detailed analysis of post-surgical hemodynamic profile of the thoracic aorta.

RC303-10 Multiparametric Myocardial MR Mapping (T1, T2 and T2*)

Tuesday, Nov. 27 11:05AM - 11:30AM Room: E350

Participants

Kate Hanneman, MD, FRCPC, Toronto, ON (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the basic techniques of myocardial MR mapping. 2) Explain the role of myocardial MR mapping. 3) Identify findings of common diseases on T1, T2, and T2* maps.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Kate Hanneman, MD, FRCPC - 2017 Honored EducatorKate Hanneman, MD, FRCPC - 2018 Honored Educator

RC303-11 Comparison of Different Cardiovascular Magnetic Resonance Sequences for Native, Stress and Post-Contrast Myocardial T1 Mapping: Preliminary Results

Tuesday, Nov. 27 11:30AM - 11:40AM Room: E350

Participants
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PURPOSE

To compare the native, stress and post-contrast T1 values obtained from different sequences for T1 mapping of the myocardium.

METHOD AND MATERIALS

We compared three T1 mapping sequences (FFM, MPI and LONG/SHORT) of 211 consecutive populations (patients and healthy volunteers) using conservative septal technique as the standardized approach. We calculated ventricular septum and related blood T1 in vivo through subsequent parametric mapping. We also analyzed the T1 differences of these sequences in native, stress and post-contrast conditions.

RESULTS

T1 values differed significantly depending on the sequence, with MPI providing consistently higher mean values than FFM (1310±62 ms vs. 1150±63 ms in native condition, 1327±63 ± 28 ms vs. 1153±61 ms in stress condition and 604±65 ms vs. 588±64 ms in post-contrast condition, mid-ventricular, respectively; $p < 0.001$), LONG providing higher and SHORT providing lower mean values than FFM (1075±109 ms vs. 1042±80 ms in native condition, 519±77 ms vs. 535±68 ms in post-contrast condition, mid-ventricular, respectively; $p < 0.001$) . T1 values also differed significantly depending on the stress, with stress FFM and MPI providing higher mean values than the native (1147±69 ms vs. 1135±63 ms, 1327±63 ms vs. 1302±57 ms, mid-ventricular, respectively; $p < 0.001$). On Passing-Bablok regression analysis, MPI is significantly correlated with FFM in native, stress and post-contrast (r=0.501, 0.450, 0.871, respectively; $p < 0.001$). FFM is significantly correlated with LONG, SHORT in mid-ventricular segment (r=0.805, 0.966, respectively; $p < 0.001$). On Bland-Altman analysis, the mean difference (95% limits of agreement) between MPI and FFM in native, stress and post-contrast is 160.1ms(48.8ms-271.4), 173.8ms(46.1ms-301.6ms), 16.8ms(42.4ms-75.9ms), respectively. The mean difference (95% limits of agreement) between FFM and LONG, SHORT in mid-ventricular segment is 32.3ms(-79.3ms-144.0), -17.2ms(-58.3ms-23.9ms), respectively.

CONCLUSION

FFM and MPI showed good agreement with MPI values are much higher than FFM. FFM and LONG/SHORT showed good agreement with LONG values are higher than FFM and SHORT values are lower than FFM. Stress increase the T1 values of myocardium in FFM and MPI.

CLINICAL RELEVANCE/APPLICATION

T1 values differed significantly depending on the sequence and therefore it is necessary to respectively establish the T1 normal reference range according to different sequences.

RC303-12 Native T1 Value and Extracellular Volume of Infarct Myocardium for Predicting Adverse Left Ventricular Remodeling

Tuesday, Nov. 27 11:40AM - 11:50AM Room: E350

Participants
Mengxi Yang, MS, Chengdu, China (*Presenter*) Nothing to Disclose
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Ying-Kun Guo, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

In T1-mapping techniques, native T1 value and extracellular volume (ECV) of infarct myocardium are applied to assess the severity of injury and predict functional recovery in patients with acute myocardial infarction (MI). We sought to investigate whether native T1infarct value and ECVinfarct is affected by microvascular obstruction (MVO) and have predict value for adverse left ventricular (LV) remodeling post-MI.

METHOD AND MATERIALS

54 MI patients underwent acute and 3-month 3T CMR, including cine, T1-mapping and late gadolinium enhancement (LGE). Infarct zone was determined by LGE image and then transposed to native T1-mapping and ECV mapping images for native T1infarct value and ECVinfarct measurement. The visible hypo-intensity core within infarct zone was eliminated when MVO presented.

RESULTS

Among 54 patients, 36 (66.67%) had MVO in acute phase and 20 (37.04%) developed adverse LV remodeling in chronic phase. There wasn't significant difference in T1infarct value between patients with and without MVO (1474.7 ± 63.5ms vs. 1495.4 ± 98.0ms, P = 0.352), while ECVinfarct is higher in patients with MVO than those without (58.66 ± 8.71% vs. 49.64 ± 8.82%, P = 0.001). T1infarct value merely had the correlation with the 3-month change of end-diastolic LV volume (rMVO absent = 0.483, P = 0.042) and predicted LV remodeling in patients without MVO (rMVO absent = 0.659, P = 0.003); ECVinfarct had the correlation with the change of end-diastolic LV volume (rall patients = 0.564, P < 0.001) and predicted LV remodeling in all patients (rMVO absent = 0.626, P = 0.005; rMVO present = 0.686, P < 0.001; rall patients = 0.622, P < 0.001). In multivariable logistic analysis, ECVinfarct was also associated with LV remodeling (ß= 0.312, P = 0.007).

CONCLUSION

In infarct myocardium, native T1 value might be influenced by MVO but ECV isn't. T1infarct value predicts LV remodeling in MVO absent MI and ECVinfarct predicts LV remodeling in all MI.

CLINICAL RELEVANCE/APPLICATION

The combination of native T1 value and ECV in infarct myocardium has the potential to predict adverse LV remodeling post-MI and select high-risk patients who need more aggressive treatments.

RC303-13 Artificial Intelligence Machine Learning-based Prediction of Hematocrit Values from Native MRI Myocardial T1-maps to Avoid Blood Sampling for Extracellular Volume Fraction Analysis

Tuesday, Nov. 27 11:50AM - 12:00PM Room: E350

Participants
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PURPOSE

To evaluate a machine learning (ML) algorithm developed in-house to estimate blood hematocrit levels (Hct) from native MRI myocardial T1-maps in order to avoid blood sampling prior to cardiac MRI studies involving extracellular volume fraction (ECV) analysis.

METHOD AND MATERIALS

A total of 51 consecutive patients (age 56±13y) selected from a prospective study who underwent cardiac MRI (Avanto, Siemens, Erlangen, Germany) at 1.5T were included. MRI protocol consisted of native (MOLLI scheme 5(3)3) and post-contrast (15-min post-Gd, scheme 4(1)3(1)2) T1-maps of the myocardium. Native blood R1 (1/T1) values were measured in the left ventricle for Hct estimation. A linear regression (LR) analysis was applied to model the relationship between the image-derived data and laboratory Hct values. For the ML approach, 31 additional features based on patient demographics, clinical history, and imaging parameters were extracted and used to train a linear Support Vector Machine employing k-fold cross validation. ECV values were calculated based on each Hct and compared by the Friedman-test. Derived Hct values were compared using linear regression and the Friedman-test.

RESULTS

Average native blood T1 and R1 measurements were 1654±142ms and 0.60±0.04s-1, respectively. Hct derived from native T1-maps by the LR and ML algorithms were 38.7±3.3% and 39.1±3.6%, respectively, and did not show statistical difference when compared to laboratory Hct values (38.7±4.8; P=0.446). The LR approach provided the following model for Hct calculation: Hct[%]=89.8×R1[native,blood] -19.0]. The LR model-based Hct demonstrated a weaker relationship with laboratory Hct values (r=0.70; P<0.001). The ML model showed a moderate relationship to blood-sampled Hct values (r=0.78; P<0.001). Analysis of the residuals demonstrated an increase in accuracy for the ML approach compared to the LR model (RMSE 3.07 vs. 3.47). ECV values derived from LR, ML, and lab techniques were in good agreement (38.1±16.9, 37.9±16.8, and 37.9±17.0%, respectively; P=0.475).

CONCLUSION

The ML-based algorithm provides accurate Hct estimation and reliable myocardial ECV calculation, highlighting its potential in clinical

workflows to generate ECV without the need for same-day laboratory Hct measurement.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates the benefit of a ML strategy to eliminate the need for blood sampling prior to cardiac MRIs involving myocardial ECV measurement.

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SSG02

Cardiac (Coronary Atherosclerosis)

Tuesday, Nov. 27 10:30AM - 12:00PM Room: S104B

CA CT VA AI

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
James C. Carr, MD, Chicago, IL (*Moderator*) Research Grant, Astellas Group; Research support, Siemens AG; Speaker, Siemens AG; Advisory Board, Guerbet SA
Konstantin Nikolaou, MD, Tuebingen, Germany (*Moderator*) Advisory Panel, Siemens AG; Speakers Bureau, Siemens AG; Speaker Bureau, Bayer AG
Arthur E. Stillman, MD, PhD, Atlanta, GA (*Moderator*) Nothing to Disclose

Sub-Events

SSG02-01 Incremental Prognostic Value of Coronary Artery Disease-Reporting and Data System (CAD-RADS) Scores Over Coronary Artery Calcium Scores (CACS) for Major Adverse Cardiovascular Event in Stroke Patients Without Chest Pain

Tuesday, Nov. 27 10:30AM - 10:40AM Room: S104B

Participants
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PURPOSE

The aim of this study was to investigate the prognostic value of coronary artery disease-reporting and data system (CAD-RADS) scores and determine the additional risk stratification benefit of CAD-RADS scores compared to coronary artery calcium score (CACS) and coronary artery disease (CAD) extent classifications in ischemic stroke patients without cardiac symptoms.

METHOD AND MATERIALS

From January 2013 to August 2014, 615 ischemic stroke patients who had at least one risk factor for CAD without chest pain underwent coronary computed tomography angiography (CCTA) and were included for final analysis. CT images were evaluated for CACS, extent of CAD and CAD-RADS scores. The primary endpoint was major adverse cardiovascular events (MACEs) defined as cardiovascular death, nonfatal myocardial infarction, unstable angina (UA) requiring hospitalization, revascularization and recurrent ischemic stroke event. Cox regression analyses were used to identify associations between CAD-RADS results and MACEs. C-statistics were calculated to compare discriminatory values of each model.

RESULTS

During the median follow-up period of 3.11 years, there were a total of 78 MACEs. Of 615 patients, 24.7% were classified as CAD-RADS 0, 19.3% as CAD-RADS 1, 17.6% as CAD-RADS 2, 18.5% as CAD-RADS 3, 15.6% as CAD-RADS 4A, 2.1% as CAD-RADS 4B, and 2.1% as CAD-RADS 5. CACS, CAD extent classification and CAD-RADS scores independently stratified risk of future MACEs (all $p < 0.05$). C-statistics revealed that both CAD extent classification and CAD-RADS scores improved risk stratification beyond CACS (C-index: 0.753 vs 0.698, $p < 0.001$ and 0.726 vs 0.698, $p = 0.041$, respectively).

CONCLUSION

In ischemic stroke patients without chest pain, CAD-RADS score had prognostic value for future MACE. In addition, CAD-RADS score provide additional risk-discrimination over CACS.

CLINICAL RELEVANCE/APPLICATION

CAD-RADS score provides additional risk-discrimination over CACS for the future major adverse cardiovascular events and can be recommended in the assessment of cardiovascular risk of stroke patient without chest pain.

SSG02-02 Machine Learning Outperforms CAD-RADS in Finding Optimal Prognostic Plaque Characteristics on Coronary CT Angiograms

Tuesday, Nov. 27 10:40AM - 10:50AM Room: S104B

Participants
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PURPOSE

To use machine learning to find an optimal combination of coronary artery imaging features on CT angiography for the prediction of all cause mortality and coronary deaths, myocardial infarction and revascularization

METHOD AND MATERIALS

CT angiography was performed and risk factor data collected. Arteries were scored using CAD-RADS and 4 other published methods and compared to a score derived using machine learning. Causes of death were determined using the National Death Index. Myocardial infarction and revascularizations were discovered by follow-up letters. Prognostic results were compared using the area under the receiver operating characteristic curves.

RESULTS

7117 patients were imaged and followed for a mean of 9.0 years. There were 414 deaths from all causes, 79 attributed to coronary artery disease as the underlying or contributing cause, 51 myocardial infarctions (MI) and 231 revascularizations. The two best machine learning models were linear discriminant with diagonal covariance matrix and a classification neural network. Respective areas under the ROC curve were 0.76 and 0.77 for all cause mortality, 0.82 and 0.82 for coronary deaths or MI, and 0.87 and 0.88 for CHD or MI or revascularization. The corresponding CAD-RADS results were 0.71, 0.79 and 0.86.

CONCLUSION

Machine learning outperformed CAD-RADS for prediction of death and coronary events.

CLINICAL RELEVANCE/APPLICATION

Machine learning can be used to provide a prognostic score on coronary CT angiography that is comparable to or better than CAD-RADS.

SSG02-03 Development of a Deep Learning Algorithm for Predicting the Coronary Artery Calcium Score Using Retinal Images

Tuesday, Nov. 27 10:50AM - 11:00AM Room: S104B

Participants
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PURPOSE

To determine if deep learning networks could be trained to estimate coronary artery calcium score (CACS) in heart CT scan from retinal images.

METHOD AND MATERIALS

All patients who obtained both ophthalmic examination and heart CT angiography at the tertiary center. Automated extraction of an OCT and retinal images was performed and linked to clinical end points from the electronic medical records. A deep neural network was trained to categorize images as either CACS<=10 (normal) or CACS>=100 (abnormal). We used the Modified VGG 11 model. We inserted one global average pooling layer instead of 2 fully-connected layers. To avoid overfitting, we had the data augmentation. At the SoftMax layer, the image that passed over the network was shown normal or abnormal binary probability value. Accuracy and Area under the receiver operating characteristic was estimated.

RESULTS

A total of 23,177 retinal images based on 15,056 examinations from 2,419 patients, who have received heart CT angiography including CACS, were extracted. At the examination level, we achieved an area under the ROC curve of 78.43% with an accuracy of 70%. At a patient level, we achieved an area under the ROC curve of 85.53% with an accuracy of 77.9%.

CONCLUSION

Using the non-invasive retinal examination including fundus photographs and OCT, deep learning networks show an impressive ability to predict the CACS, which is one of most important marker of heart disease.

CLINICAL RELEVANCE/APPLICATION

Deep-learning based screening of fundus photographs and OCT may have potential for a surrogate marker without radiation

exposure for high-risk patients with high coronary artery calcium score.

SSG02-04 Coronary Calcium Content Extracted by Machine Learning Methods from Incidental CT Scans Improves Coronary Heart Disease Prediction Accuracy

Tuesday, Nov. 27 11:00AM - 11:10AM Room: S104B

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PURPOSE

Despite significant reductions in the last few decades, coronary heart disease (CHD) remains a significant cause of mortality. Many risk factors for CHD can be mitigated by lifestyle changes and pharmacological interventions, making risk calculation for individuals an important part of prevention. Accordingly, quantification of risk is integrated into prevailing management guidelines. Determination of coronary calcium content has been shown to allow improvement in risk calculation, but requires specialized tests that are not often performed. We present a novel algorithmic method that allows for the extraction of coronary calcium scores from incidental chest CTs performed for other indications, and demonstrate its utility in improving prediction accuracy over the American Heart Association (AHA) 2013 pooled risk model in a retrospective cohort study.

METHOD AND MATERIALS

There were 14,866 patients aged 30-74 with no prior CHD diagnosis included. CT scans and different covariates for the model were extracted in the two years prior to the index date (1 June 2012). Patients were followed-up for five years. Prediction performance results were compared between the AHA 2013 model (base model) and the same model with the novel coronary calcium score inserted as an additional predictor (augmented model). Both were logistic regression models and were trained on the sample population to allow comparison. For measures requiring a threshold, 3.5% risk over 5 years was chosen.

RESULTS

Based on the likelihood ratio test, the augmented model was superior to the base model (p-value <0.001). Similarly, the augmented model achieved superior performance for all performance measures: sensitivity increased 0.85%, specificity increased 4.9%, area under the ROC curve increased by 2.2% and there was a 4.5% categorical net reclassification improvement.

CONCLUSION

In this study, use of a novel biomarker extracted using a machine learning algorithm from incidental CT scans improves predictive accuracy compared to the commonly used model. This improvement occurs both in theoretical and practical measurements of model utility; in actual use it would translate into better clinical decisions.

CLINICAL RELEVANCE/APPLICATION

Coronary calcium content extracted via novel machine learning methods from incidental CTs significantly improves coronary heart disease prediction.

SSG02-05 Radiomics of Coronary Artery Calcium in the Framingham Heart Study

Tuesday, Nov. 27 11:10AM - 11:20AM Room: S104B

Awards
Student Travel Stipend Award

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PURPOSE

To assess whether detailed coronary artery calcium (CAC) characterization based on radiomic feature extraction followed by machine learning improves prediction of cardiovascular (CV) events.

METHOD AND MATERIALS

Participants from the Offspring and third Generation cohorts of the community-based Framingham Heart Study who underwent chest CT between 2002 and 2005 were followed over a median of 9.1 years for cardiovascular events (CV) events (myocardial infarction, stroke, or death). Of those, 624 participants who had excellent image quality and CAC (Agatston score (AS)> 0) were randomly divided into discovery (n=318) and validation cohorts (n=306). CAC was segmented manually using 3DSlicer, and about 2000 radiomic features (based on intensity, shape, and texture of CAC) were extracted using pyRadiomics software. In the derivation cohort, we used an internal minimum redundancy maximum relevancy algorithm (without knowledge of events) to identify the 20 highest ranked features. Finally, a random forest classifier was used to optimize decision trees for prediction for CV events. The weighted predictive probabilty of events for each of the 20 features was summarized into a radiomic score. The performance of this score was tested independent in the validation cohort.

RESULTS

The discovery (66.1% men, 58.1±11.1 age) and validation cohorts (61.4% men, 59.3±11.2 age) had similar CV risk profile, median AS, and CV event rates (30/318 =9.7% and 29/306=9.5%, respectively). In adjusted multivariate analysis (for Framingham risk factors and AS), participants in the validation cohort, who had radiomic scores in the mid and upper tertiles had significantly higher risk for events as compared to the lower tertile (mid: HR= 9.3, p=0.03, upper: HR=16.5, p=0.007). The area under the curve (AUC) was higher for AS, radiomic score (RS), and combined AS/RS were 0.73, 0.76 and 0.79; respectively in the overall population. Performance was best in the subgroup with AS <300 (n=250, Figure)

CONCLUSION

This proof-of-concept study demonstrates that detailed CAC characterization based on radiomic feature extraction predicts CV events independent of traditional risk factors and AS. Further validation is necessary to determine clinical impact.

CLINICAL RELEVANCE/APPLICATION

Artificial intelligence may identify a prognostically important radiomic signature of CAC.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Udo Hoffmann, MD - 2015 Honored Educator

SSG02-06 Identification of Invasive and Radionuclide Imaging Markers of Plaque Vulnerability Using Computed Tomography Radiomics

Tuesday, Nov. 27 11:20AM - 11:30AM Room: S104B

Participants
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PURPOSE

Several invasive and radionuclide imaging markers of coronary plaque vulnerability have been described. Identification of these imaging biomarkers by a single, widely available non-invasive technique may provide an opportunity to identify vulnerable plaques and vulnerable patients in daily clinical practice. Therefore, our aim was to assess the diagnostic accuracy of coronary computed tomography angiography (CTA) derived radiomic features to identify attenuated plaque using intravascular ultrasound (IVUS), thin-cap fibroatheroma per optical coherence tomography and radionucleide uptake using sodium fluoride positron emission tomography morphologic (NaF18-PET) as compared to conventional qualitative and quantitative CT metrics.

METHOD AND MATERIALS

We analyzed 44 plaques in 25 patients using IVUS, OCT, NaF18-PET and coronary CTA. We assessed 7 conventional qualitative and quantitative plaque characteristics and calculated 935 radiomic parameters. We calculated receiver operating characteristics area under the curve (AUC) values using a 5-fold cross validation with 1000 repeats to assess diagnostic accuracy. We used the Kolmogorov-Smirnov test to compare the distribution of AUC values resulting from the cross-validations.

RESULTS

Radiomics outperformed conventional metrics to identify attenuated plaque per intravascular ultrasound, thin-cap fibroatheroma by optical coherence tomography and metabolically active plaques per sodium fluoride positron emission tomography in CT images (AUC: 0.72 vs 0.59; 0.80vs 0.66; 0.87 vs 0.65; p<0.001 all; respectively).

CONCLUSION

Computed tomography radiomics may allow the non-invasive identification of invasive and radionuclide imaging biomarkers.

CLINICAL RELEVANCE/APPLICATION

Radiomics is able to identify morphologic and metabolic high-risk plaque features currently olny identifiable using invasive and radionucleide imaging, which are both important components of plaque instability.

SSG02-07 Epicardial Fat is Increased in the HIV Population and Associated to Coronary Artery Plaque Burden

Tuesday, Nov. 27 11:30AM - 11:40AM Room: S104B

Participants
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PURPOSE

HIV patients are exposed to a higher risk of coronary artery disease (CAD) compared to non-infected patients. The exact mechanism responsible for this increased risk is not well understood. HIV individuals are also exposed to changes in body fat distribution characterized by greater ectopic fat. These changes may play a role in promoting atherosclerosis. Epicardial fat, which is the ectopic fat related to the heart, may play a unique role because of its location near to the coronary arteries. We hypothesize that epicardial fat volume is increased in the HIV patients and correlates with total coronary plaque volume, and with low attenuation plaque volume, which is a marker of plaque vulnerability.

METHOD AND MATERIALS

This is a cross sectional study, nested in the Canadian HIV and Aging Cohort Study (CHACS), a large prospective cohort following more than 800 HIV+ and HIV- patients. Consecutive CHACS participants with low to intermediate cardiovascular risk without symptoms or past CAD were invited to undergo cardiac computed tomography (CT) and coronary plaque imaging with CT angiography. Volume measurement of epicardial fat, total atherosclerotic plaque and low-attenuation plaque were performed. Association between epicardial fat volume, coronary plaque volume and low attenuation plaque volume was assessed using multivariate linear regression.

RESULTS

A total of 246 participants underwent cardiac CT scans. 173 were HIV+ and 73 were HIV-. HIV+ patients had greater epicardial fat volume indexed to body mass index (BMI) than HIV- patients ($p = 0.03$). In the HIV infected group, epicardial fat volume was associated with duration of antiretroviral therapy use ($ß = 1.45$, $p = 0.004$). After adjustment for traditional cardiovascular risk factors, BMI and waist circumference, epicardial fat volume was significantly associated with total plaque volume ($ß = 1.99$, $p = 0.04$) and low attenuation plaque volume ($ß = 0.86$, $p = 0.01$).

CONCLUSION

Epicardial fat volume is increased in the HIV participants . The association of epicardial fat volume with antiretroviral therapy duration and subclinical coronary artery plaque may suggest a potential mechanism that could explain the increased risk for CAD in the HIV population.

CLINICAL RELEVANCE/APPLICATION

Epicardial fat is increased in HIV patients and correlates with total coronary plaque volume and low attenuation plaque volume, a CT marker of plaque vulnerability.

SSG02-08 Subclinical Coronary Atherosclerosis among Individuals with HIV on Antiretroviral Therapy

Tuesday, Nov. 27 11:40AM - 11:50AM Room: S104B

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PURPOSE

To compare coronary plaque burden and characteristics between HIV-infected and non-HIV-infected participants

METHOD AND MATERIALS

This cross-sectional study nested in a large prospective cohort was approved by the local Institutional Review Board. All subjects provided written consent. Consecutive HIV+ and HIV- participants were prospectively recruited for cardiac computed tomography (CT). Eligibility criteria were males/females, no known coronary artery disease, low/intermediate 10-yr Framingham risk score (FRS, 5-20%), no CT contraindication. Coronary calcium scoring was done with non-contrast CT, and contrast-enhanced CT for plaque (calcified vs noncalcified, volume) and lumen assessment. Imaging assessors were blinded to HIV status. Analyses used multivariate multiple linear and logistic regression models.

RESULTS

A total of 246 participants (173 HIV+ (93% males), 73 HIV- (81 % males)) were included, with similar age (mean 55 yo, p=0.69) and FRS (median 11 %, p=0.53). Diabetes (10% vs 1.4 %, p=0.01) and smoking (28% vs 14 %, p=0.02) were more frequent in HIV+ than HIV- participants, and elevated LDL cholesterol less frequent in HIV+ participants (20% vs 32%, p=0.07). Median duration of HIV infection in HIV+ participants was 18 yrs. All were on antiretroviral therapy (median 15 yrs). After adjusting for diabetes, smoking and LDL cholesterol, prevalence and plaque extent was similar between HIV+ and HIV- participants (72 % vs 69 %, p= 0.37; 2.9 ± 3.0 vs 2.7 ± 3.8 plaques/participant, p= 0.53). HIV+ participants showed more frequent noncalcified and less frequent calcified plaques than HIV- participants (0.3 ± 0.7 vs 0.1 ± 0.5, p=0.01; 1.4 ± 2.4 vs 2.0 ± 2.0 plaques/participants, p=0.006). Number of mixed plaques (1.0 ± 1.4 vs 0.6 ± 1.4 plaques/participant, p= 0.27), mean calcium score (148 vs 141, p=0.81), plaque volume (273 vs 218 mm3, p=0.91) and prevalence of >= 70% stenosis (10% vs 6%, p=0.40) were similar between HIV+ and HIV- participants.

CONCLUSION

Noncalcified plaques are more frequent in asymptomatic HIV+ individuals under antiretroviral therapy, while calcified plaques are less frequent, in comparison to HIV- individuals, after adjustment of cardiovascular risk factors.

CLINICAL RELEVANCE/APPLICATION

Noncalcified plaques are usually considered more vulnerable plaques. Our findings suggest one anatomic substrate that could explain the increased risk of myocardial infarction in the HIV population.

SSG02-09 Atherosclerosis of Coronary Arteries in HIV Patients on Routine Non-Gated CT Chest: Incidence, Characteristics, and Risk Factors

Tuesday, Nov. 27 11:50AM - 12:00PM Room: S104B

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PURPOSE

To evaluate the incidence and risk factors of subclinical coronary artery calcification (CAC) in patients with Human Immunodeficiency Virus (HIV) infection.

METHOD AND MATERIALS

We retrospectively reviewed 143 HIV patients (M:F = 119:24; mean age, 46.4) who underwent routine non-gated CT of thorax, from May 2010 to November 2015. Each of the four main coronary arteries was identified-left main stem (LMS), left anterior descending (LAD), left circumflex (LCX), and right coronary artery (RCA)- on CT images. Calcification in each artery was categorized as absent, mild, moderate, or severe by a radiologist. A multivariate logistic regression was performed to find independent risk factors for positive CAC. Clinical and laboratory parameters reflecting the status of HIV infection, including CD4 count, viral load, duration since HIV diagnosis, and status of antiretroviral treatment.

RESULTS

Forty-one patients (28.7%) showed calcifications in one or more coronary arteries. LAD (n=38, 92.7%) was most commonly affected, followed by LCX (n=18, 43.9%) and RCA (n=13, 31.7%). CAC deposited at the proximal portion in LAD and LCX (76.3%, 77.7%, respectively) while at the mid to distal portion in RCA (61.5%). Age of CAC+ group (53.9 years) was significantly higher than that (43.4 years) of CAC- group (p < 0.001). Minimum age of HIV patient with positive CAC was 24yrs. Duration of HIV infection in CAC+ group (12.3 years) was significantly higher than that (8.6 years) in CAC- group (p<0.0344). The mean viral load was significantly lower value in CAC+ group compared to that in CAC- group (76K versus 414K, p=0.02). CAC+ group showed significantly higher CD4 cell counts than CAC- group (mean=355.9 versus 175.3, p= 0.0053). There was no significant difference in HAART status between the two groups (current HAART receivers 84.4% versus 85.7%, p=0.539). On multivariate logistic regression, age, HIV duration, and CD4 were significantly associated with CAC+ (p-values<.05)

CONCLUSION

Patients with HIV showed early onset and increased incidence of CAC and associated with higher CD4 cell counts. Duration of HIV is an independent risk factor for coronary artery calcification, in addition to age of patients.

CLINICAL RELEVANCE/APPLICATION

Awareness of increased risk of atherosclerosis development in young-age HIV-infected patients is crucial for primary prevention of future cardiovascular events.

CAS-TUA

Cardiac Tuesday Poster Discussions

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

CA

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Elsie Nguyen, MD, Toronto, ON (*Moderator*) Nothing to Disclose

Sub-Events

CA224-SD-TUA1 Preliminary Evaluation of Main Pulmonary Artery Changes in Chronic Mountain Sickness Patients with Phase Contrast MR Imaging

Station #1

Participants
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PURPOSE

To investigate the clinical value of measurement of main pulmonary artery(MPA) structure and hemodynamics,and mean pulmonary artery pressure(MPAP) in Chronic Mountain Sickness(CMS) patients with MRI phase contrast method(PC-MRI).

METHOD AND MATERIALS

22 male adult patients who were diagnosed with CMS and 20 healthy male adult volunteers at the same altitude were recruited from Dec.2016 to Feb.2018. T1WI Turbo Field Echo and 2D/QF sequence of Philips 1.5T magnetic resonance scanner was used for main pulmonary artery(MPA).Then cross-sectional area(CSA),peak velocity(PV), right ventricular stroke volume(RVSV) and regurgitant fraction(RF) were obtained.Meanwhile,relative dilatation degree (RDD) and MPAP were calculated.

RESULTS

1.Structure data: CSA and RDD of patients were(7.52±0.71)cm2 and(36.11±11.27)%;Respectively, CSA and RDD of volunteers were(6.34±1.12)cm2 and(52.08±7.54)%; CSA was bigger than that of volunteers(P<0.01);RDD was smaller than that of volunteers(P<0.01).2.Hemodynamics data: PV,RVSV and RF of patients were(72.19±9.41)cm/s,(64.43±21.48)ml and(4.31±0.93)%;PV,RVSV and RF of volunteers were(80.32±11.15)cm/s,(59.12±19.34)ml and(1.51±0.48)%.PV was lower than that of volunteers(P=0.015);RVSV was higher than that of volunteers(P=0.411);RF was bigger than that of volunteers(P=0.004). 3.MPAP(36.71±12.36)mmHg was obviously higher than that(15.77±6.69)mmHg of volunteers(P<0.01).

CONCLUSION

The long-term hypobaric and hypoxic environment leads to pulmonary hypertension such as MPA dilatation, decrease of flexibility and PV, and increase of RF and MPAP.

CLINICAL RELEVANCE/APPLICATION

PC-MRI can noninvasively provide accurate information about MPA structure, hemodynamics and pressure,so as to evaluate MPA changes in CMS patients preliminarily.

CA225-SD-TUA2 Evaluation of Gravity Effect on Inferior Vena Cava and Abdominal Aortic Flow Using Multi-Posture MRI

Station #2

Participants
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PURPOSE

To evaluate the differences of inferior vena cava flow (IVCF) and abdominal aortic flow (AAF) in the supine position (SP) and upright position (UP) of healthy volunteers, using an original magnetic resonance imaging (MRI) system that can obtain images in any posture (multi-posture MRI).

METHOD AND MATERIALS

Caval velocity-mapped images were obtained with ECG-triggered cine phase-contrast technique in the supine and upright positions

using multi-posture MRI (N = 12). The mean IVCF and AAF velocities in the region of interest in each cardiac phase were determined. In addition, flow curves in the cardiac cycle were obtained from the IVCF and AAF velocity multiplied by the each cross-sectional area. The following parameters in SP and UP were assessed. The mean IVC velocity (IVC-Vmean), the maximum IVC velocity (IVC-Vmax), the mean IVCF (IVCFmean), the maximum IVCF (IVCFmax), the cross-sectional area of IVC (IVC-CA), the mean AA velocity (AA-Vmean), the maximum AA velocity (AA-Vmax), the mean AAF (AAFmean), the maximum AAF (AAFmax), and the cross-sectional area of AA (AA-CA).

RESULTS

The IVC-Vmean in UP (3.34 ± 2.29 cm/s) was significantly lower than in SP (8.56 ± 4.46 cm/s), the IVC-Vmax in UP (4.10 ± 2.25 cm/s) was significantly lower than in SP (13.1 ± 5.09 cm/s), the IVCFmean in UP (345 ± 229 mL/min) was significantly lower than in SP (1453 ± 461 mL/min), the IVCFmax in UP (433 ± 278 mL/min) was significantly lower than in SP (2453 ± 926 mL/min), and the IVC-CA in UP (205 ± 121 mm2) was significantly lower than in SP (372 ± 207 mm2).The AA-Vmean in UP (2.10 ± 0.79 cm/s) was significantly lower than in SP (6.71 ± 2.30 cm/s), the AA-Vmax in UP (5.22 ± 2.39 cm/s) was significantly lower than in SP (17.9 ± 6.52 cm/s), the AAFmean in UP (241 ± 113 mL/min) was significantly lower than in SP (699 ± 306 mL/min), and the AAFmax in UP (572 ± 303 mL/min) was significantly lower than in SP (1823 ± 630 mL/min). However, no significant difference was observed between UP and SP in terms of the AA-CA (184 ± 50.1 mm2 and 175 ± 43.6 mm2).

CONCLUSION

Both IVCF and AAF decrease in the upright position. Multi-posture MRI makes it possible to evaluate the effect of gravity on systemic circulation.

CLINICAL RELEVANCE/APPLICATION

Clarifying the effect of gravity on IVCF and AAF might be valuable for the treatment of heart failure patients.

CA226-SD-TUA3 MR Black Blood Thrombus Imaging in the Detection of Lower Extremity Vein using Optimized 3D FSE Sequence

Station #3

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PURPOSE

Accurate detection of lower extremity deep vein thrombosis (LEDVT) and assessment of its stage are crucial for treatment decision-making. Challenges such as long scan time, and limited 3D coverage hampered the routine MR imaging for LEDVT detection. Thrombus imaging using a novel 3D FSE sequence with modulated refocusing flip angles and random k-space undersampling (referred to as MATRIX) has been evaluated in the current study.

METHOD AND MATERIALS

A total of 11 cases with acute LEDVT detected by ultrasound, with D-dimer> 500 μg/L on admission and clinical manifestation within 15 days, were prospectively enrolled in this study. All patients underwent 3.0T MR scans (uMR 770, United Imaging, Shanghai, China). Both 3D T2-weighted MATRIX and T1-weighted MPRAGE were performed in every examination with an isotropic resolution of 1mm. Seven patients received follow-up scans after one month.The thrombus area and signal intensity were measured on both T1WI and T2WI by two independent observers (Figure 1). The diagnostic agreement of thrombus detection between T2WI and T1WI was conducted using Cohenκ test. The agreement between T1WI and T2WI in the measurement of thrombus area was performed by Bland-Altman analysis.

RESULTS

Thirty segments were included in the study. There was a good agreement between the T1WI and T2WI in the detection of LEDVT (κ=1.000, p=0.000). Bland-Altman chart also showed strong agreement between T1WI and T2WI in the measurement of thrombus area. Among the 7 patients with follow-up scans, thrombi disappeared in 1 patient who underwent a thrombectomy, but were still present in the other 6 patients who underwent anticoagulation therapy only. The size of the thrombus was decreased remarkably on both T1WI and T2WI at the follow-ups. The signal intensity of thrombus decreased in 4 patients while increased in 2 patients on T2WI (Figure 1).

CONCLUSION

3D isotropic MATRIX imaging provides sufficient coverage of interested regions within 4~5minutes, and its arbitrary multi-planar reconstruction facilitates the visualization and detection of suspected thrombus. This preliminary study shows the results of MATRIX are highly consistent with that of MPRAGE in the detection of LEDVT. Furthermore, the combination of MATRIX and MPRAGE may help to assess the stage of thrombus with great confidence, as reported in an early study using 2D imaging.

CLINICAL RELEVANCE/APPLICATION

Optimized 3D FSE sequence can be used in assessment of LEDVT.

CA227-SD-TUA4 Cardiac MRI (CMR) Strain Parameters in Determining the Need for Cardiac Re-Interventions in Patients with Repaired Tetralogy of Fallot (TOF)

Station #4

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PURPOSE

To estimate the diagnostic value of CMR derived strain in determining repeat invasive cardiac intervention in patients with repaired TOF.

METHOD AND MATERIALS

65 patients with repaired TOF, aged 1-20 years at time of CMR underwent endocardial strain analysis of the longitudinal 4 chamber, circumferential short axis cine and volumetric function measured by right ventricular ejection fraction (RVEF). Right ventricular (RV) strains were calculated using a semi-automated MRI deformation software developed in-house. The 4 chamber RV endocardial contour was also divided into 6 wall regions (septal-basal, septal-mid wall, septal-apical, lateral-apical, lateral-mid wall and lateral-basal). Patients were divided into those who had CMR between two consecutive cardiac interventions (percutaneous or surgical) within 10 years (n=18) and those who had no re-interventions after 10 years of the complete TOF repair (n=47). Maximum strain was compared between the two groups with the Student's t-test (a=0.05). In addition, receiver operating characteristic (ROC) curves, which quantify the effectiveness of the strain parameters in detecting the need for re-intervention were generated. Optimal threshold values were determined based on the greatest sum of sensitivity and specificity based on the ROC curve.

RESULTS

Longitudinal global maximum strain was decreased in the re-intervention group compared to the no intervention group and 8 out of 9 segmental strain parameters were significantly decreased in the re-intervention group. Longitudinal global strain showed better diagnostic accuracy than segmental strain parameters for the longitudinal scans. Longitudinal maximum global strains of > -18.10 or circumferential mid-wall strains of >-14.94 were predictive of the need for re-intervention within 10 years with sensitivities of 60-67%, specificities of 85-87% and diagnostic accuracies of 78-83%. Longitudinal global and short axis mid-wall strains perform similarly compared to RVEF in detecting the need for re-intervention.

CONCLUSION

Patients with repaired TOF who required re-intervention within a 10 year period show impaired systolic function and contractility. Maximum strain measures perform similarly compared to RVEF in predicting the need for re-intervention.

CLINICAL RELEVANCE/APPLICATION

The use of contractility measures may complement existing criteria to guide decisions regarding re-intervention in patients with repaired TOF.

CA228-SD-TUA5 Cardiac T1, T2 and T2* Mapping: Intersegmental, Interregional and Inter-level Reproducibility

Station #5

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PURPOSE

Evaluation of the intersegmental, interregional and interlevel comparability of T1, T2 and T2* relaxation times.

METHOD AND MATERIALS

Native cardiac MRIs of 26 healthy subjects (14 w and 12 m, 26 ± 3 years) were performed on a 1.5 T scanner with automated inline motion correction. For each subject, three long (LAX) and three short axes (SAX) were acquired at corresponding slice positions. The evaluation of each segment was performed according to the AHA model by placing a segmental mid myocardial ROI. The corresponding segments of the LAX and SAX were compared in pairs. In addition, the cardiac segments were divided into groups (anterior, anteroseptal, inferoseptal, inferior, inferolateral and anterolateral as well as basal, medial, apical and the corresponding interlevel or interregional differences were analyzed.

RESULTS

In the intersegmental comparison between the corresponding LAX and SAX segments showed a significant difference in 33% in T1, 28% in T2 and 44% in T2* mapping. In the interregional comparison of the SAX segments a significant difference in 60% of grouped segments in T1, in 63% of grouped segments in T2 and in 93% of grouped segments in T2* mapping occurred. In the same comparison of LAX segments 80% of grouped segments in T1, 46% of grouped segments in T2, and 87 % of grouped segments in T2* mapping showed a significant difference. In the interlevel comparison of the SAX segments, there was a significant difference in T1 mapping between basal vs. medial ($p < 0.01$) and for basal vs. apical ($p < 0.01$), in T2 mapping between basal vs. apical ($p < 0.01$) and for medial vs. apical ($p < 0.01$). In the interlevel comparison of the LAX segments a significant difference in T1 mapping between basal vs. apical ($p < 0.01$) and for medial vs. apical ($p < 0.01$), in T2 mapping between basal vs. apical ($p < 0.01$) and medial vs. apical ($p < 0.01$), and in T2* mapping between basal vs. medial ($p < 0.01$) occurred.

CONCLUSION

T1, T2 und T2* times can vary between single heart segments in healthy people in dependence of anatomic location and acquired axes.

CLINICAL RELEVANCE/APPLICATION

Analyzing of left ventricular mapping should be done in multiple segments to get accurate results and follow-up examinations should be measured in the identical segment to obtain consistent results.

CA229-SD-TUA6 Radiomics of Coronary Artery Calcium in the Framingham Heart Study

Station #6

Awards

Student Travel Stipend Award

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PURPOSE

To assess whether detailed coronary artery calcium (CAC) characterization based on radiomic feature extraction followed by machine learning improves prediction of cardiovascular (CV) events.

METHOD AND MATERIALS

Participants from the Offspring and third Generation cohorts of the community-based Framingham Heart Study who underwent chest CT between 2002 and 2005 were followed over a median of 9.1 years for cardiovascular events (CV) events (myocardial infarction, stroke, or death). Of those, 624 participants who had excellent image quality and CAC (Agatston score (AS)> 0) were randomly divided into discovery (n=318) and validation cohorts (n=306). CAC was segmented manually using 3DSlicer, and about 2000 radiomic features (based on intensity, shape, and texture of CAC) were extracted using pyRadiomics software. In the derivation cohort, we used an internal minimum redundancy maximum relevancy algorithm (without knowledge of events) to identify the 20 highest ranked features. Finally, a random forest classifier was used to optimize decision trees for prediction for CV events. The weighted predictive probabilty of events for each of the 20 features was summarized into a radiomic score. The performance of this score was tested independent in the validation cohort.

RESULTS

The discovery (66.1% men, 58.1±11.1 age) and validation cohorts (61.4% men, 59.3±11.2 age) had similar CV risk profile, median AS, and CV event rates (30/318 =9.7% and 29/306=9.5%, respectively). In adjusted multivariate analysis (for Framingham risk factors and AS), participants in the validation cohort, who had radiomic scores in the mid and upper tertiles had significantly higher risk for events as compared to the lower tertile (mid: HR= 9.3, p=0.03, upper: HR=16.5, p=0.007). The area under the curve (AUC) was higher for AS, radiomic score (RS), and combined AS/RS were 0.73, 0.76 and 0.79; respectively in the overall population. Performance was best in the subgroup with AS <300 (n=250, Figure)

CONCLUSION

This proof-of-concept study demonstrates that detailed CAC characterization based on radiomic feature extraction predicts CV events independent of traditional risk factors and AS. Further validation is necessary to determine clinical impact.

CLINICAL RELEVANCE/APPLICATION

Artificial intelligence may identify a prognostically important radiomic signature of CAC.

Honored Educators

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CA230-SD-TUA7 Cardiac Magnetic Resonance T1 Mapping in Adolescent and Young Adult Survivors of Childhood Cancers

Station #7

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PURPOSE

Limited data based on small T1 mapping studies of childhood cancer survivors, in particular females, treated with anthracycline-based chemotherapy suggested an increase in left ventricular (LV) fibrosis. We determined using T1 mapping the severity of fibrosis in a relatively large cohort of adolescent and young adult long-term childhood cancer survivors.

METHOD AND MATERIALS

This is a prospective case-control study of 55 survivors (34 male) aged 25±7 years and 42 age-and gender-matched controls. The patients were studied at 17±7 years after completion of chemotherapy. The mean cumulative anthracycline dose was 229±86 mg/m2. Ventricular volumes, ejection fraction, native myocardial T1 and extracellular volume (ECV) were determined by cardiac magnetic resonance using modified Look-Locker (MOLLI) sequence. Late gadolinium enhancement was also quantified.

RESULTS

Left ventricular ejection fraction was lower in survivors than controls (54±5% vs 56±4%, p=0.008). However, there were no statistically significant differences in native T1 (1222±23 ms vs 1226±19 ms, p=0.31) and ECV (22.9±2.2% vs 23.8±2.4%, p=0.06) between survivors and controls. Quantification of LGE similarly did not demonstrate significant difference between survivors and controls (0.92%±1.32% vs. 0.46%±0.96%, p=0.07). Furthermore, T2 values were similar in both groups (57±4 ms vs. 58±6 ms, p=0.225). While females survivors had higher native T1 (1232±19 ms vs 1219±22 ms, p<0.001) and ECV (24.7±1.8 % vs 22.1±2 %, p<0.001) than male survivors, no differences were found when compared with female controls who had native T1 of 1228±19 ms (p=0.56) and ECV of 25.1±1.8 (p=0.23). Native T1 but not ECV correlated positively with duration since completion of chemotherapy (r=0.34, p=0.01).

CONCLUSION

In adolescent and young adult cancer survivors, T1 mapping does not reveal evidence of significant myocardial fibrosis. Intrinsic gender differences in T1 parameters probably account for the observation of increased T1 mapping values in female survivors.

CLINICAL RELEVANCE/APPLICATION

Provides incremental information that the T1 mapping values previously demonstrated in other studies is probably related to gender differences and when compared to normal volunteers, there is no significant difference. Future investigation should focus on longitudinal follow-up and using T1 mapping for risk stratification of patients with heart failure rather than asymptomatic patients.

CA236-SD-TUA8 Quantitative Evaluation of Monoexponential High B Value DWI in Cardiac Tumors

Station #8

Participants
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PURPOSE

To evaluate the feasibility, reproducibility and diagnostic performance of quantitative analysis of DWI in cardiac tumors

METHOD AND MATERIALS

18 patients, 6 males and 12 females with mean age and heart rate of 61.06+/-19.79 years-old and 66.5+/-9.17 bpm, respectively. High b value (b=0 and 300 s/mm2) DWI was done with cardiac triggering at end diastole. Manual ROI was placed by two radiologists in the lesion and pectoralis muscle at high b value and ADC map. Absolute and normalized (SIR =SIlesion /SIpectoralis muscle; ADCr=ADClesion/ADCpectoralis muscle) mean and miminum signal intensity (SIb300) and ADC were recorded. U Mann - Whitney tests, ROC curves and intraclass correlation coefficient (CCI) were calculated (=0.05).

RESULTS

5 malignant lesions (2 metastasis, lymphoma and 2 sarcoma) and 13 benign lesions (6 mixomas, 2 mitral valve caseous necrosis, 2 pericardial cysts, 1 intracavitary thrombus and 1 hydatid cyst) were observed. Significant differences in mean and minimum SIb300 (153.17 +/- 45.97 vs. 362.02 +/- 104.6 and 58.58 +/- 18.17 vs. 256.41 +/- 89.49; p0.05). Contrarilly to ADC based measures, SI and SIR displayed excellent interobserver reproducibility. ROC curves showed higher area under the curve in SI based measurements (0.82-0.89) compared to ADC based ones (0.57-0.81).

CONCLUSION

High b value DWI is feasible and reproducible technique for differentiating benign from malignant cardiac tumors. SI based measurements displayed better diagnostic performance compared to ADC based ones with excellent interobserver agreement.

CLINICAL RELEVANCE/APPLICATION

Cardiac DWI allow the characterization of cardiac lesions and masses with great diagnostic performance, high reproducibility and without the use of intravenous contrast.

Honored Educators

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CAS-TUB

Cardiac Tuesday Poster Discussions

Tuesday, Nov. 27 12:45PM - 1:15PM Room: CA Community, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Elsie Nguyen, MD, Toronto, ON (*Moderator*) Nothing to Disclose

Sub-Events

CA231-SD-TUB1 Influence of Readers' Experience on the Classification Performances of the Deep Neural Network (DNN) for Classifying Myocardial Delayed Enhancement on Cardiac MRI

Station #1

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PURPOSE

To investigate whether readers' experience influences on the classification performances of the deep neural network in recognition of myocardial delayed enhancement (MDE) on cardiac MRI.

METHOD AND MATERIALS

Four junior readers (JR) with less than 5 years' experience and four senior readers (SR) with greater than 5 years' experience from two separate institutions evaluated 1888 MDE images from consecutive 200 cardiac MRI cases. All readers were blinded to patient information. The 388 test MDE images from another 50 cases for DNN performance evaluation were classified by three senior readers by consensus. MDE patterns were classified into 7 categories (epicardial, focal, midwall, non-diagnostic, none, subendocardial and transmural). GoogLeNet was used for the architecture of DNN in recognizing images. Each reader's labeled dataset was used for training the DNNs. The trained DNNs' image classification performances were evaluated by classifying the test MDE images. The performances of detecting MDE and discriminating ischemic MDE (subendocardial and transmural) from other categories were assessed using receiver operating characteristic (ROC) curves. The MDE category concordances among readers were assessed using Fleiss's Kappa(K).

RESULTS

The agreement in classification among senior readers (K= 0.51) was stronger than for junior readers (K= 0.243). The mean area under the curves (AUC) of ROC in MDE detection by SR-trained DNNs were higher compared to JR-trained DNNs (0.836±0.014 vs. 0.783±0.030, p=0.018, respectively).The mean AUCs in discriminating ischemic MDE from other MDE categories by SR-trained DNNs were higher compared to JR-trained DNNs (0.884±0.012 vs. 0.803±0.039, p=0.007, respectively)The median accuracy for MDE classification for SR-trained DNNs was higher compared to JR-trained DNNs (51.3% vs. 44.0%, p=0.0286, respectively).

CONCLUSION

The classification performances for MDE by DNN depend on the experience of the observer who created the teacher data.

CLINICAL RELEVANCE/APPLICATION

Labeling of teacher data is necessary for DNN learning, but since the radiologist's experience affects the DNN learning result, it is necessary to pay attention to the quality of the teacher data.

CA232-SD-TUB2 Validation of Deep Learning Technique for Quantification of Cardiac Left Ventricle

Station #2

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PURPOSE

Accurate quantification of left ventricle is of great significance for reliable clinical cardiac function assessment. This study validates the effectiveness of deep learning techniques for simultaneous quantification of multiple clinical-significant left ventricle (LV) indices from short-axis cardiac MR sequences, and compare it with traditional segmentation methods and non-deep learning estimation methods. The considered indices include six regional wall thicknesses (RWT) of myocardium, three directional cavity dimensions, as well as two areas (areas of LV cavity and myocardium).

METHOD AND MATERIALS

A deep convolution neural network, equipped with recurrent network and multi-task learning is proposed to directly estimate the multiple LV indices from short axis cardiac MR sequences. A dataset of 2D short axis cine MR images of 145 subjects is used to validate the method against manually labeled ground truth following a 5-fold cross validation strategy. The subjects ages from 16 yrs to 97 yrs, with average of 58.9 yrs. The pixel spacings of the MR images range from 0.6836 mm/pixel to 2.0833 mm/pixel, with mode of 1.5625 mm/pixel. Each subject contains 20 frames throughout a cardiac cycle. For each subject, a representative mid-cavity slice is selected in this study.

RESULTS

The deep learning method achieves average mean absolute error (MAE) of 180 mm2, 2.51 mm, and 1.39 mm for areas, dimensions and RTWs. This clearly outperforms traditional segmentation-based method (274 mm2, 2.65 mm, 3.21mm) and non-deep learning method (242mm2, 2.88mm, 1.85mm). Fore reference, the maximums of these indices in our dataset are 4936 mm2, 81.0 mm, 24.4 mm, respectively.

CONCLUSION

The deep learning method provides accurate quantification results of multiple significant LV indices for all frames across the whole cardiac cycle, and outperforms traditional segmentation based method and non-deep learning estimation method.

CLINICAL RELEVANCE/APPLICATION

Deep learning method offers a feasible and reliable solution for automatically cardiac function assessment, and has a great potential implementation in clinical practice.

CA233-SD-TUB3 Impact of Virtual Monoenergetic Image Types on Image Quality of Late Iodine Enhancement with Dual-Layer Spectral CT in Patient with Hypertrophic Cardiomyopathy (HCM)

Station #3

Participants
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PURPOSE

Late iodine enhancement (LIE) has been used for evaluation of various cardiomyopathies. The aim of this study was to compare the image quality of LIE using dual-layered detector spectral CT among five type reconstruction algorithm: conventional 120kVp (Conventional image), virtual monoenergetic image (VM) at 70keV, 60keV, 50keV, 40keV.

METHOD AND MATERIALS

Twenty patients (12men, mean age 63 years old) were referred for evaluation of hypertrophic cardiomyopathy. They underwent cardiac LIE CT by electrocardiogram-gated scan. Paired three slices of myocardial basal, mid, apical image were created with five types of reconstruction (conventional, VM 70keV, 60keV, 50keV, 40keV).Each patient was visually evaluated for presence of LIE according to American Heart Association 17-segment model except for the apical segment.Objective image quality measurements such as image noise determined as the standard deviation of the attenuation value, myocardial signal-to-noise ratio (SNR), and if LIE positive, contrast-to-noise ratio between late enhancement and remote myocardial regions (CNR) were also evaluated using 16 regions of interest.

RESULTS

The median image noises of VM 70keV, 60keV and 50keV were significantly lower than that of conventional image (3.4, 3.7, 4.2 and 4.5, respectively) ($p=0.02$ for 50keV, $p<0.0001$ for others), while that of VM 40keV (5.3) was significantly higher than conventional one ($p<0.001$). The median SNR of VM 70keV, 60keV, 50keV, 40keV (19.1, 19.8, 20.5, and 20.2) were significantly higher than that of conventional image (14.3) ($p<0.0001$ for all). The median CNR of VM 70keV, 60keV, 50keV, 40keV (4.3, 6.0, 7.9 and 10.9) were significantly higher than conventional one (3.1) ($p=0.0012$ for 70keV, $p<0.0001$ for others).

CONCLUSION

The VM images showed significant noise reduction and increased SNR/CNR compared to conventional ones with spectral CT. The clinical impact of VM is warranted to improve diagnostic ability for LIE in HCM.

CLINICAL RELEVANCE/APPLICATION

The virtual monoenergetic images especially at 50keV showed significant noise reduction and increased SNR/CNR compared to conventional ones for evaluation of late iodine enhancement with spectral CT.

CA234-SD-TUB4 Utility of Dual-Energy CT for Assessment of Myocardial Fibrosis: Calculation of Extracellular Volume Fraction (ECV) Using Measured Hematocrit versus Virtual Hematocrit

Station #4

Participants

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PURPOSE

Diffuse myocardial fibrosis is a complication associated with various chronic heart diseases, including aortic stenosis. In cardiac CT or MRI, fibrosis is quantified by the fraction of tissue comprised of extracellular volume (ECV), which is equal to the blood plasma fraction (1 - hematocrit) times the ratio of delayed enhancement (ΔHU) between myocardium and blood pool. Our purpose was to evaluate two methods for calculation of a virtual hematocrit-derived ECV to simplify quantification of fibrosis, using ECV calculated from actual hematocrit (Hct) measured at time of CT examination as the standard of reference.

METHOD AND MATERIALS

61 patients with aortic stenosis (35M/26F; mean age 81 yrs) undergoing preoperative CT angiography for transcatheter aortic valve replacement (TAVR) underwent dual energy multiphase protocol including non-contrast phase and 10-minute delayed phase imaging. Virtual hematocrit values were calculated from linear regression equations developed from true measured hematocrit vs. either 1) density of blood pool from the non-contrast phase (vHct), or 2) density of blood pool from a virtual non-contrast image derived from the dual energy delayed phase using spectral separation (DEvHCT). The reference ECV was calculated from measured hematocrit and compared to the virtual methods.

RESULTS

The regression between non-contrast phase blood pool density and measured hematocrit was vHct=0.75*(HU)+7.6 (R^2=0.51). The regression between dual energy virtual-non-contrast blood pool density and measured hematocrit was DEvHct=0.34*(vHU)+27.6 (R^2=0.28). Reference mean ECV was 28.1%, mean ECV measured using vHct was 28.2% and mean ECV measured using DEvHct was 28.1%. Mean bias for ECV using vHct and DEvHct was 0.1% [-2.6% to +2.7% CI] and 0.0% [-3.3% to +3.2% CI], respectively.

CONCLUSION

Non-contrast blood pool density correlated better with measured Hct than blood pool density obtained from virtual-non-contrast images. However, this did not translate into significant differences in ECV measurements when using either virtual Hct method (vHct or DEvHct). Both virtual methods showed close agreement with the reference standard with no significant bias.

CLINICAL RELEVANCE/APPLICATION

Myocardial fibrosis may be one of several variables that may help predict outcomes after TAVR. This study demonstrates that ECV measurements derived from virtual hematocrit are accurate and may eliminate the need for additional blood tests.

Honored Educators

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CA235-SD-TUB5 Changes of Left Ventricular Myocardial Strain in Acute ST-Elevation Myocardial Infarction Patients before Left Ventricular Remodeling and Its Relation to Microvascular Obstruction: A CMR Feature Tracking Study

Station #5

Participants
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PURPOSE

To characterize the alteration in quantification of global left ventricular (LV) strain by cardiovascular magnetic resonance(CMR) feature tracking after acute ST-elevation myocardial infarction(STEMI) before LV remodeling, and to explore the relation to microvascular obstruction (MVO).

METHOD AND MATERIALS

The prospective study enrolled 32 patients with STEMI successfully treated with primary PCI who underwent CMR after 3-5days (baseline) and 4-6 months (follow-up). Cine imaging and late gadolinium enhancement(LGE) was performed at 3.0 T MR. Longitudinal global strains(GLS),circumferential global strains (GCS),global radial strains(GRS) and cardiac volume were measured by CVI 42 software based on cine sequences. MVO was assessed based on LGE sequence. According to the existence of MVO or not, all patients were divided into MVO(+) group and MVO(-) group. Mean values of GLS, GCS and GRS were compared between the two

groups of patients using an independent-samples t-test. Means of baseline and follow-up measurements were compared using a paired t-test.

RESULTS

In this study, none of the patients had LV remodeling, according to the end-systolic volume improvement<=15%. Seventeen patients were classified as MVO(+) and 15 patients as MVO(-).At baseline, there were no significant differences of GRS, GCS and GLS between the two groups (P=0.47,0.64 and 0.71). At follow-up, the GRS and GCS between MVO(+) and MVO(-) still make no significant differences (P=0.06, 0.12), while the GLS mean values of MVO(+) group significantly lower than that of MVO(-) group [(-14.10±0.51)%vs. (-16.35±0.75)%, P=0.048]. From baseline to 4-6 follow-up, the GRS, GCS and GLS of the two groups were all increased {MVO(-): [(34.51±8.52)% vs. (34.65±9.07)% , P =0.007], [(-16.91±3.14)% vs.(-18.13±3.64)% , P=0.038], [(-15.04±2.53)%vs. (-16.35 ±3.08)%,P=0.010]; MVO(+):[(29.12±6.84)%vs. (30.61±5.68)% ,P=0.101], [(-14.27±3.04)%vs.(-16.33±0.66,)%, P=0.014)], [(-11.97±2.21)%vs.(-14.10 ±1.98)% , P=0.657]}.

CONCLUSION

For acute STEMI patients without LV remodeling in 4-6 months after PCI, the GRS, GCS and GLS of LV were all increased irrespective of MVO existed or not, and the changes of GLS in group with MVO was more obvious. Which may be the evidence of LV early remodeling.

CLINICAL RELEVANCE/APPLICATION

Feature tracking can assess myocardial systolic function and myocardial damage and is recommended for prognosis assessment following acute STEMI patients.

CA168-ED-TUB7 Fluoroscopic Anatomy of the Heart: Comprehensive Understanding with Endocast Imaging and Virtual Dissection Imaging

Station #7

Participants
Shumpei Mori, Kobe, Japan (*Presenter*) Nothing to Disclose
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Robert Anderson, MD, Newcastle, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

Since any invasive procedures in a catheter laboratory are performed with fluoroscopic support, correct appreciation of the fluoroscopic cardiac anatomy is the fundamental basis of the procedures. To facilitate such understanding, structural anatomy within the cardiac contour should be visualized from multiple directions. Using computed tomography, several reconstruction techniques can be executed to achieve this, depending on the focus of attention and the structures selected for rendering. Endocast imaging, which extracts several cardiac chambers with enhancement, can demonstrate well the relationship among each chamber. The technique, however, shows only the cavities of the cardiac components without showing walls and septa. Virtual dissection imaging retracts the chambers enhanced in endocast imaging, thus visualizing the walls, septa, and intracardiac structures. Virtual dissection images are of far greater value for interventional cardiologists, because it is these structures that are their main targets. Combination of these methodologies facilitates full appreciation of the fluoroscopic anatomy of the living heart.

TABLE OF CONTENTS/OUTLINE

1. Image acquisition techniques 2. Various reconstruction techniques 3. Representative serial images to show fluoroscopic cardiac anatomy 4. Clinical implications

CA170-ED-TUB8 Tutorial for Myocardial Perfusion CT

Station #8

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TEACHING POINTS

• Specificity in detection of hemodynamically significant coronary arteries stenosis on coronary CTAs can be improved when combined with myocardial perfusion

TABLE OF CONTENTS/OUTLINE

• BACKGROUND Myocardial CT perfusion can identify perfusion defects during vasodilator stress • TECHIICAL REQUIREMENTS Minimal requirements for CT scanner: rotation and detectors Patient monitoring requirements Personnel: cardiologist, radiologist, nursing team and CT technologist Safety requirements: drugs • PROTOCOL TECHNIQUES Patient and image team preparation Scan parameters: tube voltage, radiation dose Patient positioning Stress agen and IV contrast volume and timing Patient monitoring Iterative reconstruction and image processing algorithms Pitfalls, artifacts that can mimic false positive/negative myocardial

perfusion • EXAMPLE Benefits and challenges of this protocol in practice Examples of normal/abnormal myocardial perfusion CT • IMPLEMENTATION CHALLENGES Increase awareness and availability of myocardial perfusion CT by the ordering clinicians Provide quick test results for the ordering clinicians • CONCLUSION Myocardial perfusion CT can add additional physiological information of ischemia in patients referred to coronary CTA, increasing specificity to a lower positive predictive value of obstructive lesions detected by coronary CTA

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

SSJ03

Cardiac (Myocardial Disease)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E353A

CA MR NM

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

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Sub-Events

SSJ03-01 Utility of Dual Energy CT for Assessment of Myocardial Fibrosis: Comparison of Single-Phase Iodine Map Extracellular Volume Fraction (ECV) With Standard Multiphase ECV Technique

Tuesday, Nov. 27 3:00PM - 3:10PM Room: E353A

Awards
Student Travel Stipend Award

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PURPOSE

Diffuse myocardial fibrosis is associated with chronic heart diseases, including aortic stenosis, and may be quantified using cardiac CT or MRI calculation of extracellular volume fraction (ECV). This study compared a dual-energy CT approach using an iodine map from a single phase to calculate ECV to the standard multiphase technique to calculate ECV.

METHOD AND MATERIALS

61 patients with aortic stenosis (35 male, 26 female; average age = 81 years) undergoing preoperative CT for transcatheter aortic valve replacement (TAVR) were scanned on a Force (Siemens Inc.) using dual energy mode prior to (non-contrast phase) and 10 minutes following (delayed phase) administration of 120-150 cc of iodinated contrast. Matched 1cm² regions of interest were selected in the interventricular septum and ventricular blood pool in each phase. The ROI densities obtained from blended virtual 120 kV images in each phase were used to compute the ECV (standard technique), while the dual energy data from the delayed phase only was used to calculate ECV using iodine map technique. Bias between ECV computation methods was visualized using Bland-Altman plot. Linear regression with Pearson technique was also performed.

RESULTS

The mean ECV calculated using standard method was 28%, while mean ECV measured using the iodine map method was 30%; for a mean bias of +2% [95% CI, -5% to +9%]. The Pearson correlation coefficient between the two ECV measurements was $R^2 = 0.48$.

CONCLUSION

There was good correlation between ECV measured by standard multiphase technique and ECV measured by dual energy technique using iodine maps created from the delayed phase alone. The dual energy technique trended towards mild overestimation of fibrosis, possibly attributable to beam hardening, however this difference was not significant.

CLINICAL RELEVANCE/APPLICATION

Prior studies using histopathology and cardiac MRI have shown that the greater degree of myocardial fibrosis can predict worse outcomes after surgery. ECV is an accepted way to measure myocardial fibrosis. This study demonstrates a dual energy method that simplifies ECV measurement and reduces radiation dose without significant difference relative to standard measurement of ECV.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Stefan L. Zimmerman, MD - 2012 Honored EducatorStefan L. Zimmerman, MD - 2015 Honored EducatorIhab R. Kamel, MD, PhD - 2015 Honored EducatorElliot K. Fishman, MD - 2012 Honored EducatorElliot K. Fishman, MD - 2014 Honored EducatorElliot K. Fishman, MD - 2016 Honored EducatorElliot K. Fishman, MD - 2018 Honored Educator

SSJ03-02 Occurrence of Myocardial Oedema After Sporting Event? Quantification by T1 and T2 Mapping

Tuesday, Nov. 27 3:10PM - 3:20PM Room: E353A

Participants
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PURPOSE

Purpose of this study was to analyse the occurrence of myocardial oedema in triathletes after sporting events using T2 and T1 mapping.

METHOD AND MATERIALS

29 competitive asymptomatic triathletes (45 ±10 years) underwent a CMR study performed on a 1.5T Achieva (Philips) before (baseline) and after a sporting event (follow-up). CMR protocol included SSFP cine, T2w-GraSE and T1, T2 mapping using MOLLI 5(3)3 sequence. Additionally, LGE Imaging was performed in the CMR baseline study. T1 and T2 quantification was performed using the OsiriX Software.

RESULTS

CMR performed before the sporting event revealed a normal global T1 time (with 989 ±28ms) of the left ventricular (LV) myocardium. There was no significant change in the global T1 time after the sporting event (988 ±21ms; p=0.926). Furthermore, T2 time was in the normal range before the sporting event (54 ±3ms) without relevant change after the sporting event (53 ±3ms, p=0.797). In 10 of the 29 Triathletes (34%) a focal myocardial fibrosis with a non-ischemic pattern was detected (LGE+ triathletes). Likewise, in the subgroups (LGE+ und LGE-) no significant changes in T1, T2 times before and after the sporting event were detected.

CONCLUSION

In contrast to the previously published T2 STIR data our results using T1, T2 mapping have not revealed any myocardial oedema after sporting events. Exercise-induced myocardial oedema previously detected using T2 STIR sequences might be falsely interpreted due to signal inhomogeneities.

CLINICAL RELEVANCE/APPLICATION

No myocardial oedema indicating acute myocardial injury was detected using mapping methods after sporting events, suggesting that competitive endurance events are safe.

SSJ03-03 Focal and Interstitial Fibrosis in Highly Trained Endurance Athletes

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E353A

Participants
Blanca Domenech, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose
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PURPOSE

There is evolving evidence that cumulative effects of intensive endurance exercise may induce a broad spectrum of right ventricular (RV) adaptation/remodelling patterns. Thus, our aim was to assess the prevalence of myocardial fibrosis (MF), focal and interstitial, in the myocardium and its relationship with cardiac remodelling/adaptation, among a cohort of highly trained endurance athletes as compared to control subjects.

METHOD AND MATERIALS

93 highly trained endurance athletes (>12 hours training/week at least during the last 5 years; age: 36 ± 6 years; 52.7% male) and 72 age and gender-matched controls underwent a resting cardiac magnetic resonance to assess biatrial and biventricular dimensions and function. The presence of focal MF was assessed by late gadolinium enhancement (LGE). In a subgroup of 28 athletes, T1 mapping sequence was added and extracellular volume (ECV) measurements were performed in remote myocardium to asses interstitial MF.

RESULTS

High endurance training load was associated with larger bi-ventricular and bi-atrial sizes, mildly reduced systolic ventricular function, as compared to controls in both genders ($p < 0,05$). LGE was significantly more prevalent in athletes (n=35, 37.6% vs 2.8%; $p < 0,001$), with a constant pattern in the RV insertion points (Figure 1). Among men population, those athletes with LGE tended to have trained for more hours per week (14.55±3.6 vs 12.21±3.4, $P = 0.07$). In T1 mapping sequences, abnormal ECV values (>28%) were only found in 2 of 28 subjects. Those athletes who had focal fibrosis had higher ECV at remote myocardium than those without LGE (27,3±1,8 vs 25,1±2,2; $P = 0,01$).

CONCLUSION

Highly trained endurance athletes showed ten times higher prevalence of LGE than control subjects; always confined to the hinge point. Although this pattern of LGE may be another feature of the athlete's heart, our results suggest that those with focal fibrosis might have globally higher myocardial ECV values. Its clinical impact is currently uncertain, and it still warrants further investigation.

CLINICAL RELEVANCE/APPLICATION

Myocardial fibrosis, which is a predictive factor for adverse cardiac outcome, has been also described in some endurance athletes and its clinical meaning remains controversial.

SSJ03-04 Evaluation of a Shortened Cardiac MRI Protocol of Left Ventricular Examinations: Diagnostic Performance of T1-Mapping and Myocardial Function Analysis as a Screening Method

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E353A

Participants
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PURPOSE

In this study we sought to retrospective evaluate whether a very brief CMR protocol comprising only left ventricular(LV) function analysis and T1 mapping sufficiently distinguishes patients with relevant myocardial changes with need for further examination from healthy patients.

METHOD AND MATERIALS

From October 2015 until October 2017 all patients with clinical indication for CMR for any myocardial characterisation (n = 160) were included. The scanner was a Philips Ingina 3T. The full CMR protocol comprised sBTFE Cine-Imaging, T1 and T2 mapping, T2w Dark-Blood as well as Early- and Late-Gadolinium-Enhancement. Patients were categorized into two groups depending on presence of LV dysfunction. ROC-analysis was done for results of T1-, T2- mapping and extracellular volume(ECV) in patients without LV dysfunction. Reference was depicted pathology in the conventional CMR techniques and report.

RESULTS

In the patient's cohort without LV dysfunction (n = 78 [49%]) ROC for T1 mapping was 81% with $p < 0.001$, 65 % for T2 mapping with $p= 0.4$ and 82% for ECV with $p < 0.001$. T1 mapping was superior to T2 mapping by trend; $p = 0.057$. ECV was significantly superior to T1 mapping, $p = 0.026$. For maximum T1 relaxation times of 1300ms sensitivity was 83 % and specificity was 55%; the negative predictive value was 91%. In patients with no LV dysfunction 31 (40%) patients did not exceed a maximum T1 of 1300ms; out of those none had significant myocardial alterations but 3 patients were diagnosed with chronic myocarditis. In general, out of the daily routine study population 111 (70%) patients had a pathological finding and in 49 cases (30%) CMR did not provide additional information. In that group T1 mapping detected 57% of the patients who would not benefit from additional CMR.

CONCLUSION

A shortened CMR protocol comprising T1 mapping and LV-function analysis seems to rule out clinically relevant myocardial alterations. However, 3 cases of chronic myocarditis with normal LV-function were overlooked; yet therapeutic consequences remain uncertain in this entity. These results need to be prospectively confirmed in a lager study to increase confidence in this shortened protocol in clinical use.

CLINICAL RELEVANCE/APPLICATION

The proposed protocol might allow for an improvement of efficiency of CMR examinations in the future.

SSJ03-05 Ferumoxytol-Enhanced MRI for Intramyocardial Blood Volume Mapping: Early Pre-Clinical Results

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E353A

Participants
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PURPOSE

Myocardial perfusion is important for organ vitality. The intramyocardial blood volume (MBV) represents the fractional blood volume of the intravascular space within a unit volume of myocardial tissue. Because ferumoxytol has high r1 relaxivity and a long intravascular half-life, we hypothesize that ferumoxytol-enhanced (FE) MRI may enable mapping of the MBV. We aim to evaluate the vasodilator-induced variation in myocardial T1 signal in normal swine.

METHOD AND MATERIALS

In this ARC-approved study, four healthy Yorkshire swine (33-52 kg) underwent FE-MRI at 3.0T under general anesthesia. We acquired myocardial T1 maps using 5-(3)-3-(3)-3 MOLLI and FLASH-MOLLI pre- and post-ferumoxytol infusion (4mg/kg). We induced coronary vasodilation with 4-minute cycles of adenosine infusion (200-400 mcg/kg/min). Using in-house T1 fitting algorithms, we generated myocardial T1 maps and derived T1 values from regions of interest drawn in the mid interventricular septum of short axis FE T1 maps.

RESULTS

No adverse events occurred and vital signs were stable throughout the adenosine infusion and FE-MRI exam. Myocardial T1 signal differential between pre- and post-ferumoxytol was -48.5%±6.4%. The adenosine-induced native T1 response as reflected by the slope between baseline and peak adenosine was less robust when compared to FE T1 response (3.0±0.6ms/min vs -35.3±16.1ms/min, p=0.03). During the two adenosine-on cycles post-ferumoxytol, the FE T1 values steadily shortened due to adenosine-induced vasodilation and increasing MBV. During adenosine-off cycles, FE T1 values increased towards values at rest. For adenosine 200-300 mcg/kg/min, the FE T1 shortened (decreased) 10.2±5.4% from baseline. For 400 mcg/kg/min dose, the FE T1 shortened >15% (swine #4). Of note, the increase in native T1 from baseline to peak adenosine was 0.7±0.2%.

CONCLUSION

Ferumoxytol, as a potent intravascular contrast agent, sensitizes the T1 signal to changes in the MBV and substantially amplifies the intramyocardial vascular T1 estimate. Additional work in models of varying myocardial perfusion is needed to better characterize the T1 response in normal vs pathologic states.

CLINICAL RELEVANCE/APPLICATION

Vasodilator-induced changes in ferumoxytol-enhanced myocardial T1 reflect dynamic changes in the intravascular myocardial compartment and has implications for a panoply of myocardial disease states.

SSJ03-06 Simultaneous 18F-FDG PET/MR Study for Assessment of Different Stages of Cardiac Impairment in Patients with Anderson-Fabry Disease

Tuesday, Nov. 27 3:50PM - 4:00PM Room: E353A

Awards
Student Travel Stipend Award

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PURPOSE

We evaluated the relationship between T1 mapping and 18F-FDG PET by cardiac PET/MR imaging in AFD female patients.

METHOD AND MATERIALS

Seventeen AFD female patients with normal left ventricular (LV) function underwent simultaneous cardiac PET/MR (Biograph mMR; Siemens Healthcare, Erlangen, Germany) imaging after administration of 18F-FDG and gadolinium-DPTA for assessment of late gadolinium enhancement (LGE). In all patients and in 7 female controls T1 mapping was performed using pre-contrast T1 Modified Look-Locker Inversion-recovery prototype sequence. Mean T1 values were measured by drawing 6-pixel regions of interest in the septal and lateral segments of LV apical, mid-ventricular and basal short-axis slices. Cardiac FDG uptake was quantified by

measuring the standardized uptake value in 17 myocardial segments in each subject. The coefficient of variation (COV, i.e. the standard deviation divided by the average) of the uptake of the 17 segments was calculated as an index of heterogeneity in the heart and values >0.17 were considered abnormal.

RESULTS

Five patients showed focal LGE indicating intra-myocardial fibrosis and were excluded from the final analysis. Compared with controls, mean T1 values of AFD female patients were significantly lower (1238±51.1 vs. 1334.32±26.6, $p<0.001$). At PET, 7 out of the remaining 12 patients showed abnormal COV values suggesting inflammation pattern and the other 5 demonstrated normal COV values (0.32±0.1 vs. 0.12±0.03, $p<0.005$) with homogeneous FDG uptake. Patients with abnormal COV showed higher mean T1 values of lateral segments of the mid-LV wall (1219.16±23.4 vs. 1154±62.1, $p<0.05$), suggesting a potential relationship between progressive myocyte sphingolipid accumulation and inflammation.

CONCLUSION

This study highlights the role of 18F-FDG PET/MR imaging for early detection of cardiac involvement in AFD patients allowing to identify different stages of disease progression. In particular, pseudo-normalization of T1 mapping values, associated with abnormal COV values, may represent an intermediate "inflammatory" stage before the development of myocardial fibrosis.

CLINICAL RELEVANCE/APPLICATION

Simultaneous cardiac 18F-FDG PET/MR imaging may allow early detection of cardiac involvement in AFD patients identifying different stages of disease progression.

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

SSJ04

Science Session with Keynote: Cardiac (Oncology)

Tuesday, Nov. 27 3:00PM - 4:00PM Room: E260

CA MR NM OI

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants

Gautham P. Reddy, MD, Seattle, WA (*Moderator*) Researcher, Koninklijke Philips NV;
Daniel Ocazionez, MD, Houston, TX (*Moderator*) Nothing to Disclose
Tina D. Tailor, MD, Durham, NC (*Moderator*) Nothing to Disclose

Sub-Events

SSJ04-01 Cardiac Keynote Speaker: Cardiac Complications of Oncology Therapy

Tuesday, Nov. 27 3:00PM - 3:20PM Room: E260

Participants
Gautham P. Reddy, MD, Seattle, WA (*Presenter*) Researcher, Koninklijke Philips NV;

Honored Educators

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

SSJ04-03 Myocardial Tissue Characterization in Rat Models of Anthracycline-Induced Cardiotoxicity: Histologic Change and Correlation with T1 Mapping Parameters

Tuesday, Nov. 27 3:20PM - 3:30PM Room: E260

Participants
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PURPOSE

To examine the pathologic changes in rat models of cardiotoxicity and to determine correlation with quantitative magnetic resonance imaging (MRI) parameters.

METHOD AND MATERIALS

All experiments were approved by our institutional animal care and use committee. Cardiotoxicity models were induced by injecting adult male Sprague-Dawley rats with doxorubicin (1mg/kg, twice a week). Cardiac MRI was performed with a 9.4-T scanner (Bruker Biospin Co., Billerica, MA, USA) using cine, pre- and post-T1 mapping sequences. T1 mapping sequences were performed by using a saturation recovery Look-Locker sequence. Left ventricular ejection fraction (LVEF) was evaluated using cine imaging. Native T1 and extracellular volume (ECV) were measured at the mid ventricle. All rats were sacrificed after MRI. Pathologic changes were graded according to their degree and then scored (0:absent, 1:minimal, 2:mild, 3:moderate, 4:severe) and correlated with MRI parameters (native T1 (ms), ECV (%)) and LVEF(%))

RESULTS

A total of 10 control and 14 cardiotoxicity models were included. Rats were classified into two groups, the early (n=9) and late (n=5) group, by 6 weeks after modeling. In cardiotoxicity models, LVEF decreased (control vs. cardiotoxicity subjects: 74%, 63.2%), native T1 and ECV increased (1,186 ms, 15.5% vs. 1,232.44 ms, 18.68%). The main histologic findings were vacuolar changes, inflammation, interstitial edema, expansion of interstitial space, and fibrosis. In subgroup analysis, myocardial fibrosis, expansion of interstitial space scores were significantly different between the two groups (p=0.007, p=0.002). Other histologic

factors (e.g. vacuolar changes, inflammation, interstitial edema), native T1, ECV, and LVEF were not significantly different between the two groups. ECV was correlated with fibrosis (r=0.632, p=0.015), vacuolar change (r=0.705, p=0.005), and the sum of histologic scores (r=0.694, p=0.006). Native T1 was correlated with myocardial inflammation (r=0.638, p=0.012) and expansion of interstitial space (r=0.656, p=0.011)

CONCLUSION

Prominent changes in MRI parameters and pathologic findings were noted in both early and late cardiotoxicity models, even in subjects with preserved LVEF. ECV and native T1 values showed good correlations with histologic scores.

CLINICAL RELEVANCE/APPLICATION

T1 mapping MRI is a useful quantitative method to detect anthracycline-induced cardiotoxicity.

SSJ04-04 Myocardial Tissue Phase Mapping Detects Cardiac Dysfunction in a Mouse Model of Doxorubicin-Induced Cardiotoxicity

Tuesday, Nov. 27 3:30PM - 3:40PM Room: E260

Participants
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Alexander Ruh, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Nicola Bertolino, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Jeremy D. Collins, MD, Chicago, IL (*Abstract Co-Author*) Consultant, Guerbet SA Grant, Siemens AG Grant, C. R. Bard, Inc
Michael Markl, PhD, Chicago, IL (*Abstract Co-Author*) Institutional research support, Siemens AG; Consultant, Circle Cardiovascular Imaging Inc;
Zhuoli Zhang, MD,PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
James C. Carr, MD, Chicago, IL (*Abstract Co-Author*) Research Grant, Astellas Group; Research support, Siemens AG; Speaker, Siemens AG; Advisory Board, Guerbet SA
Daniele Procissi, MS, PhD, Pasadena, CA (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Cardiotoxicity following chemotherapy is common in cancer patients treated with anthracyclines such as doxorubicin (Dox). Conventional imaging approaches to identify anthracycline associated cardiac dysfunction have targeted reductions in ejection fraction (EF) with newer approaches focusing on detecting alterations in myocardial strain. The purpose of this study was to use myocardial tissue phase mapping (TPM) to study early functional changes in a mouse model of Dox-induced cardiotoxicity.

METHOD AND MATERIALS

16 week old female C57Bl/6 mice (n = 9) were imaged at 7T. 25 mg/kg Dox was administered over 3 weeks in the form of 5 mg/kg subcutaneous pellets (Innovative Research of America, Florida, USA). Mice were imaged at baseline, 6 weeks and 10 weeks post-treatment. MRI protocol included multi-slice cine MRI covering the entire LV, and TPM in a single mid-ventricular short-axis slice. The cine images were analyzed using Segment (Medviso, AB) to calculate EF. TPM was performed using 2D cine phase contrast MRI with prospective ECG and respiratory triggering. Imaging parameters included: image/time resolution = 0.117x0.117x1 mm3x20.8 ms, tri-directional VENC=4 cm/s. TPM images were analyzed in MATLAB to measure global peak radial and longitudinal velocities at systole and diastole. Following imaging at 6 weeks, 4 mice were sacrificed for histopathologic assessment utilizing terminal deoxynucleotidyl transferase (TdT) dUTP nick-end labeling (TUNEL) to detect apoptotic cells.

RESULTS

There were no significant differences in EF (72±11% at baseline, 75±12% at 6 weeks and 63±2% at 10 weeks). Global systolic longitudinal velocity was significantly reduced at 6 weeks (p=0.03) but our power was low to detect significant differences at 10 weeks. Histopathologic results demonstrated minimal apoptosis in all mice, suggesting early-stage cardiotoxicity.

CONCLUSION

Using myocardial TPM, we detected cardiac dysfunction prior to reduction in EF and the onset of cardiomyocyte apoptosis in a mouse model of Dox-induced cardiotoxicity. Future studies comparing this technique with other myocardial tissue and functional characterization may demonstrate a role for TPM as an early biomarker of cardiotoxicity.

CLINICAL RELEVANCE/APPLICATION

In the present study, we demonstrated that longitudinal systolic velocity quantified using myocardial tissue phase mapping may represent an early imaging biomarker for doxorubicin-induced cardiotoxicity.

SSJ04-05 68Ga-Galmydar: A PET Imaging Tracer for Noninvasive Detection of Doxorubicin-Induced Cardiotoxicity

Tuesday, Nov. 27 3:40PM - 3:50PM Room: E260

Participants
Jothilingam Sivapackiam, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Shivesh Kabra, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Sylvia Speidel, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Richard Laforest, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Michael P. Rettig, St. Louis, MO (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Doxorubicin (DOX; Adriamycin), an anthracycline analogue is widely used chemotherapeutic drug in cancer. DOX treatments are susceptible to acute and chronic cardiac anomalies, including aberrant arrhythmias, ventricular dysfunction, and heart failure. PET tracers could also provide noninvasive assessment of early and reversible metabolic changes of the myocardium. Herein, we report a preliminary investigation of 68Ga-Galmydar potential to monitor DOX-induced cardiomyopathy in vivo, ex vivo, and in cellulo employing both nuclear- and optical imaging.

METHOD AND MATERIALS

Galmydar was obtained through a ligand exchange reaction. 68Ga-Galmydar was purified on C-18 column using radio-HPLC. MicroPET imaging was performed 5 d post treatment of rats either with a single dose of DOX (15 mg/kg) or vehicle as a control (saline). For correlation of PET imaging data, post-imaging quantitative biodistribution studies were also performed. In cellulo (H9c2) dose and time dependent doxorubicin treatments were also studied using live cell optical imaging.

RESULTS

68Ga-Galmydar, micro-PET static scan (10 min acquisition; 60 min post tail-vein administration) demonstrated 1.91-fold lower uptake in hearts of DOX-treated (Standard Uptake Value; SUV: 0.92, n=3) rats compared with their vehicle treated (SUV: 1.76, n = 3) counterparts. The post imaging pharmacokinetic data demonstrated heart uptake values of 2.02 fold lower for DOX treated rats compared to control counterparts (%ID/g; DOX: 0.44 ± 0.1, n=3; Control: 0.89 ± 0.03, n=3) thus correlating well with micro-PET imaging data. Employing moderate fluorescent traits of Galmydar, live cell optical imaging indicated a gradual decrease in uptake and retention of Galmydar within mitochondria of H9c2 cells following DOX-treatment, while indicating also dose-dependent pharmacological response and time-dependent uptake profiles. Furthermore, the decreased uptake in H9c2 cells also correlated with caspase-3 expression resulting from DOX-induced cardiotoxicity and cell death. Combined data indicate that 68Ga-Galmydar could provide a sensitive and specific readout of DOX-induced cytotoxicity attributed to depolarization of mitochondrial potential in heart cells.

CONCLUSION

68Ga-Galmydar could provide a noninvasive assessment of DOX-related early and likely reversible metabolic changes that remains to be evaluated clinically.

CLINICAL RELEVANCE/APPLICATION

none

RC403

Nonischemic Cardiomyopathies: New Role of Cardiac MRI

Tuesday, Nov. 27 4:30PM - 6:00PM Room: E350

CA MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Charles S. White, MD, Baltimore, MD (*Moderator*) Consultant, Koninklijke Philips NV

LEARNING OBJECTIVES

1) To recognize MRI appearance of the most common right ventricular cardiomyopathies.2) To describe the phenotypic spectrum of morpho-funcitional and tissue abnormalities of hypertrophic cardiomyopathy. 3) To review different faces and phases of the disease reflecting its natural history. 4) To analyze critical role of CMR tissue characterization of the differential diagnoses of hypertrophic CMPs, from phenotype to genotype. 5) To review T1 and T2 tissue mapping variations in different clinical scenarios. 6) To analyze prognostic implications of CMR in HCM. 7) Describe the relevant clinical findings of patients with restrictive cardiomyopathy. 8) Define the role of cardiac MR (CMR) in the evaluation of patients with restrictive cardiomyopathy. 9) Discuss the different patterns of myocardial enhancement and other ancillary imaging findings as they relate to narrowing the differential diagnosis in patients with restrictive cardiomyopathy. 10) Identify the different forms of Dilated Cardiomyopathies (DCM). 11) Apply the most common Cardiac Magnetic Resonance (CMR) techniques to differentiate between the various DCM etiologies. 12) Assess the Pros & Cons of different CMR techniques for the DCM evaluation.

Sub-Events

RC403A Arrhythmogenic and other Right Ventricular Cardiomyopathies

Participants
Karen G. Ordovas, MD, San Francisco, CA (*Presenter*) Advisor, Arterys Inc

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LEARNING OBJECTIVES

1) To recognize MRI appearance of the most common right ventricular cardiomyopathies.

RC403B Role of MRI in Hypertrophic Cardiomyopathy

Participants
Marco Francone, MD,PhD, Rome, Italy (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) To describe the phenotypic spectrum of morpho-funcitional and tissue abnormalities of hypertrophic cardiomyopathy. 2) To review different faces and phases of the disease reflecting its natural history. 3) To analyze critical role of CMR tissue characterization of the differential diagnoses of hypertrophic CMPs, from phenotype to genotype. 4) To review T1 and T2 tissue mapping variations in different clinical scenarios. 5) To analyze prognostic implications of CMR in HCM.

RC403C Restrictive Cardiomyopathy and Amyloidosis

Participants
Daniel Vargas, MD, Aurora, CO (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Describe the relevant clinical findings of patients with restrictive cardiomyopathy. 2) Define the role of cardiac MR (CMR) in the evaluation of patients with restrictive cardiomyopathy. 3) Discuss the different patterns of myocardial enhancement and other ancillary imaging findings as they relate to narrowing the differential diagnosis in patients with restrictive cardiomyopathy.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality

educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Daniel Vargas, MD - 2017 Honored Educator

RC403D Role of MRI in Dilated Cardiomyopathies

Participants
Matthias Gutberlet, MD, PhD, Leipzig, Germany (*Presenter*) Speaker, Siemens AG; Speaker, Koninklijke Philips NV; Speaker, Bayer AG; Speaker, Bracco Group; Author, Thieme Medical Publishers, Inc

LEARNING OBJECTIVES

1) Identify the different forms of Dilated Cardiomyopathies (DCM). 2) Apply the most common Cardiac Magnetic Resonance (CMR) techniques to differentiate between the various DCM etiologies. 3) Assess the Pros & Cons of different CMR techniques for the DCM evaluation.

ED002-WE

Cardiac Wednesday Case of the Day

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

AMA PRA Category 1 Credit ™: .50

Participants
Suhny Abbara, MD, Dallas, TX (*Presenter*) Royalties, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG
Sachin S. Saboo, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Fernando U. Kay, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Dhiraj Baruah, MD, Milwaukee, WI (*Abstract Co-Author*) Educator, Boehringer Ingelheim GmbH;
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Carlos S. Restrepo, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Kaushik S. Shahir, MD, Tampa, FL (*Abstract Co-Author*) Nothing to Disclose
Ameya J. Baxi, MBBS,DMRD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose
Jinglei Li, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Harold Goerne, MD, Zapopan, Mexico (*Abstract Co-Author*) Nothing to Disclose

TEACHING POINTS

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

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Suhny Abbara, MD - 2014 Honored EducatorSuhny Abbara, MD - 2017 Honored EducatorSachin S. Saboo, MD, FRCR - 2017 Honored EducatorPrabhakar Rajiah, MD, FRCR - 2014 Honored EducatorCarlos S. Restrepo, MD - 2012 Honored EducatorCarlos S. Restrepo, MD - 2014 Honored EducatorCarlos S. Restrepo, MD - 2017 Honored EducatorCarlos S. Restrepo, MD - 2018 Honored Educator

MSES41

Essentials of Cardiac Imaging

Wednesday, Nov. 28 8:30AM - 10:00AM Room: S100AB

CA CT

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Sub-Events

MSES41A Aortic Valvular Disease

Participants
John P. Lichtenberger III, MD, Bethesda, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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LEARNING OBJECTIVES

1) Describe the detailed imaging anatomy of the aortic valve, including congenital variants and malformations. 2) List incidental and known aortic valvular diseases detectable on radiography, CT, and MRI and organize that list based on epidemiology. 3) Select the best imaging modality to evaluate a given aortic valvular disease. 4) Adjust imaging protocols to optimize the evaluation of common aortic valvular diseases.

ABSTRACT

The increasing temporal and spatial resolution of imaging technology, the advancing functional data obtainable by imaging modalities, and the ever-broadening knowledge of aortic valvular disease present a challenge to both general and subspecialized imagers. This lecture will focus on the most common and most important diseases of the aortic valve encountered in clinical practice, whether those diseases are discovered incidentally or are known and must be comprehensively characterized. Emphasis will be placed on avoiding pitfalls and on obtaining and providing clinically useful information.

MSES41B Cardiac Devices: Appearance on Imaging

Participants
Karin E. Dill, MD, Worcester, MA (*Presenter*) Nothing to Disclose

MSES41C Imaging Complications of Myocardial Infarction and CABG

Participants
Seth J. Kligerman, MD, Denver, CO (*Presenter*) Nothing to Disclose

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skligerman@ucsd.edu

LEARNING OBJECTIVES

1) Learn about the early and late complications of myocardial infarction. 2) Understand how each of these manifestations appear on cross-sectional imaging. 3) Discuss medical and surgical treatment options.

ABSTRACT

Acute myocardial infarction is a leading cause of mortality in the United States. However, even if a patient survives the initial insult, myocardilal damage can lead to both early and late complications including left ventricular free wall rupture, ventricualr septal rupture, papillary muscle rupture, pericaridits, and aneurysm formation. Some of these are life-threatening complications that require immediate diagnosis. The purpose of this talk is the review the various patholgies that involve the myocardium and pericardium, review their imaging findings, and dicuss treatment options.

MSES41D Cardiac CT in Acute Chest Pain

Participants
Christian Loewe, MD, Vienna, Austria (*Presenter*) Speaker, Bracco Group; Speaker, General Electric Company; Speaker, Siemens AG

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LEARNING OBJECTIVES

1) To learn about the current and possible future role of Cardiac CT in the management of patients suffering from acute chest pain. 2) To become familiar with the most important imaging biomarkers in acute coronary syndromes. 3) To discuss possible algorithms for the management of patients with acute chest pain.

ABSTRACT

Three potentially life-threatening disorders can become clinically evident by the unspecific symptom of "acute chest pain", and in two out of them including pulmonary embolism and acute aortic syndrome CT angiography was established as the first diagnostic modality of choice. Given the high evidence for the value of Cardiac CT in ruling out relevant coronary artery disease in stable patients and facing still existing challenges to safely triage patients in chest pain units, the possible role of Cardiac CT in this clinical scenario is under evaluation and discussion. It is proven that CT can be used to safely rule out acute coronary syndromes with a very high negative predictive value and that CT can help to early discharge patients from the chest pain unit. However, the possible role in the positive diagnosis of an acute coronary syndrome is not as clear. Within this presentation, an overview about the technical possibilities of using CT in the management of acute chest pain patients will be provided. Furthermore, the most important differential diagnoses will be addressed with the most relevant imaging findings in the acute setting. The main focus of the presentation, however, will be on the existing challenges and possible solutions of using Cardiac CT in patients with acute coronary syndromes. New CT techniques, including CT derived FFR as well as CT perfusion will be introduced and their potential in the emergency setting should be outlined.

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

RC503

Read with the Experts (Cardiac Radiology) (Interactive Session)

Wednesday, Nov. 28 8:30AM - 10:00AM Room: N228

CA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0

FDA Discussions may include off-label uses.

Participants

Jill E. Jacobs, MD, New York, NY (*Moderator*) Nothing to Disclose
Cylen Javidan-Nejad, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Smita Patel, FRCR,MBBS, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Sanjeev Bhalla, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Amar B. Shah, MD, New York, NY (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Use cardiac CTA cases to allow participants to generate an appropriate differential diagnosis using Cardiac CTA and Cardiac MRI when reviewing cases. 2) Develop a better understanding of when Cardiac CTA and Cardiac MRI can be used for diagnosis.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Sanjeev Bhalla, MD - 2014 Honored EducatorSanjeev Bhalla, MD - 2016 Honored EducatorSanjeev Bhalla, MD - 2017 Honored EducatorSanjeev Bhalla, MD - 2018 Honored Educator

SSK03

Cardiac (CT, MRI and PET: General Topics)

Wednesday, Nov. 28 10:30AM - 12:00PM Room: S102CD

CA CT MR NM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Satinder P. Singh, MD, Birmingham, AL (*Moderator*) Nothing to Disclose
Jens Bremerich, MD, Basel, Switzerland (*Moderator*) Nothing to Disclose
Jadranka Stojanovska, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

Sub-Events

SSK03-01 Predictive Value of Cardiac CT, Cardiac MR, and Transthoracic Echocardiography for Cardioembolic Stroke Recurrence

Participants
Simon S. Martin, MD, Frankfurt, Germany (*Presenter*) Nothing to Disclose
Francesco Lavra, MD, Cagliari, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Atlanta, GA (*Abstract Co-Author*) Research Grant, Siemens AG
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG
Luca Saba, MD, Cagliari, Italy (*Abstract Co-Author*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; Consultant, General Electric Company; Consultant, HeartFlow, Inc; Consultant, Bayer AG; Consultant, Siemens AG; ; ;
Marly van Assen, MSc, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Taylor M. Duguay, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Brian E. Jacobs, BS, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Marco Scarabello, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Parkwood Griffith, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Marwen Eid, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To determine the sensitivity, specificity, and predictive value of cardiac CT angiography (cCTA), cardiac MR (CMR), and transthoracic echocardiography (TTE) for stroke recurrence in patients with suspected cardioembolic stroke.

METHOD AND MATERIALS

163 patients (55% men, 61.9±16.9 years) with suspected cardioembolic stroke who underwent TTE, CMR, or cCTA between January 2013 and May 2017 were retrospectively analyzed. The presence of left atrial thrombus, left ventricular thrombus, complex aortic plaque, cardiac tumors, and valvular vegetation was evaluated. The patient electronic medical records were used to determine if the patient suffered a recurrent stroke. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for each imaging modality and the diagnostic accuracy was compared using receiver operating characteristic analysis.

RESULTS

cCTA was performed in 82 patients, CMR in 81 patients, and TTE in 151 patients. 28 recurrent strokes occurred (cCTA- n=14; CMR- n=14; TTE- n=26). The sensitivity, specificity, PPV and NPV were: 14%, 79%, 12.5%, and 81.5% for CMR; 28.5%, 88.2%, 33.3%, and 85.7% for cCTA; and 11.5%, 88.8%, 17.6%, and 82.8% for TTE. There was no significant difference in diagnostic accuracy between CMR (0.53, 95% CI [0.42, 0.64]), cCTA (0.56, 95% CI [0.43, 0.69]), and TTE (0.50, 95% CI [0.43, 0.57]).

CONCLUSION

cCTA, CMR, and TTE demonstrated comparably high specificity and NPV for the exclusion of cardioembolic stroke recurrence.

CLINICAL RELEVANCE/APPLICATION

The comparable performance of cCTA, CMR, and TTE in predicting recurrent cardioembolic stroke allows physicians to choose a preferred imaging modality for patients with suspected cardioembolic stroke.

SSK03-02 Quantitative Assessment of Myocardial Infarction with Computed Tomography (CT) Using a Bolus Contrast Injection Scheme: Comparison Between Extravascular Contrast Distribution Volume (ECDV) and Extracellular Volume Fraction (ECV)

Wednesday, Nov. 28 10:40AM - 10:50AM Room: S102CD

Participants
Jie Yu, Wuhan, China (*Presenter*) Nothing to Disclose
Ping Han, MD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Ting-Yim Lee, MSc, PhD, London, ON (*Abstract Co-Author*) License agreement, General Electric Company
Aaron So, PhD, London, ON (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Myocardial viability can be assessed with CT by delineating the infarcted tissue with a higher degree of contrast retention in the late phase after bolus injection of iodinated contrast. In this study, we investigated the effectiveness of two metrics for the quantification of late iodine enhancement in myocardium for viability assessment.

METHOD AND MATERIALS

Reperfused acute myocardial infarction was induced in four farm pigs with 1-hr occlusion of the left anterior ascending artery (LAD) with a balloon catheter, and CT studies were performed within 2 weeks after the interventional procedure. After bolus injection of contrast at 3 mL/s and 0.7 mg/kg followed by saline flush, a 4-phase dynamic acquisition covering 10 min was performed with a GE Healthcare Revolution CT scanner at 100 kV, 100 mA, 280 ms/rot: 1st phase: 22 axial scans every 1-2 diastoles; 2nd: 6 scans every 15 s; 3rd: 4 scans every 30 s; 4th: 6 scans every 60 s. Dynamic images were analyzed with a model-based deconvolution approach, with the modified Johnson-Wilson-Lee tracer kinetic model used to describe the contrast exchange among the cellular and interstitial and vascular spaces in myocardium to derive ECDV in ml/g. The difference images were also generated by subtracting the images acquired at 10 min post contrast injection by the baseline images to obtain enhancement in the myocardium (ΔHUmyo) and left ventricular blood pool (ΔHUblood). ECV was then calculated as (1-Hematocrit)·(ΔHUmyo/ΔHUblood). ECDV and ECV in normal (LCx territory) and infarcted myocardium (LAD territory) were compared.

RESULTS

Mean ECV in normal and infarcted myocardium were 0.27±0.11 and 0.52±0.11 respectively. The corresponding mean ECDV calculated from the dynamic images covered up to 3 min post contrast injection were 0.28±0.07 ml/g and 0.60±0.10 ml/g respectively. Infarcted myocardium exhibited a higher percentage increase in ECDV from normal myocardium (114%) compared to ECV (93%).

CONCLUSION

ECDV may be a more sensitive marker of myocardial viability compared to ECV due to the larger difference exhibited between the normal and infarcted tissues, and can be measured with only 1/3 of the time required for ECV (3 min vs. 10 min post contrast injection).

CLINICAL RELEVANCE/APPLICATION

With bolus contrast injection, ECDV measurement could provide a faster and more reliable assessment of myocardial viability after acute myocardial infarction compared to conventional ECV measurement.

SSK03-03 Feasibility of Myocardial Extracellular Volume Fraction Quantification Using Dual-Energy CT

Wednesday, Nov. 28 10:50AM - 11:00AM Room: S102CD

Participants
Marly van Assen, MSc, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Parkwood Griffith, Charleston, SC (*Presenter*) Nothing to Disclose
Carlo N. De Cecco, MD, PhD, Atlanta, GA (*Abstract Co-Author*) Research Grant, Siemens AG
Pooyan Sahbaee, Malvern, PA (*Abstract Co-Author*) Employee, Siemens AG
Matthijs Oudkerk, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; Consultant, General Electric Company; Consultant, HeartFlow, Inc; Consultant, Bayer AG; Consultant, Siemens AG; ; ;
Marwen Eid, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Rozemarijn Vliegenthart, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Instutional Research Grant, Siemens AG
Brian E. Jacobs, BS, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose
Akos Varga-Szemes, MD, PhD, Charleston, SC (*Abstract Co-Author*) Research Grant, Siemens AG

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PURPOSE

To assess the feasibility of Dual Energy CT (DECT) to derive myocardial extracellular volume (ECV) and detect ECV differences without the need for a true non-contrast scan compared to Single Energy CT (SECT) results.

METHOD AND MATERIALS

A total of 35 patients were included in this IRB-approved, HIPAA-compliant study; 8 control patients, 17 infarct patients (focal fibrosis), and 10 cardiomyopathy patients (diffuse fibrosis). All scans were acquired using a 2nd or 3rd generation dual source CT system. A true non-contrast and delayed acquisition were used to calculate SECT-ECV, while only the delayed acquisition in dual energy mode and derived virtual non-contrast images were used to calculate DECT-ECV. In the control and diffuse fibrotic groups, a region of interest (ROI) encompassing the entire left ventricular myocardium was used to calculate ECV. Two ROIs were placed in the focal fibrotic group; one in normal myocardium and one in fibrotic myocardium.

RESULTS

The median ECV was 33.4% (IQR, 30.1-37.4) for the SECT approach and 34.9% (IQR, 31.2-39.2) for the DECT approach (p =

0.401). For both SECT-ECV and DECT-ECV, focal fibrotic and diffuse fibrotic tissue had significantly higher ECV values compared to normal myocardium (all p < 0.021). No systematic bias was observed between SECT and DECT measurements, with limits of agreement calculated at ± 9.4% (p = 0.348). The DECT acquisition had a lower radiation dose than the SECT scan by 1.1 mSv (p < 0.001), which was likely caused by the absence of the true non-contrast acquisition in the DECT approach.

CONCLUSION

Measurement of ECV with only a delayed acquisition is feasible using the DECT approach. The DECT approach provides similar results at a lower radiation dose compared to a SECT protocol.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates the feasibility of DECT for myocardial ECV measurements using only a delayed acquisition, thus eliminating the need for a true non-contrast scan and consequently reducing radiation dose.

SSK03-04 Accuracy of Myocardial Blood Flow Quantification with Dual-source CT: Validation in Human Using 15O-Water PET

Wednesday, Nov. 28 11:00AM - 11:10AM Room: S102CD

Participants
Masafumi Takafuji, Tsu, Japan (*Presenter*) Nothing to Disclose
Kakuya Kitagawa, MD, PhD, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Yasutaka Ichikawa, MD, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Masaki Ishida, MD, PhD, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoshitaka Goto, MD, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Satoshi Nakamura, MD, Tsu, Japan (*Abstract Co-Author*) Nothing to Disclose
Hajime Sakuma, MD, Tsu, Japan (*Abstract Co-Author*) Research Grant, Fuji Pharma Co, Ltd; Research Grant, DAIICHI SANKYO Group; Research Grant, FUJIFILM Holdings Corporation; Research Grant, Siemens AG; Research Grant, Nihon Medi-Physics Co, Ltd; Speakers Bureau, Bayer AG

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PURPOSE

Myocardial CT perfusion has emerged as a potential method for absolute quantification of myocardial blood flow (MBF). However, there is no standardized technique for CT MBF quantification, and dual-source CT MBF values have never been compared against positron emission tomography (PET), which is an established technique for non-invasive quantification of MBF. The aim of this study was to assess the accuracy and usefulness of absolute MBF values quantified with dual-source CT by comparing them with those quantified with 15O-water PET.

METHOD AND MATERIALS

Dynamic CT perfusion and 15O-water PET were performed in 26 patients (70+/-9 years, 22 male) with known/suspected coronary artery disease with a median interval of 48 days (interquartile range: 29-73 days). Hyperemic MBF in AHA 16 segments were quantified with a dual-source CT and its dedicated software (Force/VPCT body, Siemens). For the quantification of hyperemic MBF using 15O-water PET, non-commercial software (Carimas) was used. Comparison of hyperemic MBF quantified by CT and PET was performed on segment (n=377), vessel (n=77), and patient (n=26) levels after exclusion of 7 segments out of FOV and 32 segments with transmural myocardial infarction.

RESULTS

CT results showed excellent linear correlation with PET results at segment (r=0.87, p<0.0001), vessel (r=0.91, p<0.0001), and patient level (r=0.93, p<0.0001). Area under the receiver-operating characteristics curve for detecting reduced MBF (<2.3 mL/min/g) on 15O-water PET was 0.88, 0.91, and 0.92 at segment, vessel, and patient level, respectively. Although CT demonstrated significantly lower hyperemic MBF than PET (1.16 ± 0.29 mL/min/g vs 2.46 ± 1.56 mL/min/g, p<0.0001), there was good per-vessel sensitivity (79.5%), specificity (92.1%), negative predictive value (81.4%) and positive predictive value (91.2%) for diagnosing reduced PET-derived MBF with a CT-derived MBF cutoff value of 1.09 mL/min/g.

CONCLUSION

Hyperemic MBF quantified by CT demonstrated excellent correlation with MBF estimated by 15O-water PET, and yielded high diagnostic accuracy for detecting abnormal perfusion.

CLINICAL RELEVANCE/APPLICATION

CT MBF quantification has potential to provide objective assessment of perfusion abnormality in patients with known or suspected CAD with high accuracy comparable to 15O-water PET.

SSK03-05 Relationship Between Epicardial Adipose Tissue and Coronary Vascular Function in Patients with Normal Myocardial Perfusion by 82Rb PET/TC

Wednesday, Nov. 28 11:10AM - 11:20AM Room: S102CD

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PURPOSE

We assessed the relationship between epicardial adipose tissue (EAT) and coronary flow reserve (CFR) in patients with suspected or known coronary artery disease (CAD) and normal myocardial perfusion imaging (MPI).

METHOD AND MATERIALS

The overall population consisted of 272 subjects referred for the evaluation of suspected or known CAD to stress-rest 82Rb PET/CT and showing normal MPI. CAC score was measured according to the Agatston method. Using unenhanced CT images for CAC, EAT volume was measured (cm3). The ln(CAC+1) score and lnEAT transformation were used to reduce heteroscedasticity. Myocardial perfusion was assessed using standardized segmentation of 17 myocardial regions. The summed stress, summed rest and summed difference scores were automatically calculated. Myocardial perfusion was considered normal when the summed stress score was <3. Absolute myocardial blood flow (MBF) was computed (in milliliters per minute per gram) from the dynamic rest and stress imaging series. CFR was defined as the ratio of hyperemic to baseline MBF; CFR 2 was considered reduced.

RESULTS

In the overall population, 95 (35%) patients showed reduced and 177 (65%) normal CFR. Compared to patients with normal CFR, those with reduced CFR were older (60±11 vs. 67±9, P<0.05) and showed higher values of ln(CAC+1) (3.9±3 vs. 4.7±3, P<0.05) and lnEAT volume (4.5±1 vs. 4.7±.1, P<0.05). At univariable logistic regression analysis age, ln(CAC+1) and lnEAT resulted significant predictors of reduced CFR. At multivariable analysis, only age and lnEAT volume were independently associated with reduced CFR (hazard ratio 1.05 and 1.89 and 95% confidence interval 1.02-1.08 and 1.01-3.54, P<0.005). The addition of lnEAT to clinical data significantly increased the global chi-square of the model (from 23.8 to 28.6, P<0.05) in predicting reduced CFR.

CONCLUSION

In patients with suspected and known CAD and normal myocardial perfusion, age and EAT are strongly associated with reduced CFR confirming that visceral fat depot may directly influence coronary vascular function. Thus, EAT evaluation may play a major role in the identification of coronary vascular dysfunction in patients with normal perfusion.

CLINICAL RELEVANCE/APPLICATION

In patients with suspected and known CAD and normal myocardial perfusion, age and EAT are associated with impaired CFR confirming that visceral fat may directly influence coronary vascular function.

SSK03-06 Beyond CT-Fractional Flow Reserve (FFR): Non-Invasive Assessment of Instantaneous Wave Free Ratio (iFR), Coronary Flow Reserve (CFR) and Hyperemic Stenosis Resistance Index (HSR) from CTA

Wednesday, Nov. 28 11:20AM - 11:30AM Room: S102CD

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PURPOSE

Although FFR can be assessed by CTA, patient management in the cathlab uses eg, iFR to avoid pharmacologic stress, or CFR and HSR to assess other factors associated with increased risk of major adverse cardiac events, such as microvascular disease or endothelial dysfunction. Estimating these metrics from CTA requires matched baseline and hyperemic simulations (ie, stress simulated using results obtained from rest simulation), which no technology to date provides. We sought to determine if coupling rest/stress computational fluid dynamics (CFD) simulations from CTA is feasible, and whether resulting metrics agree with known relationships of those metrics to reference-standard FFR.

METHOD AND MATERIALS

Rest-stress hemodynamics from CTA were performed for 50 patients with invasive FFR in intermediate lesions in <90d of CTA. Rest CFD was performed using only CTA data (myocardial mass, Murray's law). Stress CFD was then performed by coupling the epicardial arteries to a microvascular resistance model using the resistances estimated by the rest CFD for each myocardial territory. Hemodynamic metrics were calculated at the same location as invasive FFR as follows: CT-FFR=stress P/aortic stress P; CT-iFR=rest P/aortic rest P; CT-CFR from average peak velocity (APV), CFR=stress APV/rest APV; and CT-HSR=(aortic stress P-stress P)/stress APV. Correlation to FFR and receiver operating characteristic area-under-the-curve (AUC) to predict FFR<=0.8 was determined for each metric.

RESULTS

Target lesion DS was 46.8±8.7%, and 40% had FFR<=0.8. Pearson correlations against invasive FFR of CT-FFR, CT-IFR, CT-CFR and CT-HSR were r=0.70, 0.69, 0.35, and -0.71, respectively (all p<0.01). Diagnostic accuracy to detect FFR<=0.8 was 0.87 (95%CI:0.77-0.98), 0.86 (95%CI:0.75-0.97), 0.72 (95%CI:0.56-0.88), and 0.9 (95%CI:0.8-0.99), respectively. These match reported relationships between invasive FFR and iFR, CFR and HSR (eg, Pearson r~0.75 for iFR and r~0.34 for CFR compared to FFR, and AUC of FFR to predict significant HSR of ~0.94).

CONCLUSION

Coupling baseline and hyperemic simulations enables key physiologic parameters dependent on both pressure and flow to be estimated non-invasively from standard retrospective CTA.

CLINICAL RELEVANCE/APPLICATION

Evaluation of coronary artery disease by CTA can non-invasively assess coronary physiology beyond FFR, delivering key physiologic

information that is used in clinical decision making for patients with angina

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Frank J. Rybicki III, MD, PhD - 2016 Honored Educator

SSK03-07 Feasibility of Coronary Flow and Velocity Measurement using 4D CTA Reconstruction

Wednesday, Nov. 28 11:30AM - 11:40AM Room: S102CD

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PURPOSE

Commercially available CT scanners can achieve gantry rotation times of 0.3 s (~3 frames per second). However, the temporal resolution might not be sufficient to calculate blood flow and velocity in the coronary arteries, which are important for the diagnosis of coronary artery disease (CAD). Currently, ~1000 projection images are acquired during each gantry rotation. The purpose of this study was to determine the feasibility of a new reconstruction technique called 4D CTA, which calculates a 3D time frame for each projection image and therefore provides high temporal resolution for flow calculations in the coronary arteries.

METHOD AND MATERIALS

The previously described 4D DSA technique (Davis, 2013) was extended for the time-resolved 3D reconstruction of coronary arteries (CA). A pig study was retrospectively analyzed, where continuous axial CT acquisitions (64 slices) were performed with a 0.4 s gantry rotation time over a period of 50 s during intravenous contrast injection. A 3D image of the vasculature was reconstructed using a short scan (235 degrees) during diastole and the CA were manually segmented. A constrained back-projection was then performed for each projection image to create a 3D time frame. The reconstructed time attenuation curves were used to calculate the blood flow and velocity in the CA based on the mean transit time. The velocity and flow values were compared to values from literature and the flow conservation was determined.

RESULTS

In the first order branches, the average diameter, velocity and flow were 4.12 mm (3.28 mm), 110.43 mm/s (128 mm/s), and 1.44 ml/s (1.07 ml/s) respectively. The same measurements for the second order branches were 1.31 mm (1.70 mm), 63.34 mm/s (46.10 mm/s) and, 0.32 ml/s (0.10 ml/s) respectively. Values given in brackets are from literature as reported in Kassab et al. (1997) The flow conservation in the measured branches of the CA was 96.71 %.

CONCLUSION

Calculated coronary arterial velocity and flow correlated well with previously reported values from the literature suggesting that flow determination from 4D CTA is feasible. Additionally, the high flow conservation shows that the calculated values are consistent.

CLINICAL RELEVANCE/APPLICATION

The presented technique could provide both anatomical and functional information in diagnostic settings as well as cath labs using existing CT systems to detect pathologies of the coronary arteries.

SSK03-08 Deep Learning Reconstruction of Non-Contrast Magnetic Resonance Coronary Angiography at 3T Machine

Wednesday, Nov. 28 11:40AM - 11:50AM Room: S102CD

Participants
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PURPOSE

Dedicated T2 preparation pulse have enabled non-contrast magnetic resonance coronary angiography (MRCA) at 3T system; however, the vascular contrast-to-noise ratio (CNR) is still inadequate for clinical use. The deep learning reconstruction (DLR) is a novel technique to improve the image quality. The purpose of this study was to investigate the effects of DLR on the image quality of 3T non-contrast MRCA.

METHOD AND MATERIALS

We enrolled 10 volunteers (2 female, mean age 48 years) with no known coronary artery disease. Non-contrast MRCA was performed on a 3T MR scanner (Galan 3T ZGO, Canon medical) with following parameters: 3D fast FE, TR/TE =5.3/1.9ms, flip angle = 12°, slice thickness = 1.7mm with ECG trigger and real time motion correction. DLR images at moderate level and high level were generated by using dedicated workstation. In the quantitative evaluation, we measured signal-to-noise ratio of 3 coronary vessels (proximal and distal segments). In the qualitative evaluation, the 2 observers graded the vessel visualization and artifacts on a 4-point scale (worst, 1; best, 4).

RESULTS

The CNR (original MRCA) was 31 ± 7 and 16 ± 5 in the proximal and distal vessel, respectively. The corresponding CNR (moderate-level DLR) was 46 ± 9 and 24 ± 10; and the CNR (high-level DLR) was 85 ± 20 and 45 ± 14. The visual scores for overall image quality and image noise were significantly better in DLR images than original images. The vessel sharpness scores were comparable among 3 reconstructions (3.4, 3.8, and 3.8 for original, moderate DLR, and high DLR, respectively). The visual scores for image noise/graininess was significantly better in DLR (2.4, 3.8, and 4.0 for original, moderate DLR, and high DLR, respectively).

CONCLUSION

Non-contrast MRCA at 3T using DLR provides higher CNR without degrading the vessel sharpness.

CLINICAL RELEVANCE/APPLICATION

The deep learning reconstruction technique contributes in improved visualization of coronary arteries in non-contrast MR coronary angiography, enabling noninvasive scrutiny of the heart.

SSK03-09 Clinical and Transthoracic Echocardiography Predictors of Non-Detectable Left Ventricular Thrombus: When Is Cardiac Magnetic Resonance Necessary

Wednesday, Nov. 28 11:50AM - 12:00PM Room: S102CD

Participants
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PURPOSE

Currently, transthoracic echocardiography (TTE) remains the most commonly used technique for the identification of LV thrombi. However, not all thrombi are visualized with TTE. Therefore, the purpose of our study was to identify predictors of unsuccessful TTE thrombus visualization and to develop a risk score to stratify which patients may benefit from cardiac magnetic resonance (CMR) to reliably detect or exclude LV thrombus.

METHOD AND MATERIALS

We performed a retrospective search of our CMR database including 10300 patients and identified 118 patients with LV thrombus and a time interval between CMR and TTE of <72h. Univariate logistic regression analysis was used to assess the association between baseline characteristics and TTE parameters with the primary endpoint (i.e. unsuccessful LV thrombus visualization on TTE). Variables with P<0.10 at univariate analysis were included as covariates in the multivariate logistic regression analysis. Receiver-operating characteristic (ROC) curve analysis was performed to examine differences in performance of each variable for prediction of the primary endpoint. A two-sided P-value<0.05 was considered to represent a significant difference.

RESULTS

In multivariate analysis, body mass index (BMI), LV end-diastolic diameter (EDD), and mitral valve regurgitation (MVR) were identified as significant predictors of unsuccessful LV thrombus visualization by TTE (all P<0.001). ROC analysis showed BMI >=26.9 kg/m2, LVEDD >=52 mm, and MVR >=2/4 to be the optimal cutoff points for prediction of the primary endpoint. The combination of the independent predictors allowed generation of a gradient response risk score of unsuccessful LV thrombus visualization by TTE (0/3 present: 0% missed; 1/3 present: 33.3% missed; 2/3 present: 79.5% missed; 3/3 present: 100% missed) (P<0.001).

CONCLUSION

Individual clinical and TTE parameters can predict the sensitivity of TTE for the successful detection of LV thrombus in heart disease. By using the presented risk score, a cost-effective strategy may be implemented by selectively referring patients to CMR when these risk factors are present.

CLINICAL RELEVANCE/APPLICATION

Clinical and TTE parameters can predict unsuccessful detection of LV thrombus in heart disease. These findings may lead to a cost-effective referral of certain patients to CMR to rule out LV thrombus.

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
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SSK04

Cardiac (Valves Imaging and Intervention)

Wednesday, Nov. 28 10:30AM - 12:00PM Room: S103AB

CA CT IR VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
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Robert C. Gilkeson, MD, Cleveland, OH (*Moderator*) Research Consultant, Riverain Technologies, LLC; Research support, Koninklijke Philips NV; Research support, Siemens AG; Research support, General Electric Company

Sub-Events

SSK04-01 Morphologic and Hemodynamic Characteristics of Low-Flow, Low-Gradient Aortic Stenosis: Cardiac CT and Echocardiography.

Participants
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PURPOSE

Aortic stenosis(AS) have a quite proportion of low-flow, low-gradient(LF/LG) AS, defined as small aortic valve area(AVA<1.0cm2) but a low mean pressure gradient(PG<40mmHg) and low flow(stroke volume<35ml/m2). Diagnosis of AS has been based on a valve area, mean PG and a peak flow velocity measured on echocardiography. However, there was a discrepancy between the measured AVA on cardiac CT and degree of AS on echocardiography. The purpose of this study was to evaluate the discrepancy between CT and echocardiography, and show the role of CT to detect LF/LG AS.

METHOD AND MATERIALS

Between June 2011 and Mar 2016, 465 patients with AS underwent CT for preoperative evaluation of aortic valve replacement. On CT, aortic annulus, AVA and aortic root size were measured. Clinical information including echocardiography findings was retrospectively collected. On echocardiography, severe AS was defined as peak velocity >4 m/s or mean PG <40mmHg. On CT, severe AS was defined as AVA <1.0 cm2. Patients were classified into four groups: Group 1) severe AS on both CT and echocardiography (n=282); Group 2) Severe AS on CT alone (n=49); Group 3) Severe AS on echocardiography alone (n=99); and Group 4) non-severe AS on both CT and echocardiography (n=35). Echocardiography and CT findings were compared among the groups.

RESULTS

AVA in both group 1 and 2 were similar (0.8 and 0.8cm2, respectively, P=0.99). However, in group 2, left ventricular ejection fraction (LVEF) (59.3 vs. 54.1%, P=0.02) and mean PG (67.5 vs. 28.5mmHg, P<0.001) ware significantly low compared to those in group 1, suggests LF/LG severe AS. Peak velocity was also smaller in group 2 (5.2 vs. 3.1m/s, P<0.001). LV mass index and B-type natriuretic peptide were no significant difference among the four groups.

CONCLUSION

In 32% of patients who required AVR due to AS, there was a discrepancy between the measured AVA on CT and degree of AS on echocardiography. Patients who showed peak velocity <4m/s or mean PG <40mmHg on echocardiography and AVA<1.0cm2 on CT show significantly lower EF, peak velocity, and mean PG, which suggests characters of LF/LG AS. CT may be useful to detect LF/LG AS.

CLINICAL RELEVANCE/APPLICATION

Since echocardiography is useful for functional evaluation of LV and CT can accurately measure the AVA, we can accurately evaluate the characteristics of AS using both modalities. The use of two modalities may help to risk stratify AS patients and to make therapeutic decision.

SSK04-02 Bioprosthesis Thrombosis After Transcatheter Aortic Valve Replacement: Cardiac Computed Tomography Findings

Wednesday, Nov. 28 10:40AM - 10:50AM Room: S103AB

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PURPOSE

To evaluate post-transcatheter aortic valve replacement (TAVR) findings such as thrombosis and leaflet dysfunction using cardiac computed tomography.

METHOD AND MATERIALS

Among 397 post-TAVR patients, 133 patients underwent cardiac CT. After excluding immediate post-TAVR CT, 49 patients (23 CoreValve, 23 Sapien XT, and 3 Sapien 3) with CT obtained more than one month after TAVR were retrospectively reviewed. Leaflet opening limitation, bioprosthesis thrombosis, leaflet degeneration, and stent eccentricity were analyzed. Baseline immediate and follow-up echocardiography parameters were collected and analyzed.

RESULTS

Median intervals between TAVR and CT was 13 months (range: 9.4 - 24.5 months). Minimal subvalvular rim-like soft tissue thickening (n= 27, 55%) and mild thickening of leaflets (n=2, 4%) are detected, but the patients are asymptomatic without hemodynamic disturbance. Leaflet opening limitation is noted in 11 (22%, 7 mild, 3 moderate, and 1 severe reduction) patients, however, there was no correlation with echocardiography parameters. TAV thrombosis is noted in 9 (18%) patients. In the patients with TAV thrombosis, transvalvular peak velocity (2.9 vs. 2.5 m/sec) and pressure gradient (20.7 vs. 13.6 m/sec) are higher than the others, but without statistical significance (P<0.05). One patient who showed highest peak velocity and pressure gradient on echocardiography (5.4 m/sec and 71 mmHg) had extensive subvalvular and valvular soft tissue thickening on CT even though she have managed with intense anticoagulation. One infective endocarditis is occur. The smaller the size of the stent lumen at the valve level, the more the peak velocity and pressure gradient increases (r=-0.4, P=0.008).

CONCLUSION

Leaflet thrombosis, subvalvular soft tissue thickening and leaflet opening limitation following TAVR is not uncommon findings in patients who performed cardiac CT. Cardiac CT can demonstrate post-TAVR findings such as subvalvular soft tissue, valve thrombosis, leaflet opening limitation and stent lumen size.

CLINICAL RELEVANCE/APPLICATION

Although the majority of patients who present leaflet thrombosis, subvalvular soft tissue thickening or leaflet opening limitation following TAVR show subclinical conditions without hemodynamic disturbance on echocardiography, follow-up cardiac CT may help to detect early complications of TAVR.

SSK04-03 Dynamic Evaluation of 3D Mitral Annular Anatomy in Primary and Functional Mitral Regurgitation Patients Using Multiphase Cardiac CT: Implications for Trans-catheter Mitral Valve Replacement Planning

Wednesday, Nov. 28 10:50AM - 11:00AM Room: S103AB

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PURPOSE

To date, there is a relative lack of data regarding the use of CT to characterize dynamic geometry of the mitral valve (MV) in patients with MV disease. The aims of this study are: 1) to obtain 3D CT measurements of the mitral annulus throughout the cardiac cycle using a prototype mitral evaluation tool, and 2) to compare these measurements among patients with primary mitral regurgitation (PMR), functional (secondary) MR (FMR), and control patients without MR.

METHOD AND MATERIALS

Patients were retrospectively identified who underwent ECG-gated cardiac CT using a dual-source scanner (SOMATOM Definition, Siemens Healthcare). Multiphasic CT data was loaded into our prototype software. Multiple anatomical parameters were recorded in 3D space throughout the cardiac cycle (0-95%, at 5% increments), and included: annular circumference, planar surface area (PSA), anterior-posterior (A-P) or inter-commissural diameter, anterolateral-posteromedial (AL-PM) or septo-lateral diameter, and annular ellipticity. Comparisons were made among the three groups, with p<0.01 considered statistically significant.

RESULTS

A total of 145 subjects (age: 63.5±14.0 years, 64% males) were included in this study: 50 control, 50 with PMR, and 45 with FMR.

Mitral annular dimensions were significantly higher in the PMR group, followed by FMR and control groups, with circumference (144±11 vs. 131±14 vs. 117±8mm), PSA (1533±247 vs. 1229±269 vs. 1005±142mm2), A-P diameter (38±4 vs. 35±5 vs. 32±2mm), and AL-PM diameter (47±4 vs 41±4 vs. 39±3mm) (all p<0.001). Notably, different patterns were observed among the three groups regarding the change in annular dimensions across cardiac phases, with FMR maintaining relatively similar size while control and PMR both had substantial size changes, but with maximal and minimal sizes at different cardiac phases. However, no statistically significant difference was demonstrated for annular ellipticity among control versus pathological groups (p>0.01).

CONCLUSION

Multiphase cardiac CT affords assessment of mitral annular dynamicity in response to various types of MV disease. The dramatic variability in annular dimensions across the cardiac cycle demonstrates the significance of obtaining multiphasic 3D measurements.

CLINICAL RELEVANCE/APPLICATION

Multiphase ECG-gated cardiac CT offers dynamic, pre-procedural evaluation of complex 3D mitral valve geometry for catheter-guided prostheses in patients with various types of mitral valve disease.

SSK04-04 Differentiation of Pannus From Other Prosthetic Valve Abnormalities Using Computed Tomography Texture Analysis

Wednesday, Nov. 28 11:00AM - 11:10AM Room: S103AB

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PURPOSE

The purpose of this study was to determine whether quantitative computed tomography (CT) texture analysis features can differentiate the cause of prosthetic valve obstruction (PVO) in patients who had undergone prosthetic valve replacement.

METHOD AND MATERIALS

We retrospectively included 46 subprosthetic masses in 39 patients who were clinically suspected prosthetic valve dysfunction and underwent cardiac CT scan from March 2010 to December 2017. The cause of PVO was assessed by redo-surgery and follow-up imaging findings as standard reference, and classified as pannus, thrombus or vegetation. CT texture analysis was performed with drawing region-of-interests of subprosthetic mass using an in-house texture analysis software and features such as first-order statistics, size and volume, and gray-level co-occurrence matrix (GLCM) features were extracted. Features on texture analysis were compared between two groups (pannus vs. thrombus or vegetation) using Mann-Whitney U test. Logistic regression analysis was performed to investigate association between quantitative CT features and pannus formation.

RESULTS

Of 46 subprosthetic masses, there were 19 cases with pannus, 14 cases with thrombus, and 13 cases with vegetation. Patients with pannus tended to be female, and had higher mean and standard deviation of CT attenuation, percentile value of the cumulative histogram (Perc25, 50, 75, 90, 95), and GLCM features (moments and contrast), and smaller volume, with statistical significance (P<0.05).On multivariate logistic regression analysis, mean CT attenuation (OR: 5.71; 95% CI: 0.48, 68.43; p=0.1691), volume (OR: 5.52; 95% CI: 0.88, 34.59; p=0.068), GLCM moments and GLCM contrast (OR: 6.00; 95% CI: 0.72, 50.40; p=0.0987 and OR: 12.07; 95% CI: 1.31, 110.90; p=0.0277) of subprosthetic mass were significantly associated with pannus.

CONCLUSION

Quantitative features on CT texture analysis may help differentiating pannus from thrombus or vegetation in patients with suspected PVO.

CLINICAL RELEVANCE/APPLICATION

Quantitative CT texture analysis can differentiate pannus from other causes of prosthetic valve obstruction and may diminish the subjectivity of visual analysis.

SSK04-05 CT Virtual Endoscopic Findings of Bicuspid Aortic Valve in Patients with Severe Aortic Stenosis: Comparison with Surgical Diagnosis

Wednesday, Nov. 28 11:10AM - 11:20AM Room: S103AB

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PURPOSE

CT has been known to have high diagnostic accuracy for bicuspid aortic valve (BAV). However, CT findings of BAV remain unclear,

CT has been known to have high diagnostic accuracy for bicuspid aortic valve (BAV). However, CT findings of BAV remain unclear. The aim of our study was to evaluate diagnostic characteristics of CT findings for BAV compared with surgical diagnosis as the reference standard.

METHOD AND MATERIALS

This retrospective study included 112 consecutive patients with severe aortic stenosis who underwent preoperative cardiac CT, followed by surgical aortic valve replacement (57% woman, mean age, 70 years [range, 27-92]). All CT images were acquired using retrospective ECG-gated helical scan, from the aortic arch to the heart. Optimal stationary systolic and diastolic phase images were reconstructed at the slice thickness of 0.5 mm, and surgical-view virtual endoscopic images were reconstructed on a workstation. CT findings included shape of orifice (oval or the letter 'Y') and the number of leaflet (2 or 3) on systolic images, and balance of leaflet size (central angle of >= 150¬° or 120-149° in the largest leaflet) and the number of commissure (2 or 3) on diastolic images. For each CT findings, oval orifice, 2 leaflets, central angle of >= 150° or 2 commissures were defined as BAV.

RESULTS

BAV was surgically found in 37% (41/112) of patients. Accuracy, sensitivity, specificity and area under the curve (AUC) (95% confidence interval) for the detection of BAV were as follows; number of leaflets, 0.86 (0.80-0.87), 0.98 (0.91-1.00), 0.79 (0.69-0.83) and 0.88 (0.82-0.93); orifice shape, 0.93 (0.87-0.96), 0.93 (0.82-1.00) 0.93 (0.87-0.99) and 0.93 (0.86-0.96); central angle, 0.92 (0.86-0.95), 0.76 (0.59-0.88), 0.98 (0.95-1.00) and 0.87 (0.79-0.93); and number of commissures, 0.87 (0.81-0.87), 0.63 (0.46-0.78), 1.00 (1.00-1.00) and 0.82 (0.73-0.88), respectively. Although there was no difference in accuracy (p = 0.147 by Cochran's Q test), sensitivity of the number of commissure or specificity of number of leaflet were the lowest among the CT findings (adjusted $p < 0.05$ for all by post-hoc Dunn's test with Bonferroni correction, respectively). AUC of number of commissure was lower than orifice shape and central angle ($p < 0.05$ for both by DeLong's test).

CONCLUSION

Although CT findings have high accuracy for detection of BAV, number of commissure showed lower sensitivity and AUC, and number of leaflet showed lower specificity.

CLINICAL RELEVANCE/APPLICATION

Knowledge of morphological CT characteristics of BAV may help diagnosis in patients with severe aortic valve stenosis.

SSK04-06 3D Printing of the Aortic Annulus Based on Cardiovascular Computed Tomography: Preliminary Experience in Pre-Procedural Planning for Aortic Valve Sizing

Wednesday, Nov. 28 11:20AM - 11:30AM Room: S103AB

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PURPOSE

to determine reliability and reproducibility of measurements of aortic annulus in 3D models printed from cardiovascular computed tomography (CCT) images.

METHOD AND MATERIALS

Retrospective study on the records of 20 patients who underwent aortic valve replacement (AVR) with pre-surgery annulus assessment by CCT and intra-operative sizing by Hegar dilators (IOS). 3D models were fabricated by fused deposition modelling of thermoplastic polyurethane filaments. For each patient, two 3D models were independently segmented, modelled and printed by two blinded "manufacturers": a radiologist and a radiology technician. Two blinded cardiac surgeons performed the annulus diameter measurements by Hegar dilators on the two sets of models. Matched data from different measurements were analyzed with Wilcoxon test, Bland-Altmann plot and within-subject ANOVA.

RESULTS

No significant differences were found among the measurements made by each cardiac surgeon on the same 3D model (p=0.48) or on the 3D models printed by different manufacturers (p=0.25); also, no intraobserver variability (p=0.46). The annulus diameter measured on 3D models showed good agreement with the reference CCT measurement (p=0.68) and IOH sizing (p=0.11). Time and cost per model were: model creation 10-15 min; printing time 60 min; post-processing 5min; material cost 1 euro.

CONCLUSION

3D printing of aortic annulus can offer reliable, not expensive patient-specific information to be used in the pre-operative planning of AVR or TAVI.

CLINICAL RELEVANCE/APPLICATION

3D models of aortic annulus printed from CCT may offer a reliable, not expensive, patient-specific pre-operative planning opportunity: they provide the final user with a unique interactive platform for both visual and tactile experiences, which are critical

for simulation of the procedure, but are not available in imaging data per se.

SSK04-07 Improving the Diagnostic Performance of 18F-FDG PET/CT in Prosthetic Heart Valve Endocarditis

Wednesday, Nov. 28 11:30AM - 11:40AM Room: S103AB

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PURPOSE

18F-Fluorodeoxyglucose (FDG) Positron-Emission Tomography/Computed Tomography (PET/CT) was recently introduced as a new tool for the diagnosis of prosthetic heart valve (PV) endocarditis (PVE). Previous studies reporting a modest diagnostic accuracy may have been hampered by unstandardized image acquisition and assessment, as well as several confounders. The aim of this study was to improve the diagnostic performance of FDG PET/CT in patients suspected of PVE by identifying and eliminating possible confounders, using both visual and standardized quantitative assessments.

METHOD AND MATERIALS

In this multicentre study, 160 patients with a PV who underwent FDG PET/CT for suspicion of PVE, as well as 77 patients with a PV who underwent FDG PET/CT for other indications (negative control group), were included. Their scans were reassessed by two independent observers blinded to all clinical data, both visually and quantitatively on EARL reconstructions. Confounders were identified using a binomial regression model, and subsequently eliminated.

RESULTS

Visual assessment of FDG PET/CT had a sensitivity/specificity/PPV/NPV for PVE of 74%/91%/89%/78%, respectively. Low inflammatory activity (CRP <40mg/L) at the time of imaging and use of surgical adhesives during PV implantation were significant confounders, while recent valve implantation was not. After elimination of significant confounders, diagnostic performance values of the visual assessment increased to 91%/95%/95%/91%. As a semi-quantitative measure of FDG uptake, an EARL-standardized SUVratio of >=2.0 was a 100% sensitive and 91% specific predictor of PVE.

CONCLUSION

Both visual and quantitative assessment of FDG PET/CT have a high diagnostic accuracy in patients suspected of PVE. FDG PET/CT should be implemented early in the diagnostic work-up to prevent negative confounding effects of low inflammatory activity (e.g. due to prolonged antibiotic therapy). As a quantitative measure of FDG uptake, an EARL-standardized SUVratio of >=2.0 is a 14 100% sensitive and 91% specific predictor of PVE. Recent valve implantation was not a significant predictor of false positive interpretations, but surgical adhesives used during implantation were.

CLINICAL RELEVANCE/APPLICATION

FDG PET/CT should be implemented early in the diagnostic work-up to prevent negative confounding effects of low inflammatory activity.

SSK04-08 Aortic Regurgitation in Hypertrophic Cardiomyopathy: A Cardiac Magnetic Resonance Study

Wednesday, Nov. 28 11:40AM - 11:50AM Room: S103AB

Participants
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PURPOSE

We sought to investigate the prevalence, mechanism and risk factors of AR in patients with HCM by cardiac magnetic resonance(CMR).

METHOD AND MATERIALS

This is an retrospective study of 105 consecutive patients (49±16 years, 70% male) with HCM who underwent CMR between April to November, 2017. Cardiac morphological, functional paremeters and AR were evaluated by multi-plane cine images and velocity-encoded phase contrast images.Patients were divided into 2 groups by AR. The clinical and CMR characteristics were compared between the 2 groups, and predictors of AR assessed on multivariable logistic regression analysis.

RESULTS

AR was identified in 38 (36%) HCM patients including 25 (66%) with left ventricle outflow tract obstruction (LVOTO). AR was also more prevalent in obstruction group than that in non-obstruction group (52% vs. 23%, *p*=0.002). Patients with AR showed older age (58± 11 vs. 45±16 years, *P*<0.001), the higher prevalence of hypertension, mitral regurgitation (MR) and aortic valve thickening (55% vs. 33%, *P*=0.03; 90% vs.61%, *P*=0.006 and 40% vs. 9%, *P*<0.001, respectively). The distance of interventricular septum that protruded into the LVOT(D1), anterior mitral leaflet (AML) and left atrial diameter were greater and LVOT effective width (D3) were shorter in patients with AR than without it (13.5± 4.4 vs.10.6±4.0 mm, *P*=0.001; 25.5± 3.6 vs. 23.5±4.1mm, *P*=0.013 and 43.6± 8.6 vs. 39.1± 8.4mm, *P*=0.01; 10.2±5.3 vs. 13.7±5.9mm, *P*=0.003, respectively). On multivariable logistic regression analysis, the independent risk factors of AR were LVOTO and age.

CONCLUSION

This study has demonstrated that AR is not an uncommon consequence secondary to HCM. Age and LVOTO are the most probably risk factors of this pathophysiology consequence.

CLINICAL RELEVANCE/APPLICATION

(dealing with CMR) 'AR is a quite common comorbidity of HCM especially in patients with LVOTO . An earlier and better control of blood pressure and relieving LVOTO are required as early as possible to delay the progress of aortic valvular degeneration.'

SSK04-09 T1 Mapping as a Predictor for Persisting Valvular Cardiomyopathy in Patients with Chronic Aortic Regurgitation After Aortic Valve Repair

Wednesday, Nov. 28 11:50AM - 12:00PM Room: S103AB

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PURPOSE

Left ventricular (LV) dysfunction is associated with poor prognosis in patients presenting with chronic aortic regurgitation. Unfortunately, LV-dysfunction often persists even after successful aortic valve (AV) repair. We aimed to evaluate the value of native T1 mapping by cardiac MRI as a predictor of valvular cardiomyopathy in patients with severe aortic regurgitation.

METHOD AND MATERIALS

31 consecutive patients (mean age 49.5±11.5 years, 52% men) with severe bicuspid (n=18) or tricuspid (n=13) aortic valve regurgitation and without previous history of coronary artery disease underwent 1.5 Tesla cardiac MR imaging. Native T1 mapping was performed using a modified Look-Locker inversion-recovery (MOLLI) sequence for quantification of diffuse interstitial myocardial fibrosis prior to AV repair and correlated with echocardiographic LV parameters before and after surgery.

RESULTS

Mean native T1 relaxation time of myocardium was 1025±44 ms (range: 898-1109 ms). There was no significant correlation between native T1 and preoperative LVEF (r=-0.1, p=0.6), LVEDD (r=-0.2, p=0.4), LVESD (r=-0.03, p=0.9), LVEDV (r=-0.02, p=0.9) and regurgitation fraction (r=-0.17, p=0.6). Fourteen patients (45%) had a postoperative decrease in LVEF more than 10% as compared to preoperative LVEF values. These fourteen patients showed significantly longer preoperative native T1 as compared to native T1 of patients with preserved postoperative LVEF (1056 ± 32 ms vs. 1019 ± 40 ms, p=0.03).

CONCLUSION

Native T1 mapping might be a promising predictor of postoperative LVEF decrease after AV repair for chronic severe aortic regurgitation.

CLINICAL RELEVANCE/APPLICATION

T1 mapping before aortic valve repair may guide and optimize aortic valve repair surgery in the future.

CAS-WEA

Cardiac Wednesday Poster Discussions

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

CA

AMA PRA Category 1 Credit ™: .50

Participants
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Sub-Events

CA238-SD-WEA1 The Devil Is In the detail: Prognostic Factors in CT of Chronic Aortic Dissection

Station #1

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PURPOSE

To determine the performance of classic morphological factors in predicting adverse events in chronic aortic dissection; To describe and validate a new predictive factor based on the relation between the size of the proximal and distal flap tears.

METHOD AND MATERIALS

72 patients with dissection of the descending thoracic aorta were assessed by CT during the subacute phase and followed clinically and with an annual CT or MRI for a median of 9 years. Previously described morphological factors in the subacute phase (aortic size, false lumen size, proximal tear size, partial lumen thrombosis) were evaluated as predictors of fast dilation and adverse clinical events. A new parameter (tear size dominance) describing the relation between the size of the proximal and distal tears was also tested.

RESULTS

A maximum diameter larger than 45 mm in the dissected descending thoracic aorta and tear size dominance greater than 1 cm^2 were the only independent predictors of rapid dilation and clinical complications (both $p < 0.01$) in our cohort. The combination of both parameters detected a subset of patients with worse clinical evolution and a shorter average time of survival free of complications (7.5 years; $p < 0.001$).

CONCLUSION

The maximum diameter of the thoracic descending aorta and the relation between the size of the proximal and distal tears measured in CT predicted adverse clinical events during the follow-up of chronic aortic dissection.

CLINICAL RELEVANCE/APPLICATION

CT performed during the subacute phase of dissection of the descending thoracic aorta provides important prognostic factors which may help determine the best treatment options for each patient.

CA239-SD-WEA2 Pitfall of Preoperative CT Information on Aortic Valvuloplasty - Analysis of Measuring Methods Intended to Comprehend Risk Factors in Image Processing and Improve the Procedure

Station #2

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PURPOSE

In this study, our purposes were to revamp and standardize the measuring and image supply methods of preoperative CT in order to reduce the cases described below: (1) Cases where valve replacement was chosen for patients with aortic regurgitation (AR) as an

indication for valvuloplasty (2) Cases where an intraoperative change of surgical methods increased operating time, blood loss, and complications. The goal was improvement in measuring precision in addition to elimination of dependence on years of experience.

METHOD AND MATERIALS

50 patients with AR for whom aortic valvuloplasty was appropriate. (Age 62.2±10.6) We devised a new measuring and image display method based on anatomy and organized it into a manual. The precision of measuring before and after standardization was evaluated by comparing the measured values of CT images with actual intraoperative values. (gH:geometric height , eH:effective height) Examination of gH and eH values obtained from CT images and actual intraoperative values. 1) Comparison and statistical analysis of measured values obtained by different measuring methods 2) Examination of influences from scan conditions, heart rates, and cardiac phases for imaging on measurement

RESULTS

As a result of the analysis of measured values of CT images and actual values, the groups with lower HR showed a higher correlation *(HR < 70: R = 0.94, HR 70-90: R = 0.86, HR > 90: R = 0.79)*. There was a weak positive correlation concerning the influence of cardiac phases for image production*(R = 0.32)*. The variations between examiners improved by an average of *43%* through standardization. Among the cases examined in this study, the fall of the valve cusp was able to be reported before surgery in 49 cases because of improved precision in the measurement of eH. Partial bending was visualized in three of the 49 cases.

CONCLUSION

The standardization established by this study increased the precision of measurement. Also, this measuring method and supplied images compiled into a manual offered secure information without variations between examiners because they required no special imaging or measuring procedures.

CLINICAL RELEVANCE/APPLICATION

Surgeons: Accurate simulations before surgery became performable and enabled precise choices of operative technique. Patients: The increase in the cases to which valvuloplasty was applicable improved the QOL, reduced operating time and blood loss, and decreased complications.

CA240-SD-WEA3 Low Radiation Dose Cardiac Computed Tomography for Left Atrium and Pulmonary Vein Imaging Using a New Protocol Based on Contrast-to-Noise Ratio

Station #3

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PURPOSE

In patients receiving catheter ablation (CA) for atrial fibrillation (AF), radiation dose in pre-procedural left atrium computed tomography (LACT) is significantly higher than fluoroscopy during the procedure. Thus, there is a need for reduction of radiation dose of LACT imaging. The purpose of this study was to compare the radiation dose between conventional protocol based on noise and a new protocol based on contrast-to-noise ratio (CNR) in LACT, and to evaluate the registration accuracy of electro-anatomic mapping (EAM) system at CA procedure in patients with AF.

METHOD AND MATERIALS

We divided 100 consecutive patients with AF underwent LACT prior to CA into the two protocols. In protocol A (n = 50), we used a tube voltage of 120 kVp and tube current of 100 to 800 mA. Target image noise level was set at 25 using attenuation based tube current adaptation at the maximal heart diameter technique. In protocol B (n = 50), tube voltage was set at 80 kVp, and the tube current was adjusted so as to obtain CNR equivalent to protocol A. CT number, image noise, CNR of the LA and muscle, and dose length product (DLP) were evaluated for each examination and compared between two protocols. Registration error between LA geometry obtained from EAM and LACT was calculated as the mean distance between EAM points and LACT surface. Procedure duration, fluoroscopy time and air kerma during the CA were compared in the two protocols.

RESULTS

The mean CT number of LA with protocol B was increased as compared with protocol A (618 ± 97 HU vs. 396 ± 55, respectively, p < 0.01). The mean image noise of LA with protocol B was increased as compared with protocol A (41 ± 5 HU vs. 26 ± 1, respectively, p < 0.01). Consequently, CNR of LA did not show any significant difference between the two protocols (p = 0.21). The mean DLP of protocol A and B were 1701 ± 529 mGy-cm and 774 ± 514 mGy-cm, respectively (p < 0.01). There was no significant difference in the registration error between protocol A and B at CA (p = 0.12). There were no significant differences in procedure duration, fluoroscopy time and air kerma between protocol A and B (p > 0.05 for all).

CONCLUSION

CNR based 80-kVp protocol achieves radiation dose reduction for LACT without sacrificing the image quality and accuracy of CA procedure.

CLINICAL RELEVANCE/APPLICATION

LACT with CNR protocol 80-kVp is useful for reducing radiation dose without degrading accuracy of the CA procedure in patients with AF.

Participants

CA241-SD-WEA4 Patients with Atrial Fibrillation Mediated Left Ventricular Systolic Dysfunction Do Not Have Left Ventricular Fibrosis

Station #4

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PURPOSE

Atrial fibrillation (AF) is known to be associated with left ventricular (LV) systolic dysfunction (LVD). The incidence and etiology of AF-induced LVD are currently unknown. One plausible mechanism for AF-mediated LVD is ventricular fibrosis; however, the association between AF and LV fibrosis is less established than it is for atrial fibrosis. We hypothesize that AF-induced LVD is not mediated by fibrosis and is thus reversible following restoration of sinus rhythm. To test this, we enrolled patients with AF undergoing pulmonary venous isolation ablation and measured baseline LV fibrosis and LV ejection fraction (EF) changes before and after ablation.

METHOD AND MATERIALS

AF ablation candidates without LV hypertrophy or ischemic heart/severe valve disease were retrospectively enrolled from 12/16-07/17 if they had undergone Arrhythmia Insensitive Rapid (AIR) T1 mapping during their pre-ablation MRI. Pre and post-contrast T1 maps and hematocrit were used to calculate extracellular volume fraction (ECV), a marker of LV fibrosis. Baseline EF values came from the clinical MRI report, and post-ablation rhythm status and EF values came from EKG, echocardiogram, or MRI reports (23±16 weeks post-ablation). Patients were considered to have LVD if their baseline EF<50%. 61 patients (mean age = 61±11 years, 41 men) were analyzed for baseline ECV and EF, of which 11 and 7 had LVD with and without post ablation EF data, respectively.

RESULTS

AIR T1 mapping created high-quality ECV maps. LV ECV was not significantly different (p=0.12) between LVD and normal EF groups. 93% of patients had normal ECV levels (<30%) and the maximum ECV measured was 32% (borderline fibrosis). The change in EF linearly decreased with increasing baseline EF (R2=0.76). For 11 patients with LVD who underwent ablation with follow-up EF measurements, 10 patients maintained sinus rhythm and their EF increased on average by absolute 14%. Two-tailed t-tests assuming equal variance indicate that there is significant ECV difference between patients based on age (<60 vs >=60 years) (p=0.04) but not based on gender (p=0.09) or AF type (paroxysmal vs. persistent) (p=0.49).

CONCLUSION

Our cohort of patients with AF-induced LVD did not have evidence of myocardial fibrosis. This suggests that patients with AF-induced LVD is reversible.

CLINICAL RELEVANCE/APPLICATION

Patients with AF-induced LVD are likely to experience improvement in EF following successful AF ablation.

CA242-SD-WEA5 Diagnostic Value of Global Cardiac Strain in Patients with Myocarditis

Station #5

Participants

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Francesco Sardanelli, MD, San Donato Milanese, Italy (*Abstract Co-Author*) Speakers Bureau, Bracco Group; Advisory Board, Bracco Group; Research Grant, Bayer AG; Advisory Board, General Electric Company; Reserach Grant, General Electric Company; Speakers Bureau, Siemens AG; Reserach Grant, Real Imaging Ltd;

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PURPOSE

To investigate the diagnostic value of myocardial strain obtained by feature-tracking cardiac magnetic resonance (CMR), comparing myocarditis patients to controls.

METHOD AND MATERIALS

A total of 46 patients with a diagnosis of myocarditis and preserved ejection fraction, who had undergone two enhanced CMR exams one during the acute phase and one at follow-up, were compared to 46 CMR exams from healthy age- and sex-matched controls. Global circumferential strain and global radial strain were calculated for each exam, along with myocardial edema and late gadolinium enhancement percentages, and with left ventricle functional parameters, through manual contouring of the myocardium.

RESULTS

Significant differences in global circumferential strain were found for controls (median -20.4, interquartile range (IQR) -23.4- -18.7) versus patients in the acute phase (-18.4, IQR -21.0- -16.1, P=.001) or at follow-up (-19.2, IQR -21.5- -16.1, P=.020). Significant differences in global radial strain were also found for global radial strain in controls (82.4, IQR 62.8-104.9) versus patients in the acute phase (65.8, IQR 52.9-79.5, P=.001), but only borderline significance was found versus follow-up (73.1, IQR 58.7-86.5, P=.066). Correlations were found between global radial and circumferential strain in all groups (acute, R=-0.580 P<.001; follow-up R=-0.399 P=.006; controls R=-0.609 P<.001), and between global circumferential strain and late gadolinium enhancement only in

myocarditis patients (acute R=0.035 P=.024, follow-up R=0.307 P=.038).

CONCLUSION

Cardiac strain could have a role in reducing the need for sequences other than cine in some low-risk acute myocarditis patients where CMR is the main diagnosing technique.

CLINICAL RELEVANCE/APPLICATION

Given the diagnostic performance of the two short-axis strain indices, global circumferential strain and global radial strain, CMR-derived strain could potentially have a role in reducing the need of sequences in addition to cine in low-risk myocarditis patients where CMR is the main diagnosing technique.

CA244-SD-WEA7 Interobserver Agreement of Virtual Transcatheter Heart Valve to Coronary Distance in Aortic Valve-in-Valve Implantation

Station #7

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Harindra Wijeysundera, MD,PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Valve-in-valve (ViV) transcatheter aortic valve replacement (TAVR) has recently emerged as a successful alternative to redo surgery in patients with a failing bioprosthetic aortic valve. Coronary ostial obstruction is a serious complication of ViV TAVR, associated with high mortality. The virtual transcatheter heart valve to coronary (VTC) distance is an important CT measurement that helps in risk stratification for coronary obstruction. We aim to determine the interobserver agreement of VTC measurements in the planning CT for ViV TAVR.

METHOD AND MATERIALS

Our cohort consisted of 54 patients with failing bioprosthetic valve considered for ViV TAVR. They all had a planning CT-gated angiography prior to the procedure. Two readers measured the VTC distance by placing a virtual cylinder of the diameter of the future transcather valve centered in the basal ring plane of the bioprosthetic valve and then propagated to the level of each coronary ostium. The VTC is calculated as the distance between the edge of the virtual cylinder and the coronary ostium. Risk stratification was performed according to two published classifications in:1)low, intermediate or high risk of coronary obstruction if VTC<3, 3-6 or >6mm respectively and 2)high or low risk if VTC<=4 or >4mm. Agreement was determined by intraclass correlation coefficient (ICC) for continuous variables and by kappa coefficient for categorical variables.

RESULTS

VTC distance agreement was excellent, especially for the left [ICC (95% CI) left VTC=0.99(0.99-0.99) and right VTC=0.94(0.89-0.96)]. When measurements were stratified in low, intermediate or high risk if VTC<3, 3-6 or >6 mm, there was a fair to good agreement for left and right VTC, with k(95% CI)=0.69(0.52-0.86) and 0.61(0.40-0.81) respectively. When measurements were stratified in high or low risk if VTC<=4 or >4mm, the agreement was good to excellent, with k(95% CI)=0.93(0.79-1.00) and 0.70(0.52-0.88) for left and right VTC respectively.

CONCLUSION

VTC distance is a highly reproducible measurement performed in the pre-evaluation CT of candidates for ViV TAVR. It is an accurate and essential measure to stratify risk of coronary obstruction. When VTC was categorized in <=4 or >4mm (high or low risk), agreement was good to excellent.

CLINICAL RELEVANCE/APPLICATION

Obtaining an accurate measurement of the VTC distance on the CT prior to ViV TAVR is crucial to stratify risk of coronary obstruction. VTC distance is highly reproducible.

CA172-ED-WEA8 Left Ventricular Outflow Tract: A Complete Review of Imaging Related Anatomy, Pathology, and Surgical Techniques

Station #8

Awards
Cum Laude
Identified for RadioGraphics

Participants
Cameron Hassani, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Shumpei Mori, Kobe, Japan (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

The purpose of this exhibit is: 1. Review the anatomy of the left ventricular outflow tract (LVOT) 2. Review LVOT appearance on CT, MR and Echocardiography 3. Explore disease processes primarily affecting the LVOT (including imaging manifestations) 4. Discuss planning of transcatheter aortic and mitral valve replacement in the context of the LVOT 5. Review common and uncommon

surgical techniques for LVOT repair

TABLE OF CONTENTS/OUTLINE

Anatomy - Development - Normal variability - Dilation - Morphology changes with stenosis Imaging modalities - CT, MR, Echo - Normal appearances (eg. Normal flow acceleration on MRI) Stenosis - Subvalvuar vs valvular stenosis Obstruction - HCM - Systolic anterior motion of the mitral valve - Mitral-septal contact - Tako-tsubo - Hypoplastic left heart syndrome - Williams syndrome Membranes - Congenital assocations (Shone's) Pseudoaneurysm - Endocarditis - Post surgical Masses - Thrombus - Neoplasm - HCM Role in Percutaneous Interventions - Neo-LVOT in Mitral Valve Replacement (TMVR) - Role in transcather aortic valve replacement (TAVR) planning - Pre-procedural LVOT calcium score in transcather aortic valve replacement (TAVR) - Percutaneous transluminal septal myocardial ablation (PTSMA) Repair - Aneurysm resection - Valve replacement - Yasui procedure - Myotomy - Konno procedure (LVOT widening)

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Cameron Hassani, MD - 2018 Honored EducatorFarhood Saremi, MD - 2015 Honored Educator

CAS-WEB

Cardiac Wednesday Poster Discussions

Wednesday, Nov. 28 12:45PM - 1:15PM Room: CA Community, Learning Center

MK CA

AMA PRA Category 1 Credit ™: .50

Participants
Daniel Ocazionez, MD, Houston, TX (*Moderator*) Nothing to Disclose

Sub-Events

CA245-SD-WEB1 CT-Derived 3D Strain for Cardiac Resynchronization Therapy in Patients with Congenital Corrected Transposition of the Great Arteries

Station #1

Participants
Michinobu Nagao, MD, Tokyo, Japan (*Presenter*) Nothing to Disclose
Kenji Fukushima, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Yuka Matsuo, MD, Shinjuku, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroki Mori, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Yumi Shiina, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Kei Inai, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Systemic right ventricle (RV) dysfunction is one of prognostic factors in congenital corrected transposition of the great arteries (ccTGA) and TGA after atrial switch procedure. Contraction of systemic RV is easily deteriorated because the RV has no effective torsion and compensates this weakness keeping cardiac output. If RV dyssynchrony develops, early timing of cardiac resynchronization therapy (CRT) should be considered. We aim to analyze ventricular dyssynchrony and deformation using CT-derived 3D strain algorithm in patients with ccTGA, TGA, and Fontan circulation pre- and post-CRT.

METHOD AND MATERIALS

Multiphase cardiac CT data set with 320-detector scanner for 13 patients (ccTGA, 7; TGA, 3; Fontan circulation, 3) who underwent implant of device for CRT or were scheduled due to refractory heart failure was retrospectively analyzed. Volume of interest (VOI) was drawn on multi-planar reconstruction of the ventricle with strain overlay using 3D-strain algorithm. Time-curves of 3D-strain for 12 VOIs in free walls of systemic and pulmonary ventricles were calculated throughout a cardiac cycle. The maximum value of 3D-strain was defined as a representative value. Dyssynchrony index was defined as the standard deviation of the phase to peak strain for 6 VOIs in systemic ventricles. Comparisons of the parameters was analyzed using Mann-Whitney u-test and paired t-test.

RESULTS

3D-strain could be obtained from the all sites with implantable device. Dyssynchrony index was significantly lower post-CRT than pre-CRT (0.44±0.16 vs. 0.19±0.07 phase, $p<0.05$). There was no significant difference in 3D-strain between pre- and post-CRT (0.35±0.13 vs. 0.42±0.22). In patients with corrected TGA, 3D-strain was significantly lower for systemic RV than for pulmonary LV (0.43±0.08 vs. 0.62±0.19, $p<0.05$). In patients with complete TGA and Fontan circulation, there was no difference in 3D-strain between systemic and pulmonary ventricles (0.33±0.04 vs. 0.26±0.16).

CONCLUSION

CT-derived 3D strain demonstrates that dyssynchrony of systemic ventricle improves post-CRT. In corrected TGA, systolic ventricular deformation impairs dominantly in systemic RV.

CLINICAL RELEVANCE/APPLICATION

CT-derived 3D-strain can assess CRT response and determine treatment strategy in adult congenital heart disease patients even if MRI cannot be performed due to implantable cardiac devices.

CA246-SD-WEB2 The Effect of Motion Correction Algorithm at Low Energy Level of Virtual Monochromatic Images in Coronary CT Angiography with Fast kVp Switching Dual-Energy CT

Station #2

Participants
Satoshi Inada, Hiroshima, Japan (*Presenter*) Nothing to Disclose
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Fang Wang, Yinchuan, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to investigate the effect of the motion correction algorithm (SnapShot Freeze: SSF; GE Healthcare) at the low energy level of virtual monochromatic images (VMI, 50 keV) in coronary CT angiography with fast kVp switching dual-energy CT (DE-CCTA).

METHOD AND MATERIALS

Twenty-five patients with heart rate below 65 bpm (42 - 65 bpm) underwent DE-CCTA using ECG-gated axial step-and-shoot scanning mode on a 64-row single-source dual-energy CT (Revolution GSI; GE Healthcare). The scan parameters for CCTA scan were used as follows: tube voltage 80/140 kVp fast switching, rotation time 0.35 s/rot, and tube current was determined to be 375 mA or 600 mA or 640 mA based on patient's BMI. VMIs at 70 keV (with and without SSF), 50 keV (with SSF), and 50 keV (with ASiR 50% and SSF) were reconstructed at the cardiac phases of 60%, 75%, and 90%, respectively. Two radiographers assessed the image quality of the 4 major coronary arteries (right coronary artery: RCA, left main trunk: LMT, left anterior descending artery: LAD, and left circumflex: LCX) by using 5-point scores (5, no motion artifacts; 4, minor artifacts; 3, moderate artifacts; 2, severe artifacts; 1, image not evaluated and vessel structures not differentiable). Average scores on the per-vessel in each cardiac phase were compared among VMIs at 70keV (with and without SSF), 50 keV (with SSF), and 50 keV (with ASiR50% and SSF).

RESULTS

In all cardiac phases, average scores with SSF were higher than those without SSF in all vessels: {70 keV (without SSF): 2.9 ± 0.8 at 60%, 3.8 ± 0.5 at 75%, 2.0 ± 2.1 at 90%; 70 keV (with SSF): 3.3 ± 0.8 at 60%, 4.3 ± 0.4 at 75%, 2.2 ± 0.6 at 90%; 50 keV (with SSF): 3.5 ± 0.7 at 60%, 4.0 ± 0.3 at 75%, 2.5 ± 0.6 at 90%; 50 keV with (ASiR 50% and SSF), 3.6 ± 0.8 at 60%, 4.4 ± 0.4 at 75%, 2.4 ± 0.6 at 90%). In addition, average scores of VMI at 50 keV (with ASiR 50% and SSF) were higher as compared with other VMIs.

CONCLUSION

With the application of motion correction algorithm SSF, motion artifact and image quality of DE-CCTA were greatly improved. Moreover, the use of low keV (50keV) VMI combined with SSF was more effective to control the motion artifact.

CLINICAL RELEVANCE/APPLICATION

Motion correction algorithm (SSF) in coronary CT angiography with fast kVp switching single source dual-energy CT was useful to reduce the motion artifacts and the use of low keV (50keV) VMI was more effective for controlling the motion artifact.

CA247-SD-WEB3 Venous Air Embolism in CT Coronary Angiography

Station #3

Participants
Alexander W. Davies, BMedSc, MBBS, Melbourne, Australia (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Venous air embolization (VAE) from incompletely primed peripheral lines is a known risk of any intravenous procedure. Depending on the quantity of air inadvertently introduced, it may potentially result in catastrophic sequelae, including air lock in right ventricular outflow tract or systemic air embolism (SAE) in patients with cardiac septal wall defects that may lead to cerebrovascular event. The risk of VAE in contrast CT coronary angiography (CTCA) that requires intravenous dual contrast and saline injections may be higher than conventional single bolus contrast CT chest imaging (CTC). This was a retrospective study of the prevalence of VAE in CTCA compared to CTC.

METHOD AND MATERIALS

All consecutive adult CTCAs and CTCs over a 3-month period were included. CTs that had no saline push or contrast were excluded. The CTCAs and CTCs were blindly, randomly and independently read by 2 cardiac CT radiologists. All patients aged over 18 were included in the study. Location and amount of VAE and SAE were assessed. Shunts, including patent foramen ovale (PFO), atrial septal defects (ASD), ventricular septal defects (VSD) and patent ductus arteriosus (PDA) were recorded. Results were compared.

RESULTS

There were 418 CTCAs (62% male; mean age: 62 years) and 100 CTC (65% male, mean age: 64 years). PFO, ASD, VSD and PDA were seen in 14.8%, 12.5%, 7.6% and 0.5% of CTCA's respectively. No shunts were indentified in CTC. VAE was seen in 22.5% of all CTCAs (with similar result in patients with shunts). Mean air volume was 1.5 mls. This was significantly higher than CTC which had 1% VAE. No SAE was identified.

CONCLUSION

The significantly increased incidence of VAE in CTCA compared to CTC is likely related to the use of dual chambered injector with doubling of peripheral lines that may be incompletely primed prior to intravenous injections. It is compounded by the frequent necessity of giving on-table intravenous beta-blocker for heart rate control in CTCA. Cardiac CT departments would need to take extreme care to exclude air in peripheral lines prior to injection as 23.7% of these patients have shunts between right and left heart posing a risk of SAE which may potentially lead to serious sequelae, including CVA.

CLINICAL RELEVANCE/APPLICATION

Secondary to the dual-bolus injection techniques of conventional cardiac CT, there is a likely appreciable increased risk of VAE, which this study aims to quantify.

CA248-SD-WEB4 Analysis of the Anatomical Features of Pulmonary Veins on Pre-Procedural Cardiac CT Images Resulting in Incomplete Cryoballoon Ablation for Atrial Fibrillation

Station #4

Participants
Yoriaki Matsumoto, Hiroshima, Japan (*Presenter*) Nothing to Disclose
Yoshinori Funama, PhD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Cryoballoon (CB) ablation is non-inferior to radiofrequency (RF) ablation for treating paroxysmal atrial fibrillation (pAF). However, some cases require additional touch-up ablation for gaps on the pulmonary vein (PV) isolation line after CB ablation. To investigate the anatomical features related to the success or failure of CB ablation for pAF on pre-procedural cardiac computed tomography (CT) images.

METHOD AND MATERIALS

We retrospectively analyzed pre-procedural cardiac CT images of 100 patients with pAF who had undergone a first CB ablation at our institution between June 2016 and April 2017. Blinded to the outcomes, we measured the angle, short- and long axis length, and the area and ovality of 4 major PV ostials on CT images. Logistic regression analysis was performed to analyze the anatomical features related to the failure (incomplete CB ablation) of PV isolation.

RESULTS

We analyzed 400 PVs in 100 patients [aged 64 (27 - 82) years, 59% male]. The rate of incomplete CB ablation was significantly higher for right- than left-sided PVs ($p < 0.001$). The anatomical feature significantly associated with incomplete CB ablation was the PV angle (adjusted odds ratio = 0.97; 95% confidence interval = 0.96 - 0.98, $p < 0.001$).

CONCLUSION

Our findings may help to select the appropriate ablation strategy (CB ablation or conventional RF ablation) to treat patients with pAF. We show that the angle is an anatomical feature significantly related to failed CB ablation.

CLINICAL RELEVANCE/APPLICATION

Anatomical information obtained on pre-procedural cardiac CT scans is useful for selecting CB ablation strategies and for predicting the treatment outcome.

CA249-SD-WEB5 Automated Cardiac MR Plane Classification Using VGG-19 Convolutional Neural Network: A Deep Learning Study

Station #5

Participants
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Tara A. Retson, MD, PhD, San Diego, CA (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Cardiac MRI (cMRI) requires acquisition of multiple oblique imaging planes. Automated recognition of imaging planes may be a necessary component for automating cardiac MRI scan prescription or automating hanging protocols. We therefore developed a convolutional neural network (CNN) to classify cMRI planes. Moreover, we sought to investigate what spatial information the CNN uses to recognize each imaging plane.

METHOD AND MATERIALS

With HIPAA-compliance and IRB waiver of informed consent, we retrospectively collected SSFP images from clinically-performed cMRIs performed at our institution from 2012 to 2017, including 195 short axis (SAX) and 945 long axis (LAX). We trained a pair of VGG-19 deep neural networks to perform classification of images into five classes: SAX, 2-chamber (2-ch), 3-chamber (3-ch), 4-chamber (4-ch), and other. The first VGG-19 network was trained to differentiate short-axis from LAX with a binary crossantropy loss. The second VGG-19 network was trained to differentiate between each of the different long-axis views using a categorical crossantropy loss function. Images from 80% of the patients were used for training, and images from 20% of the patients were used for validation. We apply saliency maps, occlusion tests and Deep Dream to assess in inner layers of the neural network.

RESULTS

The first network distinguished SAX from LAX with accuracy of 96.1%. The second network was able to classify each of the long

axis views with accuracy of 88.8%. Inspection of the saliency maps showed greater attention of the CNN to several cardiac structures when discriminating each of these views, including the endocardial cushion and basal lateral wall for the 4ch and the left ventricular outflow tract for the 3ch.

CONCLUSION

We demonstrate the feasibility of convolutional neural networks to accurately classify cardiac imaging planes with high fidelity for use in multiple potential clinical applications. Furthermore, study of the saliency maps of the neural network appear to emphasize characteristic features that discriminate between each of the imaging planes.

CLINICAL RELEVANCE/APPLICATION

Convolutional neural networks can accurately classify cardiac imaging planes, and may perform this task utilizing different features than human readers. Further exploration of these CNNs may yield new observations about image data.

CA250-SD-WEB6 Employing Artificial Intelligence to Predict Hematocrit Values from Non-Contrast CT Imaging Data-Towards Fully Automated CT-derived Myocardial Extracellular Volume Fraction Quantification

Station #6

Participants
Maximilian J. Bauer, Charleston, SC (*Presenter*) Nothing to Disclose
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U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, Siemens AG; Research support, Bayer AG; Consultant, Guerbet SA; Consultant, General Electric Company; Consultant, HeartFlow, Inc; Consultant, Bayer AG; Consultant, Siemens AG; ; ;
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Taylor M. Duguay, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Imaging approaches for the quantification of the myocardial extracellular volume fraction require the patient's hematocrit as an input variable. We assessed the performance of a machine learning approach to predict hematocrit values from non-contrast CT imaging data, demographic, and clinical information, in comparison to a linear regression model employing HU values alone.

METHOD AND MATERIALS

A total of 260 patients were retrospectively included who had undergone non-contrast cardiac CT and whose records provided hematocrit values determined from blood sampling within 2 days of the scan. We measured HU values in the ascending aorta and employed a linear regression analysis to model the relationship between the image-derived data and laboratory hematocrit values. Additional information on patient demographics, clinical history, and imaging parameters was gathered for the machine learning approach. A total of 45 features were extracted and used to train a linear Support Vector Machine (SVM) employing k-fold cross validation.

RESULTS

The model provided by the linear regression approach was Hct [%] = 0.90 x HU_blood + 0.19. This approach demonstrated a weak relationship between the model and the laboratory hematocrit values ($R^2=0.49$; $p<.001$). The machine learning model showed a moderate relationship to the hematocrit values obtained from blood sampling ($R^2=0.62$; $p<.001$). Friedman's test indicated that the medians of the laboratory hematocrit values (40.1±4.7) and the predicted hematocrit values from both models (linear regression: 39.8±3.3; SVM: 39.7±3.4) did not differ significantly ($p=.38$). Decisively, analysis of the residuals demonstrated an increase in accuracy for the machine learning approach compared to the linear regression model (RMSE_linReg=3.35 vs. RMSE_SVM=2.90).

CONCLUSION

Employment of artificial intelligence (AI) is a promising approach for the calculation of CT-derived hematocrit values. While a regression model is capable of representing the approximately linear relation between HU values and the patient's hematocrit, our machine learning approach profits from additional information resulting in an increased accuracy.

CLINICAL RELEVANCE/APPLICATION

The benefit of AI in deriving hematocrit values from CT datasets is demonstrated. This has various conceivable applications, such as CT-derived myocardial extracellular volume fraction quantification.

CA251-SD-WEB7 Delayed Enhancement of Papillary Muscles on Cardiac Magnetic Resonance Imaging in Patients with Mitral Regurgitation

Station #7

Participants
Sujin Lim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hyun Jung Koo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Dong Hyun Yang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate late gadolinum enhancement of the mitral apparatus on cardiac magnetic resonance imaging (MRI) in patients with mitral regurgitation.

METHOD AND MATERIALS

Between Jan 2000 and Dec 2017, 131 consecutive patients with mitral regurgitation (38 mitral valve prolapse without concomitant valvular diseases, 7 severe aortic regurgitation, 2 aortic stenosis, 18 severe tricuspid regurgitation, 51 rheumatic mitral disease, 13 functional mitral regurgitation, 2 others) underwent cardiac MRI. Ischemic heart disease, non-ischemic cardiomyopathy such as sarcoidosis or hypertrophic cardiomyopathy, myocarditis, endocarditis and cardiac tumors were excluded. Delayed enhancement images on cardiac MRI, clinical characteristics such as echocardiographic findings and presence of arrhythmia, pacemaker, or implantable cardioverter-defibrillator were reviewed. In 38 patients with pure mitral valve prolapse, we measured the quantitative amount of delayed enhancement of papillary muscles and left ventricular myocardium.

RESULTS

In 131 mitral regurgitation patients, papillary muscle enhancement was found in 13 patients (3 pure mitral valve prolapse, 1 severe aortic regurgitation, 2 severe tricuspid regurgitation, 3 rheumatic mitral regurgitation, 1 rheumatic mitral stenosis, 3 functional mitral regurgitation). Among them, 2 (1 pure mitral valve prolapse, 1 severe aortic regurgitation) had bilateral diffuse papillary muscle enhancement and sudden cardiac arrest due to ventricular fibrillation. In 38 mitral valve prolapse patients, 13 showed delayed enhancement (10 had myocardial enhancement, 2 had papillary muscle enhancement, and 1 had both myocardial and papillary muscle enhancement). On echocardiography, grade 4 mitral regurgitation is noted in the 13 patients. Among 3 patients with papillary muscle enhancement, 1 had ventricular arrhythmia.

CONCLUSION

In patients with mitral regurgitation, delayed enhancement of papillary muscles on cardiac MRI is not uncommon. Even in patients with mitral valve prolapse alone, 34% of the patients showed delayed myocardial or papillary muscle (8%) enhancement.

CLINICAL RELEVANCE/APPLICATION

Although we could not find the strong relationship between papillary muscle enhancement and occurrence of ventricular arrhythmia, papillary muscle enhancement on cardiac MRI should not be overlooked, considering the incidence of papillary muscle enhancement and ventricular arrhythmia in patients with mitral regurgitation.

SSM03

Cardiac (Anatomy)

Wednesday, Nov. 28 3:00PM - 4:00PM Room: S102CD

AI CA MR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Evan J. Zucker, MD, Stanford, CA (*Moderator*) Nothing to Disclose
Karin E. Dill, MD, Worcester, MA (*Moderator*) Nothing to Disclose

Sub-Events

SSM03-01 The Automated Segmentation of the Left Ventricle Myocardium from Cardiac Computed Tomography using Deep Learning

Wednesday, Nov. 28 3:00PM - 3:10PM Room: S102CD

Participants
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Joon-Won Kang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji-Yeon Ko, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
June-Goo Lee, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Segmentation of the left ventricle myocardium of the heart is important to obtain information regarding myocardial wall thickening and functional analysis data. In this study, we performed deep learning analysis for the automated segmentation of the left ventricle of the heart in cardiac computed tomography (CT) data.

METHOD AND MATERIALS

To develop a fully automated deep learning algorithm using sementic segmentation methods based on fully convolution network, 50 subjects with coronary artery diseases were used as training set, and the approach is evaluated using a data set of 1000 subjects with coronary artery diseases present whole 3D volume images of the LV. Reference standard manual segmentation data generated by experienced cardiac radiologists. Cross validation was performed using randomly selected 5% cases from the training set. The comparison of quantitative measurement data between the manual and automatic segmentations was performed using dice similarity coefficient.

RESULTS

Overall, automated segmentation data were comparable to manual segmentation data. We obtained mean 88.3% (min 78.1% and max 96.5%) of dice similarity coefficient in whole LV myocardium. The sensitivity and specificity of automated segmentation in each segment (1-16 segments) were high (range: 85.5 - 99.9).

CONCLUSION

Using a large data set, we presented a deep learning based automatic segmentation of the left ventricle of the heart, and the results was comparable to manual segmentation data with high dice index.

CLINICAL RELEVANCE/APPLICATION

Automated LV segmentation can reduce time to obtain information regarding myocardial wall thickening and LV function, and might improve the reproducibility of clinical assessment.

SSM03-02 Microcirculation Dysfunction in Patients with End-Stage Renal Disease Undergoing Dialysis: Associated with Heart Failure in the Follow-Up

Wednesday, Nov. 28 3:10PM - 3:20PM Room: S102CD

Participants
Ying-Kun Guo, MD, Chengdu, China (*Presenter*) Nothing to Disclose
Rong Xu, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
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Zhigang Yang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The dialysis treatment was used widely in the ESRD patients, but myocardial ischemia and the cardiovascular disease were the major cause of death in chronic kidney disease (CKD) patients. Our study aimed to quantitative evaluation of myocardial microcirculation dysfunction by rest CMR perfusion imaging in patients with ESRD undergoing dialysis, and to understand of the association between perfusion parameters and heart failure.

METHOD AND MATERIALS

In total, 67 ESRD patients with preserved EF (EF>=50%) and 22 healthy subjects underwent rest first-pass perfusion. The LV regional myocardial perfusion parameters were analyzed by a commercial soft included upslope, time to maximum signal intensity (TTM) and max signal intensity (Max SI). Continuous variables were compared using one-way analysis of variance (ANOVA). The association between perfusion parameters and the composite of CHF was assessed by Cox proportional hazards regression.

RESULTS

For the analysis, the Max SI of basal, mid- and apical segments were reduced in ESRD patients with preserved EF compared with normal controls (all $P < 0.05$). In contrast to the patients with preserved EF, the patients with impaired EF had lower upslope and longer TTM in the basal segment. Over a mean follow-up period of 12.5 months, 24 subjects developed heart failure. The TTM of Basal-, mid-, and apical- segments were inversely associated with risk of heart failure (per unit increment, HR:1.052, 95% CI: 1.010-1.095, HR:1.086, 95% CI: 1.033-1.143, and HR:1.084, 95% CI: 1.024-1.146, respectively) after multivariable adjustment by gender, age, BMI, dialysis time, hypertension, and diabetes.

CONCLUSION

In summary, the first-pass perfusion CMR parameters can early detect the regional myocardial microcirculation dysfunction in ESRD patients undergoing dialysis. The myocardial dysfunction can predictor the progression of heart failure.

CLINICAL RELEVANCE/APPLICATION

(dealing with first-pass perfusion CMR)CMR perfusion imaging with vasodilator can detect myocardial microcirculation dysfunction in ESRD patients undergoing dialysis.

SSM03-03 Differences in Cardiac MR-based Assessment of Myocardial 2D Strain between Subjects with Prediabetes, Diabetes, and Normal Controls in the General Population

Wednesday, Nov. 28 3:20PM - 3:30PM Room: S102CD

Participants
Tanja Zitzelsberger, MD, Tuebingen, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

In the setting of diabetes mellitus, diabetic cardiomyopathy is associated with limited event-free survival but difficult to detect. However, cardiac MR based assessment of subtle alterations of left ventricular function using 2D cardiac strain analysis may represent an early marker of disease development. Thus, we determined differences in left ventricular strain between subjects with prediabetes, diabetes, and healthy controls in a sample from the general population.

METHOD AND MATERIALS

Subjects without prior history of stroke, coronary or peripheral artery disease were enrolled in a case-controlled study and underwent 3T whole body MRI. In all patients without history of hypertension, LGE and normal ejection fraction, radial, longitudinal and circumferential strain was measured on Cine SSFP imaging (TR: 29.97ms, TE: 1.46ms, ST: 8mm) using a semiautomatic segmentation algorithm (CVI42, Circle, Canada). Differences in strain rates were derived in multivariate linear regression analysis adjusting for age, gender, BMI, blood pressure, and smoking, HDL, LDL and TG.

RESULTS

Radial and circumferential strain analysis was performed in in total 347 subjects, of which 41 (11.8%) suffered from diabetes, 92 (26.5%) from pre-diabetes and 214 (61.7%) controls. Mean HbA1c of diabetic subjects was 6.5±1mmol/mol Hb. Pre-diabetic subjects showed a significantly higher systolic global and endocardial radial strain compared to controls (p=0.036 and p=0.011 respectively), whereas diabetic subjects didn't show any significant difference (p=1.00 and p=0.811). Similarly we detected significant lower systolic global and endocardial circumferential strain values in pre-diabetic subjects (p=0.044 and p=0.009), whereas diabetic subjects didn't show a significant difference (p=1.00 and p=0.580). Regarding diastolic radial and circumferential strain we didn't find any significant difference.

CONCLUSION

In our cohort of well-treated diabetic subjects we didn't find any changes in strain values whereas pre-diabetic subjects showed early changes. Therefore early and consequent treatment of diabetes seems to be cardioprotective.

CLINICAL RELEVANCE/APPLICATION

MR based Strain Imaging is able to detect early changes in cardic function in patients with prediabetes. As these changes are not seen in well treated diabetic patients consideration should be given to early antidiabetic therapy.

SSM03-04 Left Atrial Functional Impairment in Patients with Stroke: A Cardiovascular Magnetic Resonance

Study

Wednesday, Nov. 28 3:30PM - 3:40PM Room: S102CD

Participants
Wieland Staab, MD, Goettingen, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

In 25 % of patients with ischemic stroke, no etiologic factor can be identified. Asymptomatic paroxysmal atrial fibrillation (AF) is often suspected to be the cause of these cryptogenic strokes (CS). AF is frequently associated with left atrial (LA) structural and functional alterations. Accordingly, the aim of this study was to examine LA deformation in patients with CS using cardiovascular magnetic resonance myocardial feature tracking (CMR-FT).

METHOD AND MATERIALS

29 patients with the diagnosis of CS underwent CMR imaging. Based on the initial cranial computed tomography (cCT), the patient group was divided into patients with previous ischemic lesions (recurrent CS) and patients without (first-time CS). LA deformation was analyzed based on CMR-FT of standard cine 4- and 2-chamber views including LA reservoir function (peak total strain [s], peak positive SR [SRs]), LA conduit function (passive strain [e], peak early negative SR [SRe]) and LA booster pump function (active strain [a], late peak negative SR [SRa]). Moreover, the "time to s" and "time to SRs" were calculated and expressed as a percentage of the entire cardiac cycle.

RESULTS

Previous ischemic lesions were detected in 5 of 29 patients (17%). LA conduit strain was lower in patients with recurrent CS as compared to first-time CS (6.4 ± 1.1 % vs. 10.3 ± 3.3 %, respectively, p=0.005). Furthermore, "time to s" and "time to SRs" were prolonged in patients with recurrent CS (47 ± 6 % vs. 57 ± 8%, p=0.007; and 19 ± 5% vs. 30 ± 7%, p=0.001, respectively). In multivariable regression models "time to s" and "time to SR" were independently associated with the presence of previous ischemic lesions (ß=0.41, p=0.006 and ß=0.51, p=0.015, respectively) after adjustment for traditional risk factors (age, gender, arterial hypertension, vascular disease and diabetes).

CONCLUSION

Prolonged time to peak LA reservoir strain and SR is associated with the presence of previous ischemic lesions in patients with CS. These findings propose advanced LA impairment as a distinct feature of CS which may be associated with unrecognized paroxysmal AF. Future research is warranted to confirm these findings alongside their prognostic implications in larger prospective clinical trials.

CLINICAL RELEVANCE/APPLICATION

Advanced LA impairment detected by cardiac magnetic resonance imaging may improve management of patients with or prior to CS.

SSM03-05 Machine Learning for Automated Image Quality Control and Segmentation of Large-Scale CMR Population Studies

Wednesday, Nov. 28 3:40PM - 3:50PM Room: S102CD

Participants
Wenjia Bai, DPhil, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
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Daniel Rueckert, PhD, London, United Kingdom (*Presenter*) Nothing to Disclose

PURPOSE

UK Biobank is a large-scale prospective cohort study that follows the health of 500,000 subjects across the UK. Of all the subjects, 100,000 will undergo imaging scans including brain, heart and body scans. We propose a machine learning-based and automated pipeline for cardiac MR (CMR) image quality control and segmentation on this large-scale dataset.

METHOD AND MATERIALS

CMR images were obtained from the UK Biobank under Application Number *****. Short-axis and long-axis cine images were acquired using a Siemens 1.5T scanner with the balanced steady state free precession (bSSFP) sequence. For image quality control, hybrid random forests were trained to detect landmarks on long-axis images, specifically the apex and mitral valve, which were then compared to the space encompassed by short-axis image stacks for identifying incomplete heart coverage. For image segmentation, fully convolutional networks were trained to segment the left ventricle (LV) and right ventricle (RV) on short-axis images and the left atrium (LA) and right atrium (RA) on long-axis images. The segmentation accuracy was evaluated using the Dice metric and mean contour distance error.

RESULTS

The pipeline took ~1 second for image quality control and ~10 seconds for short-axis and long-axis image segmentation. Cases

with heart coverage deemed incomplete by visual examination were automatically identified with 88% sensitivity and 99% specificity on a random test set of 3,000 subjects. Regarding segmentation accuracy, the average Dice metric is 0.94 for LV cavity, 0.88 for LV myocardium, 0.90 for RV cavity, 0.93 for LA cavity (2-chamber view), 0.95 for LA cavity (4-chamber view) and 0.96 for RA cavity (4-chamber view), evaluated on a test set of 600 subjects. The average mean contour distance error is smaller than the in-plane pixel resolution of 1.8mm.

CONCLUSION

We have proposed a machine learning-based pipeline for CMR image quality control and segmentation, which is automated, fast and accurate.

CLINICAL RELEVANCE/APPLICATION

The pipeline will facilitate the analysis of large-scale CMR population studies such as the UK Biobank and enable automated extraction of clinically relevant phenotypes including the ventricular volumes and mass. Future work could evaluate its potential to add quantitative image-derived phenotypes as part of routine clinical practice.

SSM03-06 Cardiac Adaptation of Left Ventricular Volume and Mass during a Multistage Marathon Over 4486 Km

Wednesday, Nov. 28 3:50PM - 4:00PM Room: S102CD

Participants
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PURPOSE

Long-term side effects of intense physical training and long-distance running has led to increasing concerns especially among athletes. However, the consequences on long-term endurance training on cardiac structure and function are not yet fully understood. The purpose of this study was to evaluate the effect of running a transcontinental, multistage ultramarathon of 4486km on 64 consecutive days on the heart.

METHOD AND MATERIALS

20 ultra-endurance athletes with a mean (standard deviation) age of 47.9 (10.4) years received a cardio MRI-scan at three time points (baseline, at ~2000km, ~3500km) during the multistage ultramarathon. Cardiovascular magnetic resonance (CMR) was performed on a portable 1.5 Tesla MRI unit (Magnetom Avanto™mobile MRI) which was installed on a specially hired truck. Left ventricular mass (LVM), end-diastolic volume (EDV), end-systolic volume (ESV) and myocardial strain was calculated from SSFP-cine gradient echo sequences using the commercially available software (Heart Deformation Analysis, HDA, Siemens, Erlangen, Germany). Cardiac MRI-parameters were indexed for body surface area (BSA). Ten runners were serially examined in follow-up scans eight months after the race.

RESULTS

Athletes ran at a mean running speed of 8.2 ± 1.2 km/h during the ultramarathon. Left ventricular mass increased significantly ($p<0.001$) over the course of the race while no significant changes were observed in end-diastolic volume, end-systolic volume as well as global radial, circumferential and longitudinal left ventricular strain. Results of follow-up scans showed a significant reduction in LVMi ($p=0.004$), left ventricular EDVi ($p=0.015$) and right ventricular EDVi ($p=0.045$). We did not observe any significant differences regarding myocardial strain during follow-up.

CONCLUSION

The observed structural cardiac alterations during a multistage ultra-endurance marathon indicates a physiological response to excessive cardiac volume load. The reduction in end-diastolic volumes during follow-up corresponds to the reduced endurance exercise volume within eight months after the multistage ultramarathon.

CLINICAL RELEVANCE/APPLICATION

Extreme long-distance running leads to physiological cardiac adaptations without any detectable adverse cardiovascular remodeling in non-contrast enhanced cardiovascular magnetic resonance imaging.

SSM04

Cardiac (Arrhythmia and Electrophysiology)

Wednesday, Nov. 28 3:00PM - 4:00PM Room: S103AB

CA CT MR

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Susan K. Hobbs, MD,PhD, Pittsford, NY (*Moderator*) Nothing to Disclose
Dharshan R. Vummidi, MD, FRCR, Sale, United Kingdom (*Moderator*) Consultant, Boehringer Ingelheim GmbH

Sub-Events

SSM04-01 Radiographic Features of Pulmonary Veins Morphology from Chest CT Predicts Risk of Post-Ablation Atrial Fibrillation

Wednesday, Nov. 28 3:00PM - 3:10PM Room: S103AB

Participants
Michael LaBarbera, Cleveland, OH (*Presenter*) Nothing to Disclose
Mina K. Chung, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Anant Madabhushi, PhD, Cleveland, OH (*Abstract Co-Author*) Research funded, Koninklijke Philips NV

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PURPOSE

Atrial fibrillation (AF) is the most common sustained arrhythmia, affecting 1-2% of the population. Although endovascular pulmonary vein isolation (PVI) may temporarily reduce symptoms in patients failing medical management, recurrence rates are high and identifying patients likely to have successful outcomes remains elusive. Pulmonary vein morphology and left atrial size have been previously identified as radiographic markers for AF, but have not been assessed for PVI outcome. We explore pulmonary vein and left atrial morphometry as a means of predicting response to PVI.

METHOD AND MATERIALS

A retrospective review of PVI procedures from 2014-2016 excluding prior PVI or valve surgery revealed 314 cases. 154 had pre-PVI CT imaging and clinician-assessed PVI outcome recorded in the EMR at follow-up, with 50 cases diagnosed with recurrent AF within 3 months to 1 year. 50 non-recurrent cases were randomly selected to produce a balanced dataset for analysis (n = 100). Radiographic features were obtained characterizing left atrium size, pulmonary vein morphology, and angle of vein entry into the left atrium using Syngo.Via (©Siemens Healthcare). The 5 most distinguishing features were selected by Wilcoxon rank-sum and used to train a support vector machine classifier in a 3-fold cross-validation setting. Ability to predict recurrence was assessed by area under the receiver operating characteristic curve (AUC) among all patients and the predictive ability including clinical features was investigated similarly.

RESULTS

Distinguishing radiographic features include angle between right pulmonary veins ($p = 0.063$) and angle of left inferior pulmonary vein entry into the left atrium ($p = 0.060$). Radiographic features effectively predicted recurrence of AF within 1 year of PVI (AUC = 0.65 ± 0.03) and inclusion of clinical features further improved performance (AUC = 0.77 ± 0.02). Distinguishing clinical features include age ($p < 0.001$), BMI ($p = 0.005$), left ventricular ejection fraction ($p = 0.014$), history of hypertension ($p = 0.016$), NYHA class of I or greater ($p = 0.016$), and use of apixaban ($p = 0.016$).

CONCLUSION

Pulmonary vein morphology in CT successfully predicts recurrence of AF after endovascular treatment.

CLINICAL RELEVANCE/APPLICATION

The ability to identify patients likely to have recurrent AF based on CT morphometric features may provide a pre-treatment indicator of response and anatomic features that may be targeted.

SSM04-02 Relationship Between Chronicity of Atrial Fibrillation and Left Atrial Remodeling Determined with Cardiac Magnetic Resonance Imaging in Patients with Atrial Fibrillation: Significance of Regional Left Atrial Late Gadolinium Enhancement

Wednesday, Nov. 28 3:10PM - 3:20PM Room: S103AB

Participants
Dong Kyu Lee, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
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Yu-Whan Oh, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Ho Hwang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Left atrial (LA) remodeling is associated with progression of atrial fibrillation (AF). Cardiac magnetic resonance (CMR) imaging can assess the LA remodeling with LA volume (LAV) and LA late gadolinium enhancement (LA-LGE). The distribution of LA-LGE by LAV is largely unknown. This study aimed to determine the relationship of LA-LGE distribution with LAV and progression of AF.

METHOD AND MATERIALS

195 patients (mean age: 55.7 ± 10.7 years, 82.6% men) underwent LGE-CMR examinations before ablation of paroxysmal AF (PAF, n = 121) or persistent AF (PeAF, n = 74). The LAV and LA-LGE were assessed by three-dimension reconstruction of LGE-CMR images. In each of all 9 preselected LA regions, the presence of LA-LGE was evaluated. Additionally, the incidences (in %) of LA-LGE were calculated in every LA region.

RESULTS

Of all the preselected LA regions, the anterior wall and left inferior pulmonary vein (LIPV) region showed a significantly different incidence of LA-LGE ($p < 0.05$, respectively) depending on the LAV. In all 195 patients, the incidences of LA-LGE in the anterior wall and LIPV region were 15.4% and 15.9%. The patients with PeAF showed significantly higher LA-LGE incidence in the anterior wall (31.1% vs. 5.8%, $p < 0.001$) and LIPV region (29.7% vs. 7.4%, $p < 0.001$) than did those with PAF. After adjusting for LAV, the odd ratios for PeAF of the LA-LGE in anterior wall and LIPV region were 3.8 (95% CI = 1.40-10.41, $p = 0.009$) and 3.7 (95% CI = 1.46-9.75, $p = 0.006$), respectively.

CONCLUSION

In evaluation of LA remodeling using CMR imaging, the regional LA-LGE in anterior wall and LIPV region of LA may be associated with the presence of PeAF.

CLINICAL RELEVANCE/APPLICATION

Cardiac MRI can describe the LA remodeling related to the chronicity of AF. Furthermore, the LA remodling determined with cardiac MRI may help understanding the AF mechanism.

SSM04-03 Determination of Conducting Channels from LGE CMR in Patients with Myocardial Infarction-Direct Comparison with Electroanatomic Mapping for Ventricular Tachycardia Ablation

Wednesday, Nov. 28 3:20PM - 3:30PM Room: S103AB

Participants
Avanti Gulhane, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Saman Nazarian, MD, Baltimore, MD (*Abstract Co-Author*) Scientific Advisor, Johnson & Johnson Research funded, Johnson & Johnson
Harold I. Litt, MD, PhD, Philadelphia, PA (*Presenter*) Research Grant, Siemens AG ; ; ;

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PURPOSE

LGE CMR is an excellent tool to evaluate scar in patients after myocardial infarction (MI). Electroanatomic mapping (EAM) is traditionally used to locate areas in scar tissue giving rise to ventricular tachycardia (VT) and guide ablation. However, new software using pixel signal intensity (PSI) algorithms has made it possible to locate conducting channels (CC) in scar tissue which form VT substrate using LGE CMR. We compared LGE derived CC with EAM findings in patients with VT post MI.

METHOD AND MATERIALS

We evaluated retrospectively 28 patients with previous MI and VT who underwent CMR prior to EAM and VT ablation. Short axis LGE CMR were evaluated using ADAS-VT (Galgo Medical SL, Barcelona) to identify CC within myocardial layers. A PSI-based algorithm was applied to characterize the LGE area as scar core or border zone, using 60% and 40% of the maximum LGE intensity as thresholds. CC were identified topologically by finding border zone coursing through scar core, representing corridors of viable tissue. CC on LGE-CMR were co-registered with EAM on Carto system. This data was evaluated according to AHA 17 segment model for targeted sites of VT ablation on a per patient and per channel basis

RESULTS

In 28 patients, 232 potential VT sites were identified on EAM-CMR merge, of which 129(55%) were targeted for ablation.138 sites of CC were identified. On a per patient basis, 4 CMR analyses were in total agreement with EAM, 24 had partial agreement. 87(67.4 %) CC sites matched sites of ablation, 50(21%) CC sites were detected only on CMR. 53(23%) scar sites had neither CC on CMR nor ablation on EAM. 42(32.5%) sites of ablation on EAM did not show CC on LGE CMR. CC were also correlated with sites having late(64%), fractionated(65%) potentials, critical isthmus, entry points (60%), pacing sites(60%) and induced VT(48%). LGE CMR PSI-based analysis showed sensitivity of 67.4%(95%CI 58.6%-75.4%), specificity of 52%, positive predictive value of 64%(95%CI 58 % - 69.6%) and negative predicting value of 56% and overall diagnostic accuracy of 60% in identifying sites of EAM sites of ablation.

CONCLUSION

LGE CMR PSI-based analysis has good sensitivity and positive predictive value in identifying sites of VT on EAM.

CLINICAL RELEVANCE/APPLICATION

Target sites for VT ablations can predicted by LGE-CMR to aid preprocedural planning, potentially reducing the need for extensive EAM and additional CC on CMR can also identify cause of recurrent VT

SSM04-04 Comparison of Cardiac Venous Anomalies in Complete and Congenitally Corrected Transposition of

the Great Arteries: Implications for Cardiac Resynchronization Therapy

Wednesday, Nov. 28 3:30PM - 3:40PM Room: S103AB

Participants
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PURPOSE

Cardiac resynchronization therapy (CRT) can help improve cardiac function of progressively failing subaortic morphologic right ventricles in both complete (c-TGA) and congenitally corrected (cc-TGA) transposition of the great arteries, but requires transvenous access to the subaortic morphologic right ventricle. We aim to compare the prevalence of cardiac venous anomalies and accessibility for CRT in c-TGA and cc-TGA using cardiac gated computed tomography angiography (CTA).

METHOD AND MATERIALS

With institutional review board approval, all CTA studies performed between 2007-2018 in patients with c-TGA and cc-TGA were retrospectively reviewed. CTAs were evaluated for cardiac venous anomalies and whether both subaortic and subpulmonic ventricles could be accessed via the subpulmonic atrium and coronary sinus. Statistical analysis included independent samples t-test for continuous variables and Fisher's exact test for categorical variables.

RESULTS

121 patients were included [mean age 36 years (range 18-69 yrs), 75 males (62%)] including 70 patients with c-TGA (44 atrial switch, 13 arterial switch, 13 Rastelli) and 51 with cc-TGA (48 no surgery, 3 double switch). Cardiac venous anomalies were more frequent in cc-TGA (30% vs. 6%; $p<0.001$). Accessibility was significantly higher in cc-TGA compared to c-TGA (86% vs 60%; $p<0.002$). Accesibility was lower among c-TGA patients who had undergone atrial switch compared to those with arterial switch or Rastelli procedures (39% vs. 96%, $p<0.001$). Accesibility was also significantly lower among cc-TGA patients who had undergone double switch compared to those who had not (33% vs. 89%, $p=0.048$).

CONCLUSION

Cardiac CTA identifies cardiac venous anomalies that impact eligibility for CRT. CRT eligibility is significantly lower among both c-TGA patients who have undergone atrial switch procedure and cc-TGA patients who have undergone double switch procedure compared to patients who have not.

CLINICAL RELEVANCE/APPLICATION

Cardiac-gated CTA is essential prior to CRT due to high prevalence of cardiac venous anomalies that may render the patient ineligible due to lack of access.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Kate Hanneman, MD, FRCPC - 2017 Honored EducatorKate Hanneman, MD, FRCPC - 2018 Honored Educator

SSM04-05 Anatomical Shape Differences of Left Atrium on CT Predicts Post-Ablation Recurrence of Atrial Fibrillation

Wednesday, Nov. 28 3:40PM - 3:50PM Room: S103AB

Participants
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PURPOSE

Approximately 30% of Atrial Fibrillation (AF) patients who undergo endovascular ablation experience recurring symptoms within the first year after ablation. Patients with long-standing AF demonstrate changes in left atrial morphology and the atrial appendage and pulmonary veins are known regions of interest in ablation, although the impact of morphology on ablation outcome remains unclear. In this study we employed image analysis and machine learning approaches to investigate whether the morphology of the left atrium (LA) was predictive of recurrence in patients undergoing ablation for AF.

METHOD AND MATERIALS

Pre-operative chest CT scans of 68 patients who underwent surgical ablation were acquired between July 2015 and November 2016, of which 31 had AF episodes between 3 and 12 months after ablation. LA masks were created for each patient using an in-house segmentation toolbox and verified by a cardiologist. All patient LA were registered to a common atlas defined by the LA with median volume. Sites of interest (SOI) was then defined for each patient as the regions on the atrial surface with significant difference between recurrent (AF+) and non-recurrent (AF-) patients using a t-test based comparison of the registered atrial. First order statistics of the Gaussian curvature of the surface within the SOI and deformation from atlas to patient LA were extracted,

and a 5-fold cross-validation scheme across 100 runs was conducted to evaluate performance of the features in distinguishing between AF+ and AF- patients using area under the receiver operating characteristic curve (AUC).

RESULTS

The identified regions of maximum shape variation consisted of sites around the atrial appendage and pulmonary veins. Employing feature maps from these regions to classify recurrence performed better (AUC=0.69±0.049) than features from the remaining atrial sites (AUC=0.58±0.58). Combining the feature maps with clinical features (Age, Height, BMI and Weight) produced an AUC of 0.77±0.09, while Using Clinical variables alone produced AUC of 0.66±0.11

CONCLUSION

We identified shape differences between AF+ and AF- patients as well as a set of features relating to local curvature within regions differing different between the two populations that was correlated with likelihood of recurrence.

CLINICAL RELEVANCE/APPLICATION

A systematic process for identifying patients at increased risk for post-ablation recurrence may lead to improved management.

SSM04-06 Detects Myocardial Dyssynchrony of Isolated Left Ventricular Noncompaction Patients with Preserved Ejection Fraction Using Cardiac Magnetic Resonance Feature Tracking

Wednesday, Nov. 28 3:50PM - 4:00PM Room: S103AB

Participants
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PURPOSE

Left ventricular non-compaction (LVNC) is a rare congenital cardiomyopathy, with or without LV dysfunction, and it may be asymptomatic or it may lead to severe HF, sudden death. The aim of our study is to early evaluate the myocardial dyssynchrony in isolated LVNC children with preserved EF by using cardiac magnetic resonance (CMR), and to explore the correlate factors of progress of LVNC.

METHOD AND MATERIALS

we investigated 17 isolated LVNC patients with preserved LVEF (EF>=50%), and 23 age- and gender-matched controls. The feature tracking parameters including peak strain (PS), peak displacement (PD) and strain rate in radial, circumferential, and longitudinal directions were measurement in all subjects.

RESULTS

In all patients, 14 patients were left ventricular apical (73.7%), two patients were left ventricular septum (10.5%), one patient were global left ventricular noncompaction (5.3%). The PS and PD in radial, circumferential, and longitudinal directions decreased significantly in the LVNC patients with preserved EF compared with the normal controls (all $p<0.001$), Furthermore, the PS in three directions were associated with the EF ($r=0.43$; $r=-0.41$; $r=-0.54$); and PS in three directions were also significant correlates with age ($r=-0.47$; $r=0.46$; and $r=0.47$).

CONCLUSION

CMR feature tracking can be used for the detection of early myocardial deformation in the isolated LVNC children who are subclinical left ventricular dysfunctions, and early clinical intervention might be important for the decrease of LVEF function and myocardial deformation.

CLINICAL RELEVANCE/APPLICATION

(dealing with MRI feature tracking) CMR feature tracking can detect early myocardial deformation in the isolated LVNC children with subclinical dysfunctions.

ED002-TH

Cardiac Thursday Case of the Day

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

AMA PRA Category 1 Credit ™: .50

Participants

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TEACHING POINTS

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

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Suhny Abbara, MD - 2014 Honored EducatorSuhny Abbara, MD - 2017 Honored EducatorSachin S. Saboo, MD, FRCR - 2017 Honored EducatorPrabhakar Rajiah, MD, FRCR - 2014 Honored EducatorCarlos S. Restrepo, MD - 2012 Honored EducatorCarlos S. Restrepo, MD - 2014 Honored EducatorCarlos S. Restrepo, MD - 2017 Honored EducatorCarlos S. Restrepo, MD - 2018 Honored Educator

SPSH50

Hot Topic Session: Beyond FDG: Advancing PET Imaging of the Human Disease

Thursday, Nov. 29 7:15AM - 8:15AM Room: E353A

CA MI NR NM

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Chadwick L. Wright, MD,PhD, Lewis Center, OH (*Moderator*) Nothing to Disclose
Katherine A. Zukotynski, MD, Ancaster, ON (*Moderator*) Nothing to Disclose

LEARNING OBJECTIVES

1) To highlight topics related to advances in Cardiovascular PET, Neuro PET and Oncologic PET with FDA approved radiotracers other than FDG. 2) To address myocardial perfusion and atherosclerosis imaging, amyloid imaging, and oncologic imaging.

Sub-Events

SPSH50A New PET Technologies and Acquisition Approaches

Participants
Michael V. Knopp, MD, PhD, Columbus, OH (*Presenter*) Nothing to Disclose

SPSH50B Molecular Imaging of Heart Diseases

Participants
Sharmila Dorbala, MD,MPH, Boston, MA (*Presenter*) Research Grant, Astellas Group

LEARNING OBJECTIVES

1) List clinically available novel PET radiotracers for imaging cardiovascular diseases. 2) Discuss emerging cardiac applications using radiotracers targeting amyloid fibrils, somatostatin receptors and microcalification.

URL

SPSH50C Non-FDG PET Tracers for Molecular Brain Imaging

Participants
Satoshi Minoshima, MD, PhD, Salt Lake City, UT (*Presenter*) Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd;

SPSH50D Molecular Imaging of Cancer: Where Are We Going?

Participants
Peter L. Choyke, MD, Rockville, MD (*Presenter*) Nothing to Disclose

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LEARNING OBJECTIVES

1) Familiarize participants with several new promising PET agents for cancer imaging. 2) Discuss new technologies that will enable the development of similar agents in the near future. 3) Describe opportunities and barriers to broader use of Molecular Imaging in Cancer.

ABSTRACT

Several new PET agents have been developed that promise to revolutionize the way cancer is diagnosed. Agents targeting the somatostatin receptor for neuroendocrine tumors and PSMA for prostate cancers are changing the way these diseases are managed. However, these agents took a long time to develop and even now are not fully available. New small molecule discovery technologies promise to greatly speed up the development of future agents. Many of these are also compatible with targeted radionuclide therapy. The future of this field is exciting and there is much work to be done.

RC603

Cardiac Imaging for Transcatheter Intervention Planning

Thursday, Nov. 29 8:30AM - 10:00AM Room: S103CD

CA CT IR MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Joe Y. Hsu, MD, Los Angeles, CA (*Moderator*) Nothing to Disclose

Sub-Events

RC603A Cardiac CT Acquisition: Protocol Optimization

Participants
Brian B. Ghoshhajra, MD, Waban, MA (*Presenter*) Research Grant, Siemens Healthcare USA;

RC603B Planning TAVR and Mitral Interventions

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

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LEARNING OBJECTIVES

1) Review the data supporting the utility and clinical efficacy of transcatheter interventions. 2) Discuss the role of CT for procedural planning and device selection. 3) Review how CT can be used to help improve clinical outcomes.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Jonathon A. Leipsic, MD - 2015 Honored Educator

RC603C Cardiac MRI and CT for Arrhythmia Treatment

Participants
Stefan L. Zimmerman, MD, Ellicott City, MD (*Presenter*) Project consultant, Siemens Healthcare; Research grant, American Heart Association;

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LEARNING OBJECTIVES

1) Learn how non-invasive imaging with cardiac MRI and CT are used in the evaluation of patients with cardiac arrhythmias. 2) Understand how MRI and CT can be used for imaging of the arrhythmia substrate and pre-procedural planning. 3) Comprehend the role of non-invasive imaging for sudden cardiac death risk stratification and decisions related to ICD placement.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Stefan L. Zimmerman, MD - 2012 Honored EducatorStefan L. Zimmerman, MD - 2015 Honored Educator

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

RC611

Advances in Cardiac Nuclear Imaging: SPECT/CT and PET/CT

Thursday, Nov. 29 8:30AM - 10:00AM Room: S504CD

CA CT NM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

LEARNING OBJECTIVES

1) Understand the technical advancements associated with new scintillation cameras and SPECT-CT and PET-CT cameras. 2) Appreciate the benefits of CT attenuation correction. 3) Appreciate the adjunctive benefits of anatomic definition provided with CT and physiologic/function information provided by SPECT and PET. 4) Improve interpretive skills related to SPECT and PET-CT.

ABSTRACT

Camera and software technology recently has rapidly advanced, providing improved SPECT image resolution and increased counting statistics. These advancements in turn have provided the possibility of reduced-time and reduced radiopharmaceutical dose image acquisitions. Moreover, increased flexibility in imaging protocols has been realized. Future development of these methods hold promise in increasing diagnostic accuracy and expanding diagnostic applications. The addition of CT to SPECT and PET has afforded the ability to perform attenuation correction, thereby minizing attenuation artifacts and increasing diagnostic specificity. With CT acquisitions of sufficient resolution, complementary anatomic diagnostic information is provided. In addition, more precise anatomic localization of SPECT and PET abnormalities significantly increases clinical applicability.

Sub-Events

RC611A Advances in Cardiac SPECT

Participants
E. Gordon Depuey, MD, New York, NY (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) Implement protocols that facilitate patient-centered imaging and that reduce patient radiation exposure. 2) Understand software methods to cope with lower SPECT counting statistics in order to reduce scan acquisition time and/or radiopharmaceutical injected activity and their clinical impact. 3) Understand instrumentation advances that allow new cameras to perform SPECT with markedly reduced acquisition times and/or less radiopharmaceutical activity and their clinical impact. 4) Review myocardial perfusion SPECT scans systematically to avoid artifacts and maximize diagnostic accuracy.

ABSTRACT

There has been an intersocietal effort to promote patient-centered imaging with a focus on appropriateness guidelines, cost-containment, radiation dose reduction, and the selection of the most appropriate imaging test and protocol to suit particular patient needs. The following technical advancements described facilitate implementation of patient-centered imaging. New software methods and new innovative hardware now allow for significantly shortened SPECT acquisition times without a decrease in image quality. Advancements include iterative reconstruction, resolution recovery, and noise reduction software, and focused collimation and solid state detectors incorporated into new camera designs. Attenuation correction increases diagnostic specificity and facilitates stress-only protocols. Software advancements such such as high resolution imaging, scatter correction, and respiratory gating increase diagnostic sensitivity. Even with such technical advancements, however, attention to technical detail is essential to assure optimal image quality. Camera and radiopharmaceutical quality control deserve the highest priority. A systematic review of myocardial perfusion SPECT images is essential to recognize artifacts and optimize diagnostic accuracy. Case examples will be presented to reinforce this approach.

RC611B Advances in Cardiac PET

Participants
Sharmila Dorbala, MD,MPH, Boston, MA (*Presenter*) Research Grant, Astellas Group

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 coronary artery disease. 3) Discuss novel clinical applications of cardiovascular PET imaging in systemic diseases 4) Review Case Examples of Cardiac PETs

ABSTRACT

Advances in PET detectors, radiotracer availability, clinical software, as well as hybrid PET/CT and PET/MR scanners have revolutionized the clinical and investigative applications of cardiac PET. Cardiac PET myocardial perfusion imaging, in the 1970's, was a predominantly investigative tool, with home-grown software, available at select major academic centers with access to a cyclotron. Over the last decade, with easy access to PET scanners, and to positron emitting perfusion tracers, the use of cardiac PET has exploded -well beyond major academic centers to several hospitals and to large office-based practices. Robust clinical evidence coupled with commercially available software has made quantitative myocardial blood flow assessment, a main-stream clinical application. Hybrid PET/CT scanner applications- calcium score and CT based coronary angiography-have further advanced

the applications of cardiac PET. A growing body of recent literature supports the role of targeted molecular PET to image inflammatory, infectious and infiltrative heart diseases. PET/MR is an emerging technology with promising cardiovascular applications. Each of these exciting developments has transformed cardiac PET from a predominantly investigative tool of the 1970's to the current advanced clinical tool. The primary goal of this session is to discuss the present-day clinical and emerging applications of cardiac PET/CT and PET/MR using a practical case-based approach.

RC611C Cases, Clinical Examples-Panel: How to Build Practice (Both PET and SPECT)

Participants
E. Gordon Depuey, MD, New York, NY (*Presenter*) Nothing to Disclose
Sharmila Dorbala, MD,MPH, Boston, MA (*Presenter*) Research Grant, Astellas Group

LEARNING OBJECTIVES

1) Interpret cardiac SPECT and PET scans with optimal sensitivity and specificity. 2) Recognize technical and patient-related artifacts. 3) Characterize myocardial perfusion defects whereby patients can be risk stratified with regard to risk of future cardiac events. 4) Formulate reports in a clinically relevant manner.

SSQ02

Cardiac (Great Vessels and Cardiopulmonary Disease)

Thursday, Nov. 29 10:30AM - 12:00PM Room: S404AB

CA CH CT MR VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Matthew D. Cham, MD, New York, NY (*Moderator*) Nothing to Disclose
Seth J. Kligerman, MD, Denver, CO (*Moderator*) Nothing to Disclose
Jeremy D. Collins, MD, Chicago, IL (*Moderator*) Consultant, Guerbet SA Grant, Siemens AG Grant, C. R. Bard, Inc

Sub-Events

SSQ02-01 3rd Generation Dual Source CT Pulmonary Angiographic Study at Very Low Contrast Doses: A New Frontier

Thursday, Nov. 29 10:30AM - 10:40AM Room: S404AB

Participants
Nicolo Schicchi, MD, Ancona, Italy (*Presenter*) Nothing to Disclose
Matteo Oliva, MD, Ancona, Italy (*Abstract Co-Author*) Nothing to Disclose
Corrado Tagliati, Ancona, Italy (*Abstract Co-Author*) Nothing to Disclose
Giacomo Agliata, MD, Saint-Denis, France (*Abstract Co-Author*) Nothing to Disclose
Paolo Esposto Pirani, Ancona, Italy (*Abstract Co-Author*) Nothing to Disclose
Andrea Giovagnoni, MD, Ancona, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Pulmonary Angio-CT is the first diagnostic choice for the evaluation of pulmonary embolism and usually performed with iodinated contrast media (CM) injection. The purpose of this study is to evaluate the lower amount of iodinated CM required in order to obtain a diagnostic quality pulmonary Angio-CT with the new Dual Source CT technology.

METHOD AND MATERIALS

36 patients (16 males, 20 females; mean age 40 years) were enrolled with medium-high pre-test probability of pulmonary embolism and underwent a 3rd generation Dual Source CT (Somatom Force Siemens Healthineers) scan. Three groups of 12 patients each one were randomized using 400 mgI/mL iodinated CM with different doses: group A (<5 ml), group B (<10 ml) and group C (<15 ml). The Hounsfield Unit (HU) values were sampled at predefined points of the pulmonary arteries. Each exam was also assessed qualitatively with a 5-point scale.

RESULTS

HU evaluation did not show statistically significant difference between groups A and B, while they showed statistically significant difference between group C and groups A-B (Kruskal-Wallis, p=0.025). Qualitative analysis did not find statistically significant difference between groups A, B and C (Kruskal-Wallis, p=0.12).

CONCLUSION

The new 3rd Dual Source CT technology allows for an optimization of pulmonary angio-CT study in order to obtain a diagnostic quality images with low doses of iodinated CM.

CLINICAL RELEVANCE/APPLICATION

The purpose of this study is to evaluate a reduced contrast media administration in patients with suspected pulmonary embolism in an emergency setting, especially in patients with higher risk of contrast-induced nephropathy (CIN) (i.e. nephropatic or type 2 diabetic patients).

SSQ02-02 2D-PC MRI Measurement of Pulmonary Artery Blood Flow and Left Atrial Function in Smokers: A Correlational Research

Thursday, Nov. 29 10:40AM - 10:50AM Room: S404AB

Participants
Shuangchun Ma, Dalian, China (*Presenter*) Nothing to Disclose
Zhiyong Li, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Ruyi Bao, MD, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Chen Hui, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Xin Li, Dalian, China (*Abstract Co-Author*) Nothing to Disclose
Ailian Liu, MD, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

Qingwei Song, MD, Dalian, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

To investigate the correlation between main pulmonary artery blood flow and left atrium functional parameters in smokers using two-dimensional phase contrast magnetic resonance imaging (2D-PCMRI).

METHOD AND MATERIALS

Twenty-eight smokers (all men, mean age: 39.8±7.0 years) were enrolled in this study. All of them underwent main pulmonary artery 2D-PC and cardiac scan at 3.0T MR from December 2017 to March 2018. Blood flow parameters include Peak Positive Velocity (PPV) (cm/s), Peak Negative Velocity (PNV) (cm/s), Average flow (AF) (ml/beat), Average Positive Flow (APF) (ml/beat), and Average Negative Flow (ANF) (ml/beat). The correlation between main pulmonary artery blood flow and left atrial functional parameters was analyzed.

RESULTS

There is a statistically correlation between pulmonary artery PPV and left atrial active ejection fraction (LAEFa) (p=0.022, r=0.431), and left atrium total ejection fraction (LAEFt) (p=0.032, r=0.406) respectively. Similarly, there is a statistically correlation between pulmonary artery AF and left atrium maximum volume (LAVi max) (p=0.048, r=0.378), LAEFa (p=0.040, r=0.391) and LAEFt (p=0.008, r=0.488) respectively. There is a statistically correlation between APF and LAVi max (p=0.039, r=0.392), LAEFt (p=0.028, r=0.415), respectively.

CONCLUSION

There is a positive correlation between the main pulmonary artery blood flow and left atrium function in smokers.

CLINICAL RELEVANCE/APPLICATION

This correlational research of pulmonary artery blood flow and left atrium function is helpful in further to understand and reveal the effect of smoking on the cardiovascular system.

SSQ02-03 Quantification of Pulmonary Emboli Burden by Novel 3D-Based Computed Tomography Method: Comparison with Qanadli Score, Biomarkers, and Clinical Information

Thursday, Nov. 29 10:50AM - 11:00AM Room: S404AB

Participants
Wei-Ming Huang, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose
Chun-Ho Yun, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose
Wen-Jui Wu, MD, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose
Chung-Lieh Hung, MD,PhD, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Dedicated descriptions of pulmonary emboli (PE) morphology, total emboli burden, and the possible impacts on hemodynamics and diagnostic biomarkers remained largely unexplored.

METHOD AND MATERIALS

We consecutively studied subjects suffered from acute PE who visited emergency department. On arrival hemodynamics, oxygenation status, and markers of Troponin-I/D-dimer were all obtained. Contrast enhanced spiral computed tomography (CT) for pulmonary vasculature and 3-dimensional (3D) measures of emboli burden were performed (IntelliSpace Portal [ISP] 9.0 Philips Medical Systems Nederland B.V.).

RESULTS

Among 116 subjects (mean age: 70.1±16.0, 64% female) with clinical information and CT-based 3D embolism quantification available, the mean total emboli size were 8.6cm3, Qanadli scores was 7.4, 4.6, and 12.1 for right, left side and total pulmonary trunk (reference range: 0-20), respectively. Both greater total emboli mass and pulmonary emboli Qanadli score were positively associated with higher Troponin I level (r=0.23 & 0.33, both p<0.05), and marginally associated with lower on arrival oxygenation saturation (SpO2) (by blood gas, r=-0.38, p=0.05). Instead, total emboli burden within lung parenchyma was strongly inversely associated with SpO2 (r=-0.48 & -0.42, both p<0.05).

CONCLUSION

Total thromboemboli burden assessed by quantitative CT-based modality served as a useful index for stressed cardiopulmonary circulation, and possibly provide insights into oxygenation/perfusion status.

CLINICAL RELEVANCE/APPLICATION

Total thromboemboli burden assessed by quantitative CT-based modality served as a useful index for stressed cardiopulmonary circulation.

SSQ02-06 Evaluation of Coronary Artery in Kawasaki Disease By 3D Magnetic Resonance Coronary Angiography

Thursday, Nov. 29 11:20AM - 11:30AM Room: S404AB

Participants
Chuan Fu, BS,BMedSc, Chengdu, China (*Presenter*) Nothing to Disclose

Rong Xu, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Hui Liu, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Kawasaki disease causes inflammation that is inclined to cause heart complications, such as coronary artery vasculitis, myocarditis, and heart valve problems. Our study is aimed to assessment of coronary arteries in Kawasaki disease by 3D magnetic resonance imaging

METHOD AND MATERIALS

The study group consisted of 16 pediatric patients aged 2 to 10 years (males, 87.5%; mean age, 4.8 year) with Kawasaki diseases from Jan. 2017 to Mar. 2018. All patients underwent three-dimensional (3D) whole-heart magnetic resonance imaging (1.5T, Phiilps;) using two different sequences (3D TEE sequence; 3D BTEE sequence;). Sweep time were record and the image quality was graded (from 0 to 5).

RESULTS

there were six patients with enlarged left and right ventricles (37.5%), three patients with enlarged whole-heart (18.75%), two patients with double superior vena cavas and enlarged left atrium and ventricle (12.5%). The scan time of 3D TEE sequence was One minute and forty seconds to two minute and thirty seconds (1min 40s to 2 min 30s), The scan time of 3D BTEE sequence was five minute and twenty seconds to six minute and thirty seconds (5 min 20s to 6 min 30s). For the grade of imaging quality, five patients were classes as 0-2 grade (31.25%), 11 patients were 3-5 grade (68.75) by the 3D TEE sequence, and six patients were 0-2 grade (37.5%), 11 patients were 3-5 grade (62.5%) by the 3D BTEE sequence.

CONCLUSION

3D whole-heart coronary arteries magnetic resonance imaging could obtain similar imaging quality with less scan time, it may be an excellent method to image, evaluate, diagnose, and follow-up coronary arteries lesions in pediatric patients with Kawasaki diseases.

CLINICAL RELEVANCE/APPLICATION

(dealing with 3D coronary arteries magnetic resonance imaging) 3D whole-heart coronary arteries magnetic resonance imaging could obtain similar imaging quality with less scan time.

SSQ02-07 Automatic Segmentation of Lung Volumes in Population-based Whole-Body MR Imaging: Association with Subclinical Cardiac Impairment

Thursday, Nov. 29 11:30AM - 11:40AM Room: S404AB

Participants
Ricarda V. von Kruchten, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose
Roberto Lorbeer, Greifswald, Germany (*Abstract Co-Author*) Nothing to Disclose
Tanja Zitzelsberger, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Tatyana Ivanovska, Gottingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Corinna Storz, MD, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Christopher Schuppert, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
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Lena Sophie Kiefer, MD, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Christopher L. Schlett, MD, MPH, Heidelberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Fabian Bamberg, MD, Tuebingen, Germany (*Abstract Co-Author*) Speakers Bureau, Bayer AG ; Speakers Bureau, Siemens AG ; Research Grant, Siemens AG
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Annette Peters, Neuherberg, Germany (*Abstract Co-Author*) Nothing to Disclose
Hans-Ulrich Kauczor, MD, Heidelberg, Germany (*Abstract Co-Author*) Research Grant, Siemens AG Research Grant, Bayer AG Speakers Bureau, Boehringer Ingelheim GmbH Speakers Bureau, Siemens AG Speakers Bureau, Koninklijke Philips NV Speakers Bureau, Bracco Group Speakers Bureau, AstraZeneca PLC
Holger Schulz, Neuherberg, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Both cardiac and pulmonary morphology and function can be simultaneously assessed during a single MR scan. Previous studies have shown an association between obstructive lung disease with cardiac dysfunction. Our aim is to evaluate the relationship between lung volumes and cardiac impairment in a population-based cohort study using whole-body MR scans.

METHOD AND MATERIALS

We studied 400 subjects who underwent whole-body MRI as part of the KORA FF4 cohort study, excluding subjects with established cardiovascular disease. Lung volumes were derived semi-automatically through an in-house algorithm (coronal acquired T1w sequences). Using Pearson correlation and multivariate regression (adjusted for age, sex, smoking status and BMI), lung volumes were compared with cardiac parameters of left and right ventricle (LV/RV, acquired from cine-SSFP sequences using cvi42), and standardized to body surface area.

RESULTS

A total of 356 subjects presented an average MRI-based lung volume of 4.0±1.1L and mostly standard values for cardiac parameters. In univariate analysis, a negative correlation of LV and RV stroke volume to lung volume was observed. After multivariate adjustment, stroke volume as well as end-diastolic volume of both LV (ß=-2.75, p=0.001; ß=-1.71, p=0.001) and RV (ß=-2.14, p=0.02; ß=-1.45, p=0.004) showed negative associations with lung volume, while ejection fraction, peak ejection rate and myocardial mass were not associated with lung volumes (Figure 1). These values were stronger for the LV than for the RV. In addition, for the LV, early but not late diastolic filling rate was negatively associated with lung volume.

CONCLUSION

Cardiac function and volume parameters derived from non-dedicated whole-body MRI, such as stroke volumes and biventricular end-diastolic volumes were significantly associated with lung volumes in a patient cohort without cardiovascular disease.

CLINICAL RELEVANCE/APPLICATION

These results suggest, that MRI could be an accurate, radiation-free, and possibly one-stop-shop screening tool, with the potential for early detection of subclinical heart disease in patients with emphysema and subclinical cardiovascular dysfunction.

SSQ02-08 Double Region of Interest Timing Bolus Technique to Perform Aortic CT Angiography with 40 Ml of Contrast Medium

Thursday, Nov. 29 11:40AM - 11:50AM Room: S404AB

Participants
Nobuo Tomizawa, MD, Matsudo, Japan (*Presenter*) Nothing to Disclose
Shingo Ito, Matsudo, Japan (*Abstract Co-Author*) Nothing to Disclose
Tatsuya Nakao, Matsudo, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroaki Arakawa, Matsudo, Japan (*Abstract Co-Author*) Nothing to Disclose
Kodai Yamamoto, Bunkyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Shinichi Inoh, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Takeshi Nojo, MD, PhD, Matsudo-shi, Japan (*Abstract Co-Author*) Nothing to Disclose
Sunao Nakamura, Matsudo, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

We developed a novel method to track the peak of the injected contrast medium by placing two regions of interest (ROI) at the timing bolus image. The purpose of this study was to compare the enhancement of the aorta when CT angiography was performed with 40 mL of contrast medium using the novel double ROI timing bolus (DRTB) technique with the enhancement using the conventional method.

METHOD AND MATERIALS

We prospectively included 21 patients from February to March 2018 who underwent repeated CT angiography of the aorta. In the prior scan, a total of body weight × 1.7 mL of contrast medium was injected for 25 s, and the scan timing was determined by the bolus tracking technique. The tube potential was 120 kVp and the table speed was set as fast as possible to acquire the entire aorta. In the DRTB method, timing bolus technique was performed using 9 mL of contrast medium at the level of the aortic root. An ROI was placed at the ascending and descending aorta, respectively. Time density curves of the two ROIs were drawn and the difference of the peak time (Tdiff) was recorded. The blood flow of the aorta was calculated by dividing the length of the thoracic aorta by Tdiff. The main scan was performed with a tube potential of 100 kVp. We injected 40 mL of contrast medium for 9 s and adjusted the table speed to follow the peak of the injected contrast bolus. We evaluated the attenuation of the aorta at the level of aortic root, arch, descending, celiac trunk, and iliac bifurcation.

RESULTS

The injected contrast medium during the main scan significantly reduced from 87 ± 11 to 40 mL (p <0.001). The attenuation of the aorta at the level of the aortic root, arch, descending, celiac trunk, and iliac bifurcation using the DRTB method were 408 ± 125, 425 ± 99, 421 ± 96, 414 ± 96, 417 ± 101 HU, respectively, which were all significantly higher than using the conventional method (341 ± 72, 370 ± 61, 362 ± 59, 349 ± 96, 362 ± 70 HU, respectively, all p <0.05).

CONCLUSION

DRTB method could dramatically reduce the contrast medium during aortic CT angiography while improving the enhancement than the conventional method.

CLINICAL RELEVANCE/APPLICATION

Aortic CT angiography using the DRTB method would reduce the risk of contrast induced nephropathy and also widen the indication of aortic CT to patients with chronic kidney disease.

SSQ02-09 Subclinical Changes in Cardiac Functional Parameters as Determined by Cardiovascular Magnetic Resonance (CMR) Imaging in Patients with Sleep Apnea and Snoring: Findings from UK Biobank

Thursday, Nov. 29 11:50AM - 12:00PM Room: S404AB

Participants
Adrian Curta, MD, Munich, Germany (*Presenter*) Nothing to Disclose
Holger Hetterich, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Regina Schinner, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Aaron M. Lee, London, United Arab Emirates (*Abstract Co-Author*) Nothing to Disclose
Wieland H. Sommer, MD, Munich, Germany (*Abstract Co-Author*) Founder, Smart Reporting GmbH
Harald Kramer, MD, Munich, Germany (*Abstract Co-Author*) Research Consultant, Bayer AG; Speakers Bureau, b.e. imaging AG
Nay Aung, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Mihir Sanghvi, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Kenneth Fung, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Elena Lukaschuk, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Jackie Cooper, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Jose M. Paiva, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Valentina Carapella, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Stefan Neubauer, Oxford, United Kingdom (*Abstract Co-Author*) Shareholder, Perspectum Diagnostics Ltd; Non-Executive Director, Perspectum Diagnostics Ltd

Stefan Piechnik, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Steffen E. Petersen, London, United Kingdom (*Abstract Co-Author*) Consultant, Circle Cardiovascular Imaging Inc; Consultant, GlaxoSmithKline plc

PURPOSE

Obstructive sleep apnea (OSA) is a common disorder that shows an increased risk for left ventricular (LV) and, more rarely, right ventricular (RV) dysfunction. Most studies to date have examined populations with manifest cardiovascular disease and have used echocardiography to analyze ventricular dysfunction, with little or no reference to ventricular volumes or myocardial mass. We hypothesized that there would be stepwise increase in LV mass and RV volumes from the unaffected, to the snoring and the OSA group.

METHOD AND MATERIALS

We analyzed cardiac MRI data from 4493 UK Biobank participants free from cardiovascular disease. Participants were allocated into three cohorts: (i) with OSA; (ii) with self-reported snoring; and (ii) without OSA or snoring (n=38; 1919; and 2536 respectively). We determined ventricular volumes, ejection fraction and LV mass from balanced cine-SSFP sequences.

RESULTS

Trend analysis showed a stepwise increase for LV mass in both genders ($p<0.001$) and for LV and RV ejection fraction (EF) and stroke volume (SV) as well as LV end diastolic volume in males ($p<0.02$). There was no significant difference when comparing the OSA group to the unaffected group but we found a significant difference when comparing snoring to unaffected in LV mass of females (ß=1.45±0.55g; p=0.009) and in LVEF and RVEF as well as LVSV and RV end systolic volume of males (ß=0.80±0.28%; p=0.005, ß=1.17±0.28%; $p<0.001$, ß=1.68±0.76ml; p=0.027 and ß=-2.41±0.90ml; p=0.008) respectively.

CONCLUSION

Our study suggests that the transition from snoring to OSA is an evolving process which is associated with LV hypertrophy. The different results based on the gender in the pilot data point to a gender specific progression. Separate prospective studies are needed to further explore the direction of causality.

CLINICAL RELEVANCE/APPLICATION

Sleep apnea and snoring lead to gender specific alterations in cardiac function which may require diversified prevention and treatment strategies.

SSQ03

Science Session with Keynote: Cardiac (Coronary Artery Disease: CT and MR Techniques)

Thursday, Nov. 29 10:30AM - 12:00PM Room: S404CD

CA CT MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Borek Foldyna, MD, Boston, MA (*Moderator*) Nothing to Disclose
Cristina Fuss, MD, Portland, OR (*Moderator*) Spouse, Officer, ViewRay, Inc

Sub-Events

SSQ03-01 Cardiac Keynote Speaker: Technical Advances in Coronary Artery Imaging

Thursday, Nov. 29 10:30AM - 10:50AM Room: S404CD

Participants
Borek Foldyna, MD, Boston, MA (*Presenter*) Nothing to Disclose

SSQ03-03 Free-Breathing Coronary CT Angiography Using 16-Cm Wide-Detector for Challenging Patients: Comparison with Invasive Coronary Angiography

Thursday, Nov. 29 10:50AM - 11:00AM Room: S404CD

Participants
Tao Shuai, Chengdu, China (*Presenter*) Nothing to Disclose

PURPOSE

To detected the superiority of free-breathing coronary computed tomography angiography (CCTA) with 16-cm wide-detector CT for challenging patient who cannot hold breath.

METHOD AND MATERIALS

A total of 76 patients (62% with either heart rate >75bpm or arrhythmia) unable to hold breath underwent both free-breathing CCTA and ICA were included. Two reviewers evaluated coronary arteries on the per-segment (using 18-segment model), per-vessel and per-patient basis for image quality using a four-point scale and stenosis degree. CCTA results were compared with ICA to calculate the diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

RESULTS

Out of 1368 total segments, 228(16.7%) were less than 1.5mm in diameter and were excluded in CT, 32(2.3%) with calcification and 26(1.9%) with motion artifacts and were considered positive in CT. 1082 segments (79.1%) were evaluated both on CCTA and ICA and 128(11.8%) segments had stenosis >=50% on ICA. The diagnostic accuracy, sensitivity, specificity, PPV, and NPV of CCTA were 90.8%, 88.3%, 91.1%, 57.1% and 98.3% on a per-segment basis; 93.4%, 90.6%, 94.2%, 80.5% and 97.4% on a per-vessel basis; and 92.1%, 100%, 85%, 85.7% and 100% on a per-patient basis. For patients with high heart rates or arrhythmia, 81% (vs. 79.1%) segments were evaluable, and the accuracy, sensitivity, specificity, PPV, and NPV were statistically the same as the entire study population.

CONCLUSION

Free-breathing CCTA using 16-cm wide-detector CT has high accuracy for detecting coronary artery stenosis for challenging patients in comparison with ICA.

CLINICAL RELEVANCE/APPLICATION

Wide-detector CT has high clinical value for detecting coronary artery stenosis in CCTA for patients unable to hold breath.

SSQ03-05 Influence of Contrast Media Parameters on Image Quality in Cardiac Computed Tomography: Insights from a Multicenter Registry

Thursday, Nov. 29 11:10AM - 11:20AM Room: S404CD

Participants
Ludovico La Grutta, MD, Palermo, Italy (*Presenter*) Nothing to Disclose
Alberto Clemente, Massa, Italy (*Abstract Co-Author*) Nothing to Disclose
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Marco Francone, MD,PhD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

Ernesto E. Di Cesare, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose
Massimo Midiri, MD, Palermo, Italy (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

A retrospective, multicenter, observational study on the use of contrast media (CM) in patients undergoing cardiac computed tomography (CCT) was conceived. The primary aim of the registry was to determine the influence on image quality of CM use.

METHOD AND MATERIALS

The registry included 1842 consecutive patients (>=50 per site; CCT indicated for suspected coronary artery disease) in 20 cluster sites. Every center collected demographics, CT scan parameters, CM administration protocols, radiation dose records, and adverse reactions reports. Image datasets were sent to a core lab who evaluated qualitative (intracoronary enhancement, motion artifacts) and quantitative (HU attenuation values, signal-to-noise ratio - SNR, and contrast-to-noise ratio - CNR) parameters.

RESULTS

The registry enrolled 891 men and 951 women (mean age 63±14 years, mean body mass index 26±4) who underwent CCT performed with >=64 detector rows CT scanners and several iodine contrast media protocols and molecules (iodixanol, iopamidol, iohexol, iobitridol, iopromide, and iomeprol). The core lab reported the following mean vascular attenuation: 504±147HU in the aorta, 451±146HU in the right coronary artery, 474±146HU in the left main, 451±146HU in the left anterior descending artery, and 441±149HU in the circumflex artery. SNR and CNR were improved with high iodine concentration CM (29±17 vs. 24±13 of low iodine concentration CM, p<0.0001; 35±19 vs. 30±15, p<0.0001) and >5ml/s flow rate (29±17 vs. 26±14 of <=5ml/s flow rate, p<0.0001; 35±19 vs. 32±16, p<0.0001), while they were not affected by decrease in CM volume <=80ml (28±17 vs. 27±14 of CM volume >80ml, p=0.0681; 34±20 vs. 32±16, p=0.1175). If compared to 120kV scanning, the use of low kV (n=393) improved SNR (33±21 vs. 25±13, p<0.0001) and CNR (39±23 vs. 31±16, p<0.0001). The use of iterative reconstructions (n=562) improved SNR (33±19 vs. 25±13, p<0.0001) and CNR (39±22 vs. 30±15, p<0.0001). In 80 patients the image quality was not satisfactory due to poor intra-coronary enhancement.

CONCLUSION

In a multicenter CCT registry image quality is influenced by the selection of CM parameters. The CM bolus geometry is affected by iodine concentration and flow, but it can be further refined by low kV scanning and iterative reconstructions.

CLINICAL RELEVANCE/APPLICATION

Optimization of CM parameters in conjunction with low kV scanning and iterative reconstructions improves image quality of CCT.

SSQ03-07 Deep Learning Analysis in Coronary Computed Tomographic Angiography Imaging for the Evaluation of Patients with Coronary Artery Atherosclerosis Stenosis

Thursday, Nov. 29 11:30AM - 11:40AM Room: S404CD

Participants
Dan Han, MMed, DMRD, Beijing, China (*Presenter*) Nothing to Disclose

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PURPOSE

To evaluate the feasibility of using deep learning and transfer learning approaches for coronary computed tomographic angiography (CCTA) imaging (termed coronary artery heart disease-artificial intelligence (CHD-AI)) in coronary artery atherosclerosis stenosis.

METHOD AND MATERIALS

A CCTA reconstruction pipeline was built by using deep learning and transfer learning approaches to generate simulated CCTA images from a series of two-dimensional (2D) CT images. A deep semantic segmentation network (SSN) was trained to identify coronary artery branch vessels, coronary lumen with more than 10,000 CCTA cases, which was treated as the Coronary BASE model. Based on the BASE model, retrospective CCTA images of 100 patients diagnosed with CHD by DSA were used to train a new model by transfer learning to further identify calcified plaque, non-calcified plaque and various degrees of coronary stenosis. The new model was then evaluated in 50 CHD patients by comparing the simulated CCTA images to CCTA images with digital subtraction angiography (DSA) images as the gold standard. Analysis of Kappa consistency test was used for statistical analysis to compare CHD-AI reconstruction with CCTA and DSA in detecting various degrees of coronary stenosis.

RESULTS

With only 100 CCTA cases as the training dataset, based on transfer learning, CHD-AI provided a relatively accurate simulated CCTA imaging with a Kappa value of 0.327 for detecting calcified plaque and non-calcified plaque compared to CCTA (P<0.001). For detecting coronary artery atherosclerosis with moderate and above stenosis, CHD-AI provided good sensitivity of 72% (11% more than CCTA) and negative predictive values of 80% (only 4% less than CCTA). Specificity (51%), coincidence (58%) and positive predictive values (40%) were relatively low.:

CONCLUSION

The proposed CHD-AI allows the generation of simulated CCTA images from a series of 2D CT images. This approach provides good sensitivity and negative predictive value for detecting stenosis and is relatively accurate for detecting calcified plaque and non-calcified plaque compared to CCTA. But it is still relatively high in false-positive rate.

CLINICAL RELEVANCE/APPLICATION

This CHD-AI can omit some CCTA reconstruction steps to some extent, reduce diagnostic time and the error of human eyes in assessing the degree of coronary stenosis compared with current CCTA imaging.

SSQ03-08 Deep Learning Enables Inline Image Reconstruction of Accelerated, Single-shot Coronary QISS MRA in Patients with Congenital Heart Disease

Thursday, Nov. 29 11:40AM - 11:50AM Room: S404CD

Participants
Daming Shen, Evanston, IL (*Presenter*) Nothing to Disclose
Hassan Haji-Valizadeh, Evanston, IL (*Abstract Co-Author*) Nothing to Disclose
Robert R. Edelman, MD, Evanston, IL (*Abstract Co-Author*) Nothing to Disclose
Cynthia K. Rigsby, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Daniel Kim, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Our previous study demonstrated the feasibility of 1-shot, real-time coronary Quiescent-Interval Slice-Selective (QISS) MRA in children with congenital heart disease using compressed sensing (CS). While CS produced clinically acceptable image quality, it is a poor fit for inline image reconstruction because of its slow reconstruction time (~60 s per image). Deep learning (DL) is an alternative framework for reconstructing MR images with considerably higher speed. The purpose of this study is to demonstrate the feasibility of inline image reconstruction of accelerated coronary QISS MRA using DL.

METHOD AND MATERIALS

This study entailed 2-fold accelerated, 2-shot coronary QISS MRA data sets obtained from 26 pediatric patients (mean age = 16.4 ± 7.9 years; 16 boys and 10 girls) scanned on a 1.5T scanner (Aera, Siemens). The QISS data were undersampled by an additional factor of 2 (i.e., 1-shot, real-time) and reconstructed using CS with total variation (TV) and a deep convolutional neural network adapted from a U-Net (layer depth = 5, 64 features on the first layer, GPU based tensorflow framework in Python). We fed 1-shot and 2-shot QISS images from first 20 patients (283 images) as input and output pairs to train the U-Net. Subsequently, images from the remaining 6 patients (69 images) were used to validate the trained U-Net. Using the 2-shot QISS with CS as control, we measured the DICE coefficients as a metric of reproducibility for 1-shot QISS with zero padding, 1-shot QISS with CS and 1-shot QISS with U-Net.

RESULTS

Both 1-shot QISS with CS and DL produced image quality that is comparable to 2-shot QISS (Fig. 1). The mean DICE coefficients for 1-shot QISS with zero padding, 1-shot QISS with CS and 1-shot QISS with U-Net images were 77.3 ± 7.4%, 90.0 ± 4.4% and 87.3 ± 4.1%, respectively. While the differences in DICE were significantly different for all pairs ($p < 0.05$), the difference between CS and U-Net was only 3%. The reconstruction time for U-Net (0.42 ± 0.04 s) was significantly lower ($p < 0.05$) than CS (52.3 ± 2.1 s).

CONCLUSION

This study demonstrates the feasibility of performing inline reconstruction of single-shot coronary QISS MRA using DL.

CLINICAL RELEVANCE/APPLICATION

Pediatric patients with congenital heart disease who require non-invasive evaluation of coronary origins for planning a surgical intervention may benefit from non-contrast, 1-shot coronary QISS MRA with inline image reconstruction using deep learning.

SSQ12

Molecular Imaging (Musculoskeletal, Gastrointestinal, Cardio)

Thursday, Nov. 29 10:30AM - 12:00PM Room: S504CD

CA GI MR MI MK NM

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

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

Sub-Events

SSQ12-01 Histological Validation of Chemical Exchange Saturation Transfer (CEST) imaging for the Measurement of Metabolism Status in Infarcted Myocardium

Thursday, Nov. 29 10:30AM - 10:40AM Room: S504CD

Participants
Kaiyue Diao, Chengdu, China (*Presenter*) Nothing to Disclose
Zhigang Yang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Yingkun Guo, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Wanlin Peng, MS, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose
Chunchao Xia, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

The purpose of this study was to test if the distribution of creatine shown on Chemical Exchange Saturation Transfer (CEST) MRI could differentiate infarct myocardium from the normal on pigs, by referring to LGE images and pathologic results.

METHOD AND MATERIALS

We prospectively enrolled 27 Bama miniature pigs. MI model was built by applying a ligation at the remote ending of the left anterior descending artery. CMR scan was arranged at 3 days and 2 months later for the AMI and CMI group on a 3 T whole-body scanner. A single SAX slice was used for CEST scanning by using Amide proton transfer (APT) sequence before the injection of contrast. 36 samples were collected from a saturation frequency offset from -5.0 ppm to + 5.0 ppm. The scanned pigs were humanely euthanized under deep anesthesia with KCl and the heart was excised. Triphenyl tetrazolium chloride was used to manifest the infarcted region. CEST values at the frequency of ~1.8ppm, ~2.5ppm, ~2ppm and ~3ppm were recorded respectively for each pig and Color code map was plotted based on the CEST values at a frequency offset of ~1.8ppm (Matlab). Statistic analysis was performed on R project.

RESULTS

A total of 5 AMI pigs (M, 7 months, 16.6 ± 1.2 kg), and 14 CMI pigs (M, 9 months, 27.8 ± 2.1 kg), were finally included. Statistic differences were observed for Cr, ATP, and Glu between the infarct myocardium and the normal myocardium for CMI pigs, while only Cr and ATP for AMI pigs. The color code CEST maps showed a prominent larger abnormal region with a lower concentration of creatine than the MI regions recognized on the LGE sequences and the pathology images.

CONCLUSION

This study demonstrated that the metabolic conditions measured on CEST imaging could be used for infarcted myocardium recognition and the region of myocardium with a lower creatine concentration was larger than the region confirmed with infarction, which again provided proof of the existence of the injured or stunned myocardial tissue surrounding the infarction region.

CLINICAL RELEVANCE/APPLICATION

CEST MRI provided a promising invasive way to observe metabolism status of infarcted myocardium and further studies on MI patients would be needed to validate its clinical application.

SSQ12-02 Molecular Lumbar Intervertebral Disc Alterations in Patients with Leg Length Discrepancy Before and After Therapy

Thursday, Nov. 29 10:40AM - 10:50AM Room: S504CD

Participants
Christoph Schleich, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Miriam Frenken, Dusseldorf, Germany (*Presenter*) Nothing to Disclose
Daniel B. Abrar, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Yan Klosterkemper, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Leg length discrepancy (LLD) is a frequent incidental finding during orthopedic physical examination and can be found in about two-thirds of the population without any physical complaints. According to recent studies, LLD greater than 10 mm could be a predisposing factor for early degenerations of lumbar intervertebral discs or vertebral facet joints. However, the need of its treatment is still controversial. Previous findings suggest that degeneration of the lumbar disc correlates with a decrease of glycosaminoglycan content (GAG). The purpose of this study was to elucidate the effect of LLD on GAG content in lumbar discs and to show therapy effects after the usage of shoe inserts and physical therapy.

METHOD AND MATERIALS

11 patients (25.6 ± 4.3 years) with LLD greater than 10 mm and 14 control subjects (23.9 ± 3.5 years) without LLD were examined using a 3T MR scanner. 8 patients were re-examined 6 months after physical therapy and the usage of shoe inserts. Morphological T2-weighted sequences in sagittal and transversal orientation and Glycosaminoglycan chemical exchange saturation transfer (gagCEST) sequence were performed. Subjects with bulged or herniated discs were excluded.

RESULTS

Nucleus pulposus-gagCEST values of L5/S1 disc were significantly lower in patients with LLD compared to control group ($p = 0.0008$). For all other disc levels, no significant difference was found. At follow-up, no significant difference of NP-gagCEST values at baseline and 6 months after therapy could be found ($p > 0.05$).

CONCLUSION

This study supports the hypothesis that LLD greater than 10 mm could be a predisposing factor for early molecular alterations of lumbar discs of L5/S1. Remarkably, we observed lower gagCEST values of the lumbar disc of L5/S1 caused by LLD even before any morphological pathology could be found. Biochemical disc alterations of patients with LDD could be stopped under therapy.

CLINICAL RELEVANCE/APPLICATION

This study supports the hypothesis that LLD could be a predisposing factor for early molecular alterations of the lumbar disc of L5/S1. Furthermore, lower gagCEST values of the lumbar disc of L5/S1 caused by LLD were observed before any morphological pathologies were detectable. This molecular alterations of L5/S1 of patients with LLD could be delayed under the effect of shoe inserts and physical therapy.

SSQ12-03 Blood Oxygen Level-Dependent MRI Can Evaluate the Oxygenation of Visceral Adipose Tissue in Zucker Diabetic Fatty Rats

Thursday, Nov. 29 10:50AM - 11:00AM Room: S504CD

Participants
Matteo Figini, Chicago, IL (*Presenter*) Nothing to Disclose
Yaqi Zhang, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Su Hu, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Liang Pan, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Junjie Shangguan, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Jia Yang, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Quanhong Ma, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Yuri Velichko, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Vahid Yaghmai, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Zhuoli Zhang, MD,PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Visceral adipose tissue (VAT) hypoxia is associated with insulin resistance and obesity-related chronic low-grade inflammation (metaflammation). Its evaluation is then of great importance for prevention and therapy, but current methods are invasive and focus on subcutaneous fat rather than VAT. The purpose of this study is to investigate the feasibility of evaluating VAT hypoxia with Blood Oxygen Level-Dependent (BOLD) MRI, which is sensitive to hemoglobin oxygenation, in Zucker Diabetic Fatty (ZDF) rats.

METHOD AND MATERIALS

Seven-week old ZDF rats (n=18) were provided with water and high-fat diet ad libitum; their body weight and blood glucose were monitored. At 13 weeks of age they were divided into two subgroups, receiving a daily dose of pioglitazone (ZDF-PGZ, n=9) or saline (ZDF-VE, n=9) respectively. BOLD MRI was performed at 13 and 23 weeks of age using a multi-echo spoiled gradient-echo sequence (5 echo times from 3.75 to 29.07 ms with 6.33 ms echo spacing, TR = 408 ms, voxel size = 0.47x0.38x3 mm3). R2* values were measured in the perirenal VAT. The trygliceride, cholesterol and insulin levels were measured by blood biochemistry analysis, and insulin resistance was calculated by HOMA-IR = insulin[mU/L] x glucose[mmol/L] / 22.5. Immunofluorescence was used to evaluate hypoxia by pimonidazole adduct-positive area. The proportion of Th17 and Treg cells, CD34+ and CD34++ monocytes were evaluated by flow cytometry.

RESULTS

The ZDF-VE group had hyperlipidemia ($p < 0.01$) and hyperinsulinemia ($p < 0.001$) and higher HOMA-IR ($p < 0.001$) compared to the ZDF-PGZ group. There was a significant R2* increase between the two scans for ZDF-VE (20.14 ± 0.23 vs. 21.53 ± 0.20, $p = 0.012$) but not for ZDF-PGZ (figure 1A). VAT R2* values showed a positive correlation with pimonidazole adduct-positive area, HOMA-IR, the percentage of Th17 cells and CD43+ monocytes, and a negative correlation with the percentage of Treg cells and CD43++ monocytes (figure 1B).

CONCLUSION

This study showed the feasibility of VAT oxygenation by BOLD MRI in ZDF rats with obesity induced by high-fat diet. The R2*

values obtained by BOLD MRI are also associated with insulin resistance and metaflammation.

CLINICAL RELEVANCE/APPLICATION

BOLD-MRI can be a non-invasive tool for the evaluation of visceral adipose tissue hypoxia and obesity-related insulin resistance and systemic inflammation

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Vahid Yaghmai, MD - 2012 Honored EducatorVahid Yaghmai, MD - 2015 Honored EducatorVahid Yaghmai, MD - 2017 Honored Educator

SSQ12-04 Baseline Pancreatic Beta Cell Imaging Post Pancreatic Transplantation Using Whole Body 68Ga-DOTA-Exendin-4 PET/CT: Our Initial Experience

Thursday, Nov. 29 11:00AM - 11:10AM Room: S504CD

Participants
Murali K. Logudoss, MBBS, MD, Chennai, India (*Presenter*) Nothing to Disclose
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Rajasekaran Sivaprakasam, DMRD,PhD, Chennai, India (*Abstract Co-Author*) Nothing to Disclose
Kanimozhi Damu JR, MBBS,MD, Coimbatore, India (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

Whole-pancreatic transplant and islet cells transplantation are currently available strategies aiming towards diabetes cure. Beta cell specific non-invasive functional imaging using novel PET radiotracers are now available.68Ga-DOTA-Exendin-4 PET/CT is used for detecting localised Insulinomas. However this tracer can also be used for beta cell imaging and quantification. We have attempted in this study to recognise the pattern of uptake by this tracer in patients with pancreatic transplants.

METHOD AND MATERIALS

8 patients who had undergone pancreatic transplant for Diabetes Mellitus were included in the study. After obtaining informed consent from the patients 4-5 mCi of 68Ga-DOTA-Exendin-4 was injected intravenously. One hour after injection whole body PET CT was performed and the images were analysed.

RESULTS

Among the 8 patients who had pancreatic transplant, 4 patients had Type I Diabetes Mellitus and 4 patients had Type II Diabetes Mellitus. The mean age of the patients were 36 yrs. All the 8 patients were male patients. One of the patient had undergone simultaneous pancreatic and renal transplant. Anterior and lateral MIP images demonstrated diffuse heterogeneous GLP-1R expression in vertically oriented transplanted pancreas in 7 out of 8 patients. Three dimensional PET CT imaging along revealed increase tracer uptake in the transplanted pancreas. There was no uptake in the native pancreas in 6 out of the 8 patients. There was atrophy and calcification of the native pancreatic tissue in these 6 patients. Mild tracer uptake was noted in 2 out of the 8 patients. In one patient there was very low tracer uptake in the transplanted pancreas. Fat stranding was noted surrounding the transplant tissue with areas of necrosis within. This patient was later confirmed to have transplant rejection.

CONCLUSION

In our initial study of 8 patients we conclude Exendin-4 PET/CT is very sensitive tracer for beta cell imaging. It can be used for baseline and flow up of graft imaging. Currently biopsy is the only method to prove graft rejection. However with the use of Exendin-4 PET/CT early graft rejection can be detected non invasively. We further hypothesize the future use of Exendin-4 PET/CT for quantification of beta cell mass using volumetric analysis.

CLINICAL RELEVANCE/APPLICATION

68Ga-DOTA-Exendin-4 PET/CT can be used as baseline and for follow up pancreatic transplant patients for analysis of beta cell mass.

SSQ12-05 In Vivo Bioluminescence Imaging of Transplanted Mesenchymal Stromal Cells and Their Rejection Mediated by Intrahepatic NK Cells

Thursday, Nov. 29 11:10AM - 11:20AM Room: S504CD

Participants
Jingjing Liu, Zhengzhou, China (*Presenter*) Nothing to Disclose

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PURPOSE

Mesenchymal stromal cells (MSCs) hold promise in the treatment of liver disease.However, short survival time of MSCs after intrahepatic transplantation limits their value; therefore,understanding the basis of MSCs survival and rejection may increase their utility. This study was aimed at determining the role of intrahepatic natural killer (NK) cells on MSCs survival and their retention in the liver shortly after transplant.

METHOD AND MATERIALS

Human MSCs were labeled with the Luc2-mKate2 dual-fusion reporter gene (MSCs-R), and the residence time and survival of MSCs-R xenografts after intrahepatic transplantation were evaluated by in vivo bioluminescence imaging (BLI). Coculture of MSCs and NK cells was performed to assess cytotoxicity. To evaluate the role of NK cells in rejection of the xenografted cells, the fates of transplanted MSCs-R were then assessed in vivo by BLI after activation of intrahepatic NK cells.

RESULTS

We observed a linear correlation between luciferase activity from live MSCs-R and cell number in vitro (R2 = 0.9956). In vivo, we observed a gradual decline in bioluminescent signals from transplanted MSCs-R over a region corresponding to the liver in both the control group and the NK-activated group.However, the survival time and retention of intrahepatic MSCs-R decreased more rapidly in the NKactivated group of mice compared to the control group. This indicated that activated NK cells accelerate the elimination of transplanted MSCs. Also, we found that the number of hepatic NK cells and the expression of NK activation markers significantly increased after intrahepatic delivery of MSCs. This suggested that resident NK cells, in a resting state, were activated by intrahepatic transplantation of human MSCs. Taken together, the data suggests that activated hepatic NK cells mediate, in part, rejection of the MSCs xenografts. Cytotoxicity assays showed that activated NK cells may inhibit the proliferation of MSCs and, to a certain extent, induce MSCs death.

CONCLUSION

Human MSCs could be followed dynamically in vivo by BLI, and the role of murine hepatic NK cells, especially activated NK cells, could be inferred from the loss of signals from MSCs.

CLINICAL RELEVANCE/APPLICATION

This finding may have practical clinical implications in MSCs transplantation in treating liver disease.

SSQ12-06 Assessment for NASH-Related Hepatocarcinogenesis Inhibition of Shikonin in a Murine Model Using DW-MRI

Thursday, Nov. 29 11:20AM - 11:30AM Room: S504CD

Participants
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Chang Won Jeong, Iksan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Tae-Hoon Kim, Iksan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Si-Hyeong Noh, Iksan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji-Eon Kim, Iksan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seungjin Kim, Iksan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
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Koeun Lee, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

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PURPOSE

Nonalcoholic steatohepatitis (NASH) is a major risk factor for hepatic carcinogenesis. This study was assess the effect of shikonin using diffusion-weighted magnetic resonance imaging (DW-MRI) in an NASH-related hepatocarcinogenesis murine model.

METHOD AND MATERIALS

On the second day after birth, male pups were subjected to a single subcutaneous injection of 200 μg streptozotocin (STZ) and fed high-fat (45% kcal from fat) diet from the age of 4 weeks. The mice were randomly divided into groups when the tumor area was about > 0.5 mm² as follows: STZ + high-fat diet (SH; n=6) and STZ + high-fat diet + shikonin (SHS; n=7). For the experimental group, shikonin (2.0 mg/kg) was injected intraperitoneally daily for 14 days (with diluted PBS). DW-MRI was performed to assess effects of shikonin at pre-and post-treatment. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT), glucose, cholesterol, and triglyceride were determined in plasma. The liver tissues were collected at 14 day post-treatment for hematoxylin and eosin staining.

RESULTS

The mean area of tumors were 2.56 ± 2.12 mm² at the SH and SHS groups, before treatment initiation. The tumor area changes of the SH and SHS groups were 326.28 ± 320.81% and 91.58 ± 78.22% after post-treatment. The tumor area change in the SHS group significantly lower compared to the SH group ($p < 0.05$). The mean ADC changes of the SH and SHS groups were 41.97 ± 50.48% and -9.24 ± 30.46% after post-treatment. The ADC change in the SHS group significantly decreased compared to the SH group ($p < 0.01$). AST and ALT levels were significantly lower in the SHS group than in the SH group after post-treatment. Plasma glucose, total cholesterol and triglyceride levels were not significantly different between SH and SHS groups. The SH group exhibited numerous tumors on the liver surface, whereas the SHS group exhibited fewer and smaller liver tumors. The histological findings at SH and SHS groups revealed that the tumors were hepatocellular carcinoma.

CONCLUSION

In this study, we found that the cancer inhibition effects of shikonin in a NASH-related hepatocarcinogenesis murine model by using DW-MRI.

CLINICAL RELEVANCE/APPLICATION

Shinkonin might be considered a novel preventive or therapeutic approach for NASH-related hepatocarcinogenesis.

SSQ12-07 Management of Complex Regional Pain Syndrome (CRPS) with Sigma-1 Receptor Radioligand and PET/MRI

Thursday, Nov. 29 11:30AM - 11:40AM Room: S504CD

Participants
Sandip Biswal, MD, Stanford, CA (*Presenter*) Research Grant, General Electric Company;
Peter Cipriano, BA, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
DaeHyun Yoon, PhD, Stanford, CA (*Abstract Co-Author*) Research support, General Electric Company

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PURPOSE

Complex regional pain syndrome (CRPS) is a severe chronic pain condition affecting millions worldwide. Unfortunately, there is no specific diagnostic test to identify the pain generators in CRPS, leading to poor pain management of this disease. Given sigma-1 receptors (S1Rs) specific association for pro-nociceptive processes, we determine the clinical impact of a more pain-specific PET/MRI approach for CRPS, adopting a novel high affinity sigma-1 receptor (S1R) PET radioligand ([18F]FTC-146; Ki = 0.0025 nM).

METHOD AND MATERIALS

IRB and FDA approval were obtained. Fifteen patients suffering from CRPS were referred directly from specialists in pain medicine. Whole-body (head-to-toe) PET/MR (time-of-flight PET; 3.0T MR bore; GE Healthcare) imaging was perfmored following 10 mCi IV injection of [18F]FTC-146. MR sequences included 3D axial LAVA-FLEX, high-resolution 3D axial DESS and 2D axial T2-weighted FSE scans. ROI analysis was performed (OsiriX v.6.0 64-bit). Findings from the PET/MR scans were discussed with the referring pain specialists, subsequent alterations in the pain management plan were recorded and, in a subset of cases, new treatments were applied to which outcomes were measured.

RESULTS

Fourteen out of 15 patients showed unexpected findings on [18F]FTC-146 PET/MRI, which lead to a change in the patients' pain management plans. In one specific case, a CRPS patient had severe (8-10/10) unilateral knee pain despite 2 previous unsuccessful surgeries. [18F]FTC-146 PET/MRI showed a high, focal [18F]FTC-146 PET uptake of a lesion which co-localized to an abnormal mass-like lesion in the intercondylar notch on the MRI. Subsequent arthroscopic surgery removed the [18F]FTC-146-avid lesion, which completely relieved the knee pain (0/10 pain). A separate CRPS patient with severe bilateral foreleg pain showed increased uptake of [18F]FTC-146 in the anterior compartment of both forelegs. Botulinum toxin injection in the areas of high [18F]FTC-146 uptake resulted in significant improvement in pain score (9-10/10 down to 2/10). We continue to follow the other patients to further evaluate our image findings.

CONCLUSION

A whole-body PET/MRI approach with a novel S1R PET tracer, [18F]FTC-146, can potentially identify pain generators in CRPS and improves treatment outcomes.

CLINICAL RELEVANCE/APPLICATION

The proposed whole body PET/MRI approach could alter the pain management for CRPS patients to achieve better pain-relief outcome.

SSQ12-08 Inflammation Focus Search with 18F-FDG-PET/MRI: Comparative or Additive Value of PET and MRI

Thursday, Nov. 29 11:40AM - 11:50AM Room: S504CD

Participants
Ahmet Oernek, Essen, Germany (*Presenter*) Nothing to Disclose
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Yan Li, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose
Julian Kirchner, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To evaluate the comparative or additive value of 18F-FDG PET and MRI for identifying the etiology of inflammation of unknown origin.

METHOD AND MATERIALS

A total of 24 patients (13 m, 11 w, age 42±23 [8-82] y) with suspicion of an inflammation focus due to laboratory inflammation markers (increased CRP, leukocytes) or fever and up to now non-leading conventional imaging underwent a whole-body PET/MRI. Image analyses included the detection and localization of pathologically (focal) increased tracer uptake in PET including determination of SUVmax using VOI technique and evaluation of the contrast enhancement and diffusion restriction (ADC values) of abnormal lesions in MRI. Descriptive analysis included mean values, standard deviation and range. PET/CT, clinical, and radiological follow-up as well as histopathology served as standards of reference.

RESULTS

In 17/24 patients the PET/MRI contributed to the diagnosis of a (focal) pathological etiology of the inflammatory disease (vasculitis n=5, inflammatory bowel disease n=4, pneumonia n=1, infected vascular prosthesis n=2, (active) retroperitoneal fibrosis n=1,

peritonitis and cholecystitis n=1, synovitis n=1, mycotic infection (hepatic candidosis) n=1, bone marrow activation n=1). In PET all pathological foci showed a moderately to significantly increased FDG uptake (SUVmax 5.3 ± 3.5, range 1.4-14.2). The MRI satisfactorily allows the localization of the findings, but only in 12/17 a corresponding contrast-enhancement and in 13/17 a corresponding diffusion restriction could be found. 3/17 patients showed neither a contrast-enhancement nor a diffusion restriction, but only an increased FDG uptake.

CONCLUSION

Integrated 18F-FDG-PET/MRI shows high potential in identifying the etiology of inflammation of unknown origin. The MRI satisfactorily allows the localization of the findings, but a significant higher detection rate could be found in PET compared to MRI. Considering the significantly lower dose of ionizing radiation, PET/MRI may serve as a powerful alternative to PET/CT.

CLINICAL RELEVANCE/APPLICATION

Inflammation focus search with 18F-FDG-PET/MRI

SSQ12-09 Early Detection and Measurement of Disease Activity in Experimental, Inflammatory Bowel Disease Using Target-Specific Molecular Imaging and Fluorescence Colonoscopy

Thursday, Nov. 29 11:50AM - 12:00PM Room: S504CD

Participants
Michel Eisenblaetter, MD, Muenster, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

Pro-inflammatory monocytes comprise the majority of the early inflammatory infiltrate in inflammatory bowel disease (IBD). In mice, these cells are characterised by high expression of Ly6C. Purpose of this study was to evaluate Ly6C-specific imaging for visualisation and measurement of IBD activity in comparison to perfusion-type contrast agents and assess the performance in fluorescence mediated tomography (FMT) and fluorescence colonoscopy (FC) for whole body and local application respectively.

METHOD AND MATERIALS

IBD was induced in 10 female Balb/c wild type mice by application of DSS with the drinking water. The weight was monitored as a marker of disease activity. FMT was performed before and 5 and 10 days after IBD induction. Mice received a Cy5.5-labelled Ly6C antibody (2nmol dye) or an equivalently labelled, unspecific IgG to reflect perfusion effects. In parallel, all mice underwent FC for detection and scoring of local disease activity. Histology served for correlation and validation of in vivo imaging.

RESULTS

On day 5 after IBD induction, weight loss did not allow for safe identification of IBD activity and was only significantly increased at day 10 (2% vs. 15%). Perfusion was elevated on day 5 as compared to baseline already but did not increase significantly towards day 10 as reflected by the IgG-driven signal (192 vs. 328 vs. 342 pmol tracer). Ly6C-specific tracer accumulation was, in contrast, significantly elevated on day 5 already; a further increase towards day 10 reflected the growing disease activity (110 vs. 700 vs. 1166 pmol; $p<0.001$). In vivo colonoscopy allowed for safe identification of inflammatory foci based on the specific probe accumulation but not the unspecific control. FC-based disease scoring was clearly reflected by Ly6C-specific imaging.

CONCLUSION

Target-specific imaging of Ly6C as a marker for early infiltrating, pro-inflammatory monocytes allows for sensitive and specific measurement of IBD activity in vivo by non-invasive and endoscopic approaches. It is superior over clinical examination and perfusion type contrast.

CLINICAL RELEVANCE/APPLICATION

In IBD, monitoring of disease activity and sub-clinical inflammation e.g. under therapy is a relevant challenge. Specific imaging can aid research and potentially improve multi-modal clinical imaging.

CAS-THA

Cardiac Thursday Poster Discussions

Thursday, Nov. 29 12:15PM - 12:45PM Room: CA Community, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

Participants
Joao R. Inacio, MD, Ottawa, ON (*Moderator*) Nothing to Disclose

Sub-Events

CA252-SD-THA1 Coronary Artery to Pulmonary Artery Fistula in Adults: Comparison of 256-Slice MDCT Coronary Angiography and Transthoracic Echocardiography

Station #1

Participants
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Wei Zhu, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
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PURPOSE

To review the imaging features of coronary artery-to-pulmonary artery fistula (CPAF) on 256-slice MDCT and evaluate the diagnostic performance of CT compared with conventional catheter angiography (CCA) and transthoracic echocardiogram (TTE).

METHOD AND MATERIALS

We retrospectively reviewed with a diagnosis of CPAF from amongst 19855 consecutive coronary CT angiography (CCTA) performed with 256-slice MDCT scanner (Brilliance iCT) for suspected coronary artery disease. CT images were evaluated for - origin, number, size and course (tubular/ worm-like/ significant aneurysm formation/wall attachment sign) of fistula vessels, drainage site, drainage site imaging features (pierced sign, iso-density sign, smoke sign, jet sign), and the maximum diameters of pulmonary artery(MPA). Wall attachment sign is the presence of abnormal tortuous supplying artery branches over the surface of MPA; Pierced sign is direct connection of supplying artery and MPA; jet sign is a jet of contrast from supplying artery to MPA; Smoke sign is a fuzzy dense contrast from supplying artery dispersed over less dense contrast in MPA; and isodensity sign is equal contrast density between drainage artery and MPA. 25 patients of CPAF also underwent CCA and 47 patients underwent TTE.

RESULTS

There were 72 patients with CPAF (0.36 %) in our study, of which 44 were men and 28 were women, with mean age of 55.8 ± 13.2 years (range 22- 85 years). CPAF originated from the conus artery in 55, LAD in 67 and combined conus and LAD in 50. Tubular dilation was seen in 14, worm-like dilation in 58 and aneurysm in 35 cases. Wall attachment sign was noted in 69 cases. All the cases demonstrated only a single drainage site, with 44 draining into left lateral wall of MPA, 21 in left anterolateral, 5 in anterior and 1 each in right lateral and right anterolateral walls. The mean diameter of the fistula drainage site was 2.6 ± 1.3 mm. Pierced sign was seen in 72 cases; Jet sign in 46 cases; Smoke sign in 41 cases; Isodensity sign in 24 cases. Pulmonary artery enlargement was seen in 20 patients. CCA showed CPAF in only 20 cases among 25 patients; TTE showed CPAF in only 9 patients among 47 patients.

CONCLUSION

MDCT is competent in detecting and characterizing CPAF with an excellent diagnostic performance as the first imaging modality of choice.

CLINICAL RELEVANCE/APPLICATION

To recognize CT findings of CPAF with CCTA for reducing missed diagnosis.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Sachin S. Saboo, MD, FRCR - 2017 Honored EducatorPrabhakar Rajiah, MD, FRCR - 2014 Honored EducatorSuhny Abbara, MD - 2014 Honored EducatorSuhny Abbara, MD - 2017 Honored Educator

CA253-SD-THA2 Does the Tube Voltage Affect the Characterization of Coronary Plaques on 100- and 120-kVp CT Scans

Station #2

Participants
Takanori Masuda, Hiroshima, Japan (*Presenter*) Nothing to Disclose
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PURPOSE

Lower tube voltage scan is effective for the radiation dose reduction and improving the vessel enhancement in coronary CT angiography (CCTA). However, there are only few reports that evaluate coronary plaque components using low tube voltage scan. The purpose of this study was to compare the diagnostic performance of 100- and 120 kVp CCTA scans for the evaluation of coronary plaque components.

METHOD AND MATERIALS

We included 116 patients with coronary plaques who underwent CCTA- and integrated backscatter intravascular ultrasound (IB-IVUS) studies. On 100 kVp scans we observed 24 fibrous- and 24 fatty/fibro-fatty plaques; on 120 kVp scans we noted 27 fibrous- and 41 fatty/fibro-fatty plaques. We compared the fibrous- and the fatty/fibro-fatty plaques, the CT number of the coronary lumen, and the radiation dose on scans obtained at 100- and 120 kVp. We also compared the area under the receiver operating characteristic (ROC) curve of the coronary plaques on 100- and 120 kVp scans with their ROC curves on IB-IVUS images.

RESULTS

The mean CT number of fatty- and fatty/fibro-fatty plaques was 5.71 ± 36.5 and 76.6 ± 33.7 Hounsfield units (HU), respectively, on 100 kVp scans; on 120 kVp scans it was 13.9 ± 29.4 and 54.5 ± 22.3 HU, respectively. The CT number of the coronary lumen was 323.1 ± 81.2 HU and the radiation dose was 563.7 ± 81.2 mGy-cm on 100 kVp scans; these values were 279.3 ± 61.8 HU and 819.1 ± 115.1 mGy-cm on 120 kVp scans. Using our IB-IVUS plaque findings for comparison studies, the results of ROC curve analysis identified 30.5 HU as the optimal diagnostic cut-off value for 100 kVp scans; for 120 kVp plaque images, the optimal cut-off was 37.4 HU.

CONCLUSION

For the discrimination of coronary plaque components, the diagnostic performance of 100- and 120 kVp CCTA scans is comparable.

CLINICAL RELEVANCE/APPLICATION

Lower tube voltage CCTA scans help to decrease the radiation dose without deterioration of the image quality of the coronary artery.

CA254-SD-THA3 Long-Term Prognostic Value Coronary Artery Calcium in Heart Transplant Patients

Station #3

Participants
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Gregorio Rabago, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Gorka Bastarrika, MD, Pamplona, Spain (*Abstract Co-Author*) Speaker, Bayer AG Speaker, Siemens AG

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PURPOSE

To evaluate the long-term prognostic value of coronary artery calcium (CAC) burden and its relationship with obstructive coronary allograft vasculopathy (CAV) in heart transplant recipients (HT).

METHOD AND MATERIALS

From June 2007 to December 2017, 117 HT patients undergoing coronary CT angiography (CCTA) for the evaluation of CAV were prospectively recruited. CAC was quantified using the Agatston score. According to basal CAC burden, patients were divided in two groups: absence or minimal risk (0-10) and mild-moderate-severe risk (>11). Obstructive CAV was defined as coronary stenosis >=50% luminal diameter. To analyze differences in the degree of CAC and CAV chi square test, Kaplan-Meier curves, Log-Rank test and the hazard ratio were estimated. A p-value <0.05 was considered statistically significant.

RESULTS

Eighty-six (76.8%) HT patients had no or minimal risk, whereas twenty-six (23.2%) were classified as having mild to severe risk at basal CCTA. Five patients were excluded due to the presence of stents. After a median follow-up period of 46±39 months, statistically significant association between basal CAC and the presence of obstructive CAV over time was observed (p<0.05). At 5 years, obstructive CAV occurred in 15.8% and 37.6% of HT patients with no or minimal risk and mild to severe risk, respectively (Log-rank p<0.05).The hazard ratio was 2.4 for patients with >11 basal CAC score (p<0.05).

CONCLUSION

HT patients with mild to severe risk based on basal CAC score present 2.4 times more probability to develop obstructive CAV at 5 years than patients with no or minimal risk.

CLINICAL RELEVANCE/APPLICATION

CAC score is a useful tool to stratify risk in HT patients.

CA256-SD-THA5 Automatic Segmentation of Lung Volumes in Population-based Whole-Body MR Imaging: Association with Subclinical Cardiac Impairment

Station #5

Participants
Ricarda V. von Kruchten, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose
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PURPOSE

Both cardiac and pulmonary morphology and function can be simultaneously assessed during a single MR scan. Previous studies have shown an association between obstructive lung disease with cardiac dysfunction. Our aim is to evaluate the relationship between lung volumes and cardiac impairment in a population-based cohort study using whole-body MR scans.

METHOD AND MATERIALS

We studied 400 subjects who underwent whole-body MRI as part of the KORA FF4 cohort study, excluding subjects with established cardiovascular disease. Lung volumes were derived semi-automatically through an in-house algorithm (coronal acquired T1w sequences). Using Pearson correlation and multivariate regression (adjusted for age, sex, smoking status and BMI), lung volumes were compared with cardiac parameters of left and right ventricle (LV/RV, acquired from cine-SSFP sequences using cvi42), and standardized to body surface area.

RESULTS

A total of 356 subjects presented an average MRI-based lung volume of 4.0±1.1L and mostly standard values for cardiac parameters. In univariate analysis, a negative correlation of LV and RV stroke volume to lung volume was observed. After multivariate adjustment, stroke volume as well as end-diastolic volume of both LV (ß=-2.75, p=0.001; ß=-1.71, p=0.001) and RV (ß=-2.14, p=0.02; ß=-1.45, p=0.004) showed negative associations with lung volume, while ejection fraction, peak ejection rate and myocardial mass were not associated with lung volumes (Figure 1). These values were stronger for the LV than for the RV. In addition, for the LV, early but not late diastolic filling rate was negatively associated with lung volume.

CONCLUSION

Cardiac function and volume parameters derived from non-dedicated whole-body MRI, such as stroke volumes and biventricular end-diastolic volumes were significantly associated with lung volumes in a patient cohort without cardiovascular disease.

CLINICAL RELEVANCE/APPLICATION

These results suggest, that MRI could be an accurate, radiation-free, and possibly one-stop-shop screening tool, with the potential for early detection of subclinical heart disease in patients with emphysema and subclinical cardiovascular dysfunction.

CA175-ED-THA6 Uncommon Connections in Cardiac CT

Station #6

Participants
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TEACHING POINTS

Review unusual connections among vascular structures in cardiac CT Describe connections according to involved vessels Identify presence and type of shunt Discuss potential implications for patient care

TABLE OF CONTENTS/OUTLINE

Introduction Suggested CT technique Diagnosis, pathophysiology and treatment of connections between: Coronary arteries and veins (coronary fistulas) Coronary arteries and cardiac chambers (coronary fistulas) Coronary veins and cardiac chambers (unroofed coronary sinus) Coronary and pulmonary arteries (coronary fistulas, ALCAPA syndrome) Coronary and bronchial arteries (coronary to bronchial communication) Pulmonary arteries and veins (pulmonary arteriovenous malformation) Systemic and pulmonary arteries (persistent ductus arteriosus, major aortopulmonary collateral arteries) Systemic and pulmonary veins (venovenous fistulas after Fontan surgery) Pulmonary veins (Acquired intrapulmonary venous connections) Pulmonary veins and right atrium (anomalous pulmonary venous return) Superior vena cava and left atrium (Raghib Syndrome)

CA169-ED-THA7 Cardiac MRI in Patients with Cardiac Arrhythmias - Practical Tips and Tricks

Station #7

Participants
Muhammad U. Aziz, MBBS, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Alastair Moore, MD, Burlington, VT (*Abstract Co-Author*) Nothing to Disclose
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Presenter*) Nothing to Disclose

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TEACHING POINTS

Obtaining good quality MRI in cardiac arrhythmia is challenging. The purpose of this exhibit is 1. To review the challenges caused by cardiac motion and arrhythmias during MRI 2. To describe solutions for eliminating/reducing these artifacts 3. To illustrate the solutions available for reducing artifacts in cardiac MRI

TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Arrhythmia classification & types- Atrial (PSVT, AFib, flutter); Ventricular (Vtach, V fibrillation); Extra beats (PAC, PVC, PJC); bradyarrhythmias (bradycardia, heart block) 3. ECG strips demonstrating arrhythmias 4. Challenges of arrhythmias in cardiac MRI - Motion artifact - Inaccurate quantification - Inaccurate nulling time - Pseudo perfusion defect 5. Solutions for MRI- Description and case based review with illustrations - Signal averaging - Prospective ECG triggering - Acceleration strategies a. Partial Fourier b. Non Cartesian trajectories (Spiral, radial, etc) c. Parallel Imaging (Cartesian- SENSE, GRAPPA, SMASH; Non Cartesian) d. Spatiotemporal techniques (Only temporal redundancy; temporal followed by spatial; combined) e. Compressed sensing - Cines- Real time imaging, without ECG gating - Late gadolinium enhancement- Single-shot sequence; Data every second or third beat - Flow- Free breathing sequence

Honored Educators

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

CA173-ED-THA8 Getting to the Heart of Eponyms

Station #8

Participants
Vinit Baliyan, MBBS, MD, Boston, MA (*Presenter*) Nothing to Disclose
Lara Walkoff, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Theodore T. Pierce, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
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TEACHING POINTS

• Eponyms are frequently encountered in radiology and may be confusing for those who are not familiar with these terms. • Eponyms not only honor individuals who made important observations and discoveries, but also provide opportunity to understand the subject matter. • Our purpose is to present a pictorial exhibit highlighting eponyms in cardiac imaging.

TABLE OF CONTENTS/OUTLINE

• In this section we discuss and illustrate (with still and cine images) the imaging manifestations of eponyms encountered in cardiac radiology. • We will also briefly explore the historical background of the eponyms. • Eponyms covered will include- o Cardiac anatomy- Sinus of Valsalva, Eustachian valve o Coronary artery disease- Kawasaki disease, Bland-White-Garland syndrome (ALCAPA), Arc of Vieussens o Congenital heart disease- Gerbode defect (ventricular septal defect), Tetrology of Fallot, William syndrome o Surgical procedures/maneuvers- Norwood procedure, Blalock-Taussig shunt, Glenn shunt, Fontan palliation, Jatene switch, Lecompte maneuver, Rastelli and Ross procedures, Damus Kaye Stansel procedure. o Cardiomyopathy- Yamaguchi syndrome, Fabry cardiomyopathy o Cardiac tumors- Swiss syndrome, Carney syndrome, Gorlin syndrome (fibromas), Bourneville's disease (tuberous sclerosis; rhabdomyomas) o Tumor mimics- Chiari network

CAS-THB

Cardiac Thursday Poster Discussions

Thursday, Nov. 29 12:45PM - 1:15PM Room: CA Community, Learning Center

CA

AMA PRA Category 1 Credit ™: .50

Participants
Joao R. Inacio, MD, Ottawa, ON (*Moderator*) Nothing to Disclose

Sub-Events

CA257-SD-THB1 Machine Learning to Evaluate Atherosclerotic Plaque Composition by Coronary CT: Validation with IB-IVUS

Station #1

Participants
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PURPOSE

The image histogram is a set of metrics calculated by mathematical analysis of digital images; its combination with machine learning has been reported to be of high diagnostic performance for the differentiation of malignant tumors. The purpose of this study was to determine whether machine learning with histogram analysis of coronary CT angiography (CCTA) yields higher diagnostic performance for coronary plaque characterization than the conventional cut-off method using the median CT number.

METHOD AND MATERIALS

We included 78 patients with 78 coronary plaques who had undergone CCTA and integrated backscatter intravascular ultrasound (IB-IVUS) studies. IB-IVUS diagnosed 32 as fibrous- and 46 as fatty or fibro-fatty plaques. We recorded the coronary CT number and 7 histogram parameters (minimum and mean value, standard deviation (SD), maximum value, skewness, kurtosis, and entropy) of the plaque CT number. Using 5-fold cross validation of the plaque CT number, the area under the receiver operating characteristic curve of the machine learning- (extreme gradient boosting) and the conventional cut-off method was compared.

RESULTS

The median CT number was 56.38 Hounsfield units (HU, 8.00 - 95.90) for fibrous- and 1.15 HU (-35.8 - 113.30) for fatty- or fibro-fatty plaques. The calculated optimal threshold for the plaque CT number was 36.1 ± 2.8 HU. The highest Gini index was the coronary CT number (0.19) followed by the minimum value (0.17), kurtosis (0.17), entropy (0.14), skewness (0.11), the mean value (0.11), the standard deviation (0.06), and the maximum value (0.05), and energy (0.00). By validation analysis, the machine learning- yielded a significantly higher area under the curve than the conventional method (0.92 vs 0.83, p = 0.001).

CONCLUSION

The machine learning was superior to the conventional cut-off method for coronary plaque characterization using the plaque CT number on CCTA images.

CLINICAL RELEVANCE/APPLICATION

The machine learning using CT number histogram might be useful to the characterization of coronary plaques during CCTA.

CA258-SD-THB2 Prognostic Value of Coronary CT Angiography (CCTA) in Heart Transplant Patients

Station #2

Participants
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PURPOSE

To evaluate the prognostic value of coronary CT angiography (CCTA) in heart transplant recipients (HT).

METHOD AND MATERIALS

A total of 117 HT (mean age 61.4±11.4 years; 83.8% males) undergoing CCTA for the evaluation of coronary allograft vasculopathy (CAV) were prospectively enrolled. According to the results of the initial CCTA, patients were divided based on the presence of significant CAV (defined as a coronary stenosis >=50%) or non-significant CAV (stenosis <50%). Major adverse cardiac events (MACEs) were defined as a composite of cardiac death, myocardial infarction, unstable angina, congestive heart failure, coronary revascularization, or re-transplantation. To analyze the differences between the two groups and the risk of MACEs, chi square test, Kaplan-Meier curves, Log-Rank test and the hazard ratio were estimated. A p-value <0.05 was considered statistically significant.

RESULTS

The median follow-up period was 46±39 months. At the initial CCTA 12 HT (10.3%) presented significant CAV and 105 HT (89.7%) showed non-significant CAV. At 5 years after the initial CCTA, 16 MACEs were observed in 45.3% and 13.1% of HT with significant and non-significant stenosis, respectively (Log-Rank test p<0.001). The hazard ratio for suffering a MACE in HT with significant CAV at the initial CCTA was of 5 (p=0.004).

CONCLUSION

In HT patients, the presence of CAV with >=50% coronary stenosis at initial CCTA can predict the development of MACEs, with a hazard ratio of 5 at 5 years.

CLINICAL RELEVANCE/APPLICATION

CCTA possesses prognostic value and can be used for the follow up of heart transplant recipients.

CA259-SD-THB3 Evaluation of Coronary Plaque Using Effective Atomic Number in Coronary CT Angiography with Fast kVp Switching Dual-Energy CT: Influence of Intracoronary CT-Attenuation

Station #3

Participants
Satoshi Inada, Hiroshima, Japan (*Presenter*) Nothing to Disclose
Masashi Takahashi, RT, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Tsuyoshi Kagimoto, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Tomohiro Murakami, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Naohiro Yamagami, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Takafumi Sakai, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Masahiro Nakano, Hiroshima, Japan (*Abstract Co-Author*) Nothing to Disclose
Fang Wang, Yinchuan, China (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

The purpose of this study was to investigate the influence of the intracoronary CT-attenuation on coronary plaque measurements using effective atomic number (Zeff) from coronary CT angiography (CCTA) with fast kVp switching single source dual-energy CT (ssDECT).

METHOD AND MATERIALS

A coronary artery phantom made up by acryl tube (inner diameter: 4mm) was filled with diluted contrast medium (0 mgI/mL, 5 mgI/mL, 15 mgI/mL, and 30 mgI/mL), and ABS carved pipes were used to simulate coronary plaque (stenosis of 25%, 50%, and 75%, FUYO Co.). Then it was placed in the center of the cardiac phantom (ALPHA1-VTPC; FUYO Co.). The phantom was scanned using ECG-gated axial step-and-shoot with dual-energy scan mode on a 64-row ssDECT (Revolution GSI; GE Healthcare, USA). The scan parameters were set as follows; tube voltage: 80/140 kVp fast switching, rotation time: 0.35 s/rot, and tube current: 600 mA. In addition, virtual monochromatic images (VMIs) at 70 keV and Zeff images were reconstructed from ssDECT data sets. Regions of interests (ROIs) were placed on the simulated plaque at 50% stenosis, and mean CT-numbers and Zeffs were measured.

RESULTS

In VMI images, mean CT-numbers at 0 mgI/mL, 5 mgI/mL, 15 mgI/mL, and 30 mgI/mL were 46 ± 7 HU, 58 ± 12 HU, 65 ± 9 HU, and 73 ± 11 HU, respectively. In Zeff images, mean Zeff for 0 mgI/mL, 5 mgI/mL, 15 mgI/mL, and 30 mgI/mL were 7.2 ± 0.44, 7.4 ± 0.36, 7.8 ± 0.39, and 8.3 ± 0.34, respectively. As a result, the CT-number and the Zeff of simulated plaque were increased with the increase of the concentration of diluted contrast medium (P<0.01). Furthermore, rate of increase in Zeffs were lower than that in CT-numbers (P<0.01).

CONCLUSION

The influence of intracoronary CT-attenuation on coronary plaque measurements using the Zeff was smaller than that using CT-number.

CLINICAL RELEVANCE/APPLICATION

Using the effective atomic number (Zeff) for measurement of the coronary plaque is useful for the clinical application.

CA261-SD-THB5 CT-Detected Complications after Cardiac Transplantation: Differences between Patients with and Without Bridge to Transplantation

Station #5

Participants
Nadja M. Kocher, MD, Freiburg, Germany (*Presenter*) Nothing to Disclose
Mathias F. Langer, MD, PhD, Freiburg, Germany (*Abstract Co-Author*) Nothing to Disclose

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PURPOSE

Despite substantial improvements in the management of patients with severe cardiovascular disease, heart failure is still the most common cause of death in the world. For patients with end stage heart failure, cardiac transplantation offers the best long-term survival. However, cardiac transplantation is associated with a whole range of serious complications. This study intends to investigate the frequency of CT-detected complications after cardiac transplantation in patients supported previously with a left ventricular assist device (LVAD) and patients with conventional transplantation.

METHOD AND MATERIALS

50 patients (age 52±27) after cardiac transplantation were included in this retrospective study. Information about gender, age, date of device and heart implantation, death, reason for transplantation, cardiovascular risk factors, cardiac allograft vasculopathy and acute graft rejection were obtained. All postsurgical and follow-up CT scans were screened for relevant complications such as cerebral ischemia, visceral organ ischemia, deep vein thrombosis, pulmonary embolism, hemorrhage, infection, fractures and other musculoskeletal diseases due to transplantation, malignancy and complications due to surgery. Patients with conventional transplantation were assigned to Group A (n=31), patients supported preiously with a LVAD to Group B (n=19). Frequency of complications within one month, one year and after one year following transplantation were derived for each group.

RESULTS

11 of the 50 included patients died, mostly from multi-organ failure after infection and/or ischemia. Almost all patients (except for 2) suffered at least once from an infectious disease. Postoperative infection occurred especially in Group B (36,8%, Group A: 12,9%). The other early complications could also be found at a higher frequency in Group B. Long-term complications were higher in Group A. Malignancy could only be found in Group A (29,0%) whereas complications due to surgery appeared only in Group B (15,8%).

CONCLUSION

These results revealed clear differences in the spectrum and frequency of the various complications after cardiac transplantation. Patients previously supported with a LVAD seem to have a higher risk for early complications.

CLINICAL RELEVANCE/APPLICATION

CT is the most important imaging method for early detection and, subsequently, for specific and quick treatment of serious complications after cardiac transplantation.

CA176-ED-THB6 Pathologic Entities That May Affect the Lungs and the Myocardium: Keys for Diagnosis and Prognosis with Chest CT and Cardiac MR

Station #6

Awards
Identified for RadioGraphics

Participants
Jose Gutierrez Chacoff, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Laura Jimenez-Juan, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Daniel Vargas, MD, Aurora, CO (*Abstract Co-Author*) Nothing to Disclose
Lan-Chau T. Kha, MD, MSc, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Felipe A. Sanchez, MD, Santiago, Chile (*Presenter*) Nothing to Disclose
Anastasia Oikonomou, MD, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

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TEACHING POINTS

The presence and extent of LGE in cardiac sarcoidosis is predictive of ventricular arrhythmias and death, independent of the ejection fraction.Alveolar/septal pattern of pulmonary amyloidosis has significantly worse prognosis compared with nodular parenchymal amyloidosis. Diffuse subendocardial LGE, with suboptimal nulling time of myocardium are highly suggestive of cardiac amyloidosis. Native T1 and myocardial extracellular volume have important diagnostic and prognostic value.Apical subendocardial LGE without vascular territory, usually with apical thrombus is suggestive of eosinophilic granulomatosis with polyangiitis (with history of asthma and allergy) or eosinophilic syndrome (without history of allergy).Unlike the idiopathic interstitial pneumonias, UIP and NSIP pattern related to systemic sclerosis have similar survival and extension of the CT abnormalities is the only prognostic factor of mortality and progression.

TABLE OF CONTENTS/OUTLINE

Learning objectivesIntroductionSarcoidosisAmyloidosisHemochromatosisEosinophilic granulomatosis with poliangiitisHypereosinophilic syndromeSystemic sclerosisSystemic Lupus erythematosusIgG4 diseaseErdhem-Chester diseaseRosai-Dorfman diseaseSchematic diagnostic approachTake home messages

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CA171-ED-THB7 Mapping the MAPCAs with Dual Source CT: What Do the Cardiothoracic Surgeons Want to Know?

Station #7

Participants

Vasanthakumar Venugopal, MD, New Delhi, India (*Presenter*) Nothing to Disclose
Vidur Mahajan, MBBS, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose
Harsh Mahajan, MD, MBBS, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

vasanthdrv@gmail.com

TEACHING POINTS

1. Major Aortopulmonary collateral arteries are unique lesions in which the pulmonary vascular bed is multi-compartmentalized 2. Unifocalization refers to the process of changing an abnormal multi-compartment pulmonary artery circulation to a normal single compartment circulation. 3. If neither a PV or ductus is present during primary morphogenesis, the foregut source of PA persists and the native pulmonary arteries do not form normally 4. What Does the Surgeon Need to Know Before Unifocalization? - True pulmonary artery size and arborization - Number, origin, exact course, and destination of every collateral - Exact position and severity of all stenoses in both true pulmonary arteries and collaterals - For every collateral, does it intercommunicate with true pulmonary artery: "isolated supply" or "dual supply" - Relationship of collaterals to other thoracic structures: bronchial tree, pulmonary veins, esophagus - Post-stenotic pressure in collaterals

TABLE OF CONTENTS/OUTLINE

- Basic Physiology of MAPCA - Principles of Surgical Management - What does the surgeon want to know - Imaging protocols - Dual source CT advantages - Pitfalls and Challenges - Some case examples

SPSH51

Hot Topic Session: Cardiometabolic Imaging

Thursday, Nov. 29 3:00PM - 4:00PM Room: E353C

CA

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Jadranka Stojanovska, MD, Ann Arbor, MI (*Moderator*) Nothing to Disclose

Sub-Events

SPSH51A Background and Epidemiology

Participants
David A. Bluemke, MD,PhD, Bethesda, MD (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

dbluemke@rsna.org

LEARNING OBJECTIVES

1) Define currently used concepts applied to metabolic disease. 2) Discuss components of metabolic syndrome and their impact on cardiovascular disease. 3) Analyze the results of large cohort studies assessing the metabolic disease in relationship to cardiovascular disease.

ABSTRACT

Ischemic disease of the heart is the leading cause of death and disability worldwide. A major contributor to cardiovascular disease increasingly results from metabolic disease. An underlying concept in consideration of metabolic disease is defined as metabolic syndrome. Metabolic syndrome is thought to affect 23 percent of men and women in the United States, with increasing numbers of individuals world-wide. The presence of metabolic syndrome is associated with elevated risk of cardiovascular disease related to atherosclerosis and organ dysfunction. Metabolic syndrome is defined by 3 or more of the following characteristics: abdominal obesity, hypertriglyceridemia, low HDL, hypertension and elevated fasting glucose. In this presentation, the epidemiology of metabolic syndrome and its underlying relationship to cardiovascular disease is presented on the basis of large cohort epidemiologic studies, typically using imaging methods to characterize outcomes and detect subclinical disease.

SPSH51B Coronary Artery Disease and Outcomes

Participants
Udo Hoffmann, MD, Boston, MA (*Presenter*) Institutional Research Grant, Kowa Company, Ltd; Institutional Research Grant, Abbott Laboratories; Institutional Research Grant, HeartFlow, Inc; Institutional Research Grant, AstraZeneca PLC

LEARNING OBJECTIVES

1) Identify imaging cardic and non-cardiac findings that reflect metabolic state and ahve prognostic impaortance for advrese cardiovascular outcomes. 2) Understand the methodology of using Artificial Intelligence to quantify the controbution of each of these findings to increased cardiovascuolar event risk.

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SPSH51C Cardiac Function and Non-ischemic Disease

Participants
Jadranka Stojanovska, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jstoanov@umich.edu

LEARNING OBJECTIVES

1) Understand the importance of imaging-based characterization of cardiomatabolic phenotypes in non-coronary artery disease. 2) Discuss the association between apicardial adiposity and cardiac function/mass. 3) Discuss the association of epicardial adiposity with inflammatory triggered cardiovascular diseases. 4) Discuss challanges and future direction of cardiometabolic imaging.

ABSTRACT

Interest in epicardial adipose tissue as a visceral adipose tissue of the heart and coronary arteries is rapidly growing as the

scientific evidence indicates that the anatomic specificity is an important contributor to the cardiometabolic disease. A greater epicardial adipose tissue volume is associated with diastolic dysfunction, LV hypertrophy, and non-ischemic cardiovascular disease (CVD). Epicardial adipose tissue has dual role, it can be cardioprotective to protect against CVD and proinflammatory that promotes CVD. It has been hypothesized that an epicardial pro-inflammatory phenotype triggers inflammation that correlates with LV hypertrophy, diastolic dysfunction, and CVD such as atrial fibrillation, and pulmonary hypertension. In this presentation we will demonstrate the role of quantifying epicardial adiposity in patients with atrial fibrillation, systemic sclerosis-pulmonary arterial hypertension, and diastolic dysfunction. The future role of cardiometabolic imaging is to understand epicardial adipose tissue biology by developing a diagnostic tool for analysis of epicardial adipose tissue by imaging, molecular/genetic, metabolite, and clinical profiling.

SPSH51D **Panel Discussion**

RC703

Infections and Inflammatory Cardiac Disorders

Thursday, Nov. 29 4:30PM - 6:00PM Room: S402AB

CA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Participants
Pamela K. Woodard, MD, Saint Louis, MO (*Moderator*) Research agreement, Siemens AG; Research, Eli Lilly and Company; Research, F. Hoffmann-La Roche Ltd; ; ; ; ; ;

For information about this presentation, contact:

woodardp@wustl.edu

Sub-Events

RC703A Endocarditis (Including Loefflers)

Participants
Harold Goerne, MD, Zapopan, Mexico (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

haroldgoerne@hotmail.com

LEARNING OBJECTIVES

1) To identify the imaging features of endocarditis. 2) To apply diagnostic algorithm using different imaging modalities. 3) To illustrate the appearance of endocarditis and its complications. 4) To recognize several differential diagnosis.

RC703B Pericarditis

Participants
Diana Litmanovich, MD, Haifa, Israel (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

dlitmano@bidmc.harvard.edu

LEARNING OBJECTIVES

1) To identify the imaging features of pericarditis. 2) To apply diagnostic algorithm using different imaging modalities. 3) To illustrate the appearance of pericarditis and its complications. 4) To be familiar with differential diagnosis of percarditis.

RC703C Myocarditis

Participants
Jens Bremerich, MD, Basel, Switzerland (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

jens.bremerich@usb.ch

LEARNING OBJECTIVES

1) To understand pathophysiology of myocarditis. 2) To review the impact of imaging on clinical decision making. 3) To enhance knowledge of technical aspects of imaging.

RC703D Cardiovascular Manifestations of HIV

Participants
Prabhakar Rajiah, MD, FRCR, Dallas, TX (*Presenter*) Nothing to Disclose
Harold Goerne, MD, Zapopan, Mexico (*Presenter*) Nothing to Disclose

LEARNING OBJECTIVES

1) To review the cardiovascular manifestations of HIV. 2) To illustrate the imaging features of cardiovascular manifestations of HIV. 3) To describe the impact of cardiovascular disease in HIV.

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educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/ Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator

RC703E Chagas Disease and other Cardiovascular Infections

Participants
Carlos E. Rochitte, MD,PhD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

rochitte@incor.usp.br

LEARNING OBJECTIVES

1) Recognize MRI characteristics of Chagas disease and other infectious diseases affecting the heart and understand their basic pathophysiology. 2) Gain information on new and recent research data on MRI use to investigate and understand pathophysiology of Chagas disease and other infectious disease. 3) Recognize signs in cardiovascular MR images to suspect or make the probable diagnosis of Chagas disease and other infections.

RSNA 2018 TOMORROW'S RADIOLOGY TODAY
104th Scientific Assembly and Annual Meeting
November 25–30 | McCormick Place, Chicago

RCB55

Transpositions of the Great Arteries in Your Hands (Hands-on)

Thursday, Nov. 29 4:30PM - 6:00PM Room: S401CD

CA IN VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

Participants
Shi-Joon Yoo, MD, Toronto, ON (*Presenter*) Owner, 3D HOPE Medical; CEO, IMIB-CHD; Spouse, CEO, 3D PrintHeart;
Cynthia K. Rigsby, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Rajesh Krishnamurthy, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Whal Lee, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hyun Woo Goo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Andreas Giannopoulos, MD, Zurich, Switzerland (*Presenter*) Nothing to Disclose
Lorna Browne, MD, FRCR, Aurora, CO (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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crigsby@luriechildrens.org

LEARNING OBJECTIVES

1) Understand the classic and complicated morphology of complete and congenitally corrected transposition in terms of relationship and connections among cardiac chambers and great arterial trunks and coronary arterial anatomy. 2) Learn the choices of surgical procedures for classic and complicated forms of transpositions. 3) Learn how to visualize the surgically important features of transpositions at CT and MR. 4) Correlate findings at 3D print models with imaging findings.

ABSTRACT

Complete and congenitally corrected transpositions of the great arteries are not uncommon congenital heart diseases that require surgical repair early or later in life. The surgical options and procedures vary according to the given intracardiac, extracardiac and coronary arterial anatomy. This hands-on congenital heart morphology session will provide the audience with an opportunity to learn the basic and complicated morphology of the two forms of transposition of the great arteries with special emphasis on surgical anatomy. The session will consist of 25-minute introductory lecture, 40-minute hands-on observation and 25-minute discussion and evaluation. Experts on congenital heart disease pathology will be available for guidance and answering questions throughout the session.

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RC803

MR Imaging in the Thorax

Friday, Nov. 30 8:30AM - 10:00AM Room: E353C

CA CH MR VA

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

Sub-Events

RC803A MR Imaging of Mediastinal Masses

Participants
Jeanne B. Ackman, MD, Boston, MA (*Presenter*) Spouse, Stockholder, Everest Digital Medicine; Spouse, Consultant, Everest Digital Medicine; Spouse, Stockholder, Cynvenio Biosystems, Inc; Spouse, Scientific Advisory Board, Cynvenio Biosystems, Inc; Spouse, Consultant, PAREXEL International Corporation

LEARNING OBJECTIVES

1) Comprehend value of Thoracic MRI as a problem solver in the mediastinum 2) Understand how MR assists with tissue diagnosis 3) Learn how MR can add diagnostic specificity beyond that of CT

RC803B MR Imaging of the Lung: A Practical Clinical Approach

Participants
Juergen Biederer, MD, Heidelberg, Germany (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

biederer@radiologie-darmstadt.de

LEARNING OBJECTIVES

1) To give an overview over appropriate indications for lung MRI. 2) To suggest a practical approach for the selection of suitable standard imaging protocols. 3) To discuss, how to adjust the standard examination for specific questions. 4) To make familiar with general aspects of lung MR image interpretation and the diagnostic scope of the technique.

Active Handout:Juergen Biederer

http://abstract.rsna.org/uploads/2018/18001065/2018.11.30 MRI of the Lung HandoutRC803B.pdf

RC803C MR Imaging of Cardiac Masses

Participants
Phillip M. Young, MD, Rochester, MN (*Presenter*) Consultant, Arterys Inc

For information about this presentation, contact:

young.phillip@mayo.edu

RC803D MR Imaging of Aortopathies

Participants
Cristina Fuss, MD, Portland, OR (*Presenter*) Spouse, Officer, ViewRay, Inc

For information about this presentation, contact:

fussc@ohsu.edu

LEARNING OBJECTIVES

1) To familiarize the learner with the most common familiar aortopathies, their clinical background, imaging appearance on MRI and specific considerations for MR acquisition planning.

ABSTRACT

Familial aortopahties comprise a grounp of inherited disorders of aortic aneurysms and/or dissection including. These include Thoracic Aortic Aneurysms and Aortic Dissections (TAAD), Marfan syndrome, Loeys-Dietz syndrome, and Ehlers-Danlos syndrome, only to name the most common ones.